

## Deep-Analysis (Narrative)

# Marijuana and Brain

## The Debating Focus of Science and Economy

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**SUMMARY** Marijuana has been being accepted as a medical or recreational drug by states across the United States indicating that this ever debating drug is getting approval by more and more people. Does this mean it is safe for us to accept marijuana as a daily recreational tool? The answer is no! Although substantial evidence suggested that marijuana has a lot of beneficial role in many medical conditions, it does not mean its recreational use is acceptable. If you search the web, you can find a huge pile of files discussing marijuana's negative effects on people's life and health, and on society's safety and stability. Of course, there is also plenty of supporting view on marijuana's recreational use, of them the standpoint of view is economy. However, for general people, we need balance the benefits and drawbacks before drawing some conclusions. One thing needs to be considered carefully is the domino effect of the legalization of marijuana's recreational use on the society. However, have we paid enough attention on its potential effect on our daily life, on the social value, and on the society's future? It is too early to conclude the eventual impact of marijuana on people's health and on society's existence if we can take it into consideration in a long-term period of time. ■

**KEYWORDS** Marijuana; Cannabinoid; Brain; Economy; Legalization; Society

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**A**lthough the US Food and Drug Administration (FDA) states that marijuana has “no currently accepted medical use in treatment in the United States.”, and it remains illegal for the sale of cannabis under federal law, about 20 US states and the District of Columbia had legalized the use of marijuana for medical purposes by early 2014 (see **Table 1**), and voters in Washington and Colorado passed initiatives to make their states the first in the country to allow recreational use of the drug in November 2012. Regarding the effect of marijuana on health, particularly on the brain function, has been being concentrated on for over several decades, and plenty of data indicate that this drug would undoubtedly cause unexpected impact on cerebral function, especially on adolescents. However, the overwhelming expectation of the wealth-propelling role of marijuana’s recreational use has made it overpass piles of scientific evidence and suggestion on its careful use.

### The Domino Effect of Marijuana on Society

A large body of scientific evidence has disclosed marijuana’s negative effects on people’s health. A lot of researchers worry about the potential impact of marijuana’s legalization on people’s attitudes toward the drug, i.e. perhaps making its recreational use seems more normal or acceptable. If so, the unstoppable distribution of this debating drug over the country would become more common, and it would function like the triggering card of the domino, and no force can stop it because the only thing we can do is to wait for the last card collapsed. Consequently, more and more people will become drug abuser, which leads to more cases with abus-

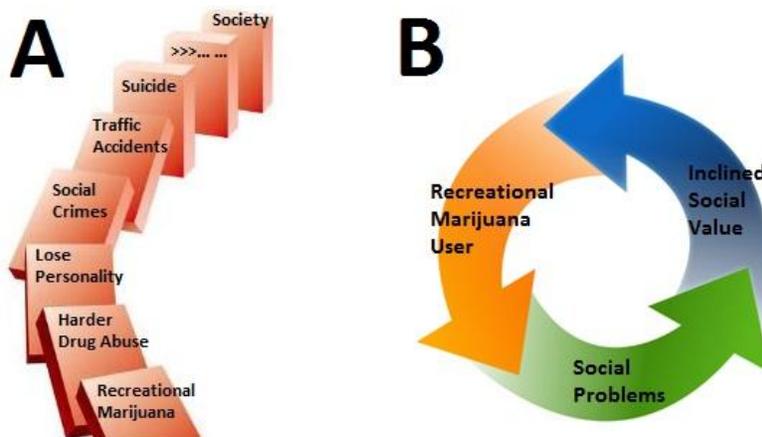
ing-drug-associated diseases resulting in far more consumption of medical resources and much more social problems like crimes, traffic accidents, suicides, and breakdown of family etc. This would eventually form a vicious circle from which the whole society would lose the basic value and be approaching collapse (see the domino effect of marijuana on society in **Figure 1**).

Nevertheless, the present situation is not that optimistic. The legalization of recreational use of marijuana on the basis of money, which generally dubbed as economy concern, has surpassed everything that related with the negative effect of marijuana’s legalization on the existence of our society. Of course, some criticizers would strictly say “no” to my present point of view. It is normal and makes people sense that “money is the first base of society’s existence”. As the social philosophy “Society has the ability to balance its yin and yang” goes on, we hope the legalization of recreational marijuana is merely a single case, and that would not alter the overall society value. Whether it would be as we expected or not largely depends on people’s knowledge on this drug, and on the careful evaluation of its effect on every aspect of the society.

### The Debating Focus of Marijuana: Cerebral Health

Marijuana, first it is a drug can induce addiction, which means it can change people’s brain by making them craving for it. From the point of medicine, marijuana belongs to cannabinoid, and has its own specific proper-

**Figure 1. The Domino Effect of Marijuana on Society**



**Table 1. States and DC Have Enacted Laws to Legalize Medical Marijuana**

State	Year Passed	Possession Limit
Alaska	1998	1 oz usable; 6 plants (3 mature, 3 immature)
Arizona	2010	2.5 oz usable; 0-12 plants
California	1996	8 oz usable; 6 mature or 12 immature plants
Colorado	2000	2 oz usable; 6 plants (3 mature, 3 immature)
Connecticut	2012	One-month supply (exact amount to be determined)
D.C.	2010	2 oz dried; limits on other forms to be determined
Delaware	2011	6 oz usable
Hawaii	2000	3 oz usable; 7 plants (3 mature, 4 immature)
Illinois	2013	2.5 ounces of usable cannabis during a period of 14 days
Maine	1999	2.5 oz usable; 6 plants
Maryland	2014	30-day supply, amount to be determined
Massachusetts	2012	60-day supply for personal medical use
Michigan	2008	2.5 oz usable; 12 plants
Minnesota	2014	30-day supply of non-smokable marijuana
Montana	2004	1 oz usable; 4 plants (mature); 12 seedlings
Nevada	2000	1 oz usable; 7 plants (3 mature, 4 immature)
New Hampshire	2013	Two ounces of usable cannabis during a 10-day period
New Jersey	2010	2 oz usable
New Mexico	2007	6 oz usable; 16 plants (4 mature, 12 immature)
New York	2014	30-day supply non-smokable marijuana
Oregon	1998	24 oz usable; 24 plants (6 mature, 18 immature)
Rhode Island	2006	2.5 oz usable; 12 plants
Vermont	2004	2 oz usable; 9 plants (2 mature, 7 immature)
Washington	1998	24 oz usable; 15 plants

ties under the conditions of intoxication and withdrawal (see **Table 2**).

A lot of people who used marijuana may only seek some kind of euphoria and sense of relaxation. But they denied it numerous side effects, and exactly these very side effects place huge impact on our daily life. For example, marijuana can cause paranoid delusion, which is somehow dubbed as the preface of psychotic disorders like schizophrenia and personality dissociation in vulnerable individuals that were strongly associated with suicide. What is the major chemical in our body that evokes such big reaction? It is tetrahydrocannabinol (THC), a very potent chemical compared to other psychoactive drugs. Once enter your bloodstream through lungs, THC will reach the brain rapidly within seconds after it is inhaled and begin to work.

THC and other endogenous cannabinoid chemicals like anandamide affect different brain regions where the pleasure, thinking, memory, movement, concentration, coordination, and sensory and time perception are related. THC performs these functions through binding molecules named cannabinoid receptors on neurons in these

brain regions and activates them. As thus the neural communication network takes an essential part in the nervous system in its normal function by using the THC and other self-produced cannabinoid neurotransmitters.

THC can change the normal function of the hippocampus and orbitofrontal cortex, key brain areas that form new memories. So the use of marijuana would impair the normal thinking and interfere with a user's ability to learn and to conduct complicated tasks. Meanwhile, THC is able to disrupt the function of the basal ganglia and cerebellum, the brain areas that are related to posture, balance, coordination, and reaction time. Therefore, those who have used marijuana cannot drive safely. Furthermore, the reward system, also known as the dopaminergic system, which governs the pleasurable behaviors like sex and eating. Marijuana, like other drugs of abuse, can stimulate neurons in the reward system to release the dominant neurotransmitter "dopamine" at a extremely high level, which contributes to the so-called "high" that marijuana users seek. This undoubtedly affects people's perception of pleasure, and would eventually slide into a common drug abuser who

**Table 2. Symptoms of Marijuana Intoxication and Withdrawal**

Intoxication	Withdrawal
Euphoria	Depression
Anxiety	Irritability
Paranoid delusions	Insomnia
Impaired judgment	Nausea
Social withdrawal	Anorexia
Slowed perception	
Increased appetite	
Dry mouth	
Conjunctival injection	
Hallucination	

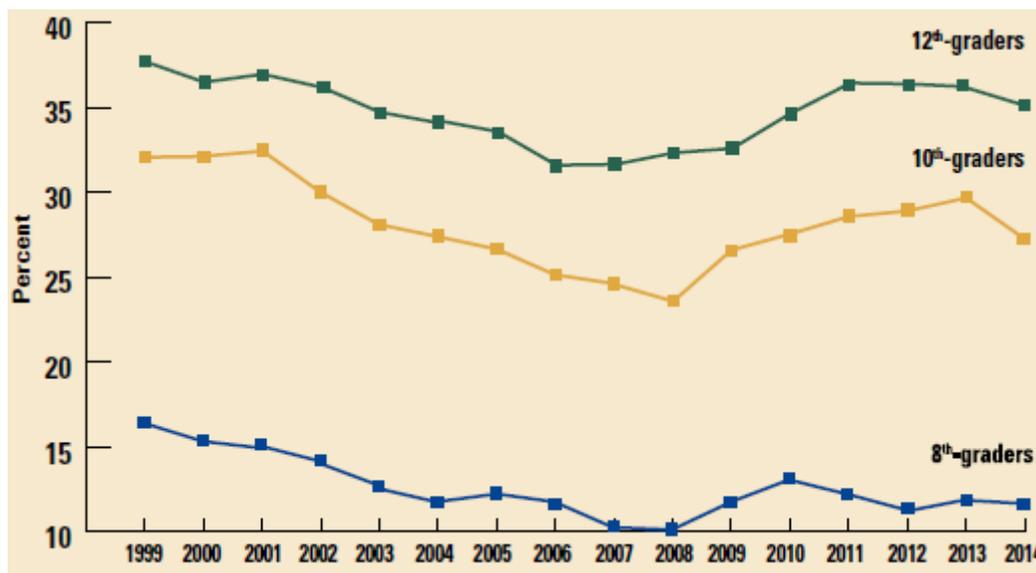
seeks not only marijuana, but also other types of street drugs.

Cumulating evidence indicates that marijuana can be addictive! During a long period of overstimulation of the cannabinoid system, marijuana can cause changes in the brain that finally result in addiction, which is a abnormal living condition in which the user cannot stop him/herself using the drug even though he/she knows it interferes with many aspects of their life. The estimated rate for marijuana-related drug dependence is approximately 10%. If the user started consuming the drug younger, this number will march up to some over 15% and to 25%-50% if they are daily users. In 2013, the National Survey on Drug Use and Health (NSDUH) presented that the overall number of marijuana use reached 4.2 million in 6.9 million Americans who were illicit drug users. Many researchers considered that marijuana-induced drug abuse is majorly from its withdrawal symptoms (see **Table 2**). These uncomfortable withdrawal manifestations like decreased appetite, irritability, restlessness, sleep difficulties, and cravings make the user unwilling to stop it even they might know the bad effects of marijuana consumption on their daily life.

In the long run, marijuana abuse will also produce lots of negative effects on cerebral health. Substantial evidence indicates that marijuana exposure in fetus, neonate, and adolescence all will delay and retard learning and memory function in their youth and late life. In further, molecular and cellular investigations revealed that the long-term impairment of marijuana on brain function was associated with the dysfunction of hippocampal neurons. More interestingly, animal study disclosed that the rodents would prefer to reuse the marijuana-containing foods if they had the chance to take them due to the reward system was activated by previ-

ous marijuana exposure. Furthermore, functional magnetic resonance imaging (fMRI) demonstrated that neural connections among different cerebral areas were impaired by frequent marijuana administration in human beings. In addition, a negative correlation exists between marijuana use extent and adulthood IQ scorings, i.e. the more marijuana you consumed, and the lower your IQ would be scored. What is the underlying mechanism of these long-term impactions of marijuana on the brain? It is the synaptic connections that were damaged for the existed ones, and interfered with the would-be newly formed ones.

As expected that marijuana exposure, especially those when they are young when the first marijuana was exposed, would functions as a gateway drug. That means marijuana use will cause the user to become abuser for harder drugs. This prime effect of marijuana on other drugs is dubbed as cerebral "cross-sensitization". From this evidence, the number of drug abuser would undoubtedly dramatically increase in the following years it the recreational marijuana would have been legalized by more states. Although the trend of legalizing recreational marijuana is increasing in more geographic areas in the USA, it also makes a lot of people become alert to its negative effect, especially the families with children. A recent survey revealed that this trend in the youth is slowing down in the view of an overall yearly abuse cases (see **Figure 2**). Besides, a more recent study found almost identical results on marijuana's popularity among adolescents, i.e. disapproval of marijuana use has increased among adolescents (age 12 to 14), although the drug's use continues to become legal in more places. Of course, these findings do not mean that parents no longer need to have the "drug talk" with their young teens, and if a teen has developed

**Figure 2. Long-Term Trends in Annual\* Marijuana Use in 8<sup>th</sup>-, 10<sup>th</sup>-, and 12<sup>th</sup>-Graders**

\*: Use in the past 12 months.

Source: University of Michigan, 2014 Monitoring the Future Survey.

an issue with marijuana use, he/she should feel comfortable approaching parents or teachers for help. Yes, it is extremely necessary!

## When Science versus Economy

For economists, marijuana's recreational use undoubtedly is a critical event for them because it would become a money machine. The reality is as expected as these economy-advocators. After three-year's legalization of marijuana's recreational use in two regions, the local taxes and selling income have made a lot of businessmen become millionaires. Today, the situation of marijuana's recreational use has been developed far beyond its daily retailing. They are preparing for entering the most-popular commercial platform – NASDAQ exchange. Although two marijuana companies have been listed in NASDAQ stock, they are only medical companies. For the cannabis social media network MassRoots, it is totally unlike these two. MassRoots wants to target on advertisement, even neither Facebook nor Twitter permits cannabis-related businesses and dispensaries to advertise on their social media platforms.

Another thing we need to consider is the impact of recreational use of marijuana on its normal medical administration. Marijuana, as a medication, has many ben-

efits in several medical conditions (see **Table 3**). One thing we need also to remind ourselves is that there are a lot of hurdles would hold the marijuana industry back and keep marijuana-based stocks like GW Pharmaceuticals, a marijuana-based research company, from realizing their potential for years or perhaps even longer, even though marijuana's medical benefits are well established under medical situations. It should be ascertained that the marijuana-associated researcher entities would lose their funding for years when they are performing marijuana's beneficial role in medical conditions in clinical trials.

## Concluding Remarks

Although it is illegal for marijuana's use under federal law, it is acceptable for some states to use this drug for medical purposes. Since 2012, marijuana's recreational use has been becoming the debating focus regarding its negative versus positive effect on people's cerebral function and on state's economy. It is currently classified as a "Schedule I" drug, meaning the federal government does not recognize it as having accepted medical use. Under the bipartisan proposals, marijuana would be moved to Schedule II, recognizing it has legitimate health purposes, with states determining their own programs and doc-

**Table 3. The Benefits of Marijuana Use**

**Alzheimer's disease** - Delta-9-THC can prevent an enzyme called acetylcholinesterase from accelerating the formation of "Alzheimer's plaques" in the brain, as well as protein clumps that can inhibit cognition and memory, more effectively than commercially marketed drugs.

**Anxiety** - Studies report that about 20 to 30 percent of recreational users experience such problems after smoking marijuana. Here's a story from Patsy Eagan of Elle Magazine, who describes how she prefers marijuana to treat her anxiety over prescription drugs.

**Arthritis** - Marijuana proves useful for many types of chronic pain conditions, but patients with rheumatoid arthritis report less pain, reduced inflammation and more sleep. However, this is not to say that arthritis patients should exchange their medication with pot; marijuana eases the pain, but it does nothing to ameliorate or curb the disease.

**Asthma** - Findings demonstrated acute airway dilation after marijuana smoking. Smoking does not appear to be an appropriate long-term method for administration of bronchodilator cannabinoid compounds for potential therapeutic purposes. THC does not appear to be a suitable bronchodilator for therapeutic use because of its systemic psychotropic and possible undesirable endocrine, immunologic and cytogenetic effects.

**Cancer, HIV/AIDS and chemotherapy** - Though the drug is illegal in the U.S., the FDA and American Cancer Society agree that the active ingredients in marijuana, or cannabinoids, have been approved by officials to "relieve nausea and vomiting and increase appetite in people with cancer and AIDS." The American Cancer Society says that "marijuana has anti-bacterial properties, inhibits tumor growth, and enlarges the airways, which they believe can ease the severity of asthma attacks."

**Depression** - Those who consume marijuana occasionally or even daily have lower levels of depressive symptoms than those who have never tried marijuana. And weekly users had less depressed mood, more positive affect, and fewer somatic complaints than non-users.

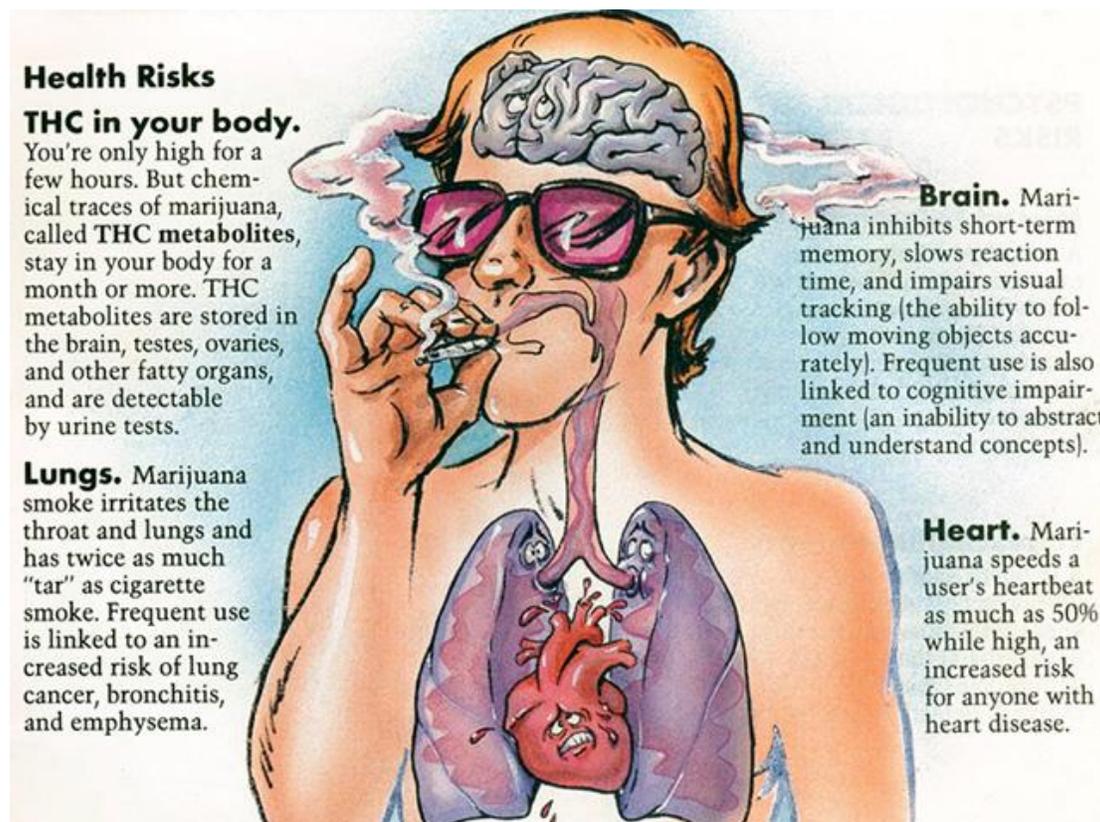
**Epilepsy** - Marijuana plays a critical role in controlling spontaneous seizures in epilepsy. Although marijuana is illegal in the United States, individuals both here and abroad report that marijuana has been therapeutic for them in the treatment of a variety of ailments, including epilepsy.

**Glaucoma** - Since the 1970s, studies have called medical marijuana an effective treatment against glaucoma, one of the leading causes of blindness in the world. Researchers say marijuana helps reduce and relieve the intraocular pressure that causes optic nerve damage, but the proponents say it helps "reverse deterioration," too.

**Hepatitis C** - Marijuana helps improve the effectiveness of drug therapy for hepatitis C, an infection that roughly 3 million Americans contract each year. Hepatitis C medications often have severe side effects like loss of appetite, depression, nausea, muscle aches and extreme fatigue. Patients that smoked marijuana every day or two found that not only did they complete the therapy, but that the marijuana even made it more effective in achieving a "sustained virological response," which is the gold standard in therapy, meaning there was no sign of the virus left in their bodies.

**Morning sickness** - 92 percent of women found marijuana's effect on morning sickness symptoms as either "very effective" or "effective."

**Multiple Sclerosis and Spasticity** - Patients had the subjective feeling that they were clinically improved, despite the fact that their posture and balance were actually impaired by smoking marijuana.

**Figure 3. Health Risk for Marijuana Use**

tors writing prescriptions. It is possible that as time passes we are going to see more concrete evidence of marijuana's benefits profile. It is believable that the legalization of marijuana's recreational use would produce some domino effects on the whole value of society. It is also reasonable for people, especially those with children, to keep their eyes on this drug's fate because it is hard to say what kind of effects would take on their

children's development and future if they accidentally used this drug. Even though businessmen do not want to see the negative comments on marijuana's impaction on people life, scientist should clearly know each aspect of marijuana's role in user's general health (see **Figure 3**), of which requires the policy-makers could balance marijuana's benefits and drawbacks. ■

## ARTICLE INFORMATION

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