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THESIS

**CANNABIS AND THE U.S. NAVY:
AN ASSESSMENT OF POLICIES TO ADOPT
AFTER FEDERAL LEGALIZATION**

by

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March 2019

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**CANNABIS AND THE U.S. NAVY: AN ASSESSMENT OF POLICIES
TO ADOPT AFTER FEDERAL LEGALIZATION**

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ABSTRACT

This thesis conducts an analysis of various policy options for the U.S. Navy to adopt after the federal legalization of cannabis. Utilizing Eugene Bardach's eight-step method, this thesis compares three possibilities for policy recommendation. The first option is to maintain the status quo, or to continue a zero-tolerance policy. The second option is one where specific job specialties would prohibit the performance of certain duties within a specified period of time after cannabis usage. The third option is one where, whatever the job, cannabis usage will be treated like alcohol in all regards.

The research shows that adopting a policy that prohibits the performance of specific job specialties for a specified period of time is the most ideal policy, as it would provide confidence in key jobs being performed with the highest confidence of completion, provide equity between civilian and military service members, would not limit the number of new recruits coming into the U.S. Navy, and would provide naval service members with a less harmful recreational drug of choice.

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LIST OF ACRONYMS AND ABBREVIATIONS

CAF	Canadian Armed Forces
CBD	Cannabidiol
CDC	Centers for Disease Control and Prevention
CSA	Controlled Substances Act
CUD	Cannabis Use Disorder
DAOD	Defence Administrative Orders and Directives
DARs	Drug and Alcohol Reports
DEA	Drug Enforcement Administration
DL	Driver's License
DoD	Department of Defense
DSM	Diagnostic and Statistical Manual of Mental Disorders
FDA	Food and Drug Administration
FEV	Forced Expiratory Volume
FVC	Forced Vital Capacity
ID	Identification
INST	Instruction
LSD	Lysergic Acid Diethylamide
NADAP	Navy Alcohol and Drug Abuse Prevention
NASEM	National Academies of Sciences, Engineering and Medicine
NIDA	National Institute on Drug Abuse
NSS	National Security Strategy
OPNAV	Office of the Chief of Naval Operations
OSA	Obstructive Sleep Apnea
PTSD	Post-Traumatic Stress Disorder
RIDA	Real ID Act of 2005
SECNAV	Secretary of the Navy
SUD	Substance Use Disorder
THC	Delta-9-Tetrahydrocannabinol
U.S.C.	United States Code
UCMJ	Uniform Code of Military Justice (Many)

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I. INTRODUCTION

The U.S. Navy has prohibited the use of cannabis since it was classified as a controlled substance in 1970. However, changing state laws that legalize cannabis are beginning to have an effect on the U.S. Navy. These law changes are currently affecting the number of waivers the Navy produces for incoming service members. A future change to the federal cannabis policy would have an even larger impact on the U.S. Navy's manpower and policies and its service members' rights and freedoms. The U.S. Navy must think ahead to prepare for the growing chance that the United States does legalize cannabis at the federal level.

A. CANNABIS WILL EVENTUALLY BE LEGAL AT THE FEDERAL LEVEL

The Controlled Substances Act (CSA) outlines the United States' federal drug policy. It outlaws any sale, importation, cultivation, and transportation of controlled substances including possession (Controlled Substances Act, 21 U.S.C. § 801, 2017); it classifies drugs into five "Schedules," listed I through V (Controlled Substances Act, 21 U.S.C. § 812, 2017). Each schedule has its own determining criteria. The schedules are listed from most to least dangerous, with "I" being the most and "V" being the least dangerous. The CSA lists cannabis¹ under the Schedule I category (Controlled Substances Act, 21 U.S.C. § 812, 2017). For a drug to be classified Schedule I, Controlled Substances Act of 1970, Title 21 United States Code (U.S.C.) § 812 (2017, para. a) specifies that a "drug or other substance has a high potential for abuse, the drug or other substance has no currently accepted medical use in treatment in the United States, and there is a lack of accepted safety for use of the drug or other substance under medical supervision." Alongside cannabis are the drugs heroin, lysergic acid diethylamide (LSD), methylenedioxy-methamphetamine (Ecstasy), Peyote, and Methaqualone (Controlled

¹ Cannabis, and not marijuana, is the chosen term used for the Cannabis Sativa plant throughout this thesis. This is because marijuana is a slang, and sometimes racist, term that is not scientifically exact. The term "cannabis" is more appropriate in serious conversations and professional research.

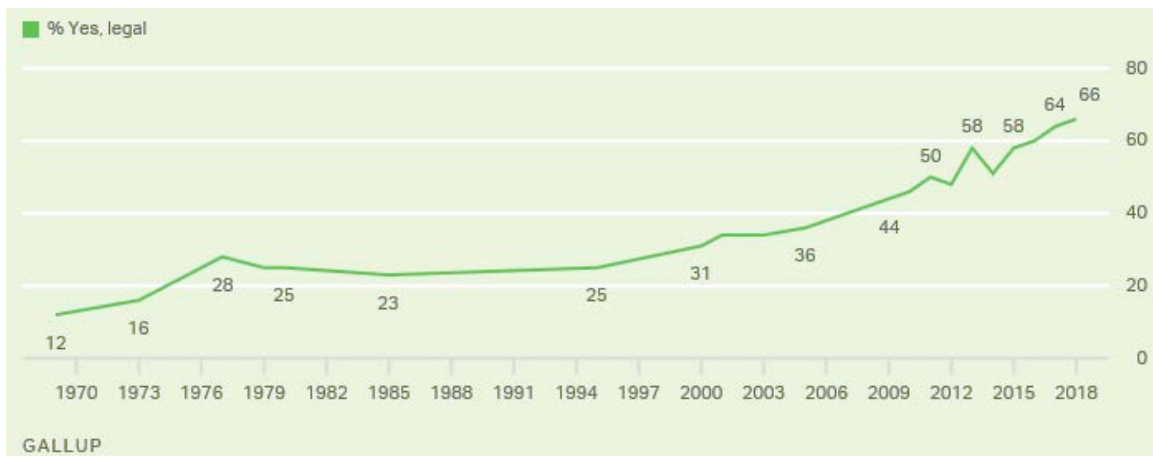
Substances Act, 21 U.S.C. § 812, 2017). In the United States, if a person possesses or distributes a controlled substance, it is considered a federal and state crime that can result in a criminal prosecution (“Controlled Substances Act,” 2019).

Cannabis is illegal to use in the United States Navy due to its status as a controlled substance. The United States Navy has a zero-tolerance policy that stems from Article 112a of the Uniform Code of Military Justice (UCMJ), which states, “any person subject to this chapter who wrongfully uses, possesses, manufactures, distributes, imports into the customs territory of the United States, exports from the United States, or introduces into an installation, vessel, vehicle, or aircraft used by or under the control of the armed forces a substance described in subsection (b) shall be punished as a court-martial may direct” (Armed Forces, 10 U.S.C. § 912a. Art. 112a., 2017). Subsection (b) specifically indicates cannabis among several other controlled substances from various schedules, including cocaine, opium, amphetamine, heroin, methamphetamine, and LSD (Armed Forces, 10 U.S.C. § 912a. Art. 112a., 2017). For a service member in the U.S. Navy, possession of cannabis could result in both a civil and criminal prosecution, with fines and prison time (“Controlled Substances Act,” 2019), and a punishment under a military court martial with a punitive discharge, up to 2 years in prison, and forfeiture of all pay and allowances (“Manual for courts martial,” 2019). Service members who are punitively discharged under a general or other-than-honorable discharge can lose their “Department of Defense and Veterans Administration benefits which includes their Post-9/11 GI Bill education benefits” (“USN/USMC Commander’s Quick Reference Legal Handbook,” 2018, p. 52) and, for those close to the 20-year retirement threshold, retirement and healthcare benefits also are jeopardized.

Since 1996, 44 states have changed their laws to allow medical cannabis use (National Academies of Sciences & Medicine [NASEM], 2017, p. 74), and, since 2012, ten states and the District of Columbia territory have legalized the use of recreational cannabis. This trend of legalization at the state level encourages political representatives to call for nationwide legalization. In October 2018, Oregon Representative Earl Blumenauer (D-OR) issued a memo to the Democratic Party’s leadership titled “Blueprint to Legalize Marijuana in the 116th Congress,” laying out a cannabis legislation process for 2019. At

the beginning of his memo, Congressman Blumenauer predicts that “by the end of 2019: Marijuana will be legal at the federal level” (Angell, 2018, p. 2). On January 9, 2019, House Resolution (H.R.) 420, which stems from Representative Blumenauer’s memo, was filed in Congress. Bill H.R. 420, otherwise known as the “Regulate Marijuana Like Alcohol Act,” would, if passed, remove cannabis from the CSA and license and regulate cannabis (Gans, 2019).

Additionally, the American population’s support of cannabis legalization has increased. Figure 1 illustrates this shift in the public’s perception of cannabis. Gallup data from 1970 through 2018 shows a 54 percent increase in favor of legalization. With two-thirds of Americans favoring legalization, support for cannabis continues to build (McCarthy, 2018).



The Gallup Poll asked: Do you think the use of marijuana should be made legal or not?

Figure 1. “Support for Legalizing Marijuana Continues to Edge Up.”
Source: McCarthy (2018, para. 2).

Changing cannabis laws in other North American countries further supports this supposition. On October 17, 2018, Canada legalized cannabis after passing Bill C-45, also known as the Cannabis Act, after it received its Royal Assent on June 21, 2018 (Canadian Legislative Branch, 2018). Passing Bill C-45 made Canada the second country, after Uruguay, and the first of the G7—seven of the most industrialized countries—to legalize the distribution, sale and recreational use of cannabis (Bilefsky, 2018). Moreover, on

September 7, 2018, Canada established policy authorizing cannabis use for military service members on the October legalization day.

In October 2018, Reuter's, among many other news outlets, reported on Mexico's Supreme Court ruling that its nation's cannabis ban was unconstitutional (Esposito & Graham, 2018). This ruling did not legalize cannabis, but it set a precedent for lower courts to follow and the Mexican government to act on, thereby paving the way for cannabis legalization in Mexico. Furthermore, officials in Mexican President Andres Manuel Lopez Obrador's administration have stated that they will bring the prohibition on cannabis to an end. They reason that ending the prohibition will contribute to the reduction of the country's poverty as well as criminal activity (Esposito & Graham, 2018).

With the two countries on the U.S. borders, and a growing number of states within the U.S. changing their cannabis laws, American opinion and evolving legislation strongly suggests that cannabis will become completely legal in the near future. This would place the U.S. Navy's zero-tolerance policy at odds with the United States federal law. To avoid a last minute and hasty scramble to create a cannabis policy for military service members, it would benefit the U.S. Navy to identify a best policy early. This ensures there is ample time to properly determine the correct policy and, upon its selection, prepare the Navy for its implementation.

B. PROBLEM DESCRIPTION

The trend of states legalizing cannabis, both medically and recreationally, suggests that the United States will legalize cannabis federally in the near future. The problem lies with what the U.S. Navy will do after federal legalization. The problem is important because the UCMJ currently prohibits cannabis use and has outlawed it for decades. If cannabis is no longer considered a controlled substance by the federal government, the U.S. Navy² has to determine if it is still necessary to prohibit it. Should the U.S. Navy keep its UCMJ-mandated zero-tolerance policy or allow its service members to use cannabis

² The U.S. Congress is the overall authority that can make changes to the UCMJ through recommendations from the Pentagon or specific military branches in accordance with the U.S. Constitution Article I, Section 8.14, which states "The Congress shall have Power ... To make Rules for the Government and Regulation of the land and naval forces" (U.S. Constitution, Article I § 8, para.14, 2015).

responsibly? And, if the Navy does authorize cannabis use for its service members, will it treat cannabis like alcohol or restrict certain job specialties from its use? Determining the right policy for the U.S. Navy is important because that policy will dictate service members' rights and responsibilities based on the perceived or actual effects of cannabis. If there is evidence that proves detrimental effects of cannabis on its service members, the U.S. Navy is obligated to enact a policy that protects them. However, if credible research reveals that the effects of cannabis are negligible (or manageable, similar to alcohol), then the U.S. Navy should consider a policy that upholds its members' rights. To that end, this thesis explores the small extant body of credible, scientific research to determine what cannabis policy the U.S. Navy should adopt after cannabis is legalized federally.

The thesis examines the question: What cannabis-use policy should the U.S. Navy adopt and apply to service members after federal legalization of cannabis? In order to answer this question, I use Dr. Eugene Bardach's eight-step method of policy analysis based on his book, *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving* to compare three policies that the United States Navy could adopt (Bardach, 2012). The three policies I compare are the status quo (or zero-tolerance policy toward cannabis), the authorized use of cannabis with the exception of certain job specialties within a specific time period, and the authorized use of cannabis comparable to that of alcohol.

Ultimately, the thesis finds that authorized use of cannabis with the exception of certain job specialties within a specific time period is the best policy for the U.S. Navy to adopt.

C. SCOPE

In this thesis, I focus solely on the U.S. Navy because I am interested in contributing to the success of the institution to which I belong. I utilize Eugene Bardach's eight step method of policy analysis because it is an effective method of policy analysis, as the literature review will show. This thesis operates within the context of cannabis legalization only. I do not explore similar policy options for other drugs because cannabis law is the only drug law radically changing and trending across the United States currently.

D. ORGANIZATION OF THE THESIS

My thesis consists of five chapters. The first chapter introduces the assumption of federal cannabis legalization, describes the problems that that assumption presents to the U.S. Navy, and indicates the specific research question, the scope of research, and the overall organization of the thesis. Chapter II, the background and literature review, explains what cannabis is, describes the health effects of cannabis on users, its effects on the efficiency of U.S. Navy service members, examines contextual military rights and freedoms, and presents studies that have used the Bardach eight-step method to show the method's versatility and efficacy. Chapter III consists of the methodology, outlining Eugene Bardach's eight-step method of policy analysis. This chapter has eight sections, one for each of the eight steps. These steps provide a framework for selecting best policies in general. Chapter IV is an application of the methodology to determine the best policy option in the context of this thesis. This chapter compares the three possibilities for policy recommendation based on specific criteria. Chapter V is a sensitivity analysis that determines the robustness of the analysis from Chapter IV. Chapter VI concludes the thesis. Bardach's eight-step method of policy analysis is summarized, and the authorized use of cannabis with limitations is recommended as being the best policy for the U.S. Navy to adopt after federal legalization is recommended

II. BACKGROUND AND LITERATURE REVIEW

In this chapter, I discuss what cannabis is along with related issues, such as efficiency, health effects, rights and freedoms of Naval service members, and present studies utilizing Eugene Bardach's eight-step method of policy analysis to show how other analysts have used the method to identify the best policy for a problem. The background and literature review support the analysis of the best policy to adopt after federal legalization. This chapter provides the evidence required to satisfy the second step of Bardach's (2012) eight-step method of policy analysis, "Assemble Some Evidence," which is heavily used in Chapter IV. Due to the fact that cannabis has been a Schedule I controlled substance and has been socially stigmatized for several decades, credible peer-reviewed studies on the drug have been limited. State legalization policies have encouraged an increase in scholarly research on the effects of cannabis, but much of this research is still in its nascence. This literature review relies heavily on several credible academic studies in an attempt to shift attention away from popular culture's depiction of cannabis toward a more rigorous scientific explanation of cannabis and its effects.

A. WHAT IS CANNABIS

The term "cannabis" refers to the dried parts of the plant such as "leaves, flowers, stems, and seeds from the Cannabis Sativa or Cannabis Indica plant" (National Institute on Drug Abuse [NIDA], 2018). The natural compounds of the cannabis plant are called cannabinoids (Di Marzo, 2014). Cannabinoids are the psychoactive constituents of the plant that are also found naturally in the human body as endocannabinoids (Staples & Adcock, 2017). There have been over 104 different cannabinoids identified in the plant (ElSohly & Gul, 2014). Amongst these cannabinoids, Delta-9-Tetrahydrocannabinol (THC) is responsible for the intoxicating or euphoric state that cannabis produces. THC is a psychoactive drug which is a chemical that acts on the brain causing mental or psychological effects (Ramachandran, 2002). Cannabis also contains the non-psychoactive compound cannabidiol (CBD). CBD is used for medical purposes and does not create any mind-altering effects. People typically use cannabis by smoking it, vaporizing it, ingesting

it, or applying it topically or sublingually (Hudak, 2016). Cannabis can be taken with THC and CBD or each can be taken separately. However, there have been studies suggesting that cannabis has an “entourage effect” where cannabis works better in situations when the whole-plant extract is administered (Weston-Green, 2018).

B. EFFICIENCY

This section presents evidence related to how cannabis affects workplace efficiency in general and specific to the U.S. Navy. Efficiency refers to the effective use of resources associated with the manpower processes of an organization. Workplace impairment, waivers, and investments costs are all cannabis-related considerations that may affect those manpower resources.

a. *Workplace Impairment*

Drug and alcohol impairment in the workplace is extremely dangerous. It poses a threat to the people and equipment that interact with the impaired individual. It also threatens the impaired individual. However, where alcohol impairment can be measured with a breathalyzer, there is no method to test for on-the-spot cannabis impairment. This shortcoming can lead to an unsafe atmosphere within the workplace. In this section, I review studies related to these issues.

First, the NASEM report (2017) discusses the association of cannabis use and occupational injuries in the review of ten studies. One of the studies it examines is Shipp et al. (2005), which analyzes the relationship of cannabis and nonfatal occupational injuries of Texas high school students. The researchers determine that “heavier cannabis use was associated with higher risk: students who reported using cannabis more than 40 times in the past 30 days were more than twice as likely to have suffered a nonfatal occupational injury as those who did not use cannabis” (NASEM, 2017, p. 224). Despite the review of this and nine other studies, the NASEM report concludes that “there is insufficient evidence to support or refute a statistical association between general, nonmedical cannabis use and occupation accidents or injuries” (Holland, 2010, p. 227). However, the Shipp, Tortolero, Cooper, Baumler, and Weller (2005) analysis does provide a statistically significant study associating cannabis use and workplace injury.

In 2016, Canada’s final report from the cannabis legalization and regulation task force discusses “workplace safety” and “impaired driving” (Health Canada, 2016). In regard to workplace impairment, the report discusses how drug and alcohol impairment can threaten the workplace, particularly in “safety-sensitive” industries like “transportation, health care, and law enforcement” due to the nature of their work (Health Canada, 2016). In any workplace there is an increased risk of death and injuries while impaired. Under the section of driving while impaired, there is a discussion on the strong need for a cannabis breathalyzer and the methods currently conducted to determine if someone is under the influence. Their review contends, similar to this thesis review of health effects, that cannabis affects the user’s judgement and psychomotor skills. There is a common consensus that THC does affect one’s performance; however, there are no reliable means of testing THC levels from bodily fluids at the moment. Currently, the Canadian law enforcement uses a standardized field sobriety test for those who demonstrate impairment. Afterwards, they go through another evaluation by Drug Recognition Experts who receive proper training of those impaired by cannabis.

Canada’s DAOD 9004–1 goes into detail regarding the standard of conduct for its country’s armed forces in regard to cannabis use. It spells out that service members must make “responsible choices” when using cannabis for any reason (Government of Canada, 2018). The instruction provides Canadian armed forces’ supervisors a list of signs by which to judge cannabis impairment (Government of Canada, 2018):

- The odour of cannabis;
- Glassy or red eyes;
- Unusual talkativeness;
- Slow reaction;
- Inattention;
- Lethargy;
- Unsteady gait;
- Poor coordination; and
- Anxiety (Section 4.7).

If a supervisor feels that a service member is unable to perform their duties or has the presence of doubt as to whether they are impaired by cannabis or not, they are required to send the service member to medical for an impairment assessment (Government of Canada, 2018).

In a recent review into the current update on cannabis breathalyzer, two companies, Hound Labs and Cannabix Technologies Inc., are in a race to create a THC breathalyzer. In fact, Hound Labs has already taken credit, via their website, for having “the world’s first marijuana and alcohol breathalyzer” (Hound Labs, 2019). Cannabix Technologies Inc.’s most recent update on its breathalyzer states that it has completed a “Breath Collection Unit” (Cannabix Technologies Inc., 2019). However, further review into updates on THC breathalyzers shows that are no current law enforcement agencies using any such device. It appears that one of these two companies are very close to a viable cannabis impairment testing method, but none are in use presently.

The research shows that cannabis impairment in the workplace can increase the risk of injury or death. Thus, keeping it out of the work environment is a must. The challenges with cannabis impairment is in determining when someone is under the influence. Mitigating these challenges means educating supervisors and law enforcement on the key impairment traits of those under the influence of cannabis. However, on-the-spot testing still needs to be developed for a concrete determination of workplace impairment.

b. Waivers

The U.S. Navy spends a lot of time managing and creating administrative tasking. Some of the time spent on these tasks include waivers and administrative separations. Cannabis is tied directly to a portion of these waivers and administrative separations. This section quantifies these tasks and forecasts that cannabis legalization could reduce the burden of these tasks.

Cannabis waivers are issued for new recruits entering the U.S. Navy who would otherwise be barred due to past cannabis use or cannabis-related incidents. Based on data processed by Martinez-Alvarez (2017) from the Naval Recruiting Command, there were 1,533 cannabis waivers granted for Naval recruits between October 2011 to January 2017.

That averages out to 23 cannabis waivers per month. Cannabis legalization would directly impact the burden of issuing waivers for new recruits. Currently, there is time and effort spent on cannabis waivers and as more states legalize cannabis, waivers will continue to increase. If the U.S. Navy were to either allow cannabis use or stop producing cannabis waivers, it would save the time and effort spent creating waivers.

c. Investment Costs

As depicted in Figure 2, from 2011 to 2016, the U.S. Navy had 4,500 service members test positive for cannabis. That averages out to 750 Naval service members administratively separated per year. Based on Mehay and Webb (2007), the average replacement cost of a Naval service member is \$17,344 (Mehay & Webb, 2007, p. 2749). The 2007 dollar value equaled \$17,344 which translates to a value of \$22,184.70 in 2019 using the 78.18 deflator from the National Defense Budget Estimates for FY 2019 (Green Book) (Office of the Under Secretary of Defense, 2018). By means of shadow pricing with 2019 dollars, the amount lost on service members testing positive for cannabis and administratively separated per year averages out to \$16.6 million (\$16,638,525), or \$99.8 million (\$99,831,150) over the six years. Conducting shadow pricing using a study by Dahlman (2007), suggests at an average of \$61,393 per Naval service member. The 2007 dollar value equaled \$61,393 which translates to a value of \$78,527.77 in 2019 using the 78.18 deflator from the National Defense Budget Estimates for FY 2019 (Office of the Under Secretary of Defense, 2018). The amount lost, given the 2019 dollars, comes out to \$58.8 million (\$58,895,812.50) annually, or \$353.3 million (\$353,374,875) over the course of six years (Dahlman, 2007, p. 16). Where this might be viewed by the U.S. Navy as an acceptable cost, it could become money saved if cannabis is authorized for service members after legalization.

Navy Active Component Unique Service Members Drug Positive	2011 (1,041)	2012 (901)	2013 (1,173)	2014 (1,252)	2015 (1,169)	2016 (1,231)
Marijuana	684	609	793	797	777	840
*Synthetic Cannabinoid: 5-fluoro-PB22-3 carboxy Metabolite	NT	NT	NT	NT	NT	0
*Synthetic Cannabinoid: AB-PINACA Metabolite	NT	NT	NT	NT	NT	0
*Synthetic Cannabinoid: MAM-2201 Metabolite	NT	NT	NT	NT	0	0
*Synthetic Cannabinoid: AB-CHMINACA Metabolite	NT	NT	NT	NT	1	0
*Synthetic Cannabinoid: JWH-018 Acid	NT	NT	NT	28	61	8
*Synthetic Cannabinoid: JWH-073 Acid	NT	NT	NT	43	60	8
*Synthetic Cannabinoid: UR-144 Acid	NT	NT	NT	49	23	0
Cocaine	214	168	180	232	252	327
d-amphetamine	74	62	75	68	14	31
d-methamphetamine	53	36	39	46	8	18
MDMA (Ecstasy)	49	20	34	46	56	57
MDA (Adam)	21	7	11	13	31	19
Codeine (39% testing in FY 2012)	5	5	12	9	3	6
Morphine (39% testing in FY 2012)	19	15	24	22	10	9
Oxycodone (35% testing in FY 2012)	22	30	53	34	8	9
Oxymorphone (35% testing in FY 2012)	46	55	90	66	15	12
Hydrocodone (39% testing in FY 2012)	NT	9	34	12	4	6
Hydromorphone (39% testing in FY 2012)	NT	11	47	18	6	7
Heroin	21	11	19	21	27	17
α-hydroxy-alprazolam (23% testing in FY 2013)	NT	NT	1	10	5	9
Lorazepam (23% testing in FY 2013)	NT	NT	1	6	4	5
Nordiazepam (23% testing in FY 2013)	NT	NT	5	4	0	3
Oxazepam (23% testing in FY 2013)	NT	NT	13	21	7	9
Temazepam (23% testing in FY 2013)	NT	NT	12	17	1	4
Source: Defense Manpower Data Center						
*Synthetic Cannabinoids (42% testing rate CY 2014 Jan - Dec)						1,404
*Synthetic Cannabinoids (42% testing rate in FY 2015)						
*Synthetic Cannabinoids (70% testing rate in FY 2016)						

Figure 2. Positive Drug Distribution from 2011 to 2016.
Source: Office of the Under Secretary of Defense
for Personnel and Readiness (2017).

These studies show that cannabis legalization and authorization can help reduce the time and effort U.S. Navy service members spend on cannabis waivers for new recruits and can also help save money on investment costs the U.S. Navy would otherwise lose on service members who are processed out for positive cannabis urinalysis.

C. HEALTH EFFECTS OF CANNABIS

In this section, I discuss the negative and positive health effects associated with cannabis. Divided into discrete sections, I present relevant literature that analyzes several health-related drawbacks and benefits that result from cannabis use, including physical, cognitive, and psychological effects.

1. Negative Effects of Cannabis

There are numerous studies on the negative health effects associated with cannabis use. I discuss three of the most prevalent negative effects that would be of concern to the U.S. Navy, including cognitive performance, physical health effects from smoking, and substance dependence.

a. Cognitive Ability

Cognitive abilities are brain skills that humans use in order to complete tasks. These abilities have a lot to do with how we learn, remember, solve problems, and maintain focus. Naval service members use these abilities while completing simple tasks such as answering the phone, communicating with others, or writing, as well as while performing more complex tasks like piloting a plane, ship-handling, or parachuting.

Studies have shown cannabis to have a negative effect on the cognitive ability of the human brain. A report on, “The Health Effects of Cannabis and Cannabinoids” (2017) by the National Academies of Sciences, Engineering, and Medicine (NASEM), studied cognition under the context of three realms: learning, memory, and attention. The NASEM report (2017) identified five good quality systemic reviews out of 94 potential reviews on cognition between 2000 and 2016. Each of the five studies covered all or some of the three realms. Three of the systematic reviews addressed learning, three addressed memory and four addressed attention. The NASEM report (2017) concluded that “there is moderate evidence of statistical association between acute cannabis use and impairment in the cognitive domains of learning, memory, and attention;” however, it determined that “there is limited evidence of a statistical association between sustained abstinence from cannabis use and impairments in the cognitive domains of learning, memory, and attention” (NASEM, 2017, p. 275).

An important part of the effect on cognition stems from the length of time residual effects of cannabis can last. Understanding how long residual effects of cannabis lasts help individuals determine when to stop using the drug prior to the start of work. Newman (2004) conducted research on the association of cannabis and pilot performance. His study examined research by Pope, Gruber, and Yurgelun-Todd (1995) on residual effects of

cannabis on the brain. The study “found that there is evidence of a residual drug effect on attention, psychomotor tasks, and short-term memory during the 12- to 24-hour period following cannabis use” (Newman, 2004). These residual effects routinely affect the “performance on tests of focused attention, visual and verbal memory and visuomotor functions” (Pope, Gruber, & Yurgelun-Todd, 1995). Heishman, Huestis, Henningfield, and Cone (1990) also discovered potential residual effects associated with cannabis use. His study concluded that cannabis can effect performance of complex cognitive tasks for one full day after use (Heishman, Huestis, Henningfield, & Cone, 1990).

Holland (2010) examines a sample of 12 studies analyzing the direct effects of cannabis on cognitive performance of infrequent users. Appendix A of this thesis compiles and presents several tables summarizing these findings. Holland’s (2010) selected sample of studies display a decrease in performance of immediate memory (Melges, Tinklenberg, Hollister, & Gillespie, 1970; Tinklenberg, Melges, Hollister, & Gillespie, 1970; Abel, 1971; Miller & Cornett, 1978; Curran, Brignell, Fletcher, Middleton, & Henry, 2002; D’Souza et al., 2004; Ilan, Smith, & Gevins, 2004; Ilan, Gevins, Coleman, ElSohly, & Wit, 2005; Hunault et al., 2009), temporal disintegration (Melges et al., 1970), delayed memory (Miller & Cornett, 1978; Curran et al., 2002; D’Souza et al., 2004), reaction time (Curran et al., 2002; D’Souza et al., 2004; Ilan et al., 2004; Ilan et al., 2005; Ramaekers et al., 2006; Hunault et al., 2009), attention (Curran et al., 2002; Hunault et al., 2009; Meyer, Pillard, Shapiro, & Mirin, 1971), verbal fluency (D’Souza et al., 2004), working memory (D’Souza et al., 2004; Ilan et al., 2004; Ilan et al., 2005), distractibility (D’Souza et al., 2004), decision-making (Lane, Cherek, Tcheremissine, Lieving, & Pietras, 2005), problem-solving (Ramaekers et al., 2006), impulsivity (Ramaekers et al., 2006), and psychomotor control (Ramaekers et al., 2006; Hunault et al., 2009). From the same tables, Holland (2010) sampled five other studies assessing the direct effects of cannabis on cognitive performance of frequent users that displayed a decrease in performance of visuospatial processing (Heishman, Arasteh, & Stitzer, 1997; Haney, Ward, Comer, Foltin, & Fischman, 1999), reaction time (Hart, Van Gorp, Haney, Foltin, & Fischman, 2001; Vadhan et al., 2007), and inhibitory control (Hart et al., 2001; Ramaekers, Kauert, Theunissen, Toennes, & Moeller, 2009).

The last sample of studies that Holland (2010) displays involves the effects of the chronic usage of cannabis on cognitive performance. The results of those studies show a decrease in math and verbal expression (Block & Ghoneim, 1993), long-term retrieval (Block & Ghoneim, 1993), selective attention (Solowij, Michie, & Fox, 1995; Fletcher et al., 1996), information processing (Solowij et al., 1995), memory (Fletcher et al., 1996; Pope & Yurgelun-Todd, 1996; Pope, Gruber, Hudson, Huestis, & Yurgelun-Todd, 2001; Bolla, Brown, Eldreth, Tate, & Cadet, 2002), learning (Fletcher et al., 1996; Pope et al., 1995; Pope et al., 2001; Solowij et al., 2002; Block et al., 2002; Bolla et al., 2002), divided attention (Fletcher et al., 1996), mental flexibility (Pope & Yurgelun-Todd, 1996), verbal fluency (Pope & Yurgelun-Todd, 1996; McHale & Hunt, 2008), word recall (Pope et al., 2001), time estimation (Solowij et al., 2002), executive functioning (Bolla et al., 2002; McHale & Hunt, 2008), psychomotor speed (Bolla et al., 2002), low-IQ attention spans (Bolla et al., 2002), decision-making (Whitlow et al., 2004; Bolla, Eldreth, Matochik, & Cadet, 2005), visual recognition (McHale & Hunt, 2008), and delayed visual recall (McHale & Hunt, 2008).

Holland (2010) concludes that among the numerous documentations on cognition, “acute effects among infrequent users [leads to] temporary disruptions in a range of cognitive domains, particularly learning and memory,” and for heavier users “cognitive effects are more limited, although one consistent finding is a general slowing of performance” (Holland, 2010, p. 161).

These studies primarily conclude that irresponsible use can lead to negative effects of cannabis on cognitive ability. Another takeaway is that cannabis use can affect performance up to 24 hours after use. These issues stress the importance of responsible usage for service members and also the risk of still being impaired the day after use. This can have a detrimental effect on service members who operate planes, submarines, ships, or other job specialties that require above-average daily cognitive ability.

b. Health Risks with Smoking

There are well known health risks associated with smoking. For those who smoke, it is common for smoking to cause a sore throat, lung irritation, a coughing, and higher

susceptibility to colds stemming from deficiencies. Long-term use can lead to asthma, lung infections, pneumonia, chronic obstructive pulmonary disease, emphysema, and cancer. However, these long-term effects are associated with cigarette smoking from the numerous toxins within. Cannabis smoke does create health issues and they are discussed.

“The Health of Effects of Cannabis and Cannabinoids” by NASEM (2017) researched cannabis smoking studies on respiratory symptoms including bronchitis. Of the several studies, one of its main reviewed studies was on Tetrault et al. (2007). Tetrault et al. (2007) examined 14 studies analyzing the connection of long-term cannabis smoking and respiratory issues. Their systematic review of the studies indicates that long-term cannabis smoking increases coughs, sputum production, and wheezing. Ultimately, they concluded that cannabis smoking causes respiratory symptoms in long-term cannabis smoking. The NASEM report’s (2017) review of numerous studies deemed of good quality, including Tetrault et al. (2007), finds a common theme between that long-term cannabis usage and an increase in respiratory symptoms. They also concluded that there was an increase in episodes of chronic bronchitis.

The NASEM report (2017) also reviewed the effects of cannabis use on pulmonary function. The report (2017) reviewed several studies, each of which concluded that cannabis smoking results in bronchitis and a reduction in forced vital capacity (FVC) in the first second within a forced expiratory volume (FEV) test. Of the four other studies that the report reviewed regarding cannabis use on pulmonary function, it found various errors in analysis that reduced the credibility of the supporting evidence. The report concluded that “there is moderate evidence of a statistical association between cannabis smoking and improved airway dynamics with acute use, but not with chronic use” and “there is moderate evidence of a statistical significance between cannabis smoking and higher forces vital capacity (FVC)” (NASEM, 2017, p. 186).

Holland (2010) also evaluated health effects from smoking cannabis. She identified that since cannabis is more often smoked, it has a direct effect on the pulmonary system. Holland’s (2010) review of Taylor’s (1988) study stated that many of the substances found in tobacco smoke are also in cannabis smoke. Those substances include “tar, carcinogens, hydrogen cyanide, carbon monoxide, polycyclic aromatic hydrocarbons, and particulate

matter” (Holland, 2010, p. 139). Holland (2010) specifies that due to the inhalation of these substances, the pulmonary function is drastically affected and most commonly lead to bronchitis. Within her review, she also identifies that smoking cannabis can lead to an increased chance of obtaining respiratory illnesses. Those illnesses, in addition to bronchitis, include the common cold and influenza. The studies she used supporting the evidence of bronchitis in cannabis smoking are Tashkin et al. (1987) and Sherrill, Krzyzanowski, Bloom, and Lebowitz (1991).

National Institute on Drug Abuse (NIDA, 2018) also discusses health risks on its website. It describes how cannabis usage can lead to the altering of the senses, altering temporal perception, changing a user’s mood, impairing body movement, challenging thinking and problem-solving, and impairing memory. When cannabis is taken in higher doses the effects can also lead to hallucinations, delusions, and psychosis. Other health effects listed on their website include problems breathing, increased heart rate, pregnancy risks, and cannabinoid hyperemesis syndrome.

These studies all strongly conclude that smoking cannabis can lead to negative health effects on the respiratory and pulmonary systems. These issues can adversely affect a U.S. Naval service member and lead to increased sick days or deteriorated work performance. However, it is worth noting that the damage from smoking cannabis is not very different than that caused by smoking tobacco and that cannabis can be delivered in other ways.

c. Cannabis Dependence

The THC in cannabis is a psychoactive drug that produces a high in those who consume it. That feeling, when used responsibly, can help people relax after a work day or contribute to a celebratory event. However, there are people who over-use drugs and alcohol or use them as an unhealthy coping mechanism; as a result, their drug use turns into a routine desire to be high. This is commonly referred to as dependency; when cannabis becomes the dependent’s high, the dependency is known as Cannabis Use Disorder (CUD). The 5th edition of *Diagnostic and Statistical Manual of Mental Disorders* (DSM), American Psychiatric Association (2013) defines CUD as “A problematic pattern of

cannabis use leading to clinically significant impairment or distress, as manifested by at least two [of the 11 criteria in Section 11 of the DSM], occurring within a 12-month period” (American Psychiatric Association, 2013). The DSM was created from the input of thousands of psychiatrists over several decades. Their input helped to classify and explain human mental health disorders which includes drug-use disorders.

Outside of the DSM, numerous cannabis related resources refer to cannabis use disorder dedicating entire sections to its prevalence. Holland’s (2010) chapter 14 by Vandrey and Haney, discuss the real risk of addiction. The authors start by discussing CUD as described by the DSM. They also explain how people who use cannabis can create a tolerance to it, can become affected by its withdrawals, can sometimes use it uncontrollably, and can use it regardless of physical or psychological problems. Overall, they conclude that many people do meet the criteria for addiction more than any other illegal drug because it is the most widely used.

The NASEM report (2017) also dedicates a chapter to cannabis dependency that it refers to as “Problem Cannabis Use.” It describes that in 2015, 22.2 million Americans were identified as current cannabis users and that 4.2 million of those Americans reported meeting criteria for CUD (NASEM, 2017, p. 333). The chapter’s summary details that the research they reviewed established “substantial evidence of a statistical association between: increases in cannabis use frequency and the progression to developing problem cannabis use” and “being male and the severity of problem cannabis use, but the recurrence of problem cannabis use does not differ between males and females” (NASEM, 2017, p. 352).

NIDA (2018) also reviews cannabis addictiveness, describing how cannabis use can lead to a mental illness known as substance use disorder (SUD). This illness details how an individual is unable to stop using cannabis despite the health effects and negative social issue it causes. It also references Hasin et al. (2015) that suggest between nine and 30 percent of people who use cannabis develop CUD. A second reference it discusses, Winters and Lee (2008), conduct research on the association between drug use as a teen and the estimated risk of acquiring a SUD. The study finds that adolescents who use cannabis prior to age of 18 are up to seven times more susceptible than adults to develop a

SUD. Similar to Holland (2010), NIDA (2018) discusses how the cessation of cannabis use leads to withdrawal symptoms, such as increased grouchiness, anxiety, and unable to sleep, reduced appetite, increased anxiety, and cannabis cravings.

Prior to legalization of cannabis in Canada, a cannabis instruction that governs the use of cannabis for the Canadian Armed Forces (CAF) was created. The Defence Administrative Orders and Directives (DAOD) 9004–1 known as the “Use of Cannabis by CAF Members” establishes a responsible use of cannabis framework (Government of Canada, 2018). Within, it details two points regarding cannabis dependency awareness. First, it defines CUD directly from the DSM described earlier in this section. Second, it deliberately warns its service members that cannabis use can be addictive. Both points display that Canada is clearly aware of the potential dependency issues associated with cannabis, but still affords its Armed Forces the option to use it.

The review of the literature on cannabis dependency provides a strong understanding of CUD and concludes that heavy cannabis usage can lead to CUD. The studies also show that the cessation of cannabis use can lead to withdrawal symptoms. Cannabis dependency can have a negative effect on Naval service members if not used responsibly. Dependency can lead to more service members entering rehabilitation and those suffering from withdrawal symptoms can exhibit drastically reduced work performance.

2. Positive Effects of Cannabis

There are numerous studies on the positive effects associated with cannabis use. I discuss five of the most prevalent positive effects that would be of benefit to the U.S. Navy. They include the reduction of anxiety, help with post-traumatic stress disorder (PTSD), pain management, minimal risk of death by overdose, and offering a safe alternative to alcohol.

a. *Anxiolytic Effects*

Many people use cannabis because they perceive that it helps reduce anxiety. Several studies reveal the anxiolytic effects of cannabis. This section reviews four studies that indicate that cannabis produces anti-anxiety effects.

Sethi et al. (1986) conducted a study published in the journal *Biological Psychiatry* and discussed the anti-anxiety effects of cannabis. Two groups of 100 individuals were compared. The control group were 50 people who did not smoke cannabis and the treated group were 50 other people who smoked cannabis regularly. Those who participated that smoked cannabis regularly displayed lower anxiety scores compared to the control group. Additionally, researchers studied the interaction between cannabis and benzodiazepine receptors in mice. Overall, they determined that cannabis use resulted in significant anti-anxiety effects in both human and animal studies, concluding “that the anti-anxiety effect of cannabis is mediated through [the] central benzodiazepine receptors” (Sethi et al., 1986).

Robson (2001) studied the therapeutic effects of cannabis and cannabinoids. Under the “Insomnia, Anxiety and Depression” section, he discusses a synthetic or man-made cannabinoid product known as nabilone that are used on patients (Robson, 2001, p. 111). The nabilone pill (1mg) was given three times daily to a control group and a treated group. For 20 anxious patients, it showed improvements on the Hamilton Anxiety Scale compared to placebo. One week into the study, anxiety scores for the nabilone patients were halved, and stayed the same throughout the rest of the treatment. Robson (2001) concluded that nabilone is a “very effective anxiolytic deserving of further study” (p. 111). Robson (2001) also conducted a comparison of his study with another nabilone using study of 11 patients. That study also displayed a “significant improvement in anxiety scores” (p. 111).

The NASEM report (2017) researched whether cannabis was an effective treatment for anxiety. One study they reviewed utilized a randomized trial of 24 people with a social anxiety disorder in which they compared a single cannabidiol dose of 600 mg to a placebo. During a simulated public speaking test, the people who had taken the cannabidiol dose had reduction in anxiety compared to those who took the placebo. The NASEM report (2017) also reviewed four other randomized controlled trials with 232 participants.

Outcomes were taken between 8 hours and 6 weeks after randomization. These trials concluded with improved benefits with cannabinoids than a placebo on anxiety. However, the NASEM report (2017) still felt that despite the fact there was evidence showing cannabidiol reduced anxiety, there was only limited evidence concluding this.

In 2012, Schier et al. reviewed studies on cannabidiol and its effect as an anti-anxiety drug (Schier et al., 2012). They conducted studies on healthy humans and humans with social anxiety disorder as well as animals. They determined that cannabidiol does have anti-anxiety or anxiolytic effects on healthy humans and animals. However, cannabidiol was especially anxiolytic in studies using patients with social anxiety disorder. Additionally, Holland (2010) briefly discusses three studies regarding the use of cannabidiol on anxiety (pp. 277, 280). Her review of one study determined that cannabidiol does play a role in diminishing anxiety (p. 277).

The studies conclude that cannabis use can help reduce anxiety. Responsible cannabis use can help service members relieve the anxiety that a stressful Naval career can create.

b. Post-Traumatic Stress Disorder (PTSD)

Several scholars have found that cannabis may help individuals dealing with the psychiatric disorder Post-Traumatic Stress Disorder (PTSD). This disorder is caused by exposure to events that are violent or life-threatening. For instance, events such as military combat, natural disasters, or sexual assault can contribute to PTSD. Naval service members are more likely to be exposed to military combat, than civilians, which increases their risk of getting PTSD. Given this fact, I explore the potential benefits of cannabis on PTSD.

Fraser (2009) conducted a clinical trial of the effects of nabilone on patients with PTSD:

For 47 patients... the usual starting dose was 0.5 mg and was titrated up or down to effect. The average effective dose of nabilone was 0.5 mg one hour before bedtime [and the patients were seen] weekly thereafter until a satisfactory response was achieved or nabilone was stopped due to side effects... Thirty-four (72%) patients experienced total cessation or lessening of severity of nightmares (28 patients had total cessation of

nightmares and 6 had satisfactory reduction)...Subjective improvement in sleep time, the quality of sleep, and the reduction of daytime flashbacks and night sweats were also noted by some patients. The results of this study indicate the potential benefits of nabilone, a synthetic cannabinoid, in patients with PTSD experiencing poor control of nightmares with standard pharmacotherapy...The author recognized the limits of this study...nonetheless... this initial positive clinical report on 34 of the 47 patients will hopefully inspire other physicians to consider using nabilone in those with persistent PTSD nightmares. (Fraser, 2009, “Abstract,” “Results,” and “Conclusion”)

The NASEM report (2017) reviewed a study on Canadian military males who were suffering from trauma-related nightmares. The study was a randomized cross-over and double-blind trial, consisting of ten participants. It compared Nabilone (between 0.5 mg and 3.0 mg) randomized amongst the ten participants, versus a placebo for seven weeks. After a two-week period, personnel were again treated and the study continued for seven more weeks. There were more positive results from the use of Nabilone treatment over the placebo treatment. Nabilone helped improve the reduction of nightmares and improved global clinical state and general well-being. The study concluded that “global clinical state was rated as very much improved or much improved for 7 of 10 subjects in the nabilone treatment period and 2 of 10 subjects in the placebo treatment period.” (NASEM, 2017, p. 124). With this study alone, the NASEM report (2017) concluded that “there is limited evidence (a single, small fair-quality trial) that nabilone is effective for improving symptoms of posttraumatic stress disorder” (NASEM, 2017, p. 124).

There are two other studies currently being conducted that are associated with cannabis use on patients with PTSD. One trial by Bonn-Miller, that started in 2016, examines the effects of cannabis on 76 veterans with PTSD symptoms using four different types of varying THC and CBD content. The four different types include a high THC, high CBD, high THC and CBD combination, and a placebo of cannabis with low levels of THC and CBD. Results for that study are expected to be finalized in April 2019 (U.S. National Library of Medicine, 2019). The second trial is a Canadian study being conducted by Eades that started in 2016. This study evaluates three different treatment types of THC and CBD formulations on 42 adults dealing with PTSD. The results of that study are expected in June of 2020 (U.S. National Library of Medicine, 2018). In regard to these two studies, the

NASEM report (2017) commented on the importance of these trials' completion. The report emphasized that those two studies "will add substantially to the knowledge base, expanding the range of cannabinoids evaluated and the opportunity to examine the consistency of effects across studies" (NASEM, 2017, p. 124).

These studies conclude that there is evidence that cannabis can help suffering service members deal with the symptoms of PTSD. This could potentially help service members, who would normally be medically discharged from the U.S. Navy, rehabilitate and continue their Naval career.

c. Pain

Among the many benefits of cannabis, pain and inflammation reduction are one of its most notable attributes. In a world full of over-the-counter and pharmaceutical pain killers, cannabis provides a natural way to relieve pain. There are several studies associating cannabis and pain relief, I discuss them in this section.

Wilsey et al. (2013) conducted a study on the effects of cannabis on neuropathic pain. The study utilized a double-blind, placebo-controlled, crossover analysis that specifically evaluated vaporized cannabis' analgesic efficacy. There was a total of 39 patients who were all dealing with neuropathic pain in spite of traditional treatments. The subjects underwent a standardized procedure where they inhaled either a low, medium, or placebo dose of cannabis. The research determined that a low dose of vaporized cannabis was comparably effective at pain reduction to neuropathic pain medications. It concluded that cannabis is effectively analgesic using the low dose treatment and that low dose was equally effective as a pain reliever to the medium dose. The study showed that "vaporized cannabis, even at low doses, may present an effective option for patients with treatment-resistant neuropathic pain" (Wilsey et al., 2013).

The NASEM report (2017) dedicated a section on whether cannabis was an effective way to treat and reduce pain. It reviewed several studies associating cannabis and pain but emphasized five fair- to good-quality studies as its primary literature. The studies utilized different types of cannabis including dronabinol (Food and Drug Administration (FDA) approved cannabinoids), smoked cannabis flower, and vaporized cannabis flower.

The report concluded that “there is substantial evidence that cannabis is an effective treatment for chronic pain in adults” (NASEM, 2017, p. 90).

Holland (2010) lists a summary of 23 published studies that researched the analgesic effects of cannabinoids. Tables 1 and 2 display each of the 23 studies including the outcome of each study’s analgesic efficacy. Of the 23 studies, 15 of those studies were effective in decreasing pain. The tables show a pain reduction in healthy volunteers (Milstein, MacCannell, Karr, & Clark, 1975; Greenwald & Stitzer, 2000; Wallace et al., 2007), cancer pain (Noyes, Brunk, Avery, & Canter, 1975a; Noyes, Brunk, Avery, & Canter, 1975b; Staquet, Gantt, & Machin, 1978), neuropathic pain (Karst et al., 2003; Berman, Symonds, & Birch, 2004; Abrams et al., 2007), acute pain (Raft, Gregg, Ghia, & Harris, 1977; Jain, Ryan, McMahan, & Smith, 1981), arthritis (Blake, Robson, Ho, Jubb, & McCabe, 2005), and chronic pain (Notcutt et al., 2004). The delivery methods that were effective in reducing pain included oral, smoked, intravenous, intramuscular, and sublingual spray.

Table 1. “Summary of Published Studies on Cannabinoid Analgesic Efficacy” Part 1 of 2. Source: Holland (2010, p. 325).

Study population	Agent	Delivery method	Outcome	Reference
Healthy volunteers	Marijuana	Smoked	+	Greenwald and Stitzer 2000
Healthy volunteers	Marijuana	Smoked	+	Milstein et al. 1975
Healthy volunteers	Marijuana	Smoked	+ moderate doses – high doses	Wallace et al. 2007
Healthy volunteers	THC	Oral	0	Naef et al. 2003
Healthy volunteers	THC	Oral	0	Zeidenberg et al. 1973
Healthy volunteers	Marijuana	Smoked	–	Hill et al. 1974
Healthy volunteers	Marijuana	Smoked	–	Clark et al. 1981
Cancer pain	THC	Oral	+	Noyes et al. 1975a
Cancer pain	THC	Oral	+	Noyes et al. 1975b
Cancer pain	benzopyranoperidine	Oral	+	Staquet, Gantt, and Machin 1978

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 2. “Summary of Published Studies on Cannabinoid Analgesic Efficacy” Part 2 of 2. Source: Holland (2010, p. 326).

Study population	Agent	Delivery method	Outcome	Reference
Cancer pain	benzopyranoperidine	Oral	–	Jochimsen et al. 1978
Neuropathic pain	Cannabidiol	Oral	0	Lindstrom, Lindholm, and Boreus 1987
Neuropathic pain	CT-3	Oral	+	Karst, 2003
Neuropathic pain	THC	Sublingual spray	+	Berman, Symonds, and Birch 2004
Neuropathic pain	THC/cannabidiol	Sublingual spray	+	Berman, Symonds, and Birch 2004
Neuropathic pain	Marijuana	Smoked	+	Abrams et al. 2007
Acute pain	THC	Intravenous	+ low doses 0 high doses	Raft et al. 1977
Acute pain	Levonantradol	Intramuscular	+	Jain et al. 1981
Acute pain	THC	Oral	0	Buggy et al. 2003
Arthritis	THC/cannabidiol	Sublingual spray	+	Blake et al. 2005
Chronic pain	THC	Sublingual spray	+	Notcutt et al. 2004
Chronic pain	THC/cannabidiol	Sublingual spray	+	Notcutt et al. 2004
Chronic pain	Cannabidiol	Sublingual spray	0	Notcutt et al. 2004

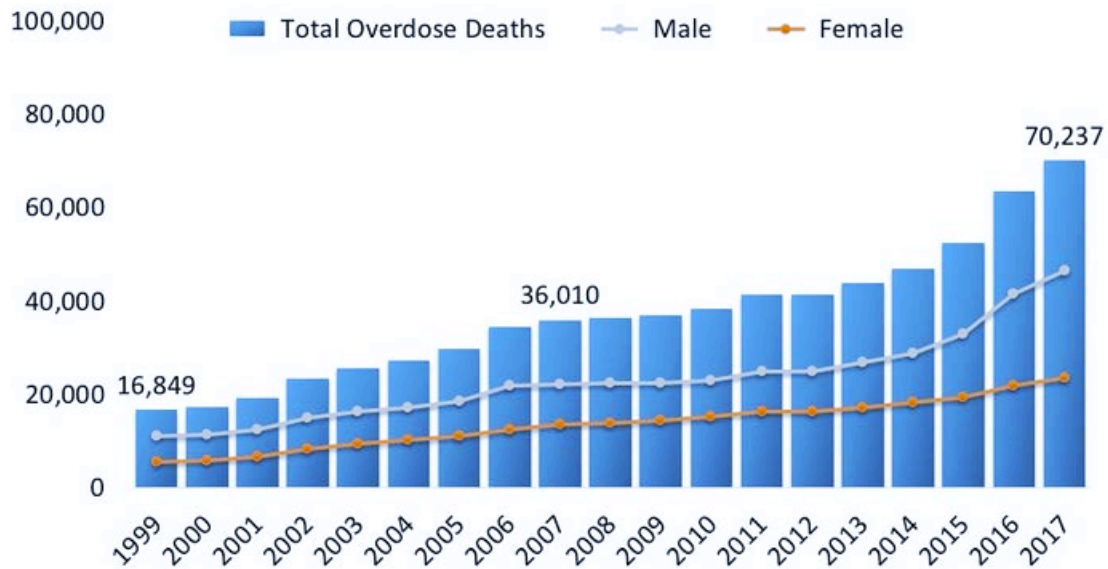
+ = decrease pain, 0 = no effect, – = increase pain

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

The majority of studies shown in this section identify that cannabis does provide analgesic effects. In Holland's (2010) conclusion of her pain management chapter, she discusses a report by the Institute of Medicine; it, like the many studies depicted here, states that cannabis can create analgesic effects (p. 327). However, Holland (2010) emphasizes the need for more studies associating cannabis and pain relief. Regardless, naval service members can benefit from using cannabis to deal with pain management. This pain management can range from responsible use of cannabis for muscle soreness to those who deal with chronic pain from major injuries.

d. Death

Every year in the United States, hundreds of thousands of people die from drug overdoses, alcohol-related causes, and cigarette smoking. Figure 3 portrays that in 2017, 70,237 Americans died as a result of a drug overdose (NIDA, 2019). According to NIDA (2019), 47,600 of those deaths were directly related to some form of opioid. According to the Centers for Disease Control and Prevention (CDC), between 2006 and 2010, the average alcohol-attributable deaths were 88,668 (Centers for Disease Control and Prevention [CDC], 2013). During that same time frame, 1,647 of those people died from alcohol poisoning alone and that number went up. As of 2015, the CDC website stated that there were 2,200 alcohol poisoning deaths annually (Centers for Disease Control and Prevention [CDC], 2015). According to the CDC website (2019) on smoking and tobacco use, a staggering 480,000 people die from cigarette smoking annually and it is currently the leading cause of preventable death.



Source: Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. Multiple Cause of Death 1999–2017 on CDC WONDER Online Database, released December 2018, para. 1.

Figure 3. “National Drug Overdose Deaths, Number among All Ages, by Gender, 1999–2017.”

According to the Navy and Alcohol Drug Abuse Prevention (NADAP) April to June 2017 Report (Navy and Alcohol Drug Abuse Prevention, 2017), there were 11,753 Drug and Alcohol Reports (DARs) filed from the 2013 fiscal year to the 2016 fiscal year. This reported number was for Alcohol alone and the incidents included driving under the influence, civilian police incidents, military police incidents, command incidents, command referrals, medical referrals, and self-referrals. The majority of the DARs were for command referrals (4,475) and driving under the influence (3,445).

To date, there are no reported or recorded deaths from cannabis overdose. There are several administrations, books, reports, studies, and websites that can confirm this. The NASEM report (2017) states “there is insufficient evidence to support or refute a statistical association between cannabis use and death due to cannabis overdose” (p. 236). Grotenhermen’s (2003) study on cannabinoids briefly discussed cannabis association and death, stating “acute fatal cases in humans have not been substantiated” (p. 343). On NIDA’s website discussing cannabis under its section on whether a person can overdose

on cannabis, NIDA (2018) states that “there are no reports of teens or adults dying from marijuana alone” (NIDA, 2018, para. “Can a person overdose on marijuana?”). The U.S. Drug Enforcement Administration (DEA, 2017) writes in its 2017 edition resource guide on *Drugs of Abuse* that “no deaths from overdose of marijuana have been reported” (U.S. Drug Enforcement Administration [DEA], 2017, p. 75).

Based on these reputable administrations, reports, and studies, cannabis is the least likely drug to cause overdose. Cannabis use would be safer to use than alcohol and tobacco. The U.S. Navy would benefit because from less harm done to their service members.

e. Cannabis Is a Safe Alternative to Alcohol

Although there is limited evidence available on cannabis, there are several credible sources that show that it is a safe alternative to alcohol. Cannabis has been shown in studies to have fewer health risks than alcohol. First, the death rate associated with alcohol in the United States equates to over 88,000 people per year (CDC, 2013) whereas cannabis has had zero reported deaths ever (Grotenhermen, 2003, p. 343; DEA, 2017, p. 75; NASEM, 2017, p. 236; NIDA, 2018, para. “Can a person overdose on marijuana?”). Second, according to the National Toxicology Program of the U.S. Department of Health and Human Services’ report on carcinogens, alcoholic beverage consumption was listed as a “known human carcinogen” (“National Toxicology Program,” 2016). Although Holland (2010) pointed out that similar substances found in tobacco smoke are also found in cannabis smoke, smokeless forms of cannabis (nor any of its compounds) were not listed on the carcinogens report. Third, Anthony, Warner, and Kessler (1994), published a large-scale survey of over 8,000 people between the ages of 15 and 64 about their drug and alcohol use. They determined that alcohol had 6.3 percentage points higher in dependence than cannabis (Alcohol 15.4, Cannabis 9.1) (Anthony, Warner, & Kessler, 1994, Table 2).

Additionally, alcohol has been linked to weight gain (Fazzino, Fleming, Sher, Sullivan, & Befort, 2017), memory impairment (Le Berre, Fama, & Sullivan, 2017), increased violence (Denson, Blundell, Schofield, Schira, & Krämer, 2018), and poorer brain white matter integrity (Thayer et al., 2017). All of these studies show the extremely

negative effects of alcohol and in several cases, those negative effects are arguably worse than negative effects of cannabis use.

D. RIGHTS AND FREEDOMS

The rights and freedoms of the American people have been an important aspect of who they are, stemming back long before the creation of the Declaration of Independence and the Bill of Rights. Americans have stood up and died for the preservation of their rights and freedoms. These rights have been preserved for over 240 years and continue today. Rights are even prioritized in the National Security Strategy (NSS), which guides our country's defense. Under the NSS Pillar IV "Advance American Influence," it states "Above all, we value the dignity of every human life, protect the rights of every person, and share the hope of every soul to live in freedom. That is who we are" (National Security and Defense, 2017, p. 37).

When an individual joins the U.S. Navy, on the surface, he or she does not lose any rights and freedoms. However, there are several examples of restrictions on Naval service members' rights. These restrictions are governed under the Uniform Code of Military Justice (UCMJ) or other military prohibitions. Some of the rights restricted include freedom of speech towards superiors, specific restrictions of political activity, the right to bear arms on a military installation, lawful search and seizure of belongings while on a ship or in the barracks, and trial by a random jury of peers when electing a court-martial. In this section, I discuss how and why freedom of speech (Kiel, 2007) and specific aspects of political party affiliation are restricted. I then discuss alcohol use in the U.S. Navy and how considerations of the *purposes* of restrictions might influence a U.S. Navy cannabis policy.

Freedoms of speech restriction in the U.S. Navy are strictly associated with Articles 88 and 134 of the UCMJ. Article 88, "Contempt toward officials," states that:

"Any commissioned officer who uses contemptuous words against the President, the Vice President, Congress, the Secretary of Defense, the Secretary of a military department, the Secretary of Homeland Security, or the Governor or legislature of any State, Commonwealth, or possession in which he is on duty or present shall be punished as a court-martial may direct." (Armed Forces, 10 U.S.C. § 888. Art. 88., 2017)

Article 134 “General Article,” states that:

“Though not specifically mentioned in this chapter, all disorders and neglects to the prejudice of good order and discipline in the armed forces, all conduct of a nature to bring discredit upon the armed forces, and crimes and offenses not capital, of which persons subject to this chapter may be guilty, shall be taken cognizance of by a general, special, or summary court-martial, according to the nature and degree of the offense, and shall be punished at the discretion of that court.” (Armed Forces, 10 U.S.C. § 934. Art. 134., 2017)

Each of these articles under the UCMJ restrict the freedom of speech for both commissioned officers and enlisted members. The purpose of these restrictions on Naval service members is to maintain order and discipline within the hierarchical structure of the U.S. Navy. The military mission depends on this, and this restriction is designed to protect rather restrict the United States and its military service members.

U.S. Navy service members are also not allowed to make statements either supporting or opposing a political party or position. They may also not participate in a political gathering while in uniform or in any fashion that could be construed as a military endorsement of those parties, positions, or gatherings. There are a total of 16 prohibitions associated with what an active duty service member shall not do according to the Department of Defense (DoD) Directive 1344.10 instruction title “Political Activities by Members of the Armed Force” (Department of Defense, 2008, pp. 3–4). This instance further displays the restrictions on U.S. Navy rights and freedoms. However, this restriction’s purpose is to prevent Naval service members from interfering in any political process through the abuse of government power.

Beside restrictions of speech and affiliation, there are also expectations of behavior and comportment. For example, although the U.S. Navy does not restrict alcohol consumption, it does demand responsible use. Any violation of the following instructions can result in a Naval service member being disciplined or separated.

- OPNAVINST 5350.4D, “Drug and Alcohol Abuse Prevention and Control,” which directly calls for the responsible use of alcohol by service members (Chief of Naval Operations, 2009).

- SECNAVINST 5300.28E, “Military Substance Abuse Control and Prevention,” which dictates a release of any service member who incurs a second alcohol related incident after successful completion of an alcohol treatment program for a first alcohol related incident (Secretary of the Navy, 2011).

Within the last five years, two drunk driving incidents in Japan resulted in a temporary ban of all alcohol use for military members in Japan. The first incident was in June of 2016, when a drunk sailor driving the wrong way on a freeway collided with two vehicles, subsequently injuring two people (Reuters, 2016). A second incident in November of 2017 involved a drunk marine driving a military truck and colliding with a smaller truck, killing a 61-year-old man (Fifield, 2017). Both incidents displayed the power of the U.S. Navy to prohibit alcohol use for the purpose of protecting both Naval service members and the civilian members in and around U.S. Navy communities.

If cannabis becomes legal at the federal level, the rights of Naval service members should be valued as part of the outcome as to whether service members’ usage of cannabis will be authorized or prohibited. As shown, the U.S. Navy can dictate when and how to implement policies of restriction. The common aims of many U.S. Navy restrictions are the advancement of order and unity within the organization, the avoidance of undue influence in the American political process, and the immediate protection of service members and their communities, whether domestic or international. Assuming the federal legalization of cannabis, it is logical that U.S. Navy cannabis policy, whether permissive or restrictive, would similarly align to these aims.

E. BARDACH STUDIES

The Bardach eightfold path or eight-step method of policy analysis was created by Dr. Eugene Bardach. His book, *A Practical Guide for Policy Analysis: The Eightfold path to More Effective Problem Solving* (Bardach, 2012) provides the eight-step method details and instructions on how to conduct a policy analysis. His method has been used to address numerous problems ranging from mental health issues in Afghanistan (Babury & Hayward, 2013) to income inequality in the United States (Billingsley, 2014) and many in between.

Bardach's eight-step method is mostly used by policy analysts and public policy graduate students who have a background in economics, public policy, and politics. Proper use of his method can lead to one or more public policy recommendations and alternatives supported by evidence. The following review highlights the variety of policy issues to which Bardach's eight-step method is applicable and effective to justify this thesis' methodology.

Kirkendoll and Heaton (2018) used Bardach's eight-step method to research a chronic sleep condition known as obstructive sleep apnea (OSA) on truck drivers in the trucking industry (Kirkendoll & Heaton, 2018). The eight-step method worked extremely well in this case because it helped identify that OSA is an issue for truck drivers and that keeping truck drivers and roads safer required a change. The study used the eight-step method to establish the negative side-effects of OSA (cognition, attention, vigilance, and visual-spatial impairment), to identify that the Federal Motor Carrier Safety Administration's lack of testing for OSA led to safety-related problems, and to compare different testing, screening, and treatment solutions. This study was able to quantify the benefits of certain solutions, showing health care cost savings in dollars and the percentage of crash reduction. Ultimately, Kirkendoll and Heaton (2018) was able to propose a policy recommendation that would increase public safety while also improving truck driver's health, extending their longevity, and reducing disability cases (Kirkendoll & Heaton, 2018).

Giuliani (2007), a graduate of the Naval Postgraduate School, completed his thesis researching post-9/11 national standards for driver's licenses (DL) and identification (ID) cards using Bardach's eight step method of policy analysis. A 9/11 commission concluded that strict national standards for U.S. DL/ID cards could thwart terrorists from illegally procuring them. The federal government responded to the 9/11 commission's recommendation by passing the Real ID Act of 2005 (RIDA). Using Bardach's eight step method, Giuliani (2007) compared three policies: status quo or allowing the current DL/ID card state issuance method, developing DL/ID card standards under the negotiated rule-making process that the Intelligence Reform Act authorized, and the institution of a national ID card issue as defined by RIDA. He concluded that implementing RIDA was

the correct policy to adopt because it gives flexibility to the states to implement the law (Giuliani, 2007).

Baker (2017), a graduate of the Naval Postgraduate School, also completed a thesis using Eugene Bardach's eight step method of policy analysis. His thesis explored the increased trend of states decriminalizing and legalizing cannabis and how the amended states' laws conflict with the current federal drug policy. He argued that a policy needs to be adopted to resolve the conflicts between federal law and state law while complying with international treaties and public safety. Using Bardach's eight step method, he compared three policies: status quo or maintaining the federal drug policy without forcing states to comply with it, strict enforcement by forcing states to comply with the federal drug policy, and rescheduling cannabis in order to meet state desires and comply with international treaties as well as public safety. Bardach's policy analysis method enabled Baker (2017) to conclude that rescheduling cannabis to a Schedule III controlled substance was the best policy choice because it protects medical patients requiring medical cannabis, ensures compliance with international drug treaties, and increases the availability of the drug in order to conduct further research (Baker, 2017).

These examples provide a very general overview of how Bardach's method can be applied to various types of policy issues in order to weigh multiple alternative solutions and ultimately recommend a new policy that best addresses the relevant criteria. Although there may be many possible approaches or methods to policy analysis, Bardach's eight-step method is most suitable to this thesis' research due to its rigor, its attention to detail, and its pursuit of the most well-reasoned policy recommendations. The methodology chapter of this thesis describes the steps of Bardach's method in detail, supporting this assertion.

III. METHODOLOGY

The eightfold path is a method of policy analysis created by Eugene Bardach. The main concept of this method is to analyze a public policy problem, create and compare policy options, and recommend a policy to mitigate the problem. There are eight steps in total; they are not required to be taken in order nor are all of them relevant to every problem. Defining the problem is the starting point and telling the story is the ending point. Constructing alternatives and selecting criteria by which to evaluate them are the initial steps after defining the problem. Assembling evidence is reoccurring throughout the entire process, but it is designed to support defining the problem and projecting alternative outcomes. This methodology chapter will discuss each step in detail.

A. STEP ONE: DEFINE THE PROBLEM

The first step is “define the problem” (Bardach, 2012, p. 1). The purpose of problem definition is to create a straightforward sentence that gives the policy analysis purpose, a direction for procuring evidence, and builds a structure to get to the final step, “tell your story” (Bardach, 2012, p. 70).

There are several helpful techniques to consider when defining the problem. To start, thinking in terms of “deficit and excess” (too few/too many, too small/too big, too expensive) helps define quantifiable problems (Bardach, 2012, p. 1). This technique helps to assess problems that may not currently exist but that might in the future. However, if a problem is already well defined, this technique may prove unnecessary. To make a “deficit and excess” problem definition strong, it should include a quantitative aspect, such as a magnitude. Policy analysts use the pertinent information they have gathered surrounding the problem to calibrate these magnitudes or estimate them in the absence of such information. This magnitude, estimated or not, will contain a range and a point estimate. If there is no logical way for the analyst to guess a number, then they will use a metric which is defined qualitatively in order to quantify the problem. Moreover, referring to “the odds” of the problem helps better describe the uncertainties—especially those resistant to quantification—within the problem definition (Bardach, 2012, p. 6).

Another support aspect to step one is making the problem definition evaluative. This is to prove the problem definition is legitimated through facts. Two ways Bardach suggests achieving this is by asking “What private troubles warrant definition as public problems and thereby legitimately raise claims for making something better through public resources?” and then by pinpointing government failure in areas expected to function well and perform effectively (Bardach, 2012, p. 2). Using the right language when evaluating the problem is important. This language, known as “Issue Rhetoric,” is often unique to the problem’s environment and makes sense to the worlds responsible for mitigating the problem it defines (Bardach, 2012, p. 4).

This first step is iterative. Revisiting the elements of this step is necessary to correct errors and to address the problem differently to give the ultimate policy recommendation a better chance at success. Step one is so crucial that getting it done right necessitates repeating it. Revisiting the methods in step one ensures that policy recommendations actually reflect a well-defined problem.

B. STEP TWO: ASSEMBLE SOME EVIDENCE

Step two is “assemble some evidence” (Bardach, 2012, p. 11). This step supports the overall policy analysis process of the eight-step method. The objective of this step is to collect data that can be turned into “information” and, ultimately, translated into “evidence” (Bardach, 2012, p. 11). This translation adds relevance to the problem and contributes to producing a sound policy recommendation. Collecting evidence helps evaluate the landscape, scope, and particulars of the problem.

There are several different techniques for procuring evidence. For starters, prior to assembling evidence, contemplating the right information to research ensures that time is spent efficiently and that the data collected is appropriate. Collecting evidence without thoughtful purpose wastes time and leads to rework. Taking time at the beginning to brainstorm can significantly benefit the process of evidence collection. An important part of brainstorming is making educated guesses. Thinking critically about the most useful types of evidence and the best methods of procurement can reduce wasted time, energy, and money (resources).

Critical thinking also helps determine the value of the evidence as it relates to the defined problem. If the evidence leads to a better decision, a better policy outcome, or a marginal difference between the status quo and the ultimate policy recommendation, the evidence has value. Selecting credible evidence from reputable sources can help ensure collecting valuable evidence. Relying heavily on evidence from advocacy-based sources because it is simply readily available can introduce bias into the body of evidence.

Identifying successful policies that other credible organizations have implemented can point analysts in the right direction for evidence collection. Finding studies that have dealt with the same or a similar problem and comparing them can create a valuable piece of assembled evidence. Additionally, comparisons of similar entities and organizations can reveal how problems relate and, in turn, be used as evidence. Extrapolating generalized solutions from specific cases can also translate into evidence.

Two concepts can help defend against confirmation bias and overconfidence bias when assembling evidence. To protect against confirmation bias, a valuable asset in evidence collection is the opinion of critics. A critic's perspective can help determine what evidence to search for and, in some cases, where to find it. Critical feedback can also improve the current policy. Discussing ideas with critics as well as sympathizers can formulate a network, leading to more valuable evidence opportunities. To avoid overconfidence bias while assembling evidence, keeping an open mind is very valuable. Procuring strongly objective points of view from informants can lead to evidence that covers all sides of a problem and can help to mitigate bias. This also contributes to the full understanding of the entire spectrum of evidence.

C. STEP THREE: CONSTRUCT THE ALTERNATIVES

Step three is “construct the alternatives” (Bardach, 2012, p. 16). The purpose of this step is to create alternative policy options that would ultimately solve or alleviate the problem. There are several techniques to help determine alternatives and ensure they are well-structured.

Creating a large list of alternatives initially will help provide a diverse outlook to the different aspects of the policy analysis. Analysts will narrow down the list to two or

three main alternatives that are best focused on solving the problem. The status quo is always first on the list of alternatives. Using the status quo helps better understand what is currently happening in the world of the problem. Dedicated effort on the problem definition will result in the dismissal of the status quo option.

Using ideas that are politically salient is an excellent starting point for constructing alternatives. Alternatives can come from politicians, pilot or experimental studies, best practices, and from prominent institutions or people. Building alternatives off these concepts or improving upon them can help compile a comprehensive list. Assessing causes can also help construct alternatives. Identifying choke points, constraints, and bottle necks are useful tools in problem mitigation, which can be helpful when working in complex systems.

Lessons learned by other institutions can help formulate or rule out alternatives. They can help compare plans of other jurisdictions, countries, militaries, and communities to see what certain alternatives are missing or what needs to be added in order to bolster an alternative. More alternative ideas can be collected, by the analyst, from executive offices and professional associations that publish material on relatable problems.

After collecting a comprehensive list of alternatives, narrowing the list down is vital to focusing in on a problem. Shortening the list is done through determining the basic strategic drive of an alternative and then distinguishing between the general alternative and its more specific variations.

D. STEP FOUR: SELECT THE CRITERIA

Step four is “select the criteria” (Bardach, 2012, p. 31). In the fourth step, analysts use criteria as an evaluative standard by which to judge the policy outcome of each alternative.

There are several evaluative criteria that are commonly used in step four. The following is a list of some of the most common criteria (Bardach, 2012):

- Efficiency—Striving to be efficient or most effective.

- Equality—Working towards being equal in status, having equal rights, or given equal opportunities.
- Fairness—Just treatment, removing discrimination or favoritism.
- Justice—Ensuring fairness and being reasonable.
- Equity—Being fair and unbiased.
- Freedom from government control—Ability to act without restraint from the government.
- Privacy—Freedom of observance from other people.
- Safety—Protection from danger or injury.
- Legality—Abiding by the laws of the city, state, or nation.
- Robustness—Being strong or in good condition to resist further issues.
- Improvability—Allowing room to be made better.
- Any Other Criteria—Any criteria can be utilized if justified and explained properly (pp. 33–41).

In some policy analysis situations, certain criteria will be more important than others. Properly “weighting” criteria may depend on political considerations, the mission or philosophy of the institution enacting the policy, or issues of property and privacy.

To avoid confusion, the analyst should focus in on one primary criterion. Later, other criteria can be collected around the primary. This primary criterion is the “principal objective to be maximized or minimized” and the main focus of the problem definition (Bardach, 2012, p. 44).

To better formulate priorities of the criteria, the analyst will sort them based on value maximization, values that are constraints, or values where more is better. To make reading and discussion of the criteria easier, the analyst will group all the positive criteria and all the negative criteria. In order to avoid mistaking an alternative for criterion and vice

versa, the analyst should recall that “alternatives are courses of action and criteria are mental standards for evaluating the results of action” (Bardach, 2012, p. 46).

E. STEP FIVE: PROJECT THE OUTCOMES

The fifth step is “project the outcomes.” The purpose of this step is to anticipate the results of the alternatives constructed in step three.

There are three difficulties that step five must overcome. The first one is “policy” and it pertains to the inherent challenges in predicting the future (Bardach, 2012, p. 47). The future is an uncertain realm and regardless of how good a policy is, it cannot provide convincing evidence of what is to come. The second difficulty is “be realistic” (Bardach, 2012, p. 48). For policy analysts, being realistic can be difficult. The belief that a preferred policy will achieve wonders blinds analysts of the costs the policy, if implemented, will actually inflict. The third challenge is “the 51–49 principle” (Bardach, 2012, p. 48). In the middle of a policy conflict, an analyst might defend a policy outcome that only has 51 percent confidence as if it merited 100 percent confidence, which, in turn, misleads other analysts and stakeholders.

Producing projections of policy outcomes from alternatives can be logically conducted by combining both models and evidence. Using multiple models can illuminate unanticipated elements of the problem or an alternative’s potential outcomes. Models must be grounded in evidence about the “initial conditions” or current facts surrounding the problem (Bardach, 2012, p. 49). Goals of modeling include creating estimates of magnitude, break-even analyses, and threshold analyses, all of which can help quantify predicted outcomes.

To best account for uncertainties when projecting outcomes through models, analysts should use sensitivity analyses (Bardach, 2012, pp. 53–54). Analysts should also create scenarios of their own around different alternatives and follow those scenarios to their logical conclusion. This will allow analysts to confront irrational optimism by considering the most threatening or detrimental potential outcomes or “undesirable side-effects” (Bardach, 2012, p. 55). These might include “moral hazards,” “reasonable regulation drift[ing] towards overregulation,” or the distortion of policy implementation to

serve a particular sub-group's interests (Bardach, 2012, p. 56). There is also a possibility that envisioned benefits from a good policy will fail to materialize. An analyst has to consider the costs of being wrong if their policy or advice is followed. Creating an "outcomes matrix" where the policy alternatives and evaluative criteria are shown in an overview can help facilitate these considerations (Bardach, 2012, p. 59). It also helps the analyst better understand what they have and what they still need to learn. This matrix also prepares the analyst for the following step, confronting trade-offs. In that step, this matrix can help omit criteria and alternatives if they are no longer feasible. After the matrix is finalized, it can be helpful when arriving at step eight, where the analyst tells a story regarding the outcome from the first seven steps.

The outcomes matrix is a simplified procedure that displays an overall assessment of each alternative and evaluates them according to the decision criterion. Rows and columns comprise the outcomes matrix, the former displays the alternatives' projected outcomes, while the latter displays the alternative name, the decision criteria, and the final assessment. A criterion measurement scale number will be awarded to each alternative based on how well the alternatives' outcome satisfies each decision criteria. The final assessment is determined by adding up the sum of the awarded number multiplied by the criterion weight and dividing by the total number of criteria used. If a weight is not used, the final assessment is determined simply by adding up the sum of the awarded numbers. The final assessment number that is the highest is the most satisfying alternative.

F. STEP SIX: CONFRONT THE TRADE-OFFS

The sixth step is "confront the trade-offs." The purpose of this step is to explain trade-offs amongst alternatives based on the evaluative criteria. In some cases, there are alternatives that produce better outcomes based on the chosen criteria than every other alternative and this is called "dominance" (Bardach, 2012, p. 63). However, for other outcomes that have mixed results, this step seeks to clarify those results properly.

The first concept in confronting trade-offs is avoiding common pitfalls and remaining focused on the outcomes. A conversion of alternatives into outcomes is necessary before the trade-offs can be properly confronted. For example, one policy might

save a certain amount of money while another policy provides a good or service. This example is the most common trade-off converted by analysts. The best way to evaluate trade-offs is if projected outcomes can be expressed monetarily. From this conversion, the outcome with the highest net value is chosen. This is a perfect procedure to utilize if budgets are unlimited; however, if budgets are limited, monetary consideration can affect outcomes of alternatives when comparing the cost-effectiveness per unit criteria. In some situations, where one alternative is not cost-effective or has a considerably low score when judged by one criterion, it may be judged better by some different criteria. In the event of a tie, the trade-off analysis needs to prioritize which alternatives and criteria to emphasize.

Instituting an equally measurable standard throughout criteria is important in justly determining an alternative. If two alternatives, judged by the same set of criteria, are the same, one is chosen based on the weight of the criteria. If again the two alternatives are the same with the weight of the criteria the same, money becomes the commensurable metric. However, it is important to note that there are some rare problems, known as “multi-attribute problems” (Bardach, 2012, p. 65), that are rationally unsolvable.

In confronting trade-offs, a base case is selected in order to compare other alternatives to it. The base case can be the simplest option of what currently exists, or the status quo. Three other potential base cases include any and all naturally occurring future conditions associated with business as usual, any change from an alternative that was not placed on the list of alternatives from step three, and the projections of a recently implemented policy option that is used to prove its effective or ineffective results. Selecting a base case helps to focus attention on the value of the case itself or instead show how controversial it is. It may also provide a way of uniformly establishing a context against which trade-offs are judged amongst the other alternatives listed. Ultimately, other alternatives are compared to the base case in order to improve what currently exists.

At the end of step six, the expansion of the eight-fold path and the utilization of an outcomes matrix should lead to at least one, and in some allowable cases more than one, superior alternative to solve or mitigate the problem established in step one. As the analysis moves forward, the analyst must consider what the process and politics of getting the

chosen alternative implemented are, and the ability of the institution, which implements the policy, to fund and operate the policy in the long run.

G. STEP SEVEN: DECIDE!

The purpose of this step is to decide on a policy and to check the clarity of the analysis thus far. In order to achieve the purpose, the analyst selects a policy and applies a question test to the policy. The purpose of the question test is to determine if the alternative is worthy of selection. To complete the test, the analysis needs to be screened through a thought-provoking question, “If it is so good, why is it not already happening?” If the process fails the question test, the analyst will create a new variant of the basic policy idea that should pass the test.

H. STEP EIGHT: TELL YOUR STORY

The eighth and final step is “tell your story.” This is where policy analysts explain the outcome of the steps they performed. After defining, and in some cases redefining, the steps of the eightfold path, the hard work has come to a new policy outcome. The presentation of this new policy may take many forms and may address different audiences or campaigns of policy change.

To tell the story effectively, an analyst must be able to relate the complex information from all previous steps in the simplest form. In order to create the simplest and most relatable presentation of the new policy, the analyst must assess who the audience is and what his or her relationship to that audience is. Tailoring the “story” of the policy analysis and recommendation to the proper audience will help the analyst avoid creating confusion or misinterpretation.

Additionally, the analyst needs to give thought to who in the political world will use this policy outcome for or against the problem. Written and oral methods of the results can either help or hurt the problem it intends to resolve. The analyst needs to rationalize the proper way to deliver the message. If there is a clear policy recommendation, the analyst should compare and contrast any and all objections that might be of concern for specific

audiences. Analysts should also discuss the next best policy and how it shapes up against the policy they have chosen to ultimately prove why the chosen policy is better.

When telling the story, the analyst should lead with the problem statement and make clear what motivates the analysis. Then, explaining the alternatives and the criteria by which those alternatives were judged clarifies the process of ruling out other potential recommendations. This includes discussing probabilities and likelihoods of policy implementation and its effects based on the evidence. To guarantee that the audience comes away with the message that the analyst is presenting, it is necessary to state the bottom line up front. All other details simply support that bottom line.

IV. APPLYING BARDACH'S METHODOLOGY

This chapter applies Bardach's (2012) eight-step method of policy analysis. In the first chapter of this thesis, I defined the problem that led to the research question: *What cannabis-use policy should the U.S. Navy adopt and apply to service members after federal legalization of cannabis?* This was step one, "Define the Problem" and chapter I satisfied the first step of Bardach's eight-step method. The second chapter of this thesis presented evidence on the effects of cannabis and discussed how certain rights and freedoms of U.S. Navy service members can be prohibited. All the evidence collected for chapter IV's assessment was completed in the literature review of chapter II. This was step two, "Assemble Some Evidence," and satisfied Bardach's second step. This chapter examines the alternative approaches identified in chapter I for the U.S. Navy's consideration. The end of the chapter contains steps four, five, and six. They discuss selecting the criteria, projecting the outcomes, and confronting the trade-offs, respectively. The analysis in this chapter is subjective, and I understand that others may determine alternative outcomes that may differ from the outcome presented in this study. However, the following assessment is my determination, based on my research and my experience.

A. STEP THREE: CONSTRUCT THE ALTERNATIVES

This step places the alternatives in two general concepts. The alternatives either maintain a zero-tolerance policy on cannabis use or authorize cannabis use for U.S. Navy service members. There are three options for these two general concepts. The first approach, the status quo of a zero tolerance on cannabis use, is an option proposed by Dr. Bardach that allows present trends to continue. The second approach authorizes the use of cannabis but prohibits use by certain job specialties for a specified period of time. The third approach authorizes cannabis use and treats it similarly to alcohol.

1. Status Quo / Zero-Tolerance Policy on Cannabis Use

Maintaining the status quo with the zero-tolerance policy on cannabis is relevant here because this is how the U.S. Navy has conducted business for the past 35-plus years. Under the status quo, more Naval service members would avoid negative health effects of

cannabis but they would also be unable to take advantage of the positive health effects. Naval service members might question their rights and freedoms and ask why they are unable to consume cannabis despite its federally legal status.

2. Authorized Cannabis Use with Limitations

This policy would authorize cannabis use for a large portion of the Navy. The current illegal status has limited scientific study, meaning that there is limited data about the average duration of effect on users. Until further evidence is generated, restricting certain job specialties from consuming cannabis (such as pilots, ship-handlers, and doctors) between two and 28 days prior to performing their job would apply to this policy alternative. Other job specialties not listed would treat cannabis in a way similar to alcohol. This alternative is similar to the precedent set by Canada's policy which restricts cannabis use in a number of job specialties for 28 days prior to the performance of their duties. Some of those performances also include pilots, aviation jobs, diving, submarine services, and several others. The full list of limited job specialties is located under section 5.2 "Prohibitions Before and During the Performance of Specific Duties," of the DAOD 9004-1 (Government of Canada, 2018).

3. Authorized Cannabis Use Comparable to Alcohol

The final policy alternative treats cannabis in the same manner as alcohol. This is due to the fact that cannabis, like alcohol, has intoxicating effects and those effects could be treated equally. Under the Navy's Alcohol Policy, service members shall not consume alcohol to the extent that it: impairs their mental and physical abilities on duty or while performing military duty, renders that service member less dependable or reliable, brings discredit to the member or the U.S. Navy, or produces behavior that violates Naval Instructions or the UCMJ (Chief of Naval Operations, 2009). Those who irresponsibly drink, or are drunk, on duty violate Article 112 of the UCMJ "Drunk on Duty" and are subject to a court-martial (Armed Forces, 10 U.S.C. § 912. Art. 112., 2017). Naval service members must be clear of effects prior to the performance of their duties. This alternative would allow for the widest availability of use among service members.

B. STEP FOUR: SELECT THE CRITERIA

The purpose of the criteria is to judge the constructed alternatives from step three and determine the best possible outcome among them. The previous section discusses the alternatives selected to change or maintain the U.S. Navy cannabis policy. This section lists and explains criteria formulated to evaluate the alternatives' outcomes as well as satisfies Bardach's step four.

Describing the criteria that is used to choose a policy recommendation allows those who either support or oppose cannabis use, to understand the reasoning behind any decision made. The research, my U.S. Navy experience, and my understanding of cannabis has led me to three criteria that I believe are the most essential in determining a recommendation from the proposed alternatives. The criteria I choose are efficiency, health effects, and rights and freedoms. These three criteria provide the most relevance to the U.S. Navy based on evidence assembled. The alternative that satisfies the majority of the selected criteria will be the policy recommended.

1. Efficiency

The purpose of choosing efficiency as decision criteria is to judge the administrative and institutional burden that the policy would have on the U.S. Navy. Efficiency helps determine if the implementation of an alternative results in an efficient use of manpower, resources, and time, which is extremely important to the U.S. Navy's mission. I particularly focus on the administrative burden the alternatives place on the U.S. Navy to maintain good order and discipline. For example, it is costly to punish and separate trained Naval service members for violating substance use policies. Similarly, dealing with service members who are under the influence in the workplace is also costly.

2. Health Effects

The purpose of using health effects as decision criteria is to judge the positive and negative health effects that the policy could create for the U.S. Navy service members. The U.S. Navy has a keen interest in the health and well-being of its service members. The bulk of the literature review addresses this criterion. The health effects criteria help determine

if the implementation of an alternative results in better or worse health for U.S. Naval service members.

3. Rights and Freedoms

The purpose of using U.S. Navy service members' rights and freedoms as decision criteria is to judge whether the rights and freedoms of U.S. Navy service members are properly considered under the status quo or a cannabis policy for the U.S. Navy. Rights and freedoms are very important to U.S. Naval service members because they fight and die to preserve the rights of others, and because advancing freedom is the core tenet of the National Security Strategy. While the rights of service members are often easy to overlook by the institution, the institution should only ask members to give them up if absolutely necessary. The U.S. Navy routinely asks its officers and enlisted sailors to make life and death decisions and holds them accountable for their actions. The extent to which various policies treat them like adults is a valid and important consideration.

4. Criterion Weights

To properly assess the alternatives, I evaluate them with respect to three criteria. The most vital part of the U.S. Navy is its service members—they sacrifice their lives, bodies, and psychological wellness to support the Navy's mission and to protect not only the military organization but also the United States and its citizens. In return for those sacrifices, and to advance its stated mission, the U.S. Navy should be concerned first and foremost with safeguarding the health (both physical and psychological) of its members. Thus, "Health Effects" is the primary criterion, the main objective of the problem definition, and is given the largest weight. The "Efficiency" and "Rights and Freedoms" criteria are the secondary criterion. These two criteria are given a lesser weight but equal to one another because their importance is not so significantly discernable that they merit one to be greater than the other. Taken as a percentage, the three criteria's sum will equal 100 percent, representing the total of all weights. Fractionally, the 40 percent weight allocation for "Health Effects" is communicated as 0.4, while the remaining two criteria, "Efficiency" and "Rights and Freedoms," are allocated equal weights of 30 percent, or 0.3.

I understand that others may come to a different conclusion on the weight of the criteria, but this is what I have determined based on the research and my experience.

5. Criterion Measurement Scale

This thesis uses a numbered scale to measure each alternative based on the criteria. The measurement of each alternative will be given the following numbers:

- 3—This measurement signifies that the alternative will satisfy the criteria substantially.
- 2—This measurement signifies that the alternative will meet the criteria but only modestly.
- 1—This measurement signifies that the alternative will meet the criteria but marginally.
- 0—This measurement signifies that the alternative does not meet the criteria.

6. Select the Criteria Conclusion

The criteria selection may be the single most subjective step of Bardach's method. The goal, however, is to make calculated decisions based on the assembled evidence and the analyst's personal experience in order to produce a policy recommendation. There is no defined scale or metric to find the best tactic for a significant determination like that of a U.S. Navy cannabis policy. The method used is complex and nuanced, but the intention of selecting these decision criteria is to produce a sound and viable policy recommendation for cannabis in the U.S. Navy. Efficiency, health effects, and rights and freedoms are the chosen criteria for this policy analysis and will be utilized in the next section in order to project the outcomes.

C. STEP FIVE: PROJECT THE OUTCOMES

This section discusses the criterion weights, utilizes an outcomes matrix to determine probable outcomes, displays the final assessment created by the outcomes matrix, and confront the trade-offs. The outcomes matrix that this section uses to determine the probable outcomes in this section will evaluate the alternatives described in section A by the criteria defined in section B.

1. **Alternative #1: Status Quo / Zero-Tolerance Policy on Cannabis Use**

The status quo or zero-tolerance policy on cannabis use prohibits Naval service members from using cannabis. Assuming the federal legalization of cannabis, this alternative will force the U.S. Navy to continue to turn away potential recruits and will require the U.S. Navy to generate even more waivers. This will also increase the risk of administrative separations as cannabis use becomes more ubiquitous in civilian life. Those administrative separations necessarily result in the loss of investment the U.S. Navy has made in those service members. Workplace impairment will remain low as the threat of administrative separation would continue to mitigate cannabis use on the job. Table 3 displays the outcomes matrix for the possible outcomes of the status quo, and a description of each outcome follows.

Table 3. Outcomes Matrix. Alternative #1: Status Quo / Zero-Tolerance Policy on Cannabis Use

<u>Alternative</u>	<u>Criteria #1</u> <u>Efficiency</u> <u>(0.3)</u>	<u>Criteria #1</u> <u>Total</u>	<u>Criteria #2</u> <u>Health</u> <u>Effects</u> <u>(0.4)</u>	<u>Criteria #2</u> <u>Total</u>	<u>Criteria #3</u> <u>Rights and</u> <u>Freedoms</u> <u>(0.3)</u>	<u>Criteria #3</u> <u>Total</u>	Final Assessment
Status Quo / Zero-Tolerance Policy	1	0.3	2	0.8	0	0	0.37

a. Efficiency

Cannabis in the workplace can increase the risk of injury or death. Avoiding the risk of workplace impairment would maintain the U.S. Navy's current efficiency rate. This would ensure that the chance of Naval service members at work under the influence of cannabis is all but eliminated. However, the U.S. Navy is overburdened with waivers and it also processes out 750 service members who test positive for cannabis on average annually (Officer of the Under Secretary of Defense for Personnel and Readiness, 2017). Processing out service members alone costs the U.S. Navy between \$16.6 and \$58.8 million per year (Mehay & Webb, 2007; Dahlman, 2007; Officer of the Under Secretary

of Defense for Personnel and Readiness, 2017). Both the overabundance of waivers and the out-processing of service members additionally cost the U.S. Navy countless man-hours. For these reasons, this alternative grade is one (1).

b. Health Effects

The negative health effects associated with cannabis include poor cognitive performance, health risks associated with smoking, and the risk of chemical dependence. All of these can have a drastic effect on service members if cannabis is used irresponsibly. Keeping cannabis out of the U.S. Navy greatly reduces exposure to these negative health effects. However, it also eliminates exposure to the positive effects of cannabis. There is growing evidence that positive cannabis health effects can greatly help Naval service members with anxiety, PTSD, and pain, if used responsibly. More so, those who would have otherwise used cannabis in place of alcohol will continue to use alcohol and deal with the critical effects that alcohol produces in the human body, as described in Chapter II, Section 2.e. For these reasons, this alternative grade is two (2).

c. Rights and Freedoms

U.S. Naval service members fight for Americans to maintain their rights and freedoms. In some cases, such as freedoms of speech, political activity, unauthorized firearms on a military installation, search and seizure, and trial by a jury of peers, restrictions of and adjustments to the rights and freedoms of service members are necessary to maintain order, unity, security, or safety. However, there is no evidence to suggest that restricting cannabis (assuming federal legalization) would serve the purposes that other accepted restrictions serve. Moreover, due to the fact that alcohol is not a controlled substance and responsible use is authorized federally, there is no convincing reason that cannabis should not be treated likewise. For these reasons, this alternative grade is zero (0)

2. Alternative #2: Authorized Cannabis Use with Limitations

This alternative allows cannabis use for all service members but prohibits certain job specialties from using cannabis prior to the performance of certain duties within a specific period of time. Some of those specialties would include pilots, parachuters, divers,

doctors, nuclear operators and maintainers, submariners, and ship handlers. The timeframes associated with the limitations would range from 28 days prior to job performance to entire deployment periods. The reason for these limitations is to ensure that the service member is completely free of cannabis' residual effects prior to commencement of any vital job performance and also to keep service members clear of cannabis effects during the operational commitment that a deployment demands.

The U.S. Navy will not turn away as many potential recruits and will not administratively separate as many service members for using cannabis. This will allow the U.S. Navy to save time, manpower resources, and investment costs. More service members will, however, use cannabis and some may end up going to work under the influence. The point of special considerations for certain job specialties is to mitigate those problems, or at least the worst of them. Additionally, more service members will use cannabis, increasing the exposure to negative health effects. However, they will be able to capitalize on the good health effects, too. If the U.S. Navy permits and regulates cannabis use, those who struggle with substance dependence will have the opportunity to rehabilitate, as opposed to being administratively separated (as is the case in Alternative 1). Table 4 displays the outcomes matrix for the possible outcomes of authorized cannabis use with limitations, and a description of each outcome follows.

Table 4. Outcomes Matrix. Alternative #2: Authorized Cannabis Use with Limitations.

<u>Alternative</u>	<u>Criteria #1</u> <u>Efficiency</u> <u>(0.3)</u>	<u>Criteria #1</u> <u>Total</u>	<u>Criteria #2</u> <u>Health</u> <u>Effects</u> <u>(0.4)</u>	<u>Criteria #2</u> <u>Total</u>	<u>Criteria #3</u> <u>Rights and</u> <u>Freedoms</u> <u>(0.3)</u>	<u>Criteria #3</u> <u>Total</u>	Final Assessment
Authorized Cannabis Use with Limitations	2	0.6	3	1.2	3	0.9	0.90

a. *Efficiency*

Currently, the U.S. Navy processes out 750 service members annually for testing positive for cannabis. This costs the Navy between \$16.6 and \$58.8 million a year (Mehay & Webb, 2007; Dahlman, 2007; Officer of the Under Secretary of Defense for Personnel and Readiness, 2017). If only the specialty service members were tested for cannabis randomly prior to the commencement of specific performances, then this would save the U.S. Navy a large majority of the up to \$58.8 million lost as a result of administrative separations (Mehay & Webb, 2007; Dahlman, 2007; Officer of the Under Secretary of Defense for Personnel and Readiness, 2017). Additionally, on average 23 waivers are processed every month for new recruits who have used cannabis or have had a cannabis-related drug charge on their record (Martinez-Alvarez, 2017). By authorizing cannabis use (regardless of the limitation of job specialties), waivers would no longer be necessary prior to joining the U.S. Navy. This would greatly reduce the time spent and paperwork necessary to process in new recruits. However, authorizing cannabis use would create a risk of workplace impairment despite rules prohibiting on-the-job use. This rise would create challenges to the daily mission of the U.S. Navy and ultimately its efficiency. For these reasons this alternative grade is two (2).

b. *Health Effects*

Based on the literature review, cannabis can provide relief to those who deal anxiety, PTSD and pain. The responsible use of cannabis for these issues can greatly improve the effectiveness of some service members' daily work production. It can also reduce the number of service members who are medically discharged for PTSD and serious pain issues, allowing them instead to rehabilitate and remain in the U.S. Navy. Additionally, cannabis use has never led to an overdose of any kind, which increases safety among users—especially among those who might otherwise abuse carcinogenic and overdose-prone substances like alcohol. Some studies have shown cannabis to have a residual effect from 12 to 24 hours after use; for that reason, limiting certain job specialties greatly enhances safety and reduces risk of mishaps (Newman, 2004). For these reasons this alternative grade is three (3).

c. *Rights and Freedoms*

In this alternative, cannabis restriction would apply only to certain job specialties during a specified time frame primarily due to the residual effects that cannabis creates. However, during assignments where these service members are not performing their duties, and outside the specified period of time, service members will be able to use cannabis outside of working hours. This alternative's grade is high because the limited nature of the restrictions only on certain job specialties serves the purpose of achieving order and security while avoiding unnecessary restrictions on cannabis consumption for the remaining population of service members. For these reasons this alternative grade is three (3).

3. *Alternative #3: Authorized Cannabis Use Comparable to Alcohol*

This alternative allows cannabis use for all U.S. Navy service members and treats it the same as alcohol. In this context, the only prohibitions associated with cannabis use would be up to eight hours prior to any duty day and during any deployments. The reason for these limitations is to ensure service members are free of cannabis effects prior to commencement of duty and also to keep service members clear of cannabis effects during the operational commitment of a deployment. This alternative will provide savings on the investment costs originally lost on service members processed out for using cannabis under the status quo. Service members will reap the benefits of the positive health effects associated with cannabis use but will also acquire the negative health effects as well. With more service members using, there is an increase in a risk of workplace impairment, which can lead to workplace mishaps. Table 5 displays the outcomes matrix for the possible outcomes of the authorized cannabis use comparable to alcohol, and a description of each outcome follows.

Table 5. Outcomes Matrix. Alternative #3: Authorized Cannabis Use Comparable to Alcohol.

<u>Alternative</u>	<u>Criteria #1</u> <u>Efficiency</u> <u>(0.3)</u>	<u>Criterion</u> <u>#1 Total</u>	<u>Criteria #2</u> <u>Health</u> <u>Effects</u> <u>(0.4)</u>	<u>Criterion</u> <u>#2 Total</u>	<u>Criteria #3</u> <u>Rights and</u> <u>Freedoms</u> <u>(0.3)</u>	<u>Criterion</u> <u>#3 Total</u>	Final Assessment
Authorized Cannabis Use Comparable to Alcohol	2	0.6	2	0.8	3	0.9	0.77

a. Efficiency

As previously discussed, the service members processed out for a positive cannabis urinalysis costs the U.S. Navy between \$16.6 and \$58.8 million (Mehay & Webb, 2007; Dahlman, 2007; Officer of the Under Secretary of Defense for Personnel and Readiness, 2017). In this alternative, cannabis would no longer be tested for and the U.S. Navy would therefore retain its investment on all service members it would have otherwise processed out. Additionally, cannabis waivers would no longer be necessary. Also, due to the U.S. Navy allowing the responsible use of cannabis, new recruits would no longer need to be screened for cannabis consumption, resulting in less time and effort spent on paperwork. However, there would be an increased chance of workplace impairment due to the fact that cannabis users may report to work either completely under the influence or while still experiencing the residual negative effects associated with irresponsible cannabis use. This could result in a negative effect on the efficiency of the U.S. Navy. For these reasons, this alternative grade is two (2).

b. Health Effects

The literature review displays how responsible cannabis use can provide relief to users. The entire fleet would be privy to the benefits from the positive effects of cannabis, but particularly so for those service members who are dealing with anxiety, PTSD, and

pain. The fact that there have been zero reported deaths from cannabis overdose also supports a policy unrestricted use. However, with studies showing that cannabis can have residual effects from 12 to 24 hours, there is a potential for mishaps associated with high-risk job specialties (Newman, 2004). Additionally, unrestricted use potentially exposes a greater number of service members to the negative health effects associated with cannabis use. The irresponsible use of cannabis can affect cognitive ability, create health risks with those who smoke it, and result in chemical dependence. For these reason, this alternative grade is two (2).

c. *Rights and Freedoms*

As previously discussed, the federal legalization of cannabis effectively likens it to alcohol. Since the U.S. Navy would not restrict responsible cannabis use, this alternative protects the rights and freedoms of its service members. For these reasons, this alternative grade is three (3).

4. Outcomes Matrix Conclusion

This chapter assessed the alternatives from section A with the criteria from section B using an outcomes matrix suggested by Bardach. Table 6 assembles the results for ease of comparison. None of the alternatives fully met the criteria. This is attributable to the fact that the limited research on cannabis leaves room for speculation regarding how cannabis could potentially positively and negatively affect service members and the overall organization of the U.S. Navy. This chapter compares only a handful of the pros and cons associated with cannabis prohibition and authorization. Considering only efficiency, health effects, and rights and freedoms, this analysis finds that “authorized cannabis use with limitations” is the best outcomes of the three alternatives.

Table 6. Final Combined Outcomes Matrix

<u>Alternative</u>	<u>Criteria #1 Efficiency (0.3)</u>	<u>Criteria #1 Total</u>	<u>Criteria #2 Health Effects (0.4)</u>	<u>Criteria #2 Total</u>	<u>Criteria #3 Rights and Freedoms (0.3)</u>	<u>Criteria #3 Total</u>	Final Assessment
Status Quo / Zero- Tolerance Policy	1	0.3	2	0.8	0	0	0.37
Authorized Cannabis Use with Limitations	2	0.6	3	1.2	3	0.9	0.90
Authorized Cannabis Use Comparable to Alcohol	2	0.6	2	0.8	3	0.9	0.77

D. STEP SIX: CONFRONT THE TRADE-OFFS

This section confronts the trade-off associated with each alternative by considering the positive and negative consequences of instituting each alternative.

1. Alternative #1: Status Quo / Zero-Tolerance Policy on Cannabis Use

This policy ensure service members remain healthy and keeps the workplace free of impairment however there are four possible trade-offs associated with this alternative. First, the U.S. Navy would continue to lose their investments in service members who test positive on urinalysis. Second, the amount of time and effort spent on paperwork associated with waivers would continue to build up as more new recruits use cannabis assuming federal legalization. Third, the positive health benefits from cannabis, which would greatly help service members dealing with anxiety, PTSD, and pain, are lost. Lastly, prohibiting service members' rights and freedoms to use cannabis dissimilarly to alcohol would create resentment from those who would prefer to reap the benefits of cannabis use in place of using prescription drugs, tobacco, or alcohol.

2. Alternative #2: Authorized Cannabis Use with Limitations

This policy ensure the U.S. Navy retains investment costs on service members who would otherwise be processed out for using cannabis, reduce waivers associated with new recruits coming in the U.S. Navy, provide service members with positive health benefits, and would not unnecessarily restrict the rights and freedoms of service members however, there are three trade-offs associated with this alternative. The first trade-off is the risk of workplace impairment. With authorizing cannabis usage in any context, service members can show up to work either totally influenced or still experiencing residual effects of cannabis. This will necessitate a better understanding by supervisors of the signs of cannabis intoxication. It will also require a tougher stance on those in violation of being intoxicated by cannabis while on duty. Second, there is a risk of negative health effects of cannabis use primarily on those who do not use it responsibly. Those negative health effects include impaired cognitive ability, health risks associated with smoking, and chemical dependence. Lastly, there is a limited and temporary restrictions of rights and freedoms with the purpose of reducing risk in certain job specialties. Some service members may find this upsetting; however, until further evidence clarifies the duration and impact of residual cannabis effects, limiting job specialties and setting time frames on consumption is a safe alternative.

3. Alternative #3: Authorized Cannabis Use Comparable to Alcohol

This policy ensure the U.S. Navy retains investment costs on service members who would otherwise be processed out for using cannabis, reduce waivers associated with new recruits coming in the U.S. Navy, provide service members with positive health benefits, and would not unnecessarily restrict the rights and freedoms of service members however, there are three trade-offs associated with this alternative. First, as previously discussed, there is a greater risk of workplace impairment for the entire service fleet. This will increase how often service members report to work either under the influence or still experiencing the residual effects of cannabis. This again will necessitate a better understanding by supervisors of the signs of cannabis intoxication. It will also require a tougher stance on those in violation of being intoxicated on cannabis while on duty. The second trade-off is

a greater risk of negative health effects on service members from irresponsible cannabis use. These negative effects can include impaired cognitive ability, health risks associated with smoking, and chemical dependence. The U.S. Navy will be responsible for determining standards of responsible cannabis use and for educating service members on those standards. The third trade-off is the increased risk of mishaps within certain job specialties that require much more cognitive ability and acuity than others, which could be even more detrimental to people and equipment.

E. STEP SEVEN: DECIDE

In the preceding sections of chapter IV, I completed step five, “project the outcomes,” and use of an outcomes matrix to determine that authorizing cannabis with limitations is the best policy recommendation for the U.S. Navy. In this section, I employ step seven, “decide,” where I apply a question test to determine if the alternative is worthy of selection. The question, “If it is so good, why is it not already happening?” is used to satisfy this step.

Since 1970, cannabis has been illegal in the United States generally and in the U.S. Navy specifically. For that particular reason, considerations for cannabis use within the U.S. Navy have been irrelevant. Assuming the federal legalization of cannabis, the likely reason that this policy would not have been implemented is that limited available evidence leads to uncertainty about the positive and negative health effects of cannabis and the U.S. Navy is risk adverse. However, using Bardach’s eight-step method of policy analysis has facilitated a comparison of the available evidence to determine that there are supporting reasons for authorizing cannabis use with limitations. The reasoning behind this policy include:

- Saving future investment costs by retaining service members who would have otherwise been administratively separated for failed urinalysis due to cannabis use;
- Saving time and effort as a result of eliminating cannabis waivers for new recruits;

- Capitalizing on the positive health benefits associated with cannabis use for service members who deal with anxiety, PTSD and pain; and
- Maximizing the rights and freedoms generally of service members by allowing reasonable cannabis use, while contributing to order and security by restricting use only for certain job specialties prone to high-risk mishaps.

V. SENSITIVITY ANALYSIS

I use sensitivity analysis to examine whether different criteria score assessments might change the final policy outcome score, thereby testing the robustness of the outcomes matrix. This additional analysis anticipates potential counterarguments related to my judgement regarding the criteria weights and scores.

First, I create an excel spreadsheet where I perturb the alternative criteria scores. There are three alternatives, each with three criteria, so there are nine possible elements to change, and for each combination I change anywhere from only one element to all nine. Each time I change an element, I only change it up one or down one. If the score is already at a maximum, I only consider changing it down, likewise if the score is already at a minimum, I only consider changing it up. I ultimately finish with 3,888 different combinations of alternative scoring combinations.³ The idea is to consider all different combinations of scores that are generally in the same neighborhood as the scores I assign in Step Five. If the reader and I employ the same criterion weights, alternative two (Authorized cannabis use with limitations) has the highest score for 68 percent of them while alternative three (Authorized cannabis use comparable to alcohol) has the second highest score for 31 percent of them. Thus, if we agree on the weights, and we are relatively close on the individual scores, we would still likely conclude that alternative two (Authorized cannabis use with limitations) is superior. In fact, under almost no circumstance would we find alternative one (status quo / zero-tolerance policy) to be the best. This analysis is illustrated in the top row of Table 7.

³ There are five elements that can go up, down, or remain unchanged. There are two elements that can either go down or remain unchanged, and there is one element that can go up or remain unchanged. Thus, $3^5 * 2^4 = 3,888$.

Table 7. Sensitivity Analysis

Criteria			Alternatives		
Efficiency	Health	Freedom	ALT #1	ALT #2	ALT #3
0.3	0.4	0.3	0.01	0.68	0.31
0.25	0.5	0.25	0.04	0.69	0.27
0.33	0.33	0.33	0.01	0.71	0.28
0.05	0.9	0.05	0.12	0.62	0.26
0.9	0.05	0.05	0.05	0.56	0.39

The rest of Table 7 illustrates the same analysis, but for a variety of sets of weights. The second analysis adjusted the weights to slightly increase the favor of health effects, as depicted in row two of Table 7. Their weights are as follows: efficiency 0.25, health effects 0.50, and rights and freedoms 0.25. The 3,888 combinations led to the second alternative (Authorized cannabis use with limitations) identified as the best policy 69 percent of the combinations. This policy was followed by alternative three (Authorized cannabis use comparable to alcohol), identified as the best 27 percent of the combinations, while alternative one (Status-Quo) is recommended 4 percent of the combinations. Overall, this analysis led to the same result as my analysis and also supports eliminating alternative one (Status-Quo) 96 percent of the combinations.

The third analysis adjusted the weights to an equal portion for each criterion and are shown in the third row of Table 7. Their weights are as follows: efficiency 0.33, health effects 0.33, and rights and freedoms 0.33. The 3,888 combinations led to the second alternative (Authorized cannabis use with limitations) identified as the best policy 71 percent of the combinations. This policy was followed by alternative three (Authorized cannabis use comparable to alcohol), identified as the best 28 percent of the combinations, while the status quo is recommended 1 percent of the combinations. Overall, this analysis led to the same result as my analysis and also supports eliminating alternative one (Status-Quo), 99 percent of the combinations.

The fourth analysis adjusted the weights to heavily favor health effects, as shown in the fourth row of Table 7. Their weights are as follows: efficiency 0.05, health effects 0.90, and rights and freedoms 0.05. The 3,888 combinations led to the second alternative (Authorized cannabis use with limitations) identified as the best policy 62 percent of the combinations. This policy was followed by alternative three (Authorized cannabis use comparable to alcohol), identified as the best 26 percent of the combinations, while the status quo is recommended 12 percent of the combinations. Overall, this analysis led to the same result as my analysis and also supports eliminating alternative one (Status-Quo) 88 percent of the combinations.

The fifth and final analysis adjusted the weights to heavily favor efficiency, as shown in the fifth row of Table 7. Their weights are as follows: efficiency 0.90, health effects 0.05, and rights and freedoms 0.05. The 3,888 combinations led to the second alternative (Authorized cannabis use with limitations) identified as the best policy 56 percent of the combinations. This policy was followed by alternative three (Authorized cannabis use comparable to alcohol), identified as the best 39 percent of the combinations and status quo being recommended 5 percent of the combinations. Overall, this analysis led to the same result as my analysis and also supports eliminating alternative one (Status-Quo), 95 percent of the combinations.

Even though some readers might not agree with the exact scores that I gave each alternative's criterion, adjusting scores and weights still supports eliminating alternative one (Status-Quo) through every iteration of the sensitivity analysis. Moreover, assuming a score value differential of one, either higher or lower, the sensitivity analysis shows that my analysis remains accurate.

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VI. CONCLUSION AND RECOMMENDATIONS

This chapter satisfies Bardach's eighth and final step: "tell the story." This chapter concludes the thesis and offers suggestions for future research.

A. STEP EIGHT: TELL THE STORY

Chapter I of this thesis satisfies Bardach's step one: define the problem. I indicate that the trend of U.S. states and geographically proximate countries legalizing cannabis use implies a high likelihood that cannabis will become federally legal. Assuming federal legalization, I define the consequent problem that the U.S. Navy will have to consider whether to alter its cannabis-use policy to better reflect federal law. This problem definition leads to the guiding research question: What cannabis-use policy should the U.S. Navy adopt and apply to service members after federal legalization of cannabis?

Chapter II of this thesis satisfies Bardach's step two: assemble some evidence. Reviewing relevant literature leads to explaining what cannabis is, compiling credible data to compare the positive and negative consequences of cannabis on efficiency, health effects, and rights and freedoms, as well as presenting studies that effectively use Bardach's eight-step method. Specifically, the literature review assembles efficiency-related evidence including workplace impairment, waivers, and investment costs. It then assembles health-related evidence including cognitive ability, health risks associated with smoking, chemical dependence, anxiolytic effects, PTSD, pain, death, and cannabis as a safe alternative to alcohol. The literature review then describes the purposes behind the various U.S. Navy restrictions on service members' rights and freedoms. Chapter III follows from the literature review of several Bardach studies to describe in greater detail the Bardach methodology.

Chapter IV of this thesis satisfies steps three through seven. In the third step, I construct the alternatives. The alternatives I construct are: the status quo (or zero-tolerance policy of cannabis), authorized use of cannabis with the exception of certain job specialties within a specific time period, and authorized use of cannabis comparable to that of alcohol.

In the fourth step, I select the criteria. The criteria consist of efficiency, health effects, and rights and freedoms. Health effects are the primary criteria and are given a weight of 0.4, whereas efficiency and rights and freedoms are the secondary criteria that are each given weights of 0.3. I then evaluate each alternative using these criteria.

In step five, I project the outcomes. To project the outcomes, I utilize an outcomes matrix to determine the alternative with the best overall final assessment score. I determine this by grading each criterion, multiplying these scores by the assigned criterion weight, summing up the total of each of the multiplied numbers, and dividing by the total number of criteria. The results show that “authorized cannabis use with limitations” policy has the highest final assessment score. The final assessment score results of the three alternatives are listed, from highest to lowest:

- Authorized Cannabis Use with Limitations—0.90
- Authorized Cannabis Use Comparable to Alcohol—0.77
- Status Quo / Zero-Tolerance Policy—0.37

In step six, I confront the trade-offs by indicating both the positive and negative consequences of each alternative.

In the seventh step, I decide. In the decide step, I employ a question test. The question, “If it is so good, why is it not already happening?” helps me determine if the alternative is worthy of selection. To date, cannabis is and has been illegal in both the U.S. and the U.S. Navy for decades. Assuming federal legalization, this would be the first opportunity for the U.S. Navy to consider a cannabis-use policy. If this policy had other consideration opportunities while legal, then the likely reason for this policy’s lack of implementation would be due to a combination of its limited evidence and the uncertainty associated with the positive and negative health effects of cannabis use.

Using Bardach’s (2012) eight-step method of policy analysis helps determine the supporting reasons for authorizing cannabis use with limitations policy. The support for this policy includes: saving future investment costs on service members who would have otherwise been processed out for failed urinalysis due to cannabis use, saving time and

effort as a result of eliminating cannabis waivers for new recruits, capitalizing on the positive health benefits associated with cannabis use for service members who deal with anxiety, PTSD and pain, and maximizing the rights and freedoms of service members by allowing reasonable cannabis use.

In Chapter V, I use sensitivity analysis to determine the robustness of the outcomes matrix results from step five. The analysis displays that 3,888 different combinations of alternative criteria scores using five different weight combinations all result in the second alternative selected as the best outcome. The second most selected alternative is the third alternative, authorized cannabis use comparable to alcohol. There were two important takeaways from the sensitivity analysis. First, it shows that the results from the outcomes matrix deployed in step five are robust. Second, it shows that the status quo is the worst of the three alternatives and that eliminating the status quo from potential policies is statistically sound.

Chapter VI satisfies the eighth and final step, tell the story. Ultimately, I contend that the authorized cannabis use with limitations policy is the best policy recommendation for the U.S. Navy. Bardach's eight-step method of policy effectively provides the best policy alternative with supporting evidence.

After federal legalization of cannabis and based on my analysis using Bardach's eight-step method, I recommend to the U.S. Navy that authorizing cannabis with limitations is the best policy to consider moving forward. The motivation behind this analysis is based on the trend of states and countries changing their cannabis laws giving rise to the increase chance that cannabis will be legal at the federal level and the fact that the United States Navy will have to address what it will do when this happens. In this section, I will briefly discuss each step that lead to the recommended policy.

B. FUTURE RESEARCH

I discuss several cannabis-related topics in this thesis that help support a policy recommendation for the U.S. Navy. However, there are studies, ideas, and concepts that are absent from the cannabis discussion that could strengthen this and other cannabis-

related policies. Some of those ideas are listed here and suggest the need for additional research.

- 1. The Length of Time it Takes for Residual Effects of Cannabis to Cease**

This study leads to a policy recommendation that limits specific job specialties from using cannabis prior to duty performance. This is strongly due to the limited evidence regarding how long the residual effects of cannabis last on the consumer. Determining how long cannabis effects the body and mind can help determine the exact length of time cannabis should be prohibited prior to the performance of duties. It can also help determine if certain job specialties need to be limited at all.

- 2. Conducting a Cost-Benefit Analysis on the Implementation of Cannabis in the U.S. Military**

Part of this thesis discusses the investment costs lost on service members who are administratively separated from the U.S. Navy for positive urinalysis. This is one of many numbers that could be utilized in an overall net profit or net loss of authorizing cannabis in the U.S. military. Cost and Benefits as well as inputs from all branches could greatly enhance the evidence necessary to provide a recommendation to policy analysts seeking whether cannabis should be authorized or prohibited across all U.S. military branches.

- 3. The Effects of Responsible Cannabis Use on Work Performance on Canada's Service Members**

Canada has already legalized responsible cannabis use for its military and performing studies on the effects of cannabis on its service members can help provide evidence for other countries considering cannabis-use policies. Studies on physical training, test taking, pain management, PTSD, daily work performance, and in different job specialties can all help provide evidence to better inform a U.S. Navy cannabis-use policy.

APPENDIX. A SUMMARY OF STUDIES LISTING CANNABIS EFFECTS

Table 8. Part 1 of 2. “Summary of Studies Assessing the Direct Effects of Cannabis on Cognitive Performance” of infrequent users.
Source: Holland (2010, p. 162).

Investigators	Drug investigated (dose)	Cannabis use history of participants	Outcome
INFREQUENT USERS			
Melges et al. 1970	Oral marijuana extract (0, 20, 40, 60 mg THC)	Unspecified (“normal male graduate students”) [N=8, within-subjects design]	Decreased performance: immediate memory and temporal disintegration No effect: sustained attention and delayed memory
Tinkenberg et al. 1970	Oral marijuana extract (0, 20, 40, 60 mg THC)	Less than 1x/month [N=8, within-subjects design]	Decreased performance: immediate memory
Abel 1971	Smoked marijuana (undetermined THC content)	Unspecified (previous use, but not quantified) [N=20, between-subjects design, matched on performance on test of immediate free recall (prior to drug administration)]	Decreased performance: immediate memory No effect: delayed memory
Miller and Cornett 1978	Smoked marijuana (0, 5, 10, 15 mg delta-9-THC)	2–4x/week [N=16, within-subjects design]	Decreased performance: immediate and delayed memory
Curran et al. 2002	Oral marijuana extract (0, 7.5, 15 mg delta-9-THC)	Less than 1x/week [N=15, within-subjects design]	Decreased performance: delayed and immediate memory, complex reaction time, and attention No effect: reasoning, simple reaction time, implicit memory, verbal fluency, rapid visual information processing, and mental calculation

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 9. Part 2 of 2. “Summary of Studies Assessing the Direct Effects of Cannabis on Cognitive Performance” of infrequent users.
Source: Holland (2010), pp. 162–163.

Investigators	Drug investigated (dose)	Cannabis use history of participants	Outcome
D'Souza et al. 2004	Intravenous 0, 2.5, 5 mg delta-9-THC	Median 21–50×/lifetime [N=22, within-subjects design]	Decreased performance: immediate and delayed memory, verbal fluency, working memory, distractibility, and reaction time No effect: learning and recognition and vigilance
Ilan, Smith, and Gevins 2004	Smoked marijuana (0, 3.45% delta-9-THC)	Between 1×/month and 1×/week [N=10, within-subjects design]	Decreased performance: immediate and working memory and reaction time
Ilan et al. 2005	Smoked marijuana (0, 1.8, 3.6% delta-9-THC)	Mean 15–17 cigarettes/month [N=24, mixed between- and within-subjects design]	Decreased performance: immediate and working memory and reaction time
Lane et al. 2005	Smoked marijuana (0, 0.89, 1.77, 3.58% delta-9-THC)	Between 2×/month and 12×/month [N=10, between-subjects design]	Decreased performance: decision making
Ramaekers et al. 2006	Smoked marijuana (0, 250, 500 µg/kg delta-9-THC)	Mean 3.4×/month [N=20, within-subjects design]	Decreased performance: problem solving, impulsivity, psychomotor control, and reaction time No effect: decision making
Hunault et al. 2009	Smoked marijuana [0, 29.3 (9.8%), 49.1 (16.4%), 69.4 mg (23.1%) delta-9-THC]; cigarettes containing 700 mg tobacco/300 mg cannabis	Mean 7.7 cigarettes/month [N=24, within-subjects design]	Decreased performance: immediate memory, sustained attention, psychomotor control, and reaction time No effect: selective attention and divided attention

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 10. Part 1 of 2. “Summary of Studies Assessing the Direct Effects of Cannabis on Cognitive Performance” of frequent users.
Source: Holland (2010), pp. 163–164.

Investigators	Drug investigated (dose)	Cannabis use history of participants	Outcome
FREQUENT USERS			
Meyer et al. 1971	Smoked marijuana (0, 250 mg marijuana leaf) and ad lib session (average): 420 mg (infrequent); 380 mg (frequent)	Frequent users: approximately every day [N=6] Infrequent users: ≤ 1x/week [N=6]	Decreased performance: sustained attention in infrequent users
Heishman, Arasteh, and Stitzer 1997	Smoked marijuana (0, 3.55% delta-9-THC)	Mean 4.4 cigarettes/week [N=5, within-subjects design]	Decreased performance: visuospatial processing No effect: immediate memory, time perception, and reaction time
Ward et al. 1997	Smoked marijuana (0, 1.8, 3.1% delta-9-THC)	Minimum 4 days/week [N=7, within-subjects design]	No effect: visuospatial processing, divided attention, immediate and delayed memory
Haney et al. 1999	Smoked marijuana (0, 1.8, 3.1% delta-9-THC)	Mean 5.8 days/week; 6.7 cigarettes/occasion [N=12, within-subjects design]	Decreased performance: visuospatial processing Enhanced performance: divided attention No effect: immediate and delayed memory
Hart et al. 2001	Smoked marijuana (0, 1.8, 3.9% delta-9-THC)	Mean 6.1 days/week, 4 cigarettes/day [N=18, within-subjects design]	Decreased performance: reaction time and inhibitory control Enhanced performance: sustained attention No effect: attention, immediate and delayed memory, visuospatial processing, reasoning, mental flexibility, and mental calculation

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 11. Part 2 of 2. “Summary of Studies Assessing the Direct Effects of Cannabis on Cognitive Performance” of frequent users.
Source: Holland (2010), pp. 164–165.

Investigators	Drug investigated (dose)	Cannabis use history of participants	Outcome
Vadhan et al. 2007	Smoked marijuana (0, 1.8, 3.9% delta-9-THC)	Mean 6 days/week; 3.9 cigarettes/day [N=36, within-subject design]	Decreased performance: reaction time No effect: decision making
Ramaekers et al. 2009	Smoked marijuana (0, 500 µg/kg delta-9-THC)	Infrequent users: 55×/year; 1.2 cigarettes/occasion [N=12] Frequent users: 340×/year; 2.3 cigarettes/occasion [N=12]	Infrequent users: Decreased performance: psychomotor control, divided attention, and inhibitory control No effect: problem solving Frequent users: Decreased performance: inhibitory control No effect: psychomotor control, divided attention, problem solving

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 12. Part 1 of 4. “Sample of Studies Assessing the Effects of Chronic Cannabis Use on Cognitive Performance.”
Source: Holland (2010), pp. 165–166.

Investigators	Length of abstinence prior to testing	Cannabis use history of participants	Outcome
Block and Ghoneim 1993	24h	Frequent users: 7 or more times/week; 6.2 years; median use 20–39×/last thirty days [N=52] Moderate users: 5–6×/week; 5.8 years [N=28] Infrequent users: 1–4×/week; 5.5 years [N=64] Nonusers: [N=72]	Decreased performance: math and verbal expression and long-term retrieval No effect: vocabulary, interpreting literary works, short tests of educational ability, concept formation, learning, word associations, free associations, psychomotor tests
Solowij, Michie, and Fox 1995	Minimum 24h (range 1–30 days)	Infrequent: ≤ 2×/week [N=16] Frequent: ≥ 3×/week [N=16] Controls: mean 9×/lifetime [N=16] Short duration: 3–4 years [N=16] Long duration: ≥ 5 years [N=16]	Decreased performance: selective attention and information processing
Fletcher et al. 1996	72h	Older users: median 5.2 cigarettes/day, 2–7 days/week, 34 years [N=17] Older nonusers: [N=30] Younger users: median 3.8 cigarettes/day, 2–7×/week, 8 years [N=37] Younger nonusers: [N=49]	Decreased performance: memory and learning (older users worse than older nonusers), selective and divided attention (older users worse than older nonusers) No effect: story recall, sorting task, response time, visual search, attention, mental flexibility No differences between younger users and younger nonusers on any measure

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 13. Part 2 of 4. “Sample of Studies Assessing the Effects of Chronic Cannabis Use on Cognitive Performance.”
Source: Holland (2010), pp. 166–167.

Investigators	Length of abstinence prior to testing	Cannabis use history of participants	Outcome
Pope and Yurgelun-Todd 1996	Minimum 19h (inpatient)	Frequent users: median 29 of the past thirty days, cannabinoids in urine [N=65] Infrequent users: median 1 in past thirty days, no cannabinoids in urine [N=64]	Decreased performance: mental flexibility, verbal fluency (only significant among lower-IQ users), delayed memory (figures), and learning No effect: immediate memory, delayed memory (words, prose), visuospatial processing
Pope et al. 2001	28 days (urine toxicology)	Current frequent users: at least 5,000×/lifetime [N=63] Former frequent users: 5,000×/lifetime, but fewer than 12 times in last 3 months [N=45] Controls: no more than 50 times [N=72]	Decreased performance: word recall, verbal learning and memory No effect: attention, visuospatial memory (except current users committed more errors at day 0), word association, mental flexibility, executive functioning, immediate and delayed memory (after 28 days)
Solowij et al. 2002	Median 17h	Long-term users: mean duration 23.9 years, near-daily use [N=51] Shorter-term users: mean duration 10.2 years, near-daily use [N=51] Nonuser controls: [N=33]	Decreased performance: learning and time estimation No effect: mental flexibility, attention
Block et al. 2002	24+ hours	Frequent users: 7 or more times/week; duration 2 or more years [N=18] Controls: no use or use 1–2×/lifetime [N=13]	Decreased performance: learning

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 14. Part 3 of 4. “Sample of Studies Assessing the Effects of Chronic Cannabis Use on Cognitive Performance.”
Source: Holland (2010), pp. 167–168.

Investigators	Length of abstinence prior to testing	Cannabis use history of participants	Outcome
Bolla et al. 2002	28 days (inpatient)	Light users: mean 11 joints/week [N=7] Moderate: mean 42 joints/week [N=8] Heavy: 94 joints/week [N=7]	Decreased performance: verbal memory, visual learning and memory, executive functioning, psychomotor speed, attention (only in lower-IQ subjects; enhanced performance in higher-IQ subjects) No effect: recognition, impulsivity
Eldreth et al. 2004	25 days (inpatient)	Frequent users: at least 4x/week, at least 2 years [N=11] Controls: no current/past use [N=11]	No effect: attention
Whitlow et al. 2004	12h	Regular users: 25 of 30 days, duration at least 5 years [N=10] Controls: <50x/lifetime, not in previous year [N=10]	Decreased performance: decision making No effect: pattern recognition, delayed matching
Bolla et al. 2005	25 days (inpatient)	Frequent users: 53–84 joints/week [N=5] Moderate users: 8–35 joints/week [N=6] Controls: less than 8 days/month [N=11]	Decreased performance: decision making

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

Table 15. Part 3 of 4. “Sample of Studies Assessing the Effects of Chronic Cannabis Use on Cognitive Performance.”
Source: Holland (2010), pp. 168–170.

Investigators	Length of abstinence prior to testing	Cannabis use history of participants	Outcome
McHale and Hunt 2008	24h	Experiment 1: Regular users: at least 1×/month for past 6 months [Total N=37] a) Recent users—used within past week [N=12] b) Abstinent users—used within past month but not past week [N=25] Controls: nonusers [N=23] Experiments 2 & 3: Frequent users: at least 3×/week, 2 cigarettes/session, used within past seven days [N=18] Controls: [N=10] Heavy tobacco users: [N=20]	Decreased performance: verbal fluency, visual recognition, delayed visual recall, executive function No effect: prospective memory

The sources in the reference column were listed as reviewed by Holland (2010); they were not reviewed by the author for this thesis.

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