AN ANALYISIS OF THE CURRENT KNOWLEDGE LEVELS OF CERTIFIED FLIGHT INSTRUCTORS ON CONTROLLED SUBSTANCES SPECIFIC TO MARIJUANA

By

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Dedicated to my Guardian Angels,

Thank you for always being there for me.

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ABSTRACT

The purpose of this study was to identify the current level of knowledge of aspiring professional pilots regarding controlled substances specific to marijuana. There has been a significant rise in the popularity of recreational and medical marijuana use. Although several states have moved to legalize both the medical and recreational use of marijuana, the Federal Aviation Administration maintains strict regulations forbidding marijuana use. Due to the rise in popularity of medical and recreational marijuana use, including cannabidiol (CBD), pilots must be aware of the regulations and risks regarding marijuana products. This study sought to identify a relationship between college graduation status and the current knowledge levels of Certified Flight Instructors (CFIs) at Middle Tennessee State University's (MTSU) flight school regarding controlled substances specific to marijuana and CBD. A twenty-one question testing instrument was used to collect quantitative data from the CFI's at MTSU's flight school. Results of this study failed to prove statistical significance, but still indicated that CFI's that have graduated from college have an increased knowledge level on controlled substances specific to marijuana than CFI's that are still enrolled college.

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LIST OF ABBREVIATIONS

AME – Aviation Medical Examiner

CAMI – Civil Aerospace Medical Institute

CBD – Cannabidiol

CFI – Certified Flight Instructor

DOT – Department of Transportation

FAA – Federal Aviation Administration

MRO – Medical Review Officer

NTSB – National Transportation Safety Board

THC – Tetrahydrocannabinol

CHAPTER I - INTRODUCTION

There has been a significant rise in the popularity of recreational and medical marijuana use. Not only has marijuana use increased, but many of the nation's states have moved to legalize and decriminalize medical marijuana use (Procon.org, 2023). Twenty-one states have legalized recreational marijuana use (Procon.org, 2023). Marijuana products have become readily available and easily accessible to the public, including in Tennessee. Although several states have moved to legalize both the medical and recreational use of marijuana, the Federal Aviation Administration (FAA) maintains strict regulations forbidding marijuana use.

Due to the rise in popularity of medical and recreational marijuana use, including cannabidiol (CBD), pilots must be aware of the regulations and risks regarding marijuana products. Studies have found the deteriorating effects of marijuana on pilot performance can last up to 24 hours, and pilots under the influence of marijuana often lack awareness of their performance deterioration (Leirer et al., 1985, 1989, 1991). There continues to be a rising trend of positive marijuana drug tests and increasing trends of cannabinoid concentrations found in aviation fatalities. Moreover, there is a scarcity of literature and conversation on marijuana's impact on pilot performance. This study will identify a relationship between college graduation status and the current knowledge levels of Certified Flight Instructors (CFIs) at Middle Tennessee State University's (MTSU) flight school regarding controlled substances specific to marijuana and CBD.

Literature Review

Much of the literature on drug use trends points out that there has been a consistent rise in illicit drug use and specifically in marijuana use among adults (Akparibo & Stolfi, 2017). Not only does the literature agree that marijuana use continues to rise in the U.S. adult population, but some literature also suggests that marijuana use by pilots has continued to increase. Many studies have cited the state's legalization of marijuana for having played a dominant role in encouraging this trend (NTSB, 2020). As states continue to legalize medical and recreational marijuana use, marijuana products have become increasingly accessible to the public. Products containing marijuana can be purchased at legal dispensaries and at local convenience stores. Not only are marijuana products more easily consumed, but a significant rise in the potency of a modern dose of cannabis has also been observed (Australian Transport Safety Bureau, 2004). A stronger potency of cannabis causes stronger psychoactive effects for the marijuana user and has also been associated with increased dependency (Norris et al., 2018). This can also be correlated with the rise and popularity of marijuana use.

The Federal Aviation Administration's (FAA) Civil Aerospace Medical Institute (CAMI) forensic toxicology laboratory performs toxicological analysis on specimens involved in fatal aviation accidents (Norris et al., 2018). The toxicological analysis screens the specimen for the prevalence of illicit drugs, including cannabinoids. The test results are then stored in the CAMI toxicology database, which has since been utilized in various studies to analyze drug trends observed in aviation (NTSB, 2020).

The National Transportation Safety Board (NTSB) has released an updated study analyzing drug use trends from 2013-2017 in addition to their original drug trend analysis

analyzing toxicology results from 1990-2012. Test results from the CAMI toxicology database were matched with any accident involving a fatal aviation accident found in the NTSB's Aviation Accident Database. The NTSB found a significant increase in evidence of illicit drug use and specifically marijuana use found in the toxicology results of pilots who died in aviation-related accidents compared to the original study's results. It is important to note that the NTSB has recognized this increasing trend of marijuana use is an issue of safety that has yet to be effectively addressed.

The FAA also utilized the CAMI toxicology database to identify cannabinoid trends in pilots over ten years, most recently from 2007-2016 (Norris et al., 2018). Similar to the NTSB, Norris et al. found that marijuana use trends significantly increased compared to their original study in 1997-2006. The overall median blood concentration of tetrahydrocannabinol (THC) from the current ten-year study compared to the past ten-year study from 1997-2006 showed a significant increase of 433%. That being said, Norris et al. found that throughout the current ten-year study, a downward trend was reflected in the blood concentrations of THC. This could be an encouraging trend that marijuana use by pilots may be beginning to decrease. The researchers recognize the influence of the legalization of recreational and medical marijuana use and the increased potency of marijuana on the concerning evidence of increasing marijuana use trends. Ongoing efforts by CAMI have been mentioned in Norris et al.'s research regarding increasing education for pilots on marijuana's negative effects and impact on aviation safety.

Akparibo & Stolfi also conducted a study that yielded similar findings as the NTSB and FAA (2017). The researchers pulled data from the NTSB's Aviation Accident

Database from any fatal aviation accident from 2012-2014, including demographic information and toxicological information found in the CAMI toxicology database. Their study found marijuana to be the most popular illicit drug abused by pilots and found evidence that marijuana use by pilots rose from 6.2% in 2002 to 7.5% in 2013. Comparing their previous studies, from 1994-2013, Akparibo & Stolfi observed marijuana use to more than double. The researchers have attributed this large increase to the state's legalization of marijuana.

In addition to the previously discussed studies, trends of marijuana use specific to college students have experienced a significant increase following the legalization of marijuana (Miller et al., 2017). Undergraduate students at Washington State University were surveyed before and after the legalization of marijuana, and the analyzed results found an increase in both the reported marijuana use and the frequency of use. There is limited literature specific to undergraduate students enrolled in a pilot training program, but Bradshaw performed a more narrow analysis of marijuana trends at a large southern university on students enrolled in the pilot program (2007). Bradshaw's study found that pilots-in-training reported a higher range of marijuana use than current pilots, who all reported never using marijuana. However, several factors reduced the validity of this study, including a low participation percentage and the accuracy of the results relied on self-reporting.

FAA Regulations

Although several states have legalized medicinal and recreational marijuana use, the Federal Aviation Administration (FAA) has not made any adjustments or authorized any exceptions to the current laws. The FAA has prohibited the use of marijuana, as cited

in 14 CFR 91.17, for any person acting or attempting to act as a crewmember of a civil aircraft. This law also includes using any legally prescribed Tetrahydrocannabinol (THC)-containing products, including cannabidiol (CBD) products, by licensed physicians as cited by 14 CFR 61.53 (a)(2). Regulation 61.53 (a)(2) prohibits pilots from acting as active crewmember if taking any medication that would exclude them from meeting the requirements for the necessary medical certificate. All pilots must hold a current medical certificate authorized by an Aviation Medical Examiner (AME) to exercise the privileges of their pilot certificate (FAA, n.d.). If a pilot is unable to meet the requirements for their necessary medical certificate, that person will not be legally authorized to act as a pilot. Failure to meet the requirements for a first, second, and third-class medical certificate also includes the verified failure of a drug test or refusal to submit to a required U.S. Department of Transportation drug test (14 CFR 67.107, 207, 307 (b)(2)). Pilots who fail to adhere to the prohibited use of marijuana will result in the removal of performing safety-sensitive functions, required participation in a substance abuse evaluation, and completion of counseling or treatment (Carver, 2018).

The knowing carriage of marijuana on an aircraft is also federally prohibited by 14 CFR 91.19. Legally, pilots are only authorized to knowingly transport marijuana products if under a Federal or State statute or agency. Otherwise, violation of this law will result in the FAA permanently revoking the involved pilot's certificate as required by federal law (FAA, 2022). Federal law also requires the FAA to revoke the involved aircraft's registration for five years. This law and penalties apply to all pilots and all aircraft, including airlines. If an airline's aircraft is involved in the carriage of marijuana products, the airline will lose the operation of that aircraft for five years.

CBD Products

Cannabidiol (CBD) is a chemical in marijuana that can be found in hemp and non-hemp plants (CDC, 2022). Hemp is any portion of the Cannabis sativa plant with less than 0.3% of tetrahydrocannabinol (THC), the psychoactive component in marijuana. CBD use has grown in popularity due to its potential medicinal properties while also being non-impairing, or not producing the "high" effect. The Controlled Substances Act, amended by the 2018 Farm Bill, legalized hemp products, but there is still limited research on the effects of CBD. Not all CBD-marketed products are regulated by the FDA, and therefore users can be at risk for consuming CBD products that contain varying levels of THC (Poreda, 2020). The legalization of hemp has enabled CBD products to gain traction with big distributors, including local grocery stores or convenience stores, making CBD products easily accessible to the public. Not only is CBD widely available, but CBD is used in a wide array of products for varying uses, including facial products, skincare, drinks, pain relief, etc. CBD products can often be hard to easily identify due to confusing or misleading labeling with small font sizes or misinformation. Consumers must maintain caution and awareness when considering using CBD products.

Although cannabidiol (CBD) typically has trace or no amounts of THC, the body breaks down and metabolizes CBD the same way it does with THC (Poreda, 2020). This can be a danger to pilots as 14 CFR 120.7 (h) requires any person performing a safety-sensitive job to be subjected to required Department of Transportation (DOT) drug testing (FAA Aviation Safety Drug Abatement Division, 2020). Safety-sensitive functions include any flight crewmember duties under part 121 (commercial scheduled air service) and part 135 (commercial non-scheduled air service) operations. While a pilot

should consider the effects that CBD use may have on the integrity of their medical certificate, a pilot using CBD products can also be at risk of producing a positive drug test. DOT drug tests do not test for the level of THC, but the level of cannabinoid metabolites (Poreda, 2020). Cannabinoid metabolites are the chemical found in the blood after the body metabolizes THC. The body also metabolizes CBD the same way as THC and will leave behind the same metabolite tested for in DOT drug tests (Poreda, 2020). This leaves pilots using CBD products vulnerable to testing positive for marijuaan.

If a pilot was to submit a marijuana-positive DOT drug test, the DOT has prohibited cannabidiol (CBD) use, intentionally or inadvertently, as a legitimate medical explanation for the positive result (DOT, 2020). A Medical Review Officer (MRO) will review all positive test results. The MRO could potentially accept the pilot's explanation of CBD use as reasoning for the marijuana-positive drug test, but the MRO is legally prohibited from changing a positive result to a negative result (Poreda, 2020). Therefore the pilot is still left with a positive drug test which will reflect negatively on the FAA and often their employer.

THC Impact on Pilot Performance

Similarities

The literature on tetrahydrocannabinol's (THC), the psychoactive component in marijuana, impact on pilot performance is extremely limited and is over 20 years old (Meacham et al.,1976; Leirer et al., 1985, 1989, 1991). As of right now, there are only five studies that have been performed on THC's impact on pilot performance by two sets of researchers. Of the related studies found, the most recent experiment on the impact of

THC on pilot performance was conducted in 1991. All five studies observed similar deteriorations in pilot performances while under the influence of marijuana.

Meacham et al. observed a significant decrease in pilot performance while intoxicated (1976). The researchers observed the intoxicated participants commit major navigational errors, significant altitude deviations, and major fuel planning errors. A later study was conducted by the same researchers, Meacham et al., in April of 1976 and they once again observed a significant decrease in pilot performance while under the influence of THC. Meacham et al. observed major deviations in altitudes, headings, and standard holding patterns which they associated with the participants' experience with short-term memory and alterations in concentration (1976).

Leirer et al. performed a similar preliminary study on marijuana's impact on pilot performance and also observed similar deteriorations in pilot performance (1985). Not only were they able to detect major vertical and lateral deviations, but the researchers observed significant impairment in aileron changes, elevator changes, and distance off-center on landing. Unlike Meacham et al.'s studies, Leirer et al. discovered a highly concerning behavior from the participants that the pilots seemed to lack any awareness of their impaired performance. It is important to note that every major error committed by the participants in both, Meacham et al. and Leirer et al.'s, studies could have easily led to dire consequences in a real flying scenario. It has been concluded that flying while under the influence of marijuana significantly decreases a pilot's ability to fly and is unsafe.

All five studies sought to determine the period of impairment experienced by the participants while under the influence of marijuana (Meacham et al., 1976; Leirer et al.,

1985, 1989, 1991). Meacham et al. determined the maximum impairment of the participants was within the first 30 minutes of initial intoxication (1976). In their later study, the researchers collected consistent results, with the first 30 minutes of initial intoxication being the period of the heaviest influence of marijuana on pilot performance (1976). Both studies also observed significant deteriorations in pilot performance that lasted up to four hours after the participants were initially intoxicated. Similarly, Leirer et al. observed the participants commit significant errors within the first four hours of initial intoxication (1985). Unlike Meacham et al., Leirer et al.'s preliminary study observed significant deteriorations in pilot performance up to 24 hours after initial intoxication. The 24-hour carry-over effects were replicated in Leirer et al.'s third experiment and were concluded to be heavily influenced by the task difficulty.

Task difficulty was considered to play a significant role in the impact of marijuana on pilot performance by all five studies (Meacham et al., 1976; Leirer et al., 1985, 1989, 1991). Meacham et al. determined that flight tasks can accentuate the disruptive cognitive effects of marijuana (1976). This idea is consistent with Leirer et al.'s experiments, as the researchers were able to identify their results were heavily influenced by task difficulty (1991). Leirer et al.'s experiment one utilized what the researchers considered to be, "a very primitive computerized aircraft simulator," which resulted in various complaints from the participants on the difficulty of use (1985). Experiment one resulted in observed significant deteriorations in pilot performance up to 24 hours after initial intoxication. In experiment two, Leirer et al. utilized a much more technologically advanced aircraft simulator that provided the participants with a much more realistic flying experience (1989). The researchers could not recreate the 24-hour carry-over effects and correlated

these results with the ease of operating the more realistic aircraft simulator. Leirer et al. performed a third experiment with the sole intention of testing this hypothesis. The third experiment utilized the same technologically advanced simulator, but the researchers increased the difficulty of the flight tasks to include radio communication, traffic avoidance, emergency procedures, and poor weather conditions (1991). As the researchers hypothesized, the task difficulty heavily impacted the pilot's performance while under the influence of marijuana, and the 24-hour carry-over effects were replicated in the first experiment.

Methodology

All five studies conducted experiments using a range of 6-10 participants and used quantitative methodology (Meacham et al., 1976; Leirer et al., 1985, 1989, 1991). Each study quantified the pilots' performance slightly differently, but all studies collected a baseline performance before initial marijuana intoxication to be compared to the performance at different intervals after intoxication. Meacham et al. videotaped each participant's flight sequences before intoxication, 30 minutes after intoxication, 2 hours after intoxication, 4 hours after intoxication, and 6 hours after intoxication (1976). The video recordings were then analyzed at 10-second intervals for changes in the standardized flight pattern, altitude, and headings. Radio navigation and the center deviation indicator (CDI) were analyzed at 5-second intervals. Unlike the other studies, Meacham et al. collected qualitative data at the 30-minute interval regarding the participants' experienced "high" on a scale of 1-10.

Leirer et al. combined the two typical methods of quantifying pilot performance; measuring everything and measuring specific critical moments during a selected

maneuver (1985). The researchers accomplished this by measuring every control yoke and throttle movement and the critical points of certain required maneuvers. The measurement of every control yoke and throttle movement helped to determine changes in the controlling method of the aircraft simulator. The measurement of critical points of certain required maneuvers helped to determine how successful the procedure was performed. Leirer et al.'s second and third experiments quantified the pilot performance through a single dependent measurement by standardizing performance scores for each variable collected. The scores were standardized for each participant and each experimental condition. The quantitative methodology is largely advantageous for all of the studies as the participants' performances, pre and post-intoxication, were easily analyzed for infrequencies.

Participants

All five studies recruited a range of 6-18 participants holding current pilot certificates and had experienced marijuana use before participating in the study (Meacham et al., 1976; Leirer et al., 1985, 1989, 1991). Meacham et al. recruited six participants, with three of the participants holding private pilot certificates and three employed as professional pilots (1976). This study also recruited pilots that were self-claimed marijuana users that considered themselves to be infrequent users. Meacham et al.'s later study recruited 10 participants, with three of the participants holding private pilot certificates and seven of the participants employed as professional pilots (1976). Unlike their initial study, only three pilots considered themselves infrequent users, using marijuana products less than two times a week. Seven of their pilots considered

themselves moderate users, using marijuana products at least three times a week. The participants ranged in age from 21-40, and all identified as males.

Similarly, Leirer et al.'s first experiment recruited ten pilots holding private pilot certificates. The participants had a mean of 303 hours of flight time and held third-class medical certificates. The mean age of the participants was 29 ,and they considered themselves to be experienced in smoking marijuana. For this study, the researchers only admitted participants that smoked marijuana less than daily. The second experiment sought to establish a relationship between age and the impact of tetrahydrocannabinol (THC) on pilot performance (1985). Leirer et al. recruited 18 participants, nine young pilots of whom had a mean age of 25.5 years of age and nine older pilots with a mean age of 37.6 years of age. The majority of the participants held at least a private pilot single-engine land (SEL) certificate. The third experiment recruited 11 participants that all held current pilot certifications. All 11 participants had experience with marijuana use before participation in the study, but two of the participants were dropped from the study as they were revealed to have used marijuana outside the confines of the study. The following nine participants had a mean age of 70 and a mean of 377 hours of flight time. Five of the participants held SEL certification, and four of the participants held multi-engine (MEL) certification.

Limitations

Much of the literature on tetrahydrocannabinol's (THC) impact on pilot performance identifies the dangers and effects of marijuana use during flight but utilized outdated technology that fails to fully replicate a realistic and modern flight experience (Meacham et al., 1976; Leirer et al., 1985, 1989, 1991). Meacham et al. utilized an ATC-

510 instrument flight simulator, which replicates an extremely outdated version of a small general aviation aircraft (1976). The ATC-510 flight simulator is fitted with round dial instruments and outdated radio navigation and communication, which are rarely found in modern aircraft.

In experiment one of Leirer et al.'s experiments, the flight simulator was an extremely basic setup consisting of a control yoke, comparable to a yoke found in a small general aviation aircraft, a CRT (cathode-ray tube) monitor, and a keyboard to control the aircraft's power settings and flaps (1985). While Leirer et al. used the most advanced aircraft simulator, the Frasca 141 computer-controlled aircraft simulator, for experiments two and three out of all five studies, the Frasca 141 still has many limitations. The flight simulator was rigged to simulate a small single-engine general aviation aircraft that utilized round dial instrumentation but more advanced radio navigation and radio communication.

The technological limitations are important because all five studies fail to replicate a standard flight experience with modern aircraft. In today's industry, many aircraft manufacturers have moved from analog instrumentation to electronic flight displays for small general aviation aircraft (NTSB, 2010). It has also become a popular trend to retrofit the installation of older aircraft instrumentation with newer electronic flight displays. These flight displays contain an entirely new visual display and are commonly accommodated with global positioning systems (GPS) and autopilot functions. While the transition to electronic flight displays is meant to increase safety, these new technologies come with challenges and risks. As the studies demonstrated, task difficulty greatly impacts the deteriorating cognitive effects of marijuana, and further research must

be conducted to analyze the impact of marijuana on pilot performance in modern and technologically up-to-date aircraft simulators (Meacham et al., 1976; Leirer et al., 1985, 1989, 1991).

A major limitation of all five of the studies includes the choice to focus on general aviation and somewhat basic maneuvers. The majority of the participants were low-time private single-engine (SEL) pilots, and all three of the flight simulators mimicked small SEL fixed-gear aircraft (Meacham et al., 1976; Leirer et al., 1985, 1989, 1991). Leirer et al.'s first experiment required the participants to perform a very basic simulated flight comprised of departing from one airport and landing at a second airport. (1985). Experiments two and three required the participants to perform a more complex flight scenario consisting of flying a rectangular flight pattern around a runway while performing a set of standard maneuvers under varying weather conditions (1989, 1991). Meacham et al. analyzed the participants performing basic instrument maneuvers, including a holding pattern for four consecutive minutes, straight and level flight, turns, 3D maneuvering, and radio navigation (1976). All five studies performed basic flight procedures typical general aviation pilots may experience. With that said, the studies ceased to examine flight performance at the level of air carrier operations. Ultimately, what is at stake here is whether the data collected from these studies can be applied or further corroborated for pilot performance while under the influence of marijuana at the air carrier level of operations.

The research collected by all five studies had its limitations purely due to technological limitations. Data collection focused heavily on significant errors committed by the participants while under the influence of marijuana, which can be attributed to the

lack of capability to sufficiently monitor the subtle deteriorating effects of marijuana on pilot performance (Meacham et al., 1976; Leirer et al., 1985, 1989, 1991). Leirer et al. acknowledge that the subtle effects on pilot performance after smoking marijuana can go unnoticed by the user and therefore should not dependen on their own judgement to determine their ability to safely fly an aircraft (1991). In other words, the effects of marijuana can be easily unrecognized by the user, making it unsafe for the user to determine that their capabilities are within a safe standard. These subtle effects can be highly detrimental to the safety of pilots and should be further researched.

Statement of the Problem

The goal of this study is to identify the current level of knowledge of aspiring professional pilots regarding controlled substances specific to marijuana. Largely due to the legalization of marijuana, several studies have observed a significant rise in the popularity of recreational and medical marijuana use. These trends have also maintained their validity for cannabinoid concentrations found in pilots. Not only have marijuana products risen in popularity, but cannabidiol (CBD) products have increased attention due to their potential medicinal properties while also being non-impairing or not producing the “high” effect. CBD and Marijuana products have become readily available and easily accessible to the public, including in Tennessee.

While states have moved to legalize marijuana, the FAA maintains the strict prohibition of marijuana use for pilots. There is evidence of the effects of Tetrahydrocannabinol (THC) on pilot performance, and it has been observed that THC degrades pilot performance to a certain extent. That being said, there is an apparent lack of literature on the effects of THC on pilot performance. It has also been clear the rising

trends of marijuana use found in pilots is an issue that must be further addressed, which is a concern also mentioned by the NTSB. The goal of this study is to identify the level of awareness and understanding of the risks of marijuana use. Additionally, this study will identify a relationship between college graduation status and the current knowledge levels of Certified Flight Instructors (CFI's) at Middle Tennessee State University's (MTSU) flight school regarding controlled substances specific to marijuana by addressing the following research questions:

- What are the current knowledge levels of Certified Flight Instructors (CFI's) at Middle Tennessee State University's flight school that have graduated from college and are still enrolled in college regarding controlled substances specific to marijuana?
- What is the current proficiency level of Certified Flight Instructors at Middle Tennessee State University's flight school regarding the FAA regulations pertaining to marijuana?
- What is the current level of awareness of Certified Flight Instructors at Middle Tennessee State University's flight school regarding the impact of THC use on pilot performance?
- What is the current level of awareness of Certified Flight Instructors at Middle Tennessee State University's flight school regarding the impact of cannabidiol (CBD) use on a DOT drug test?

Chapter II – Methodology

The research was conducted using a testing instrument to determine the current knowledge levels of Certified Flight Instructors (CFI's) at Middle Tennessee State University's (MTSU) flight school on controlled substances specific to marijuana. The testing instrument collected numerical data and therefore the quantitative research method was most appropriate for this research. Demographic data collected about the participants was limited and included information on their employment status as a flight instructor for MTSU's flight school, full-time or part-time employment status, gender identification, and if the participant has graduated from college or is still enrolled in college. Only the status of the participant's graduation and if they were currently employed as a flight instructor at MTSU's flight school were answered directly by the participant on the testing instrument. All other demographic data was collected through direct communication with MTSU's Department of Aerospace's HR Generalist. This method allowed for the most accurate data collection as the data was coming straight from MTSU's flight school.

Following permission obtained by Middle Tennessee State University's (MTSU) Director of Aerospace Airport Operations, the testing instrument was distributed to the participants during MTSU flight instructor staff meetings. These meetings had in-person attendance of MTSU Certified Flight Instructors (CFI's) and were therefore the best option for administering the test instrument. The test instrument consisted of 21 questions that could be categorized into three different categories; FAA regulations regarding marijuana, THC impact on pilot performance, and CBD impact on Department of Transportation (DOT) drug testing. The test question contained one correct answer choice

and four incorrect answer choices. This enabled the test instruments to be easily scored to determine the current knowledge levels of MTSU's CFIs in each of the three categories. Not only were the test results easily calculated, but the test was able to be completed quickly and efficiently. The study was approved by the Middle Tennessee State University (MTSU) Institutional Review Board (IRB), as protocol # as seen in Appendix A.

Participants

For this study, the participants were made up of 49 Certified Flight Instructors (CFI's) at Middle Tennessee State University's (MTSU) flight school that were currently employed during the time of the study. A CFI is a certified flight instructor whose role is to instruct student pilots on how to safely operate an aircraft. CFI's at MTSU are typically currently enrolled students or graduates of the MTSU Aerospace program and have sought the opportunity to work as a CFI as a way to time build. CFI's at MTSU's flight school were chosen as the participants for this study as there was an almost evenly distributed group of both graduated and still enrolled college students that made up the 102 total CFI population at MTSU. The CFIs at MTSU's flight school that participated in this study were made up of 40 CFIs that had already graduated college and 9 CFIs that were still enrolled in college at the time of the study. The hypothesis for this study sought to determine if those with a completed college education had a higher level of knowledge about the risks and hazards of marijuana and cannabidiol (CBD) use in relation to aviation than those who were still enrolled in college. This relationship was chosen as it is to be assumed that those who have graduated from college should have completed all required courses in the aerospace program and therefore should be more knowledgeable

of topics as sensitive as controlled substances specific to marijuana use. Those that have yet to graduate have not yet completed all required courses and therefore may have a lesser understanding of controlled substance use specific to marijuana use. Due to the uneven amount of CFIs that had graduated college and were still enrolled in college, there was an unbalanced collection of data.

CFI's at MTSU's flight school was also chosen because due to the nature of the flight instructing position. CFI's at MTSU are typically individuals seeking the opportunity to time build and are not seeking to be career flight instructors. Instead, the typical progression for CFI's after they reach their hour requirements is to pursue a professional pilot career such as an airline pilot. For this research, it was advantageous to have participants that could benefit from their experience from participating in the study due to its relevance to their careers. It was the hope that the CFI's that participated in the study were brought higher awareness of the dangers and risks of marijuana and cannabidiol (CBD) and could apply it as they moved on to their careers as professional pilots.

Three factors required a participant to be removed from the study; those that do not consent or request their data to not be used, any Flight Instructor Staff not employed at MTSU's flight school during the time of the study, and any minors. The testing instrument required participants to choose the option of "I Consent to Participate" or "I decline to participate". If the participant chose the option to "consent to participate", the participant was directed to continue the survey. If the participant chose to "decline to participate" they were redirected to the end of the testing instrument which prevented them from continuing the survey. According to 14 CFR 61.403, Certified Flight

Instructors must be 18 years of age to be eligible for the Certified Flight Instructor Certificate. This eliminated any possibility of having a participant under the age of 18 participate in the study. The testing instrument required the participants to answer “yes” or “no” if they were currently employed as flight instructors at Middle Tennessee State University’s flight school. If the participant answered "No", the participant was redirected to the end of the survey. This removed any possibility of a participant who is not currently employed as a flight instructor from continuing the study.

The participants were sorted into two groups, Certified Flight Instructors (CFI’s) at Middle Tennessee State University’s (MTSU) flight school that have already graduated college and CFIs at MTSU’s flight school that are still enrolled in college. There were 40 CFI participants that had already graduated college and 9 CFI participants that were still enrolled in college at the time of the study. The participants were directly asked three demographic questions including their graduation status, if they were currently employed as flight instructors for MTSU’s flight school, and if they were above the age of 18. All 49 flight instructor participants were employed at MTSU’s flight school during the time of the study. Other demographic information collected by the researcher was provided by MTSU’s Aerospace HR Generalist. There were 102 total CFIs at MTSU’s flight school during the time of the study, 50 were full-time employees and 52 were part-time employees, 13 identified as females and 89 identified as males during the time of the study.

Instrument

This study utilized an online test instrument to determine the current knowledge levels of Certified Flight Instructors (CFI’s) at Middle Tennessee State University’s

(MTSU) flight school regarding controlled substances specific to marijuana attached to Appendix B. The test instrument was made up of 21 multiple-choice questions organized into three categories. The first category of questions are pertaining to the FAA regulations related to marijuana. The second category of questions is pertaining to the effects of THC on pilot performance. The third category of questions is pertaining to the impact of CBD on DOT drug testing. Each of the test questions had one correct answer and four incorrect answers. Of the four incorrect answers, an "I do not know" option was included as an optional answer choice. The "I do not know" answer choice was included to help eliminate the potential for false-positive test results by removing the participant's need to randomly choose an answer. The test instrument was field tested by multiple professors prior to the distribution of the survey.

The test instrument was administered through Qualtrics' online platform which was accessed through a QR code. The QR code was distributed to the participants by the researcher during the flight instructor staff meetings. Once the QR code was scanned with the participant's personal device, the participant's device was directed to the online survey. The Informed Consent form was the first page to be seen by the participant. Directly underneath the informed consent, the participant was asked to choose an option of " I consent to participate" or "I decline to participate". If the participant chose to "consent to participate", the participant was directed to the next section of questions. If the participant chose to "decline to participate" the participant was redirected to the end of the survey. This was to prevent anyone who did not consent to participate in the study from continuing their participation.

The next questions would be the only two demographic questions asked on the Qualtrics survey. The first demographic question was regarding the participant's graduation status; "I have graduated college." or "I am still enrolled in college.". The second demographic question asked was whether they were currently employed as a flight instructor at Middle Tennessee State University's flight school. If the participant chose "yes", the participant was directed to continue the survey, and if the participant chose "no" the participant was redirected to the end of the survey. This was to prevent any participant that was not currently employed as a flight instructor at MTSU's flight school to continue their participation in the study. Both demographic questions required the participant to choose an answer in order for the participant to continue the study.

Following the demographic questions, the participant was directed to the 21 multiple-choice test questions regarding marijuana and Cannabidiol (CBD). While the 21 multiple choice questions were categorized into three different categories, FAA regulations regarding marijuana, THC impact on pilot performance, and CBD impact on drug testing, the multiple choice questions were displayed in a random order with no identifier of which category they fell into. After the participant completed the 21 multiple choice questions, the participant was redirected to a short debrief page thanking the participant for their time. This ends the test instrument and the participant's experience in the study.

Procedure

The researcher contacted Middle Tennessee State University's (MTSU) Aerospace HR Generalist, to gather preliminary data regarding the number of Certified Flight Instructors (CFI's) at Middle Tennessee State University's flight school, how

many CFIs are part-time or full-time employees, gender identification, and graduation status. Of the 102 CFIs at MTSU's flight school, 50 were full-time employees and 52 were part-time employees, 13 identified as females and 89 identified as males during the time of the study. There were 54 CFIs that had already graduated college and 48 CFIs that were still enrolled in college at the time of the study.

The researcher then contacted Middle Tennessee State University's (MTSU) Director of Aerospace Airport Operations via email, to gain permission to recruit MTSU's flight school Certified Flight Instructors (CFI's) in-person during their flight school staff meetings to participate in the study. Permission was granted by Middle Tennessee State University's (MTSU) Director of Aerospace Airport Operations to attend the staff meetings and the researcher then prepared a short script describing the study's goals and expectations for the testing instrument. The script included a brief overview of the Informed Consent form included in the Qualtrics survey, the online survey platform used for the testing instrument. Participants were also made aware in the script that their participation was completely voluntary and anonymous and that there would be no compensation for their participation in the study.

Following IRB approval, the researcher attended Middle Tennessee State University's flight school staff meetings in person to recruit Certified Flight Instructors (CFI's) for participation in the study. The administration of the testing instrument during the flight instructor staff meetings was chosen due to the high potential of recruiting as many participants as possible. There were two different types of flight instructor staff meetings that were attended, mandatory and voluntary. Twice a semester, one at the beginning of the semester and one in the middle of the semester, the MTSU flight school

requires all CFIs to be in attendance at their mandatory staff meetings. The researcher attended the first summer semester mandatory flight school staff meeting to recruit participants in the study. The MTSU flight school also holds regular town hall meetings throughout the semester with voluntary attendance for MTSU flight instructors. The researcher attended # townhall meetings to recruit participants for the study.

Following the brief script, a QR code was distributed to the participants to access the online testing instrument. The participants used their personal devices to scan the QR code and gain access to the Qualtrics survey. The survey took about 5-10 minutes to be completed by the participants. Qualtrics, the online platform used for the testing instrument, was also used to collect all of the results from the participants. Once the participants completed the online testing instrument, the data collection was complete and their participation in the study was done.

CHAPTER III – DATA ANALYSIS

Of the 52 collected results, 50 participants consented to participate and 2 participants declined to participate. Of the 50 consenting participants, 1 participant responded “No” to the question regarding whether they were currently employed as a flight instructor at Middle Tennessee State University’s flight school, therefore leaving 49 useable responses. All remaining 49 participants answered “Yes” to the question regarding if they were at least 18 years of age. The testing instrument encompassed 21 test questions that were organized into three different categories. If the participant answered the test question correctly, the participant would receive a point for that question. If the participant answered the test question incorrectly, the participant would receive zero points for that question. There were 21 possible points.

An independent-samples t-test was run to determine if there were differences in test scores in each of the three test categories, Federal Aviation Administration (FAA) regulations regarding marijuana, tetrahydrocannabinol (THC) impact on pilot performance, cannabidiol(CBD) impact on DOT drug testing, between Certified Flight Instructor’s (CFI’s) that have graduated from college and CFI’s that were currently enrolled in college. A breakdown of the raw scores and means for both groups of CFIs for all three test categories’ combined scores can be seen in Table 1.

Table 1

Raw test scores and means for both groups of CFIs

I am still enrolled in college	I have graduated college
3	6
8	6
4	0

9	5
7	7
7	11
8	7
4	5
1	8
	2
	10
	11
	7
	2
	8
	6
	4
	4
	7
	11
	6
	5
	9
	3
	10
	12
	10
	10
	9
	5
	12
	9
	7
	3
	11
	12
	5
	5
	7

	9
Mean: 6.6977	Mean: 6.958333

Analysis of test scores for FAA Regulations

An independent-samples t-test was run to analyze if there were differences between the test scores of Certified Flight Instructors (CFI's) that have graduated from college and CFI's that were currently enrolled in college for the Federal Aviation Administration (FAA) regulations regarding marijuana test category. After assessing the boxplot in SPSS Statistics for values greater than 1.5 box-lengths from the edge of the box, there were no outliers in the data. Test scores for both CFI's that have graduated from college and CFI's that were still enrolled in college were not normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). Although there was a violation of normality, the t-test was run "regardless, because the independent-samples t-test is fairly robust to deviations from normality" (Laerd Statistics, 2015). There were 40 CFI's that had already graduated college and 9 CFI's that were still enrolled in college. The test scores were higher for CFI's that had already graduated college ($M = 2.7750$, $SD = 1.57688$) than CFI's that were still enrolled in college ($M = 2.4444$, $SD = 1.33333$). There was homogeneity of variances for the test scores for CFI's that had graduated college and CFI's that were still enrolled in college, as assessed by Levene's test for equality of variances ($p = .700$). CFI's that had graduated had a mean test score .33056, 95% CI [-.81105 to 1.47216] higher than CFI's that were still enrolled in college. The results of the two-tailed P value equals 0.563, which indicated that there was not a statically significant difference between test scores between the CFI's that had graduated from college and the

CFI's that were still enrolled in college. In order to prove statistical significance, a $p <$ .05 would be necessary to prove that the mean difference between the two groups is statistically significant. Therefore, the alternative hypothesis for Research Question Subsection A is rejected and the null hypothesis has failed to be rejected. The results of the FAA regulations regarding marijuana test category can be seen in Table 2. A breakdown of the raw scores and means for both groups of CFI's for the FAA regulations regarding marijuana test category scores can be seen in Table 3.

Table 2

T-test results for test category: FAA regulations regarding marijuana

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Test scores	Equal variances assumed	.151	.700	.583	47	.282	.563	.33056	.56747	-.81105	1.47216
	Equal variances not assumed			.649	13.552	.264	.527	.33056	.50960	-.76583	1.42694

Table 3

Raw test scores and means for both groups of CFIs: FAA regulations regarding marijuana

I am still enrolled in college	I have graduated college
1	3

4	2
2	0
4	1
2	3
3	5
4	3
1	1
1	5
	0
	4
	4
	2
	1
	4
	3
	1
	1
	1
	4
	3
	3
	3
	1
	3
	5
	3
	4
	3
	3
	6
	5
	3
	0
	4
	5
	2

	1
	2
	4
Mean: 2.4444	Mean: 2.7750

Analysis of test scores for THC impact on pilot performance

An independent-samples t-test was run to analyze if there were differences between the test scores of Certified Flight Instructors (CFIs) that have graduated from college and CFI that were currently enrolled in college for the tetrahydrocannabinol (THC) impact on pilot performance test category. There were 40 CFI participants that had graduated college and 9 CFI participants that were still enrolled in college. An independent-samples t-test was run to determine if there were differences in test scores between CFI's that had graduated college and CFI's that were still enrolled in college. There was an outlier in this data, as assessed by inspection of a boxplot. This outlier is being ignored as a second independent-samples t-test without the outlier was run but revealed essentially the same results as the data that included the outlier. Test scores for both groups of CFI's, graduated and undergraduates, were not normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$), but the t-test was run "regardless, because the independent-samples t-test is fairly robust to deviations from normality" (Laerd Statistics, 2015). There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .980$). The test scores were higher for CFI's that had graduated college ($M = 2.8750$, $SD = 1.22344$) than CFI's that were still enrolled in college ($M = 2.2222$, $SD =$

1.20185). The results of the two-tailed P value equals 0.154, which indicated that there was not a statically significant difference between test scores between the CFI's that had graduated from college and the CFI's that were still enrolled in college. Therefore, the alternative hypothesis for Research Question Subsection B is rejected and the null hypothesis has failed to be rejected. The results for the THC impact on pilot performance test category with the outlier can be seen in Table 4. A breakdown of the raw scores and means for both groups of CFIs for the THC impact on pilot performance test category scores can be seen in Table 5.

Table 4

T-test results for test category: THC impact on pilot performance (with outlier)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Test scores	Equal variances assumed	.001	.980	1.451	47	.077	.154	.65278	.45002	-.25254	1.55810
	Equal variances not assumed			1.467	12.031	.084	.168	.65278	.44487	-.31624	1.62180

Table 5

Raw test scores and means for both groups of CFIs: THC impact on pilot performance

I am still enrolled in college	I have graduated college
3	3
2	2
3	0

2	2
4	2
3	3
2	2
0	4
3	2
	0
	3
	4
	4
	1
	3
	3
	2
	3
	5
	3
	2
	2
	4
	2
	3
	4
	4
	6
	5
	2
	3
	2
	3
	3
	4
	3
	2
	3
	3

	4
Mean: 2.2222	Mean: 2.8750

Analysis of test scores for CBD impact on DOT drug testing

An independent-samples t-test was run to analyze if there were differences between the test scores of Certified Flight Instructor (CFI) that have graduated from college and CFIs that were currently enrolled in college for the cannabidiol (CBD) impact of Department of Transportation (DOT) drug testing test category. There were 40 CFI participants that had graduated college and 9 CFI participants that were still enrolled in college. An independent-samples t-test was run to determine if there were differences in test scores between CFI's that had graduated college and CFI's that were still enrolled in college. There was an outlier in this data, as assessed by inspection of a boxplot. This outlier is being ignored as a second independent-samples t-test without the outlier was run but revealed essentially the same results as the data that included the outlier. Test scores for both groups of CFI's, graduated and undergraduates, were not normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$), but the t-test was run "regardless, because the independent-samples t-test is fairly robust to deviations from normality" (Laerd Statistics, 2015). There was no homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .029$). A Welch t-test was run to determine if there were differences in test scores between CFI's that had graduated college and CFI's that were still enrolled in college due to the assumption of homogeneity of

variances being violated. The test scores were higher for CFI's that had graduated college (*M* = 1.5128, *SD* = 1.29517) than CFI's that were still enrolled in college (*M* = 1.0000, *SD* = .94281). The results of the two-tailed P value equals 0.174, which indicated that there was not a statically significant difference between test scores between the CFI's that had graduated from college and the CFI's that were still enrolled in college. Therefore, the alternative hypothesis for Research Question Subsection C is rejected and the null hypothesis has failed to be rejected. The results for the THC impact on pilot performance test category with the outlier can be seen in Table 6. A breakdown of the raw scores and means for both groups of CFI's for the CBD impact on DOT drug testing test category scores can be seen in Table 7.

Table 6

T-test results for test category: CBD impact on DOT drug testing (with outlier)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Test scores	Equal variances assumed	5.105	.029	1.171	47	.124	.248	.51282	.43793	-.36819	1.39383
	Equal variances not assumed			1.412	18.776	.087	.174	.51282	.36318	-.24794	1.27358

Table 7

Raw test scores and means for both groups of CFIs: CBD impact on DOT drug testing

I am still enrolled in college	I have graduated college
1	0
1	2
0	0
2	2
3	2
0	3
1	2
1	0
0	1
	2
	3
	3
	1
	0
	1
	0
	1
	0
	1
	4
	1
	0
	2
	0
	4
	3
	3
	0
	1
	0
	3
	2

	1
	0
	3
	4
	1
	1
	2
	1
Mean: 1.0000	Mean: 1.5128

CHAPTER IV – DISCUSSION

The primary goal of this study, as defined in Chapter I, was to identify a relationship between college graduation status and the current knowledge levels of Certified Flight Instructors (CFIs) at Middle Tennessee State University's flight school regarding controlled substances specific to marijuana as established in the research question and subsection A, B, and C. Following the data collection and analysis, it was revealed that there was no statistical significance found. Although no statistical significance was proven, the data still proved valuable in proving the hypothesis that CFI's that have graduated from college will score a higher test score in all three categories than CFI's that are still enrolled in college. The mean test score for CFI's that have graduated from college in comparison to CFI's that were still enrolled in college was higher for all three test categories, Federal Aviation Administration (FAA) regulations regarding marijuana, tetrahydrocannabinol (THC) impact on pilot performance, cannabidiol (CBD) impact on Department of Transportation (DOT) drug testing.

The research question sought to determine what the current knowledge levels are of Certified Flight Instructors (CFI's) at Middle Tennessee State University's (MTSU) flight school that have graduated from college and are still enrolled in college regarding controlled substances specific to marijuana. The mean test score for CFI's that had graduated college (M =6.958333) was higher than the mean test score for CFI's that were still enrolled in college (M =6.6977).

Additionally, of the 21 possible points that could be achieved on the testing instrument, the mean test scores for both CFI's that had graduated and were still enrolled in college

were revealed to be quite low. It is important to note that while CFI's that had graduated from college had higher test scores than CFI's that were still enrolled in college, both groups, on average, had failing test scores. The highest score for all participants was 12 points, which still would have resulted in a failing test score. From these results, it can be assumed that there is a lack of knowledge of CFIs, that have graduated from college and are still enrolled in college, on controlled substances specific to marijuana.

The research question was then divided into three subsections for each of the three test categories: Subsection A, Subsection B, and Subsection C. Research Question Subsection A inquired about the current proficiency level of CFI's, undergraduates, and graduates, was regarding the first test category, FAA regulations pertaining to marijuana. Research Question Subsection B inquired about the current level of awareness for CFI's, undergraduates and graduates, regarding the second test category, tetrahydrocannabinol (THC) impact on pilot performance. Finally, Research Question Subsection C inquired about the current level of awareness of CFI's, undergraduates and graduates, regarding the third test category, cannabidiol (CBD) impact on Department of Transportation (DOT) drug testing.

Research Question Subsection A sought to determine the current proficiency level of Certified Flight Instructors (CFI's) at Middle Tennessee State University's (MTSU) flight school that have graduated from college and were still enrolled in college regarding Federal Aviation Administration (FAA) regulations pertaining to marijuana. The hypothesis stated that CFI's at MTSU's flight school that have graduated from college will have higher test scores pertaining to FAA regulations of marijuana than CFI's at MTSU's flight school that are still enrolled in college. While no statistical significance

could be proven (p = 0.563), the mean test score for CFI's that have graduated from college (M = 2.7750, SD = 1.57688) was higher than the mean test score for CFI's that were still enrolled in college (M = 2.4444, SD = 1.33333). Therefore, this finding ultimately supports the hypothesis that CFI's that have graduated from college will score higher than the CFI's that are still enrolled in college.

Research Question Subsection B sought to determine the current level of awareness of Certified Flight Instructors (CFI's) at Middle Tennessee State University's (MTSU) flight school that have graduated from college and were still enrolled in college regarding the impact of tetrahydrocannabinol (THC) use on pilot performance. It was hypothesized that CFI's at MTSU's flight school that have graduated from college will have higher test scores pertaining to the impact of THC use on pilot performance than CFI's at MTSU's flight school that are still enrolled in college. Once again, no statistical significance could be proven (p =0.154), but the mean test score for CFI's that had graduated from college (M = 2.8750, SD = 1.22344) was higher than the mean test score for CFI's that were still enrolled in college (M = 2.2222, SD = 1.20185). This finding supports the hypothesis that CFI's that have graduated from college will score higher than CFI's that are still enrolled in college, even though there was no statistical significance proven.

Research Question Subsection C sought to determine what the current level of awareness was of Certified Flight Instructors (CFI's) at Middle Tennessee State University's (MTSU) flight school that have graduated from college and were still enrolled in college regarding the impact of cannabidiol (CBD) use on a Department of Transportation (DOT) drug test. The hypothesis stated that CFI's at MTSU's flight

school that have graduated from college have higher test scores pertaining to the impact of CBD use on a DOT drug test than CFI's at MTSU's flight school that are still enrolled in college. Continuing the pattern, no statistical significance could be proven (p = 0.174), but the mean test score for CFI's that have graduated from college (M = 1.5128, SD = 1.29517) was higher than CFI's that were still enrolled in college (M = 1.0000, SD = .94281). The mean test scores support the hypothesis that CFI's that have graduated from college will score higher than CFI's that were still enrolled in college.

Recommendations

Following the completion of this study, the recommendation is made to consider further research to uncover the cause of Middle Tennessee State University's (MTSU) flight school's Certified Flight Instructors (CFI's) that have graduated from college higher test scores than CFI's that are still enrolled in college. Several factors could contribute to this result, but it is important to determine if there is a class, training, or educational program offered in the Aerospace program that has offered CFI's further education on the risks and regulations regarding marijuana. Identification of the class, training, etc. can be imperative to growing or advancing the curriculum to better support MTSU's aerospace students as they enter the aviation industry. The results could also be a product of time as those that have graduated college are often closer to achieving their flight hours and therefore more likely to be actively job searching or applying to jobs in the industry.

Not only is it important to identify contributing factors to the results of this study, but the mean score for all participants in this study fell remarkably low (M =6.6977*,* M = 6.958333). The testing instrument had 21 possible points, and the results revealed a less

than 50% average test score. These results raise the question if there is a lack of discussion on the risks and dangers of marijuana and cannabidiol (CBD) use for pilots. It is heavily recommended that it would be advantageous for MTSU's aerospace program to expand or develop a curriculum to better prepare and educate its students on controlled substances specific to marijuana. Drug use regulations and policies are strictly enforced with little forgiveness, and with the rise in popularity and accessibility of marijuana products and specifically cannabidiol (CBD) products, it is necessary for aspiring professional pilots to be fully knowledgeable on this topic.

Limitations

This study surveyed its participants from Middle Tennessee State University's flight school, and therefore focused on one specific flight school, and did not encompass the complete makeup of the certified flight instructor population in the United States. The participants in this study represented slightly less than half of the entire Certified Flight Instructor (CFI) population, 102 CFI's, at Middle Tennessee State University's flight school. Additionally, because the data collection was completed during the Summer Semester Flight Instructor Staff Meeting, it could be assumed that many of the participants in this study had recently graduated during the prior Spring Semester preventing a balanced collection of data. The sample size of CFI's that had graduated from college, 40 participants, was much larger than the CFI's that were still enrolled in college, 9 participants. While the T-test did not prove statistical significance, the imbalance in the two groups of participants potentially limited the findings in this study.

Directions

To further this research, the study can be expanded to include Certified Flight Instructors (CFI's) employed at alternate Part 141 flight schools associated with AABI accredited universities. To further determine the current knowledge levels of CFIs on controlled substances specific to marijuana, it is important to expand the participant pool to CFIs at more than one flight school and particularly target flight schools across the entire United States. The research can also be expanded to include not only Certified Flight Instructors (CFI's) employed at Part 141 flight schools associated with AABI accredited universities but CFI's that are employed at Part 61 flight schools or Part 141 flight schools unassociated with AABI accredited flight schools. This research can be geared to determine if Part 141 or Part 61 or Part 141 unassociated with a university are more capable of informing CFI's on the risks and hazards of using marijuana or cannabidiol (CBD) products. To combat the large influx of data, a more advanced statistical test, such as a MANOVA, can be used to more thoroughly analyze the large influx of data. Eventually, the study can be expanded to include other groups of pilots other than CFIs. It could be interesting to target student pilots, private pilots, and commercial pilots. Not only can this research target pilots in training, but professional pilots should also be targeted to determine if in-house training programs are sufficiently informing their employees of the risks and hazards of marijuana and CBD use.

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APPENDICES

APPENDIX A- IRB APPROVAL LETTER

Office of Research Compliance
2269 Middle Tennessee Blvd.
Sam H. Ingram Bldg (ING) Room 010A
Box 124
Murfreesboro, TN 37132
www.mtsu.edu/irb

Date: May 3, 2023
PI: Quinn Cunningham
Department: Middle Tennessee State University, Aerospace
Re: Initial - IRB-FY2023-87
An Analysis of the Current Knowledge Levels of Certified Flight Instructors on Controlled Substances Specific to Marijuana

The Middle Tennessee State University Institutional Review Board has rendered the decision below for An Analysis of the Current Knowledge Levels of Certified Flight Instructors on Controlled Substances Specific to Marijuana . The approval is effective starting May 3, 2023.

Decision: Approved
Category: 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Findings:
Research Notes:

Please note:

Any **modifications to the approved study must be submitted for review through Cayuse IRB**. Please note, as well, that according to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to complete the required training. If you add researchers to an approved project, please add them to the project within Cayuse IRB for approval **before** they begin to work on the project.

Any unanticipated harm to participants or adverse events must be reported to the Office of Compliance, and any subsequent changes to the protocol must be submitted to the IRB for review before implementing this change.

You must submit an end-of-project form to the Office of Compliance upon completion of your research. Completed research means that you have finished collecting data.

All research materials must be retained by the PI or faculty advisor (if the PI is a student) for at least three (3) years

after study completion and then destroyed in a manner that maintains confidentiality and anonymity.

All approval letters and study documents are located within the Study Details in Cayuse IRB.

We wish you a successful research project,

Middle Tennessee State University Institutional Review Board

APPENDIX A – TESTING INSTRUMENT QUESTIONS

An Analysis of the Current Knowledge Levels of Certified Flight

Start of Block: Block 3

INFORMED CONSENT

Study Title: An Analysis of the Current Knowledge Levels of Certified Flight Instructors on Controlled Substances Specific to Marijuana
Protocol Number:
Approval Date:
Principal Investigator: Quinn Cunningham
Institution: Middle Tennessee State University

You are being asked to participate in a research project. The following information is provided to inform you about the research project and your participation in it.

1. Purpose of the study: This study is intended to identify the current level of knowledge of aspiring professional pilots regarding controlled substances specific to marijuana. Marijuana products have become readily available and easily accessible to the public, including in the state of Tennessee. This study is intended to identify a relationship between education level and current knowledge levels of Certified Flight Instructors (CFI's) at Middle Tennessee State University's flight school regarding controlled substances specific to marijuana.

2. Description of procedures to be followed and approximate duration of the study: Participants will complete an online test consisting of 21 questions on the FAA regulations regarding marijuana, THC impact of pilot performance, and CBD impact on DOT drug tests. The total participation time will be approximately 10 minutes.

3. Compensation for participation: N/A

Here are your rights as a participant:

a) Your participation in this research is voluntary.

b) You may skip any item that you don't want to answer, and you may stop the research at any time. Note that if you leave an item blank, you will be warned that you missed one, just in case it was an accident. You can still click that you don't want to answer. Some items may be required in order to accurately present the study.

c) There are no risks associated with your participation besides possible discomfort with some of the questions.

d) There are no real benefits to you from participating besides possibly learning something about the research.

e) You will NOT be asked to provide any identifiable personal information.

f) All efforts, within reason, will be made to keep the personal information in your research record private, but total privacy cannot be promised. Your information may be shared with people at MTSU (such as the MTSU Institutional Review Board) or other agencies (such as the Federal Government Office for Human Research Protection) if you or someone else is in danger or if we are required to do so by law.
Contact Information: If you should have any questions about this research study please contact:
Principal Investigator: Quinn Cunningham
Contact Information: qsc2f@mtmail.mtsu.edu
Faculty Advisor: Dr. Paul Craig
Contact Information: Paul.Craig@mtsu.edu

For additional information about giving consent or your rights as a participant

in this study, please contact the Middle Tennessee State University (MTSU) Office of Compliance at 615-494-8918 or via email at irb_information@mtsu.edu. (http://www.mtsu.edu/irb)

If you're ready to get started, please make your choice below before clicking the arrow button.

Thanks again for volunteering your time to this project!

I have read the information above. I am at least 18 years old. I believe I understand the purpose, risks, and benefits of the research, and I know what I will be expected to do as a study participant.

Q24 Please choose one of the following

- ○ I consent to participate (1)
- ○ I decline to participate (2)

Skip To: End of Survey If Please choose one of the following = I decline to participate

Page Break

Q Are you a college graduate or are you still currently enrolled in college?

- ○ I have graduated college. (1)
- ○ I am still enrolled in college. (3)

Q25 Are you currently employed as a flight instructor at MTSU's flight school?

- ○ Yes (2)
- ○ No (3)

Skip To: End of Survey If Are you currently employed as a flight instructor at MTSU's flight school? = No

End of Block: Block 3

Start of Block: Question Tour Block 2

Q1 If while driving your car, you are pulled over by a law enforcement officer and are asked to submit to a drug test. What is the consequence of refusing to take the test?

- ○ The FAA can revoke your First Class Medical for failing to take the test. (1)
- ○ The FAA will require you to submit to a DOT drug test following the incident. (2)
- ○ The FAA cannot enforce any consequence. (6)
- ○ The FAA will recognize this as a negative drug test. (7)
- ○ I do not know (8)

Page Break

Q2 Can a pilot use medical marijuana products if prescribed for a medical condition by a licensed medical practitioner and still act as a pilot in command or in any other capacity as a required pilot flight crewmember?

- ○ Yes a pilot can use prescribed medical marijuana products. (1)
- ○ No a pilot cannot use prescribed medical marijuana products. (2)
- ○ Only with permission from their employer. (3)
- ○ Only with permission from the FAA. (4)
- ○ I do not know (5)

Page Break

Q3 A pilot may NOT attempt or act as a crewmember of a civil aircraft while using…

- Any drug that affects the person's faculties in any way contrary to safety. (1)
- Non-drowsy approved cold medication. (2)
- Acetaminophen or Ibuprofen products. (3)
- Prescribed medication approved by their AME. (4)
- I do not know (5)

Page Break

Q4 From whom must a pilot have authorization from to operate a civil aircraft within the United States with the knowledge that marijuana products, as defined in Federal or State statutes, are carried in the aircraft?

- A state agency (1)
- A pilot cannot carry marijuana products no matter the circumstance. (2)
- An employer (3)
- No authorization is needed. (4)
- I do not know (5)

Page Break

Q5 Because several states have legalized recreational and medical marijuana use, can pilots knowingly transport marijuana on an aircraft?

- ○ No, because Federal Law prohibits the knowing transportation of marijuana. (1)
- ○ Yes, but only if a pilot is transporting the marijuana from one legalized state to another legalized state. (2)
- ○ Yes, no matter the circumstance. (3)
- ○ Yes, but only if the flight path goes through legalized states, or within one legalized state. (4)
- ○ I do not know (5)

Page Break

Q6 What is the penalty for pilots who knowingly transport controlled substances, including quantities of marijuana amounting to more than simple possession?

- ○ The Department of Transportation (DOT) must permanently revoke the certificates of that pilot. (1)
- ○ The Department of Transportation (DOT) must permanently revoke the certificates of that pilot and the registrations of the aircraft used must be revoked for 5 years. (2)
- ○ The Federal Aviation Administration must permanently revoke the certificates of that pilot. (3)
- ○ The Federal Aviation Administration (FAA) must permanently revoke the certificates of that pilot and the registrations of the aircraft used must be revoked for 5 years. (4)
- ○ I do not know (5)

Page Break

Q7 If due to using CBD products (intentional or inadvertent), you receive a marijuana-positive DOT drug test, how will this result be treated?

- This will be treated as a positive test. (1)
- This will be treated as a negative test. (2)
- This will be treated as a special case requiring further explanation. (3)
- This will be treated as inconclusive. (4)
- I do not know (5)

Page Break

Q8 What factors most impact a pilot's performance while under the influence of marijuana?

- ○ The time of the pilot's last meal. (1)
- ○ The quantity/dosage of THC consumed and the flight task difficulty. (2)
- ○ The time of day the pilot is flying. (3)
- ○ The method of consumption of THC. (4)
- ○ I do not know (5)

Page Break

Q9 The maximum impairment of performance and skills while piloting an aircraft under the influence of marijuana is during the first:

- ○ 30 minutes (1)
- ○ 1 hour (2)
- ○ 4 hours (3)
- ○ 6 hours (4)
- ○ I do not know (5)

Page Break

Q10 The residual effects of cannabis can last up to how many hours.

- ○ 8 hours (1)
- ○ 12 hours (2)
- ○ 24 hours (3)
- ○ 48 hours (4)
- ○ I do not know (5)

Page Break

Q11 What is a major concern of a pilot operating an aircraft under the influence of marijuana?

- A pilot may fall aslee. (1)
- A pilot may experience feelings of anger. (2)
- A pilot is often unaware of their performance deterioration. (3)
- A pilot will often become dizzy and become physically unable to fly the plane. (4)
- I do not know (5)

Page Break

Q12 Piloting under the influence of marijuana can cause alterations in concentration, and in some cases complete loss of orientation resulting in:

- ○ Navigational errors (1)
- ○ Major altitude deviations (2)
- ○ Stalling and loss of control events (3)
- ○ All of the above (4)
- ○ I do not know (5)

Page Break

Q13 THC can be detected in urine for up to:

- ○ 30 days, depending on frequency of use (1)
- ○ 40 days, depending on frequency of use (2)
- ○ 45 days, depending on frequency of use (3)
- ○ 50 days, depending on frequency of use (4)
- ○ I do not know (5)

Page Break

Q14 THC can be detected in blood for up to:

- ○ 7 hours (1)
- ○ 12 hours (2)
- ○ 7 days (3)
- ○ 12 days (4)
- ○ I do not know (5)

Page Break

Q15 Which of the following must take DOT-required drug tests?

- ○ Part-time employees performing safety-sensitive job functions (1)
- ○ Ground handling employees (2)
- ○ Baggage loaders (3)
- ○ Full-time ticketing agents (4)
- ○ I do not know (5)

Page Break

Q16 What is the maximum percentage of THC that CBD products can contain in order to be marketed as CBD?

- Less than 0.3% (1)
- Less than 0.5% (2)
- Less than 0.7% (3)
- Less than 0.03% (4)
- I do not know (5)

Page Break

Q17 Can commercially available CBD products be a risk for containing high enough levels of THC to make a drug test positive?

- ○ No, because the FDA regulates CBD products. (1)
- ○ Yes, because the FDA does not regulate CBD products. (2)
- ○ No, because drug tests only test for THC. (3)
- ○ Yes, because CBD products are just topical THC products. (4)
- ○ I do not know (5)

Page Break

Q18 In the event you receive a positive DOT drug test result, who can accept the explanation that the positive test was the result of using CBD products and not using marijuana?

- ○ Medical Review Officer (MRO) (1)
- ○ Federal Aviation Administration (FAA) (2)
- ○ Department of Transportation (DOT) (3)
- ○ Employer (4)
- ○ I do not know (5)

Page Break

Q19 If the Medical Review Officer (MRO) accepts the explanation that the positive test was the result of CBD products and not using marijuana, what can the MRO do?

- ○ Change the positive drug test result to a negative result. (1)
- ○ Discard the positive test and re-test you at a later date. (2)
- ○ Label the test as inconclusive and re-test you at a later date. (3)
- ○ The MRO cannot do anything and must treat the drug test as a positive result. (4)
- ○ I do not know (5)

Page Break

Q20 Among other substances the DOT required drug tests checks for:

- ○ Level of THC in the blood (1)
- ○ Cannabinoid Metabolites (2)
- ○ Level of THC in the urine (3)
- ○ BAC (Blood Alcohol Content) (4)
- ○ I do not know (5)

Page Break

Q22 What product is okay for a pilot to drink without risk of testing positive on a drug test?

- Image:Otto's cbd cider pear rhubarb (1)
- Image:Wyld cbd raspberry sparkling water (2)
- Image:Recess blackberry chai sparkling water (3)
- Image:Wild tonic blueberry basil kombucha (4)
- I do not know (5)

End of Block: Question Tour Block 2

I thank you for your time spent taking this survey.
Your response has been recorded.