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Drug use, Impulsivity, and Cognitive Functioning

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DRUG USE, IMPULSIVITY, AND COGNITIVE FUNCTIONING

by

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Dedication

This thesis is dedicated to my family, who has stood by me throughout all of my trials and accomplishments, and whose unconditional love has given me the strength to pursue my goals and dreams.

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Abstract

The purpose of the present study was to investigate the relationships between impulsivity, frequency of drug use, and two aspects of cognitive functioning: working memory and processing speed. Two theories are proposed that attempt to explain the relationship between these variables. First, the *trait-based* theory holds than an impulsive predisposition precedes and determines the extent of drug use and abuse. Second, the *drug-induced state* theory holds that drug use itself increases the probability of impulsive thinking and impulsive behaviors. Research supports that impulsivity and drug use interact in complex ways that affect cognitive processes.

In the current study, it was predicted that impulsivity would be positively correlated with frequency of drug use, and negatively correlated to working memory and processing speed. It was also predicted that frequency of drug use would be negatively correlated with working memory and processing speed. Participants were 101 students recruited from a private university in Miami, Florida. Data was collected in face-to-face interviews and students were compensated with extra credit in their psychology classes. Impulsivity was measured using the *Barrat Impulsiveness Scale – 11* (BIS-11; Patton, Stanford, & Barratt, 1995). Drug use was measured using a Substance Use Questionnaire which was comprised of questions adapted from the *Substance Use History Questionnaire* (SUHQ; Stevens, & Smith, 2001) and the *Drug Use Questionnaire* (DAST-20; Skinner, 1992). Cognitive functioning was assessed using two subscales, Coding and Letter-Number Sequencing, from the *Wechsler Adult Intelligence Scale – Fourth Edition* (WAIS-IV; Wechsler, 2008). Demographic information was also collected.

As predicted, and consistent with previous literature, impulsivity was found to have a significant positive relationship with drug use. However, contrary to our prediction, impulsivity was not significantly related to the two aspects of cognitive functioning measured, working

memory or processing speed. Also contrary to our prediction, we did not find a significant relationship between frequency of drug use and working memory or processing speed.

Additional analyses revealed that men reported significantly higher frequency of substance use and scored significantly higher than women on motor impulsivity. It was also found that women scored significantly higher than men on processing speed. Whites were found to score significantly higher than African Americans on working memory as well as motor impulsivity. Hispanics reported significantly higher frequency of substance use than African Americans. Atheists/Agnostics reported significantly higher rates of drug use than Protestant Christians and also scored significantly higher on working memory than Roman Catholics. Theoretical and practical implications for these results were discussed.

There were several limitations in this study that should be taken into account in future research. Although a relatively notable portion of the participants in the current study were found to be highly impulsive (19%), many of them did not use drugs (25%). Hence, drug use may have served as a mediating variable between initial levels of impulsivity and deficits in working memory and processing speed, which may be why a direct relationship between drug use and cognitive functioning was not found. Also, participants were not part of a clinical population and tended to be younger in age. Because of this, we were not able to obtain a sample of long-term drug users in which prolonged drug use may have had its permanent effects. Future research should investigate the effects that long term drug use has on cognitive functioning over time among individuals diagnosed with Substance Use Disorders, in a longitudinal study conducted from adolescence through adulthood.

Drug Use, Impulsivity and Cognitive Functioning

Psychoactive substances have been used by various cultures since ancient times. Substances are considered psychoactive when they cross the blood-brain barrier and create changes in the brain (Stevens & Smith, 2001). The earliest evidence of the use of these substances traces back to the production of wine and beer in 4000 BCE (Heath, 2001). Opium use has been traced back to 2000 BCE and psychoactive mushrooms to 1500 BCE. Cannabis use was evident by 450 BCE and the use of the tobacco, coca, and peyote plants appear to have originated around 200 CE (Heath, 2001). However, more recently these substances have been associated with abuse and addiction in the modern world.

In the 20th century drug use peaked in 1980s, slowly declined until the 90s, yet began to rise again in the 2000s (Ray, Ksir, & Hart, 2009). In 2009, 4.6 million emergency room visits were associated with the abuse or misuse of drugs, adverse reaction to drugs, or other drug related problems (SAMHSA, 2010). Marijuana use has been steadily rising, and in 2010 it was at its highest point since the early 1980s among 12th graders (NIDA, 2011). From 2009 to 2010, lifetime use of ecstasy (3,4 Methylene-dioxy-N-methylamphetamine, MDMA) among 8th graders increased from 2.2 percent to 3.3 percent. Prescription and over-the-counter medications accounted for most of the top drugs abused by 12th graders in 2010 (NIDA, 2011). Clearly, drug abuse and addiction have become critical problems in the United States.

Considerable research has been done on drug addiction and its treatment and prevention. Cadogan (1999) argued that one of the reasons addicts stop using substances is because the harmful outcomes they produce (such as health and legal problems), eventually outweigh the pleasures they provide. However, instead of waiting until drug users hit “rock bottom,” targeting predisposing factors may be helpful in the prevention of initial drug use. Studies have supported the notion that certain personality traits may serve as risk factors for substance-related problems (Swendsen, Conway, Rounsaville, & Merikangas, 2002). Specifically, impulsivity has been shown to be more prevalent among drug users and perhaps may be a contributor to addictive disorders (Oberlin & Grahame, 2009).

Impulsivity and Drug Use

Impulsivity is the tendency to choose small immediate rewards over larger delayed rewards (Oberlin & Grahame, 2009), and is characterized by risk-taking, lack of planning, and impairment in inhibititory responses (Bornovalova, Lejuez, Daughters, Rosenthal, & Lynch, 2005; Feil et al., 2010). Because impulsivity prevents an individual from rationally weighing the benefits and consequences of his/her actions, it facilitates risky behaviors such as drug use, unprotected sex, gambling, etc. Rosenthal, Edwards, Ackerman, and Knott (1990) found that inpatients for alcohol, cocaine, opioid, and polysubstance use were found to be collectively more impulsive than nonpatients. Nicotine-dependent individuals have also been found to exhibit elevated levels of impulsivity (Herzig, Tracy, Munafò, & Mohr, 2010). In another study, Peña, Andreu, and Graña (2009) found that the major predictors of alcohol and marijuana use were the personality factors aggressiveness and impulsivity.

It seems that impulsivity, which is seen more frequently in younger populations such as adolescents and young adults, may predispose individuals to use drugs. Drug use can lead to adverse consequences and eventually addiction, which is characterized by increased drug intake, loss of control over drug intake, and compulsive drug taking and drug seeking (George & Koob, 2010). It is important to take into account the factors that contribute to drug use as well as the consequences involved with this behavior. Although drug addiction is often viewed as one disorder, it is important to note that drugs produce different patterns of addiction and affect different areas of functioning (Feil et al., 2010). Depending on the drug of abuse and the stage of addiction, drugs may produce cognitive impairment, social withdrawal, abandonment of responsibilities, or other DSM axis I disorders such as depression and anxiety.

Drugs of Abuse

Alcohol is one of the most widely used recreational substances in the world (Kunin, 2003), as well as the oldest (Ray, Ksir, & Hart, 2009), and has relaxant as well as euphoric effects (Feil et al., 2010). All types of alcohol, including beer, wine, and distilled spirits, are formed by the fermentation of fruits or grains (Ray et al., 2009). Early in the 20th century, alcohol was the first psychoactive substance to become demonized in American culture, that is, to be seen as a source of evil, i.e., moral decay (Ray, Ksir, & Hart, 2009). Consumed legally and illegally since the 1920s, alcohol has been prohibited by the 18th amendment in the US Constitution and then made available once again by the 21st amendment (McKim & Hancock, 2013). This was because while alcohol was nationally prohibited in 1920, this act was a failure as people began to make, buy, and sell alcohol illegally and related crime became more profitable and more organized (Ray, Ksir, & Hart, 2009). However, with the end of prohibition in 1933, a national alcohol binge was triggered which rose into the 1970s and peaked in 1981.

Currently, binge drinking by college students results in more than 1,700 deaths a year from traffic accidents, falls, suffocation, drowning, and overdose (Temperance Revisited, 2008). Alcohol is a central nervous system depressant (Grunberg, Berger, & Hamilton, 2011) and as such, it shares parallel characteristics with similar drugs (e.g. barbiturates, benzodiazepines, and opiates). Both alcohol and opiate addictions are characterized by an intense withdrawal and negative affect when the person is not using. After the initial intoxication during a binge, profound dysphoria and physical and emotional pain often follow (Feil et al., 2010). The withdrawal syndrome associated with alcohol is medically more severe and more likely to cause death than withdrawal from opiate drugs (Ray et al., 2009).

Opiates are derived from the poppy plant, *Papaver somniferum*, and have a history of medical use 6,000 years old (Ray, Ksir, & Hart, 2009). Opiates have relieved more human suffering than any other medication, but their use is still fraught with significant misuse, abuse, and addiction (Shurman, Koob, & Gutstein, 2010). The two natural narcotics found in opium, morphine and codeine, along with synthetic forms like heroin, are subject to abuse and dependence. In fact, prescription forms of opiates, like Vicodin and Oxycontin, are vastly abused in the United States (Ray et al., 2009). Because opiates are central nervous system depressants, they slow respiratory centers in the brain and can easily lead to overdose and death, especially when mixed with other depressants (e.g. alcohol).

Nicotine is the addictive ingredient in tobacco products which has been used since the 1700s in the United States (Ray, Ksir, & Hart, 2009). Nicotine addiction is not associated with major intoxication but is instead characterized by highly compulsive intake to the point that daily activities (e.g. eating, sleeping) are disturbed and constrained by the patterns of nicotine intake (Feil, Sheppard, Fitzgerald, Yücel, Lubman, & Bradshaw, 2010). Nicotine withdrawal is associated with intense dysphoria, irritability, sleep disturbances, and craving. Currently, cigarette smoking related illnesses are the leading avoidable causes of death in the United States, amounting up to 440,000 a year (Ray et al., 2009), and as such, are important public health concerns.

Marijuana is the most widely used illicit substance in the world (Sugarman, Poling, & Sofuoglu, 2011). This substance is a preparation of leafy material from the Cannabis plant that is smoked and the primary psychoactive agent is THC, i.e. Tetrahydrocannabinol (Ray, Ksir, &

Hart, 2009). Marijuana smoking produces a euphoric “high” as well as slower cognitive performance, hunger, and increased heart rate (Ray et al., 2009). Marijuana addiction shares aspects of both opioid and nicotine addiction, with an initial intense binge and intoxication stage that progressively transitions to regular marijuana intake during the day and dysphoria during abstinence (Feil et al., 2010). Marijuana has also been used for its medical properties throughout history, i.e., its anticonvulsant properties, its relief of tension, migraines, and pain, and the relief it brings to individuals who suffer from glaucoma and nausea due to chemotherapy for cancer (Ray et al., 2009). In recent times, however, marijuana has been associated with recreational use and abuse.

Cocaine is a stimulant which is extracted from the leaves of the Coca plant which grows in South America. Coca leaves have been used since ancient times, before 2500 BCE, by the Incas (Van Dyke & Byck, 1983). The Incas would chew the leaves to avoid fatigue while working in the fields. In the 19th century Sigmund Freud (1856 – 1933) was one of the first researchers to investigate its properties; he found it to be a local anesthetic. Freud also used cocaine to treat depression and morphine addiction (Ray, Ksir, & Hart, 2009). In the 20th century cocaine has been used as a local anesthetic for eye surgery. Today, the coca leaves are still used by the descendents of the Inca to prevent altitude sickness in tourists in the form of a tea.

The effects of cocaine are intense and rapid; therefore there is great potential for abuse and addiction. Also, acute cocaine poisoning leads to profound stimulation, progressing to convulsions, which can cause respiratory or cardiac arrest (Ray, Ksir, & Hart, 2009). Another class of similar stimulants, the amphetamines, share properties with cocaine. Both drugs produce preoccupation and anticipation regarding use of the drug and induce major binge and intoxication phases. These drugs also produce an intense craving and binges can last hours or days, followed by intense dysphoria, anxiety, and craving during withdrawal (Feil et al., 2010).

Amphetamines (e.g. methamphetamine,"speed," diet pills, Adderall, Ritalin, etc.) also cause central nervous system stimulation that can lead to respiratory or cardiac arrest. These substances were initially used medically as bronchial dilators for asthma patients, to treat depression and fatigue, and as appetite suppressants for obesity. More recently these drugs have been prescribed for ADHD, and there has been an increase in recreational use as well as in abuse of prescriptions. At moderate doses, amphetamines impair decision making processes, and at higher doses the individual may become easily panicked, paranoid, and even violent. Sometimes, overly high doses of amphetamines can produce a psychotic state in which the individual is paranoid and has lost touch with reality. This condition can last for days or weeks after consumption (Ray, Ksir, & Hart, 2009).

Ecstasy, or MDMA, is often classified as an amphetamine because it increases body temperature and heart rate, produces elevated mood and euphoria, and its use is marked by depressive mood states during withdrawal (Jaehne, Majumder, Salem, & Irvine, 2011). However, MDMA's effects are mainly attributed to a great utilization of serotonin in the brain (Verrico, Miller, & Madras, 2007), unlike amphetamines, which mainly use dopamine and norepinephrine (Ray, Ksir, & Hart, 2009). Because MDMA uses up so much serotonin there is usually a depletion of the chemical in the following days, contributing to a depressed mood. MDMA has also been classified as a hallucinogen because of its psychedelic properties, even though the chemical structure of the molecule is more similar to amphetamines (Ray et al., 2009).

Another class of drugs which mainly utilizes serotonin is the hallucinogens (Aghajanian & Marek, 1999). Because these drugs are able to produce hallucinations and an altered sense of reality, they are also referred to as psychomimetics and described as being “mind-viewing” drugs that can create religious or spiritual experiences (Ray, Ksir, & Hart, 2009). Hallucinogens are also capable of producing euphoria, dysphoria, and at high doses, psychosis (Brust, 1993). This class of drugs, which includes LSD, mescaline (from the peyote cactus), and psilocybin (the active ingredient in psychedelic mushrooms), has been used for centuries in several cultures for religious and ceremonial purposes (Hofmann, 2009). These drugs produce pupil dilation, elevated pulse rate, blood pressure and temperature, and although they may even cause death from convulsions or respiratory arrest, dependence on these drugs has not been shown and lethal doses are very high, making it hard to overdose (Ray et al., 2009).

Inhalants are also associated with hallucinations and psychosis (Jung, Lee, & Cho, 2004), yet these drugs work in very different ways than hallucinogens. Inhalants include volatile substances (e.g. paints, glues, etc.) and gases such as butane and nitrous oxide which are inhaled to produce high levels of short-term intoxication. Inhalants produce intoxicating effects including slurred speech, confusion, and motor impairments (Ray, Ksir, & Hart, 2009), and they also cause great damage to the brain (Yip, Mashhood, & Naudé, 2005). Use of inhalants has been linked to kidney damage, brain damage, and peripheral nerve damage, yet several users die from suffocation because these drugs reduce the amount of oxygen to the brain (Ray et al., 2009).

The different effects that drugs have, not only behaviorally, but physiologically, make patterns of abuse and addiction different, depending on the drug used. These different patterns of drug use and addiction suggest that the addiction process is not a unitary process and that these varying neuropsychological mechanisms may explain different drug use patterns that may ultimately lead to unique versions of compulsive drug seeking and drug taking (Koob & Le Moal, 2008). Several studies have investigated the association between drug use and impulsivity, and it seems that most drugs of abuse have some association to impulsive behaviors (Peña, Andreu, & Graña, 2009). It is noteworthy that several studies use similar, yet varying, definitions of impulsivity and, therefore, measure different aspects of it.

For example, Roderique-Davies and Shearer (2010) assessed sub-scale levels of impulsivity in recreational ecstasy users by using measures of motor impulsiveness, cognitive impulsiveness (attentional), and non-planning impulsiveness. Heavy ecstasy users exhibited higher levels of non-planning and cognitive impulsivity, but not motor impulsivity. The authors suggest that this may be because impulsivity is related to a difficulty in concentrating on the task at hand and not thinking about the future, rather than acting without thinking. However, many ecstasy users are also polydrug users, indicating that other drugs could have also been related to these measures of impulsivity (Roderique-Davies & Shearer, 2010). It has been suggested that as addiction develops, different levels or types of impulsivity may be involved (Winstanley, Olausson, Taylor, & Jentsch, 2010).

Attentional, Motor and Non-planning Impulsivity

The *Barrat Impulsivity Scale, 11th edition* (Patton, Stanford, & Barratt, 1995), which has three sub-scales (attentional, motor, and nonplanning impulsivity), has been used in many studies to assess impulsivity (Ersche, Turton, Pradhan, Bullmore, & Robbins, 2010; Roderique-Davies & Shearer, 2010; Winstanley, Olausson, Taylor, & Jentsch, 2010). The attentional sub-scale is reflective of the degree to which an individual can focus on the task at hand or tolerate cognitive complexity, the motor subscale reflects action without due consideration, and the non-planning subscale reflects a lack of regard for the future (Winstanley, Olausson, Taylor, & Jentsch, 2010).

Attentional impulsivity refers to rapid shifts in the focus of attention, which can be exacerbated by anxiety, and deficits in this area are characterized by poor attention or vigilance.

Motor impulsivity involves hyperactivity due to the need for movement, which can be exacerbated by stress, and deficits in this area are characterized by acting without thinking. Non-planning impulsivity involves attitudes and conclusions precipitated by the lack of reflection of situations; deficits in this area are characterized by an inability or lack of planning ahead of time (Lyke & Spinella, 2004; Orozco-Cabal, Barratt, & Buccello, 2007). Therefore, an individual's overall level of impulsivity may be thought of as the combination of these three areas.

Attentional, motor, and non-planning impulsivity have been consistently shown to be related to drug use (Lyke & Spinella, 2004). For example, researchers have used the BIS-11 with substance users and have reported high impulsivity scores among cocaine dependent adults (Lane, Moeller, Steinberg, Buzby, & Kosten, 2007) and ecstasy users (Bond, Verheyden, Wingrove, & Curran, 2004). Higher scores on the BIS-11 have predicted higher levels of crack/cocaine use (Lejuez, Bornovalova, Reynolds, Daughters, & Curtin, 2007) and the number of daily cigarettes smoked (Dom, Hulstijn, & Sabbe, 2006c).

Trait and Drug Induced Theories of Impulsivity

Several theories have been developed which address the role of impulsivity in drug use. First, the *trait-based* perspective holds than an impulsive predisposition precedes and determines the extent of drug abuse (Carroll, Anker, Mach, Newman, & Perry, 2010). Second, the *drug-induced state* view holds that drug use increases or decreases the probability of impulsive choice. Impulsivity has consistently been shown to be a biologically-based, heritable characteristic with emergent psychological properties linked to the development and maintenance of substance use disorders (Bornovalova, Lejuez, Daughters, Rosenthal, & Lynch, 2005). Also, Carrol et al. (2010) declared that the role of impulsivity has been shown to predict differing drug-seeking behaviors at several phases of the addiction process.

Some studies have also supported the notion that the degree of impulsivity is related to the severity and duration of drug use (Dom, D'haene, Hulstijn, & Sabbe, 2006; von Diemen, Bassani, Fuchs, Szobot, & Pechansky, 2008). This could imply that higher levels of impulsivity predispose individuals to consume higher levels of drugs and develop more severe patterns of use. However, this could also imply that while impulsivity may be a precursor to drug use, drug use itself affects impulsivity because being intoxicated interferes with inhibitory responses. Hence, being under the influence facilitates impulsive behaviors that lead to further drug use.

In another study by De Wit (2009), impulsivity was described as a possible determinant as well as a possible consequence of drug use. As a determinant, impulsivity may be a risk for experimentation and continued drug use. However, drug use itself may increase impulsive behaviors either through their direct, acute effects or through long-term use that may affect the brain. De Wit (2009) proposes that drugs may impair inhibition or decision-making, which can result in an increased likelihood of engaging in risky behaviors such as escalation of drug use. Also, Rogers, Moeller, Swann, and Clark (2010) reported that the behavioral development of drug use, as well as the outcome, is impacted by impulsivity. However, the authors state that it is unclear whether impulsivity is a predisposing trait that increases the probability of developing a clinically significant illness, or if the cumulative effects of drug use promote the expression of impulsive behavior.

Winstanley, Olausson, Taylor, and Jentsch (2010) also suggested that the relationship between impulsivity and drug use is cyclic; naturally occurring differences in impulsivity may predict drug use, but drug exposure can also increase impulsive responding, which in turn facilitates further drug use. The authors suggest that this is because persistent drug use results in a short-sighted view of the future and decisions are made with little regard to their consequences.

In conclusion, they propose that impulsive tendencies are the predictors of risk for substance abuse and that impulsive behavior if fueled by the early stages of drug use. Also, Lejuez et al. (2010) suggest that certain individuals may have a predisposition to impulsivity, yet consequences of excessive drug use may further exacerbate this predisposition. Nevertheless, there seem to be several studies which support the notion that impulsivity is an inherent personality trait which predisposes individuals to drug use.

Petry (2002) measured and compared levels of impulsivity among individuals who were in an active phase of alcoholism, those who were in remission, and controls who did not have alcohol abuse problems. Substance abusers in the active phase had higher scores on impulsivity than both groups, and those in remission had higher scores on impulsivity than controls. These results demonstrate that impulsivity is a trait-like construct which remains present even when individuals abstain from drug use. However, since substance abusers in the active phase had the highest scores for impulsivity, this indicates that impulsivity is enhanced by drug use itself. While it seems that drug abuse augments impulsive behaviors, Carroll, Anker, Mach, Newman, and Perry (2010) reviewed several animal studies that support the trait-based perspective and indicate that impulsivity precedes and facilitates drug use.

Is Impulsivity Heritable?

The fact that impulsive traits have been conserved across phylogeny for millions of years indicates that manifestations of rapid action, quick decision making, and reward-seeking behaviors represent an advantage for many species, including humans (Winstanley, Olausson, Taylor, & Jentsch, 2010). However, at higher levels impulsivity can result in negative consequences. Researchers stress that animal studies are critical in determining whether impulsivity is hereditary because the laboratory environment provides the opportunity to test for causal links involving impulsive behaviors. Winstanley et al. (2010) state that there are considerable individual differences in rats' propensity to consume alcohol. This provides the potential opportunity to identify biological markers for susceptibility to drug use. Using animal studies also helps to eliminate some of the confounding variables found in human studies due to history of drug use.

If impulsivity is a heritable risk factor for drug use, then selection for high and low drug preference in animals should result in parallel differences in impulsivity (Perry, Larson, German, Madden, & Carroll, 2005). That is, animals bred to have a preference for drug administration should also have higher levels of impulsivity. In their study, Perry et al. (2005) measured levels of impulsivity in drug-naïve rats and found a significant linear relationship between impulsivity and later drug intake. Results suggested that initial varying levels of impulsivity predicted acquisition of cocaine self-administration. In another study, Oberlin and Grahame (2009) proposed that over time, alleles that increase alcohol preference become concentrated in populations of mice and are passed own. By using alcohol-naïve mice which were bred as high-alcohol preference or low-alcohol preference subjects, researchers assessed heritable differences in impulsivity. Oberlin and Grahame (2009) demonstrated that lines of selected high-alcohol drinking mice were more impulsive than low drinking lines. This study provided evidence towards viewing impulsivity as a heritable endophenotype that precedes drug use.

One of the first and most widely cited studies to examine whether impulsivity predicts drug intake in rats was done by Poulos, Le, and Parker (1995). In this study, the authors examined impulse control in rats, assessed with the delay-of-reward task and subsequent alcohol self-administration. Experimenters allowed rats to choose from 2 food pellets that were presented immediately or 12 pellets delivered after a 15 second delay. The rats were classified under three groups of levels of impulsivity: low, medium, and high. The high impulsive rats subsequently consumed more alcohol than did the group designated as medium or low impulsive. Overall, impulsivity scores were found to be significantly correlated with magnitude of later alcohol self-administration (Poulos, Le, & Parker, 1995). The finding that high impulsivity is correlated with alcohol consumption may also mirror clinical depictions of alcohol abuse in humans.

While animal studies are critical in providing information pertaining to the genetic contributions of impulsivity, studies involving human participants are also valuable. For example, Dougherty, Mathias, Tester and Marsh (2004) compared levels of impulsivity in women whose age of first drink was before 18 years (early onset) and those whose age of first drink was 21 years or older (late onset). Researchers found that women who reported early onset of drinking had significantly higher impulsivity-related errors on a measure than those who reported late onset of drinking. Also, longitudinal studies have been conducted which support the trait-based theory of impulsivity. For example, McGue, Lacono, Legrand, Malone, and Elkins (2001) measured levels of behavioral inhibition and found that impulsivity at age 11 years predicted drinking onset by age 14 years.

Further evidence that impulsivity is hereditary is found in studies which support that drug use and its related behaviors may be transmitted down generations, possibly contributing to initial trait levels of impulsivity in children. In a study by Knop, Teasdale, Schulsinger, and Goodwin (1985), sons of alcoholic fathers were compared to controls who did not have drug use history in their families. Sons of alcoholic fathers were rated higher on measures of impulsivity than controls. Petry, Kirby, and Kranzler (2002) assessed nondrug using females for levels of impulsivity. Taking their parental drug use history into account, authors found a positive correlation between impulsivity and paternal drug use. Also, Riggs, Chou, and Pentz (2009) found that parental marijuana use was positively related to child impulsivity, supporting a role for parental drug use in the development of child behavioral problems. These studies suggest that drug use, which may exacerbate impulsivity, is passed down generations and contributes the manifestation of impulsivity as a hereditary trait.

One study which contributes to the perspective that impulsivity is hereditary was conducted by Ersche, Turton, Pradhan, Bullmore, and Robbins, (2010). Measures of impulsivity were recorded for 30 sibling pairs, one of which had a drug addiction problem and one who did not, and 30 unrelated, nondrug taking controls. Siblings of chronic users had higher levels of trait-impulsivity than control volunteers, and the chronic user pairs had higher impulsivity than both groups. Trait impulsivity was not only increased in drug users but also in their siblings, indicating that this trait could be an endophenotype and predisposing risk factor for the development of drug dependence. Additionally, impulsivity was highest in the drug using group, suggesting that impulsivity may be exacerbated by chronic drug exposure.

Drug Use and Cognitive Functioning

A review of several animal and human studies indicated that impulsivity is a heritable trait which contributes to drug use. Drug use, in turn, disrupts normal brain functioning (Volkow, 2008). The frontal cortex in the brain has a key role in working memory (George & Koob, 2010), perceiving, storing, processing and using information (Campbell & Reece, 2004), and other cognitive functions which are affected by drug use. Fried, Watkinson, and Gray (2005) conducted a longitudinal study which assessed individuals on neurocognitive functions. Children were assessed from infancy to adulthood, prior to drug use, on I.Q., processing speed, and memory. Those individuals who later smoked marijuana were shown to perform significantly worse on processing speed, immediate, and delayed memory when compared to the control group. However, those who had stopped using marijuana for three months did not show any cognitive impairments, suggesting that marijuana use may not produce irreversible neurocognitive effects.

In another study by Hanson, Winward, Schweinsburg, Medina, Brown and Tapert (2010), researchers found that marijuana users performed worse than controls on measures of verbal learning and verbal working memory. Although users learned fewer words after approximately three days of abstinence, they performed similarly to controls after two and three weeks without substance use. However, whereas verbal learning and verbal working memory improved during the three weeks of abstinence, users were less accurate than controls on an attention and vigilance tasks throughout the three week abstinence period. Researchers suggest that some deficits (i.e. attention) due to marijuana use may actually persist for longer periods, and it is unclear whether they are reversible. Also, Hinson, Jameson, and Whitney (2003) found that reduced working memory capacity was predictive of a more impulsive decision-making style.

Willford, Chandler, Goldschmidt, and Day (2010) found deficits in processing speed among current tobacco smokers as well as children of alcohol drinkers and tobacco and marijuana smokers. In another study, Halpern, Pope, Sherwood, Barry, Hudson and Yurgelun-Todd (2004) assessed processing speed and impulsivity among non-users, moderate users, and heavy users of MDMA. MDMA users, as a whole, exhibited deficits on measures of processing speed and impulsivity compared to non-users. Furthermore, whereas there were slight differences between moderate users and non-users, heavy users of ecstacy displayed significant differences between non-users on processing speed and impulsivity.

There seem to be specific aspects of the executive cognitive functioning processes in the brain that seem to be affected by drug use. For example, working memory (Romer, Betancourt, Giannetta, Brodsky, Farah, & Hurt, 2009; Hanson, Winward, Schweinsburg, Medina, Brown and Tapert, 2010) and processing speed (Verdejo-García, del mar Sánchez-Fernández, Alonso-Maroto, Fernández-Calderón, Perales, Lozano, & Pérez-García, 2010; Fernández-Serrano, Pérez-García, Río-Valle, & Verdejo-García, 2010) have been shown to be impaired in users of alcohol, marijuana, cocaine, tobacco, MDMA, methamphetamines and hallucinogens. It is likely that these deficits are directly involved in the process of drug use and the inability to abstain from drug use.

Working Memory and Processing Speed

Working memory involves the short-term storage and manipulation of information necessary for cognitive performance, including comprehension, learning, reasoning and planning (Deiber et al., 2007). A commonly used measure of working memory is a subscale in the *Wechsler Adult Intelligence Scale, fourth edition* (Wechsler, 2008); the letter number sequencing task involves asking participants to listen to a sequence of letters and numbers and repeat the sequence (Verdejo-García et al., 2010). The WAIS-IV also has a subscale for assessment of processing speed, i.e., coding, in which participants replace numbers with symbols as fast and as accurately as possible. Processing speed involves components of central processing as well as speed of the thinking process (Kennedy, Clement, & Curtiss, 2003).

Impulsivity, Drug Use, and Cognitive Functioning

Impulsivity is also affected by chronic drug exposure. Some studies suggest that drug exposure may lead to neurocognitive restructuring of areas related to inhibitory responses. The frontal lobes use past experience and knowledge to produce current behavior as well as guide future behaviors and respond to our environment (Stuss, Picton, & Alexander, 2001). In turn, deficits in suppressing responses and evaluating and delaying rewards lead to risky, poorly conceived impulsive behaviors (Crews & Boettiger, 2009). Jentsch and Taylor (2001) reviewed data from laboratory animals indicating that chronic drug use may lead to frontal cortical cognitive dysfunctions that result in an inability to inhibit inappropriate responses. Also, Winstanley, Olausson, Taylor, and Jentsch (2010) reviewed several studies and concluded that drug exposure can alter inhibitory control functions in the brain which regulate drug seeking behaviors. It is likely that both pre-existing differences and consequences of drug use contribute to the observed differences between users and non-users (Jentsch & Taylor, 2001).

The frontal cortical areas of the brain oversee behavioral control through executive functions such as motivation, planning, attention, and inhibition of impulsive responses (Crews & Boettiger, 2009). The frontal lobe receives input from all sensory modalities, integrates memories, and uses working memory of temporary information to assess costs and rewards when carrying out planned behaviors (Crews & Boettiger, 2009). As a result, harm caused to the brain may impair critical areas of behavior regulation and lead to greater impulsivity. For example, Feil et al., (2010) propose that deregulation of the frontal cortex is associated with faulty decision making and inability to inhibit compulsive behaviors. In addition, the pattern of behavior seen in individuals with damage to the frontal cortex is highly similar to addictive behaviors (Bechara, 2005). In a study with adults who suffered from lesions to the front part of the brain, individuals were found to exhibit impulsive decision making (Fellows & Farah, 2003). Also, heavy drinking induces neurodegeneration and dysfunction of the frontal cortex (Crews & Boettiger, 2009).

Inhibitory responses in the brain are often invoked to override impulsive thoughts and behaviors that have been automatically elicited (Crews & Boettiger, 2009). Thus, when drug use reaches a level that causes impairments in this process, the individual’s ability to redirect automatic responses towards drug use is reduced. Deficits in impulsive behavior may then lead to further drug use, essentially making the process a continuous cycle. In a study by Romer, Betancourt, Giannetta, Brodsky, Farah, and Hurt (2009), researchers found that working memory and processing speed were inversely related to impulsivity. Researchers suggest that early impulsive behaviors lead to drug use and that the drug use itself interferes with the normal development of executive cognitive functioning. Therefore, while it seems that impulsivity may be a predisposing trait which facilitates drug use, the resulting damage caused to the brain may lead to dysfunctions of the inhibitory processes in the cortex, which in turn, facilitates further drug use via impulsivity.

Drugs of Abuse and Cognitive Impairments

Different drugs utilize different neurotransmitter systems and activate varying areas of the brain, resulting in different patterns of addiction and cognitive deficits (Barry & Appel, 2009; Sershen, Hashim, & Lajtha, 2010). Neuropsychological studies reveal an association between alcohol dependence and impaired cognitive inhibitory control, altered impulse control and reduced activity in the frontal cortex (Feil et al., 2010). Also, severity of alcohol use is associated with verbal fluency, decision-making decrements, and impairments in working memory (Fernández-Serrano, Pérez-García, Río-Valle, & Verdejo-García, 2010).

Alcohol seems to be one of the most damaging drugs to the body and the brain. Acetaldehyde, the primary metabolite in alcohol, can irritate and damage tissue directly. Perhaps the biggest concern with alcohol abuse is the damage done to the brain tissue with chronic alcohol use; ventricles and fissures in the cortex are enlarged due to tissue loss. This condition can lead to alcohol dementia, which is a global decline of intellect. Alcohol abuse can also lead to Wernick-Korsakoff syndrome, which presents with symptoms of confusion, ataxia, abnormal eye movements, and an inability to remember recent events or learn new information (Ray, Ksir, & Hart, 2009).

Opiates are popular drugs of abuse, especially heroin, which is the most abused opiate drug among adults and is associated with substantial mortality rates (Feil et al., 2010). Opiates depress the respiratory centers in the brain, which damages brain tissue and can result in overdose and death (Ray, Ksir, & Hart, 2009). Feil et al., (2010) demonstrated a relationship between opiate dependence and impaired decision making and executive functioning. Individuals dependent on opiates tend to choose more risky options, showing a reduction in decision making skills. Opiate dependent individuals have also been shown to process information slower than their non-drug using family members (Weinstein, Feldtkeller, Law, Myles, & Nutt, 2000).

Feil et al., (2010) found that tobacco smokers as well as abstainers had deficits in response inhibition. Smoking history has also been correlated with measures of executive and problem solving skills, with heavy smokers performing significantly worse than moderate or light smokers (Razani, Boone, Lesser, & Weiss, 2004). Several studies assessing marijuana use have found detrimental effects on working memory, analogical reasoning, decision making skills (Fernández-Serrano, Pérez-García, Río-Valle, & Verdejo-García, 2010), processing speed (Castle & Ames, 1996), and altered activation patterns and less efficient processing of the prefrontal cortex and hippocampus (Block et al., 2002).

Studies done on acute, recreational, and long term cocaine users have found an association between cocaine use and impaired behavioral response inhibition, performance monitoring, decision-making abilities (Feil et al., 2010), working memory and analogical reasoning (Fernández-Serrano, Pérez-García, Río-Valle, & Verdejo-García, 2010). Individuals who use methamphetamines demonstrate poorer performance on attention and information processing speed, learning and memory, and working memory when compared to non-meth dependent individuals (Mahoney, Jackson, Kalechstein, De La Garza, & Newton, 2010). In a study by Parsegian, Glen, Lavin, and See (2011), authors demonstrated that methamphetamine experienced rats showed selective impairments that were identical to deficits produced by lesions of the prefrontal cortex. Researchers concluded that chronic methamphetamine abuse leads to attentional deficits in tasks requiring intact prefrontal cortex function.

MDMA use has been found to result in significant deficits on measures of processing speed, verbal fluency, working memory, reflection impulsivity and decision making in recreational users (De Sola et al., 2008; Fisk & Montgomery, 2009; Hanson, Luciana, & Sullwold, 2008; Quednow, Kühn, Hoppe, Westheide, Maier, Daum, & Wagner, 2007). Use of hallucinogens has been found to be related to impairments in working memory and reasoning (Verdejo-García et al., 2010). Studies on inhalant use have shown a global decrease in brain activity, especially in the frontal lobes (Yip, Mashhood, & Naudé, 2005), which control functions such as motivation, planning, attention, inhibition, memory, and impulsivity (Crews & Boettiger, 2009).

However, it is difficult to accurately distinguish the different effects drugs have on areas of the brain because many drug users tend to be polysubstance users. For example, Verdejo-García et al., (2010) measured levels of impulsivity and cognitive functioning in polydrug using rave attenders. Rave attenders were regular users of cannabis, cocaine, methampethamine, hallucinogens, and alcohol. Results showed that polysubstance users had significantly elevated scores on impulsivity and had poorer performance on indices for working memory, processing speed, analogical reasoning, inhibition and switching errors, time estimation, and decision making. Although it is difficult to separate the effects of different drugs, it seems that overall drug use is associated with impulsivity and impairs cognitive functioning.

One theoretical developmental perspective that has been put forth on the origin of impulsivity suggests that there is an imbalance between subcortical reward systems that mature more rapidly than frontal cortical control systems and that this lag results in poor control over impulsive behavior (Casey, Getz, & Galvan, 2008). This lag may result in an inability to control drug-related actions. Also, the complete maturation of these areas of the brain is thought to not occur until the third decade of life, during which changes in grey matter and myelination take place (Crews & Boettiger, 2009). This places adolescents and young adults at a higher risk for engaging in impulsive behaviors, such as drug use. In concordance with this lag notion are several studies which suggest that drug use during adolescence may disrupt normal maturational processes that take place early in life and that this may result in altered structure and functioning of the brain (Romer et al., 2009; Jernigan, 2005). These alterations in normal brain functioning may facilitate impulsive action by preventing inhibitory responses.

Another view is that impulsive acts, such as engaging in risk behaviors, are related to normal cognitive maturation and that these risks are a natural part of development (Romer et al., 2009). Behavioral studies show that performance on tasks including inhibitory control, decision-making and processing speed continues to develop during adolescence (Crews & Boettiger, 2009). During adolescence, tasks of selective attention, working memory and problem solving improve. This is consistent with frontal-cortical synaptic pruning and myelination taking place (Blakemore & Choudhury, 2006). However, eventually impulsive behaviors may become dysfunctional and interfere with these neurological processes (Romer et al., 2009), suggesting that other factors related to impulsivity, such as drug use, are perhaps mediating variables between impulsivity and cognitive deficits.

Rationale, Operational Definitions and Hypotheses

Rationale

Impulsivity is a predisposing trait, which may be heritable, in the commencement of drug use (Oberlin & Grahame, 2009; Winstanley, Olausson, Taylor, & Jentsch, 2010). In turn, varying drugs affect different areas of the brain which result in deficits related to impulsive behaviors and further drug use (Feil et al., 2010; Fernández-Serrano, Pérez-García, Río-Valle, & Verdejo-García, 2010). Drug use itself may even be a mediating variable between initial levels of impulsivity and resulting cognitive deficits. That is, impulsivity is related to initial drug use, and further drug use affects areas of cognitive functioning. Also, using different drugs may affect brain functioning differently, resulting in varying cognitive deficits.

Operational Definitions

Impulsivity. Impulsivity refers to the tendency to choose small or immediate rewards over larger delayed rewards and is characterized by risk-taking, lack of planning, and impairment in inhibitory responses. Three important components of impulsivity related to drug use are: attentional, motor, and non-planning impulsivity.

Drug use. Drug use refers to the recreational use of psychoactive substances and is defined by the frequency of substance use. See the DSM-IV-TR (2000) for a complete list of psychoactive substances.

Cognitive functioning. Cognitive functioning refers to a range of abilities of the brain to learn, remember, process, organize information plan and problem-solve. Two important components of cognitive functioning related to drug use are working memory and processing speed.

Hypotheses

Hypothesis 1: Impulsivity will be positively correlated with frequency of drug use across all subjects.

Hypothesis 2a: Impulsivity will be negatively correlated with working memory across all subjects.

Hypothesis 2b: Impulsivity will be negatively correlated with processing speed across all subjects.

Hypothesis 3a: Frequency of drug use will be negatively correlated with working memory across all subjects.

Hypothesis 3b: Frequency of drug use will be negatively correlated with processing speed across all subjects.

Method

Participants

Participants were 101 Barry University students (76 females, 25 males), most of whom volunteered in the study for extra credit (See Appendix A for cover letter). Participants were recruited via flyers that were posted in the psychology department of Barry University (See Appendix B) as well as emails that were sent by the administrative assistant (See Appendix C). Ages ranged from 18 to 48 years (M = 23.11, SD = 6.19).

Materials and Procedure

Demographic assessment. A demographic questionnaire was administered including questions related to age, sex, ethnicity, etc (See Appendix D).

Drug Use. A substance use questionnaire was administered to assess substance use habits. The questionnaire consisted of questions adapted from the *Substance Use History Questionnaire* (SUHQ; Stevens, & Smith, 2001) and the *Drug Use Questionnaire* (DAST-20; Skinner, 1992), in which phrasing was modified in order to include a range of drugs and quantify answers. The instrument consisted of 2 Likert scale questions and 12 yes or no questions, such as ‘How long ago did you last take a drug or drink?’, ‘Have you neglected your obligations, family, school, or work because of drinking or drug use in the past year?’, and ‘Do you often wish you could diminish or stop your use of alcohol or drugs?’ The questionnaire took approximately 10 minutes to complete (See Appendix E).

Impulsivity. The *Barratt Impulsivity Scale* (BIS-11; Patton, Stanford, & Barratt, 1995) was used to measure impulsivity. The BIS-11 includes 30 items using 4-point ratings (1 = never/rarely, 2 = occasionally, 3 = often, 4 = almost always/always) of statements such as “I don’t pay attention,” “I squirm at plays or lectures,” and “I am future oriented” (See Appendix F). Answers were scored to yield a score for total impulsivity as well as three factors of impulsivity: attentional, motor, and non-planning impulsivity. Attentional impulsivity refers to task-focus, intrusive thoughts, and racing thoughts. Motor impulsivity refers to the tendency to act on the spur of the moment and consistency of lifestyle. Non-planning impulsivity refers to careful thinking, planning and enjoyment of challenging mental tasks. Also, total impulsivity scores were categorized under: low impulsivity, normal impulsivity, and high impulsivity. Scores lower than 52 out of 120 were categorized as ‘low impulsivity’. Individuals scoring between 52 and 71 out of 120 and were categorized as ‘normal impulsive’. Individuals scoring between 72 and 120 were categorized as ‘high impulsive’. The internal consistency coefficients for the BIS-11 total score range from 0.79 to 0.83 for separate populations of under-graduates, substance-abuse patients, general psychiatric patients, and prison inmates (Patton et al., 1995). Test-retest reliability for the BIS-11 total score is 0.83 (Stanford, Mathias, Dougherty, Lake, Anderson, & Patton, 2009). In the current study, the internal consistency for the BIS-11 scale was found to be high (Cronbach's alpha = .81).

Cognitive functioning. Two subscales of The *Wechsler Adult Intelligence Scale*, fourth edition (WAIS-IV; Wechsler, 2008) were be used, Letter-Number Sequencing (LNS) and Coding, to measure working memory and processing speed, respectively. The LNS scale took about 10-15 minutes to complete and coding took about 5 minutes to complete. Reliability is reported to range from .96 to .98 for the LNS subscale and from .87 to .92 for coding subscale (Sattler & Ryan, 2009). These subscales were administered by the author in a standardized manner and a testing-friendly environment on campus.

Results

The demographic statistics of our 101 subject population were calculated as follows: Participants were predominantly female; 75.5%. In terms of ethnicity, they were predominantly Hispanic; 38%. In regards to sexual orientation, the majority of participants identified as heterosexual; 90%. In terms of religious affiliation, the participants were equally distributed among three predominant groups; Protestant Christians, 30%, Atheist/Agnostic, 30%, and Roman Catholics, 29%. With regards to religious practice, the majority of participants reported some frequency of attendance at religious services; 65%. In terms of academic level, approximately a third of participants were college freshman; 30%. In regards to marital status, the majority of participants reported to be single; 73%. In regards to household status, half of participants reported to live with parents or family; 50%. In terms of household income, the majority of participants reported incomes of 30,000 to 90,000 or more a year; 58% (See Table 1 for participant demographics).

Table 1

Participant Demographics

	Participants (*N*)	Percentage
1. Gender		
Females	75	75.5 %
Males	25	25.5 %
2. Race/Ethnicity		
Hispanic	38	38 %
African American	22	21.5 %
White	22	21.5 %
Caribbean Islander	13	13 %
Asian	2	2 %
Hawaiian/Pacific Islander	1	1 %
American Indian/		
Alaskan Native	1	1 %
Other	2	2 %
3. Sexual Orientation		
Heterosexual	91	90 %
Homosexual	3	3 %
Bisexual	4	4 %
Prefer not to identify	3	3 %
4. Religious Affiliation		
Protestant Christian	30	30 %
Atheist/Agnostic	30	30 %
Roman Catholic	29	28 %
Evangelical Christian	3	3 %
Jewish	2	2 %

Muslim	1	1 %
Hindu	1	1 %
Buddhist	1	1 %
Other	4	4 %
5. Religious Practice		
Never	36	35 %
Few times a year	28	28 %
Once/twice a month	16	16 %
Once a week	13	13 %
More than once a week	8	8 %
6. School Level		
Freshman	31	30 %
Sophomore	20	20 %
Junior	19	19 %
Senior	17	17 %
Graduate	14	14 %
7. Marital Status		
Single	74	73 %
Unmarried couple	13	13 %
Married	7	7 %
Engaged	4	4 %
Divorced	2	2 %
Separated	1	1 %
8. Household		
Parents/family	51	50 %
Roommates	23	23 %
Alone	15	15 %
Partner/Spouse	12	12 %
9. Income		
less than $10,000	15	14 %
$10,000 to $29,000	28	28 %

$30,000 to $49,000	22	22 %
$50,000 to $69,000	14	14 %
$70,000 to $89,000	9	9 %
$90,000 or more	13	13 %

Note. *N* = 101.

In terms of drug use, participants reported predominantly using alcohol, followed by marijuana, nicotine, cocaine, ecstasy (MDMA), tranquilizers, hallucinogens, amphetamines, and then opiates in that order (see Table 2 for exact percentages).

Table 2

Amount of Frequency of Use Reported per Drug Type

Drug Type	Participants (*N*)*	Percentage
Alcohol	67	42 %
Marijuana	38	24 %
Nicotine	22	14 %
Cocaine	9	6 %
Ecstasy	7	4 %
Tranquilizers	7	4 %
Hallucinogems	6	3 %
Amphetamines	4	2 %
Opiates	1	1%
Inhalants	0	0 %

Note. *N* = 101. *Individuals were able to acknowledge use of more than one drug

The majority of participants were current substance users as opposed to past substance users; 94.1% versus 4.9%. The majority of participants reported that they had used drugs either today or yesterday; 19.6% (see Table 3 for drug use frequency descriptives).

Table 3

Amount of Participants for Frequency of Use

	Participants (*N*)	Percentage
Past User (Over 1 year ago)	5	6 %
Used today/yesterday	28	35 %
Used in the past week	20	25 %
Used 2-3 weeks ago	14	17 %
Used 1-6 months ago	8	10 %
Used over 6 months ago	6	7 %

Note. *N* = 81.

The means and standard deviations for total impulsivity scores (BIS-11; Patton, Stanford, & Barratt, 1995), drug use frequency (SUHQ; Stevens, & Smith, 2001; DAST-20; Skinner, 1992), working memory (WAIS-IV; Wechsler, 2008), processing speed (WAIS-IV; Wechsler, 2008), and age (Demographic Questionnaire) were calculated. See Table 4.

Table 4

Means and Standard Deviations for all Variables

Variable	*M*	*SD*
1. Total Impulsivity	61.67	10.84
2. Drug use Frequency	4.61	4.17
3. Working Memory	9.15	1.78
4. Processing Speed	10.91	2.73
5. Age	23.11	6.20

Note. *N* = 101.

Correlational analyses revealed that, as predicted by Hypothesis 1, there was a significant positive relationship between total impulsivity scores in the BIS-11 and frequency of drug use, $r = .48$, $p < .001$. Correlations of all variables are summarized in Table 5.

Table 5

Correlations, and Coefficient Alphas for all Variables.

Variable	TI	DUF	WM	PS	Age
Total Impulsivity (TI)	(.81)	.48**	.17	.05	-.11
Drug use Frequency (DUF)		-	.05	.03	.02
Working Memory (WM)			-	.21*	.06
Processing Speed (PS)				-	-.08
Age					-

Note. *N* = 101.

*$p < .05$. ** $p < .01$.

When categorizing individuals based on their impulsivity scores, groups were divided into low, normal, and high impulsiveness. It was found that low, normal, and high impulsivity individuals significantly differed from one another on frequency of drug use F (2, 101) = 10.75, p < .001. Post-hoc analyses using Tukey's HSD revealed that participants who were categorized as having low impulsivity had significantly less frequency of drug use than participants who were categorized as having normal impulsivity, p = .007. Participants who were categorized as having low impulsivity also differed significantly from participants who were categorized as having high impulsivity, p < .001. Participants who were categorized as having normal impulsivity differed significantly from participants who were categorized as having high impulsivity, p = .024. Categories of impulsivity (low, normal, and high) did not differ significantly from one another on working memory F (2, 101) = 2.83, p = .064, or on processing speed F (2, 101) = .014, p = .867 (See Table 6).

Table 6

Means and Standard Deviations for Low, Normal, and High Categories of Impulsivity Scores for Substance Use Frequency and WAIS-IV Subtest Scores

	Low Impulsivity		Normal Impulsivity		High Impulsivity	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Substance Use Frequency	1.41	2.78**	4.66	3.95**	7.32	4.11**
Working Memory	10.06	2.22	8.92	1.57	9.11	1.88
Processing Speed	10.65	3.28	11.02	2.52	10.79	3.03

Note. *N* = 101. (BIS-11; Patton, Stanford, & Barratt, 1995; WAIS-IV; Wechsler, 2008)
*p < .05. ** p < .01.

Regarding Hypotheses 2a and 2b, total impulsivity was not significantly correlated with working memory, $r = -.17$, $p = .096$, or processing speed, $r = .05$, $p = .643$ (See Table 5). This was contrary to what was predicted.

Regarding Hypotheses 3a and 3b, there were no significant relationships between the frequency of drug use and working memory, $r = .05$, $p = .614$, or processing speed, $r = .03$, $p = .764$ (See Table 5). Working memory was found to have a significant positive relationship with processing speed, $r = .21$, $p = .032$. Age was not found to be significantly correlated with total impulsivity, $r = -.11$, $p = .291$, frequency of drug use, $r = .02$, $p = .814$, working memory, $r = .06$, $p = .522$, or processing speed $r = -.08$, $p = .414$ (See Table 5).

When looking at the three sub-factors of impulsivity, additional analyses revealed that frequency of drug use was positively correlated with attentional impulsivity, $r = .35$, $p < .001$, motor impulsivity, $r = .45$, $p < .001$, and non-planning impulsivity, $r = .36$, $p < .001$ (See Table 7).

Table 7

Correlations for Attentional, Motor, and Non-planning Impulsivity Scores on the BIS-11 with Substance Use Frequency and WAIS-IV Subtest Scores

Variable	Attentional Impulsivity	Motor Impulsivity	Non-Planning Impulsivity
Substance Use Frequency	.346**	.445**	.359**
Working Memory	-.103	-.148	-.145
Processing Speed	-.091	.131	.067

Note. $N = 101$. (BIS-11; Patton, Stanford, & Barratt, 1995; WAIS-IV; Wechsler, 2008)
$^*p < .05$. $^{**}p < .01$.

T-tests were carried out in order to determine the differences between users and nonusers of the most commonly used drugs and impulsivity. On average, alcohol users (*M* = 65.59, *SD* = 10.32) had higher total scores on impulsivity than nonusers (*M* = 55.03, *SD* = 8.46), *t*(94) = 5.05, *p* < .001. Marijuana users (*M* = 65.22, *SD* = 9.85) had higher total scores on impulsivity than nonusers (*M* = 59.92, *SD* = 11.12), *t*(94) = 2.37, *p* = .020. Cocaine users (*M* = 68.78, *SD* = 7.46) had higher total scores on impulsivity than nonusers (*M* = 61.25, *SD* = 11.00), *t*(94) = 2.00, *p* = .048. Finally, nicotine users (*M* = 68.32, *SD* = 10.00) had higher total scores on impulsivity than nonusers (*M* = 60.39, *SD* = 10.62), *t*(94) = 2.95, *p* = .004 (See Table 8).

Table 8

Means and Standard Deviations of Total Impulsivity Scores on the BIS-11 for Users and Non Users for Drug Types

	Users		Non Users		
Type Of Drug	*M*	*SD*	*M*	*SD*	
Alcohol	65.59	10.32	55.03	8.46	**
Marijuana	65.22	9.85	59.92	11.12	*
Cocaine	68.78	7.46	61.25	11.00	*
Nicotine	68.32	10.00	60.39	10.62	**

Note. *N* = 101.
**p* < *.05*. ** *p* < .01.

In regards to gender differences, men were found to have significantly higher scores on motor impulsivity (*M* = 23.52, *SD* = 3.73) than women (*M* = 21.29, *SD* = 4.45), *t*(99) = 5.09, *p* = .026. Men and women also differed significantly on substance use frequency, with men (*M* = 7.00, *SD* = 4.12) engaging in more use than women (M = 3.83, SD = 3.90), *t*(99) = 12.08, *p* <

.001. Finally, women (*M* = 9.56, *SD* = 2.27) scored higher on processing speed than men (*M* = 11.36, *SD* = 2.74), *t*(99) = 2.37, *p* = .004 (See Table 9).

Table 9

Means and Standard Deviations for Motor Impulsivity Scores on the BIS-11, Substance Use Frequency, and Processing Speed for Men and Women

	Men		Women		
Variable	*M*	*SD*	*M*	*SD*	
Motor Impulsivity	23.52	3.73	21.29	4.45	*
Substance Use Frequency	7.00	4.12	3.83	3.90	**
Processing Speed	11.36	2.74	9.56	2.27	**

Note. *N* = 101.
**p* < .05. ** *p* < .01.

A significant difference among ethnic groups was found regarding motor impulsivity, *F* (3, 91) = 3.27, *p* = .025. Specifically, post-hoc analyses using Tukey's HSD revealed that Whites (*M* = 23.50, *SD* = 4.13) scored significantly higher than African Americans on motor impulsivity (*M* = 20.05, *SD* = 4.19), *p* = .047. Differences between all other ethnic groups on motor impulsivity were not significant. There was also a significant difference between ethnic groups in terms of substance use frequency, *F* (3, 91) = 2.84, *p* = .042. Post-hoc analyses using Tukey's HSD showed that Hispanics (*M* = 5.74, *SD* = 4.32) reported significantly higher rates of drug use than African Americans (*M* = 2.73, *SD* = 3.40), *p* = .032. Differences between all other ethnic groups on substance use frequency were not significant. Finally, there was a significant difference between ethnic groups in terms of working memory, *F* (3, 91) = 3.55, *p* = .018. Specifically, post-hoc analyses using Tukey's HSD revealed that Whites (*M* = 9.95, *SD* = 1.84) scored significantly higher than African Americans on working memory (*M* = 8.50, *SD* = 1.45), *p* = .035. Differences between all other ethnic groups on working memory were not significant (See Table 10).

Table 10

Means and Standard Deviations for Impulsivity Scores on the BIS-11, Substance Use Frequency, and WAIS-IV Subtest Scores among Ethnic Groups

	Substance Use Frequency		Working Memory		Motor Impulsivity	
	M	*SD*	*M*	*SD*	*M*	*SD*
White	4.27	4.19	9.95	1.84*	23.50	4.13*
African American	2.73	3.40*	8.50	1.44*	20.02	4.19*
Caribbean Islander	3.62	3.75	8.38	1.94	23.77	5.07
Hispanic	5.74	4.32*	9.34	1.80	21.47	4.24

Note. *N* = 101. (BIS-11; Patton, Stanford, & Barratt, 1995; WAIS-IV; Wechsler, 2008)
*$p < .05$. ** $p < .01$.

There was a significant difference between religious groups in terms of substance use frequency, *F* (4, 91) = 3.67, *p* = .008. Post-hoc analyses using Tukey's HSD showed that Atheists/Agnostics (*M* = 6.07, *SD* = 4.00) reported significantly higher rates of drug use than Protestant Christians (*M* = 2.40, *SD* = 3.42), *p* = .004. Differences between all other religious groups were not significant in terms of substance use frequency. Also, there was a significant difference between religious groups in terms of working memory, *F* (4, 91) = 2.59, *p* = .042. Specifically, Post-hoc analyses using Tukey's HSD revealed that Atheists/Agnostics (*M* = 10.00, *SD* = 2.00) scored significantly higher than Roman Catholics on working memory (*M* = 8.72, *SD* = 1.51), *p* = .050. Differences between all other religious groups were not significant in terms of working memory (See Table 11).

Table 11

Means and Standard Deviations for Impulsivity Scores on the BIS-11, Substance Use Frequency, and WAIS-IV Subtest Scores among Religious Groups

	Substance Use Frequency		Working Memory	
	M	*SD*	*M*	*SD*
Protestant Christian	2.40	3.42**	8.77	1.72
Roman Catholic	5.14	4.39	8.72	1.51**
Evangelical Christian	4.33	1.53	9.00	1.00
Atheist/Agnostic	6.07	3.96**	10.00	2.00**
Other	4.00	2.45	8.75	2.22

Note. $N = 101$. (BIS-11; Patton, Stanford, & Barratt, 1995; WAIS-IV; Wechsler, 2008)
*$p < .05$. ** $p < .01$.

Discussion

As predicted, and consistent with previous literature (Lyke & Spinella, 2004), impulsivity was found to have a significant positive relationship with drug use. Individuals who scored higher on measures of impulsivity also reported significantly higher rates of drug use. In addition, frequency of drug use was also found to have a significant positive relationship with all sub-factors of impulsivity: attentional, motor, and non-planning impulsivity. This means that individuals who reported higher frequency of drug use tended to have rapid shifts of attention, displayed hyperactivity due to the need for movement (i.e. acting without thinking) and had an inability to plan ahead (Lyke & Spinella, 2004; Orozco-Cabal, Barratt, & Buccello, 2007).

Also, individuals who were categorized as low, normal, and highly impulsive differed significantly from one another on frequency of drug use. Specifically, individuals who used the least drugs or no drugs at all tended to score lower than 52 on the BIS-11 and be categorized as 'low impulsive'. Scores lower than 52 out of 120 are representative of an individual who is over-controlled or did not complete the questionnaire honestly (Stanford, Mathias, Dougherty, Lake, Anderson & Patton, 2009). Individuals who reported a low to moderate frequency of drug use tended to have scores between 52 and 71 out of 120 and were categorized as ‘normal impulsive’, meaning they were within the normal limits of impulsivity. Individuals who reported the highest frequency of drug use tended to score between 72 and 120 and were categorized as ‘high impulsive’. In the college sample reported by Stanford, Mathias, Dougherty, Lake, Anderson and Patton (2009), individuals that scored 72 or higher were more than twice as likely to have shoplifted an item over $10, and were more than twice as likely to have been involved in self-mutilation when compared to those who scored lower. Both shoplifting and self-mutilation are considered to be impulsive behaviors.

Our results indicated that users of alcohol, marijuana, cocaine, and nicotine were found to have significantly higher impulsivity scores than nonusers. This finding is consistent with previous literature, which has found that alcohol users (Rosenthal, Edwards, Ackerman, and Knott, 1990), marijuana users (Peña, Andreu, and Graña, 2009), cocaine users (Lane, Moeller, Steinberg, Buzby, & Kosten, 2007), and nicotine users (Dom, Hulstijn, & Sabbe, 2006c) scored significantly higher on impulsivity when compared to nonusers.

Previous research has consistently found substance users to be highly impulsive (Lane, Moeller, Steinberg, Buzby, & Kosten, 2007; Dom, D'haene, Hulstijn, & Sabbe, 2006; von Diemen, Bassani, Fuchs, Szobot, & Pechansky, 2008) and indicated that impulsivity is a heritable personality trait (McGue, Lacono, Legrand, Malone, & Elkins, 2001; Knop, Teasdale, Schulsinger, & Goodwin, 1985; Ersche, Turton, Pradhan, Bullmore, & Robbins, 2010). In fact, Poulos, Le, and Parker (1995) classified alcohol-naive rats under three levels of impulsivity: low, medium, and high. The high impulsive rats subsequently consumed more alcohol than did the groups designated as medium or low impulsive. These infrahuman results indicated that impulsivity may be a personality trait that affects an individual's predisposition to consume drugs, and the more impulsive the individual, the higher the predisposition to consume drugs.

There are two theories which attempt to explain the relationship between drug use and impulsivity; the 'trait-based' theory and the 'drug-induced state' theory (Carroll, Anker, Mach, Newman, & Perry, 2010). The 'trait-based' theory proposes that impulsivity is a stable trait that precedes and determines the extent of drug use, whereas the 'drug-induced state' theory holds that drug use increases or decreases the probability of impulsive behaviors. It is likely that while impulsivity predisposes the individual to initial drug use, the drug use itself interrupts regular inhibitory responses in the brain, which may then lead to continued drug use (Winstanley, Olausson, Taylor, & Jentsch, 2010). In fact, Petry (2002) found that substance abusers in the active phase of alcoholism had higher scores on impulsivity than those who were in remission as well as controls. However, substance abusers in remission had higher impulsivity scores than controls, suggesting that impulsivity is enhanced by drug use itself.

Contrary to our predictions in Hypotheses 2a and 2b, impulsivity was not significantly related to the two aspects of cognitive functioning measured, working memory and processing speed. Some studies have found impulsivity to be inversely related to aspects of cognitive functioning such as working memory (Romer, Betancourt, Giannetta, Brodsky, Farah, & Hurt 2009), processing speed, and decision making (Verdejo-García, Sánchez-Fernández; Alonso-Maroto, Fernández-Calderón, Perales, Lozano, & Pérez-García, 2010). However, it seems that drug use may be a mediating variable between impulsivity and deficits in cognitive functioning (Winstanley, Olausson, Taylor & Jentsch, 2010). Whereas impulsivity itself may not lead to cognitive deficits, it may lead to risky behaviors such as drug use which in turn may modify the structure of the brain and damage areas responsible for executive functioning. A case in point is that although a relatively noteworthy portion of the participants in the current study were found to be highly impulsive (19%), many of them did not use drugs (24%). Hence, drug use may serve as a mediating variable between initial levels of impulsivity and deficits in working memory and processing speed over time.

Also, harm caused by drug use to areas of the brain that control planning, attention, and inhibition of impulsive responses may impair critical areas of behavior regulation and may lead to greater impulsivity (Crews & Boettiger, 2009). This means that initial or moderate substance use may create a lag or delay in inhibitory responses, which then facilitates further drug use. This prolonged or ‘compulsive’ drug use then severely disrupts major areas of cognitive functioning. In the current study, subjects were not part of a clinical population and tended to be younger in age. Because of this, it is probable that we were not able to obtain a sample of long-term drug users incurred extreme damage to areas of the brain responsible for executive functioning caused by prolonged substance use.

Contrary to the predictions made in Hypotheses 3 a and 3b, this study did not find a significant relationship between frequency of drug use and the two aspects of cognitive functioning measured, working memory and processing speed. Although previous studies have found a relationship between drug use and aspects of cognitive functioning (Fernández-Serrano, Pérez-García, Río-Valle, & Verdejo-García, 2010; Castle & Ames, 1996; Weinstein, Feldtkeller, Law, Myles, & Nutt, 2000), it may be that these effects are reversible with abstinence, since many of the users in our study (around 19%) reported to have been abstinent for over one month to one year. For example, Fried, Watkinson, and Gray (2005), found that with abstinence, cognitive impairments found in marijuana users were reversible after three months of not using marijuana. Similarly, Hanson, Winward, Schweinsburg, Medina, Brown and Tapert (2010) found that marijuana users performed worse than controls on aspects of cognitive functioning, yet they performed similarly to controls after three weeks of abstinence. In the current study, although 60% of users had used today/yesterday or in the past week, the rest of participants (40%) had not used drugs for several weeks to over a year.

Also, Halpern, Pope, Sherwood, Barry, Hudson and Yurgelun-Todd (2004) assessed processing speed and impulsivity among non-users, moderate users, and heavy users of ecstasy (MDMA). Ecstasy (MDMA) users exhibited deficits in processing speed and impulsivity, which were significantly different when compared to non-users. However, there were only slight differences between moderate users and non-users of ecstasy (MDMA). These results suggest that slight to moderate drug use may not lead to the cognitive deficits seen in heavy substance users. In the current study, mean drug use score was relatively low (4.6, out of a total frequency score of 15), therefore, our sample did not consist of many heavy drug users. This may have accounted for the lack of cognitive deficits seen in those who did report use.

Our results indicated that there were gender differences in regards to impulsivity scores. Specifically, men scored significantly higher than women on motor impulsivity. This is consistent with previous research, which has found that men tend to be more impulsive than women (Stoltenberg, Batien, & Birgenheir, 2008). Stoltenberg, Batien, and Birgenheir (2008) used the BIS-11 to measure impulsivity among men and women as it related to alcohol problems. They found that at high levels of impulsivity, there was no difference between men and women on probability of having alcohol problems. However, as impulsivity decreased, the risk for alcohol problems increased more dramatically for men. They also found that higher levels of motor impulsivity in men accounted for a significant amount of the gender difference in risk for alcohol problems. That is, impulsivity mediated the association between gender and risk for alcohol problems.

In the current study, we also found gender differences among substance abuse frequency. Specifically, men engaged in more drug use than women. This is consistent with previous research, which has found that men tend to abuse drugs more frequently and in higher amounts than women (Sinadinovic, Berman, Hasson, & Wennberg, 2010). Previous research has also found that initiation of drug use tends to occur at a younger age for males (Back, Lawson, Singleton, & Brady, 2011), and that men tend to seek treatment more often than women (Back, Payne, Simpson, & Brady, 2010). This discrepancy in gender may be due to initial levels of impulsivity being higher in men than women, which may predispose them to engage in more risky behaviors such as alcohol and drug use.

In the current study, it was also found that women scored significantly higher than men on one aspect of cognitive functioning, processing speed. Research reporting on gender differences regarding cognitive functioning, such as processing speed, is lacking. Our results reflect a difference in the ability of males and females to process information simultaneously, or multitask. Razumnikova and Volf (2012) measured activity in the left and right hemispheres of men and women during creative tasks. They found that women demonstrated better attention and global processing when compared to men, and that they tended to use both hemispheres at once, whereas men tended to use selective functions in the left hemisphere. This is in accordance to the corpus callosum theory, which states that women have a wider corpus collosum than men and that this makes it possible for them to multitask more efficiently (Criss, 2006). If women have the ability to multitask more efficiently than men, then it would make sense that their processing speed is faster because they would be more proficient at juggling different bits of information simultaneously. Criss (2006) suggests that these skills may be acquired in response to a demanding environment, including housework, tasks relating to child-rearing, having a job outside the home, and other responsibilities.

Our study also found that ethnic groups differed significantly in the areas of motor impulsivity, frequency of drug use, and working memory. Whites were found to score significantly higher than African Americans on working memory as well as motor impulsivity. With regards to working memory, few studies have reported differences among ethnic groups. In fact, some studies have not found a significant difference between Whites and African Americans on working memory (Mungas, Widaman, Reed, & Tomaszewski Farias, 2011). With regards to impulsivity, few studies have reported differences among ethnic groups, and some have found no significant difference between Whites and African Americans (Vitacco, Neumann, Robertson & Durrant, 2002). However, in their study, Vitacco, Neumann, Robertson and Durrant (2002) found that African Americans had higher scores on family rapport and social conformity when compared to Whites. These ‘protective’ factors may be mediating the relationship between ethnicity and impulsivity. For example, if individuals have good rapport with family members and conform to conservative societal norms, they may be better at controlling impulses, such as drug use, that are in opposition to societal or familial values. Future studies should explore possible differences among ethnic groups in terms of working memory and impulsivity, and should take into account other variables that may serve as mediators, such as social and familial factors.

In our study, Hispanics were also found to significantly differ from African Americans on frequency of drug use, with Hispanics reporting significantly more substance use. However, these results are in conflict with studies which have found that African Americans and Hispanics do not differ significantly in terms of marijuana use, and have even reported higher rates of cocaine use among African Americans versus Hispanics (Dillon, Turner, Robbins, & Szapocznik, 2005). Also, Lundgren, Chassler, Ben-Ami, Purington and Schilling (2005) found higher rates of drug-related emergency room visits among African Americans when compared to Hispanics. However, other studies have found that Hispanics reported higher rates of substance use, in every drug category, when compared to African Americans (Wu, Woody, Yang, Pan, & Blazer, 2011). Further research needs to explore differences among ethnic groups in order to get a clearer idea of substance use habits among them and the variables controlling usage.

In regards to religious groups, there was a significant difference found between Atheists/Agnostics versus Protestant Christians in terms of substance use frequency. Specifically, Atheists/Agnostics reported significantly higher rates of drug use than Protestant Christians. This is in accordance to previous research, which has found that Atheists and Agnostics reported the highest rates of illegal drug use when compared to 15 other religious groups (Ellis, 2002). In another study, Engs and Mullen (1999) found that non-religious individuals consumed more alcohol, tobacco, marijuana, amphetamines, LSD, and ecstasy when compared to very religious individuals. They also found Roman Catholics to be the group with the second highest amount of drug use, consistent with the current study, which also found Roman Catholics to be the second highest group in substance use frequency.

Sanchez, Opaleye, Chaves, Noto, and Nappo (2011) asked Catholics and Protestant Christians questions regarding their drug use as well as perceived protective factors that they believed helped them stay away from drugs. Catholics considered licit drugs to be less harmful than illicit drugs and were especially tolerant to alcohol consumption. Protestant Christians, however, described all drugs as being harmful to one’s health. Also, Catholics described protective factors to include family values and having a relationship with God that led to self-knowledge and an increase in self-esteem, which would then decrease their interest in drug use. Protestant Christians, however, described protective factors to include their own religiosity and religious beliefs, as well as the “fear of God,” which included fear of future consequences, shame, and surrender to God. They also considered the church and the pastor’s words as a form of prevention. These findings suggest that individuals invoke several religious concepts to justify their choice for not using drugs. And, it appears that Protestant Christians are stricter in following the ‘word of God’ to not use drugs, whereas Catholics value having a relationship with God rather than ‘fear’ the consequences of drug use. Also, Roman Catholics derive from European culture, which uses alcohol as a standard part of their diet. Protestant Christians derive from American Puritanical culture which rejects alcohol use.

Also, our results showed that Atheists/Agnostics scored significantly higher than Roman Catholics on working memory. There is limited research in this area; however, Brown (2007) proposed that this is due to the closed nature of the belief system of individuals who are very religious, and that non-religious groups have higher cognitive complexity and flexibility. He states that dogmatic individuals can have a tendency to compartmentalize and isolate their beliefs, whereas individuals with more open belief systems have a readiness to make connections between disparate beliefs. The author explained that when given information inconsistent with their current schema, dogmatic individuals tend to discard the information or ignore it, which may make it difficult in dogmatic individuals to deliberate about multiple pieces of information and limit cognitive capabilities. He also suggested that this phenomenon may work in the reverse; it may be that inadequate cognitive capabilities make it difficult to maintain and deliberate about multiple pieces of information, which may lead the person to ignore new contradictory information. In essence, individuals whose working memory capacity is restricted would be less capable of seeing all options, weighing all decisions, and would be less likely to attend to the crucial information that would persuade them to change a belief. Indeed, Brown (2007) did find a negative correlation between dogmatism and scores on working memory.

In conclusion, we suggest that our results support that the *trait-based* theory best explains the correlation found between reported substance use and impulsivity scores. Specifically, we propose that impulsivity is a heritable trait which contributes to initiation and maintenance of risky behaviors such as drug use. Previous studies have supported the idea that impulsivity is a biologically-based, heritable characteristic with emergent psychological properties linked to the development and maintenance of substance use disorders (Bornovalova, Lejuez, Daughters, Rosenthal, & Lynch, 2005; Carrol et al, 2010; Dom, D'haene, Hulstijn, & Sabbe, 2006; von Diemen, Bassani, Fuchs, Szobot, & Pechansky, 2008). Because we did not find a significant correlation between drug use and cognitive functioning, but we found a significant correlation between impulsivity and drug use, we suggest that impulsivity is a characteristic that predisposes individuals to engage in substance use. This is in accordance to animal studies and twin studies which support that impulsivity may be transmitted down generations, possibly contributing to initial trait levels of impulsivity and experimentation with drug use (Carroll, Anker, Mach, Newman, & Perry, 2010; Knop, Teasdale, Schulsinger, & Goodwin, 1985; Petry, Kirby, & Kranzler, 2002; Riggs, Chou, & Pentz, 2009).

Limitations

The current study had some limitations that would be useful to take into account when doing further research in the areas of drug use, impulsivity, and cognitive functioning. First, participants in this study were not of a clinical population. This means that the drug use reported may have been relatively mild in comparison to those who have been using substances heavily and/or for long periods of time. Due to this limitation, the authors were unable to observe any cognitive deficits that long and/or heavy drug use might have caused in the brain of long term users. Further research should investigate the effects of long term drug use, 10 – 30 years, and its effect on cognitive functioning among individuals diagnosed with Substance Use Disorders.

Also, in the current study, subjects were undergraduate and graduate students recruited from a university, and tended to be younger in age than the general population. Because of this, we were not able to obtain a sample of representative drug users in the general population, which may include more long-term users. The authors also did not collect information regarding when drug use began or for how long the use had continued; the only data recorded aside from frequency of current substance use, was the last time any substance had been used. Further research should focus on longitudinal data and follow participants from adolescence into adulthood, in order to determine specific functions that drug use may interrupt in the brain. It would also be of interest to determine which particular drugs interrupt specific aspects of cognitive functioning, such as working memory, processing speed, decision-making, and other executive functions.

Appendix A

Barry University
Cover Letter

Dear Research Participant:

Your participation in a research project is requested. The title of the study is "Personality Characteristics, Behavior, and Cognitive Skills." The research is being conducted by Patricia Sotolongo, a student in the Psychology Department at Barry University, and it is seeking information that will be useful in the field of clinical psychology. The aims of the research are to examine personality characteristics, behaviors, and cognitive skills. In accordance with these aims, the following procedures will be used: A questionnaire with items from two scales that assess personality characteristics and behavior, and two tests that assess cognitive skills follow this letter. The questionnaire also includes a brief demographic survey. I anticipate the number of participants to be 88.

If you decide to participate in this research, you will be asked to do the following: Answer the questions on the questionnaire and complete the tests that follow this letter. The questionnaire and tests are estimated to take 45 minutes to complete.

Your consent to be a research participant is strictly voluntary and should you decline to participate or should you choose to drop out at any time during the study, there will be no adverse effects on your grades.

The risks of involvement in this study are minimal. The following procedures will be used to minimize the risks: You can skip any questions you do not want to answer or drop out of the study at any time. The benefit to you for participating is that you may receive extra credit in your current psychology course for your participation. You will receive proof of participation for class credit after the experiment.

As a research participant, information you provide is anonymous, that is, no names or other identifiers will be collected. Any published results of the research will refer to group averages only, and data will be kept in a locked file in the researcher's office for two years and then destroyed. By completing and returning the questionnaires and tests you have shown your agreement to participate in the study.

If you have any questions or concerns regarding the study or your participation in the study, you may contact me, Patricia Sotolongo, by phone at (786) 301-1869 or by email at patricia.sotolongo@mymail.barry.edu or my supervisor, Dr. Koncsol, by phone at (305) 899 – 3277 or by email at skoncsol@mail.barry.edu. You may also contact the Institutional Review Board point of contact, Barbara Cook, by phone at (305) 899-3020 or by email at bcook@mail.barry.edu.

Thank you for your participation.

Sincerely,

Patricia Sotolongo

Appendix B

PARTICIPANTS NEEDED

to participate in an anonymous research study about **personality traits, behaviors, and cognitive skills.** Your participation may yield **extra credit in your current psychology classes.**

You will be asked to answer some demographic questions, as well as questions regarding your personality characteristics, behaviors, and thinking.

Duration: The study takes about 45 minutes to complete.

Time slots: Time slots are available through appointment only. To reserve a time slot please contact Patricia Sotolongo through email or telephone.

For questions and/or participation contact:

Patricia Sotolongo
patricia.sotolongo@mymail.barry.edu
786-371-1076

Dr. Stephen Koncsol
skoncsol@mail.barry.edu
305-899-3277

Institutional Review Board:
Barbara Cook
bcook@mail.barry.edu
305-899-3020

To participate contact:

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Appendix C

Subject line: Research Opportunity

Attachment: Flyer

Body:

Attention psychology students:

to participate in an anonymous research study about personality traits, behaviors, and cognitive skills, please contact **Patricia Sotolongo** at patricia.sotolongo@mymail.barry.edu **or** 786-301-1869.

You will be asked to answer some demographic questions, as well as questions regarding your personality characteristics, behaviors, and thinking.

The study takes about 45 minutes to complete and your participation may yield extra credit in your current psychology classes.

Time slots are available by appointment only. To reserve a time slot please contact Patricia Sotolongo via email or telephone.

Appendix D

Demographic Questionnaire

1) Age: ____

2) Sex: F M

3) Current school level: Freshman Sophomore Junior Senior Graduate

4) Race/Ethnicity:

O American Indian or Alaska Native

O Hawaiian or other Pacific Islander

O White, non-Hispanic

O Asian

O African American

O Caribbean Islander

O Hispanic

O Other ___________________

5) Sexual Orientation: Heterosexual Homosexual Bisexual Unsure Prefer not to identify

6) Marital Status:

O Single

O Married

O Engaged

O Divorced

O Separated

O Member of an unmarried couple

7) Religious Affiliation:

O Protestant Christian

O Roman Catholic

O Evangelical Christian

O Jewish

O Muslim

O Hindu

O Buddhist

O Other: ______________

8) How often do you attend religious services?

O More than once a week

O Once a week

O Once or twice a month

O A few times a year

O Never

9) What is your total household income?

O Less than $10,000

O $10,000 to $29,999

O $30,000 to $49,999

O $50,000 to $69,999

O $70,000 to $89,999

O $90,000 or more

10) Household:

Do you live…

O By youself

O With parent(s) or family member(s)

O With roommates

O With partner or spouse

Appendix E

Drug Use Questionnaire

1. What substances do you currently use? (Check all that apply)

___ alcohol

___ amphetamines (uppers, Adderall, meth, speed)

___ cocaine

___ tranquilizers (downers, Xanax (bars), Valium)

___ marijuana

___ hallucinogens (acid, LSD, mushrooms)

___ nicotine (cigarettes)

___ inhalants (household/cleaning products)

___ MDMA (ecstasy, mollies)

___ opiates (heroin, Oxycontin, Vicodin)

___ other (specify) ____

___ I do not use any of the above substances.

___ Past user (If you used drugs in the past, please treat the following questions in regard to your past drug use – disregard the term 'in the past year').

*How long ago did you stop using? ____________________________

2. What are your current substance use habits with the drugs you use most often?

Drug # 1(specify) _____________

O	O	O	O	O
Rarely use (once a year or less)	occasional use (few times a year)	monthly use	weekly use	heavy/daily use

Drug # 2 (specify) _______________

O	O	O	O	O
Rarely use (once a year or less)	occasional use (few times a year)	monthly use	weekly use	heavy/daily use

Drug # 3 (specify) _______________

O	O	O	O	O
Rarely use (once a year or less)	occasional use (few times a year)	monthly use	weekly use	heavy/daily use

3. How long ago did you last take a drug or drink?

O	O	O	O	O
Today/yesterday	Last week	2-3 weeks ago	1-6 months ago	over 6 months ago

Other (specify) ____________________________________

4. Do your friends or family think you use more than you should? ___ yes ___ no
5. Do your friends or family worry or complain to you regarding your drug or alcohol use?

   ___ yes ___ no
6. Do you think you use more than other people who use? ___ yes ___ no
7. Have your drug or drinking habits caused you adverse side effects such as losing a job, getting arrested, have medical problems related to use, family or relationship problems, or be aggressive or violent to the point of disruptive behavior such as getting into fights or engaging in vandalism in the past year? ___ yes ___ no
8. Have you neglected your obligations, family, school, or work because of drinking or drug use in the past year? ___ yes ___ no

9. Do you often wish you could diminish or stop your use of alcohol or drugs?

   ___ yes ___ no

10. Have you sought medical help or social support (such as AA or NA) for your drinking or drug use habits in the past year? ___ yes ___ no

11. Have you experienced a ‘blackout’ (forgotten a portion of the day/night) because of your drinking or drug habits in the past year? ___ yes ___ no

12. Have you engaged in illegal activities to obtain alcohol or drugs in the past year?

    ___ yes ___ no

13. Have you experienced withdrawal symptoms (felt sick) when you stopped drinking or taking drugs in the past year? ___ yes ___ no

14. Have you had any medical problems (emergency room visits, etc.) as a result of your drug use in the past year? ___ yes ___ no

Have you drank or used drugs in an inappropriate setting in the past year (such as at work, school, professional settings, etc.)? ___ yes ___ no

Appendix F

DIRECTIONS: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.

O	O	O	O
Rarely/Never	Occasionally	Often	Almost Always/Always

1	I plan tasks carefully.	O	O	O	O
2	I do things without thinking.	O	O	O	O
3	I make-up my mind quickly.	O	O	O	O
4	I am happy-go-lucky.	O	O	O	O
5	I don't "pay attention."	O	O	O	O
6	I have "racing" thoughts.	O	O	O	O
7	I plan trips well ahead of time.	O	O	O	O
8	I am self controlled.	O	O	O	O
9	I concentrate easily.	O	O	O	O
10	I save regularly.	O	O	O	O
11	I "squirm" at plays or lectures.	O	O	O	O
12	I am a careful thinker.	O	O	O	O
13	I plan for job security.	O	O	O	O
14	I say things without thinking.	O	O	O	O
15	I like to think about complex problems.	O	O	O	O
16	I change jobs.	O	O	O	O
17	I act "on impulse."	O	O	O	O
18	I get easily bored when solving thought problems.	O	O	O	O
19	I act on the spur of the moment.	O	O	O	O
20	I am a steady thinker.	O	O	O	O
21	I change residences.	O	O	O	O
22	I buy things on impulse.	O	O	O	O
23	I can only think about one thing at a time.	O	O	O	O
24	I change hobbies.	O	O	O	O
25	I spend or charge more than I earn.	O	O	O	O
26	I often have extraneous thoughts when thinking.	O	O	O	O
27	I am more interested in the present than the future.	O	O	O	O
28	I am restless at the theater or lectures.	O	O	O	O
29	I like puzzles.	O	O	O	O
30	I am future oriented.	O	O	O	O

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