DISORDERED CAFFEINATION:

A BIOCULTURAL ANALYSIS OF ADVERSE REACTIONS TO CAFFEINE

by

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This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Mary Cameron, Department of Anthropology, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the Dorothy F. Schmidt College of Arts and Letters and was accepted in partial fulfillment of the requirements for the degree of Master of Arts.

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ABSTRACT

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While coffee culture has long since been positively associated with intellectual and working life, the health and safety of its primary stimulant, caffeine, has recently fallen under scrutiny by the FDA. This medical anthropology thesis provides a biocultural synthesis of caffeine culture, health effects, and biological variation in adverse effects related to pharmacodynamics and pharmacokinetics. Supporting evidence for variation in responses to caffeine was found through surveying 100 participants, investigating caffeine consumption levels, perceptions and health beliefs, adverse effects experienced, and medical encounters. Increased rates of adverse effects were found for students, pharmaceutical and over-the-counter drug users, and for participants reporting negative or ambivalent perceptions of caffeine, intolerance, or sensitivity to caffeine. Variation in rates of adverse effects suggests biocultural interactions account not only for patterns in pharmacological data, but are also clinically significant in constructing risk of caffeine intoxication.

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I. INTRODUCTION
CAFFEINE CULTURE AND CHANGING BIOLOGIES

Despite considerable variation in local cuisines around the globe, caffeine consumption remains a unifying experience, stretching across varied cultures and landscapes. Rituals of consumption may vary by locale—but nonetheless represent a shared desire to awaken, refresh, stimulate, and connect with others. The United States is no exception, with 85% of Americans awakening and associating the smell of coffee with a vast array of psychophysiological effects arising from the inhibition of the neurotransmitter adenosine (Ribeiro & Sebastião 2010; Mitchell et al. 2014). Freshly brewed coffee has become a sensory association tied to morning rituals that offer some constancy to the perceived ordered chaos of contemporary life. The context of this consumption exists within an ever-changing biological and cultural landscape. Caffeine consumption has allowed humanity to push beyond our perceived limits of fatigue and distraction, while this apparent biological utility has also necessitated culturally constructed boundaries of normality and abnormality in patterns of usage and responses.

The constant negotiations around caffeine use between the normal and abnormal, the useful and harmful, the physiological and the cultural, is part of how humans contend with risk and reward in an ever-changing cultural environment. The initial inspiration for this project came from my own negotiations with the risks and rewards of caffeine consumption. Paradoxically, while this thesis itself has been fueled by more cups of coffee than I can count, a single cup of coffee was once enough to make the world spin

for me, fueling not focus, but anxiety, nausea, and vomiting. How does a response to such a common substance change so radically over time? The literature on caffeine suggests responses are impacted by a host of variables that vary both between and within individuals. Although caffeine has been studied in fields such as pharmacology and psychology, there are markedly few qualitative studies, and none to-date that elicit narratives of adverse reactions from participants. In order to help fill these gaps in the research literature, this thesis project involved collecting surveys and narratives of caffeine intoxication—commonly known as overdose—as well as stories of chronic yet constructive use over time from 100 participants. Through both statistical analyses and narrative analysis, this study addresses which factors contribute to adverse or positive reactions and how these experiences are interpreted by those who live through them.

Through the lens of medical anthropology, the study examines the biocultural factors mediating Americans' perceived rewards and risks of caffeine. Utilizing the diagnostic criteria of the American Psychiatric Association's Caffeine-Related Disorders, it was found that the average number of adverse symptoms experienced is approximately seven. Five symptoms are required for a diagnosis of Caffeine Intoxication. Most participants report having a primarily positive relationship to caffeine, meaning on average, these symptoms are generally not interpreted as impacting daily, normal functioning or quality of life, as the second APA diagnostic criteria necessitates. Certain participant characteristics were associated with elevated rates of adverse effects, including student status, pharmaceutical and over-the-counter drug use, negative perceptions of caffeine, and sensitivity or intolerance to the substance. Participants facing

severe adverse reactions reported significant physiological and psychological distress, including two cases of hospitalization.

The quantification of adverse effects yields patterns in the data when sorted by descriptive independent variables, such as co-administration with other drugs. In addition to data on drug combinations, the survey also examines participants' perceptions of sensitivity, tolerance, health beliefs, and medical encounters related to caffeine. Sensitivity and tolerance levels were found to be associated with the number of adverse effects reported. This association suggests that the experience of adverse effects informs self-defined knowledge of sensitivity and tolerance. Furthermore, this indicates self-reported sensitivity may be a useful tool in a clinical context regarding caffeine. While self- knowledge could be better integrated into diagnostics and build patient-practitioner trust, it was also found that nearly all participants were unaware of the existence of Caffeine-Related Disorders.

This thesis raises questions as to a number of causal factors in adverse reactions and motivating factors in consumption, yet it was found there is a lack of integration or exchange between different fields of knowledge. The rhetoric on caffeine generally remains specific to psychology, pharmacology, history, sociology, and is not readily integrated into lay-person knowledge. The holistic and comparative field of medical anthropology provides a unified theoretical framework for analysis.

The construction of caffeine disorders reflects the vast biological and behavioral variation underlying the practice of caffeine consumption. Vast pharmacological research supports a conclusion of significant variation in metabolism and subsequent effects. Tobacco smoking, for example, speeds the rate of caffeine metabolism, while various

pharmacological drugs have been shown to have the converse effect. Tobacco usage in this study was found to be associated with higher caffeine consumption, while pharmaceutical drug use was found to be associated with higher average reported adverse symptoms. In the larger context of American patterns of drug use, the reduction of tobacco usage in recent years in conjunction with increased pharmaceutical usage has metabolic implications that may put more at risk of adverse effects. Will consumption patterns self-adjust to slower metabolic rates, or will physicians continue to see cases of caffeine overdose, intoxication, and caffeine-drug interactions?

The cultural transformation that followed the industrial revolution actively created new boundaries of acceptable behavior in Western societies. In light of our day-to-day obligations that require living by the clock, fatigue can often not be treated with the obvious solution, sleep. When faced with these newfound demands on attention, alertness, and productivity, we have developed a number of cultural adaptations to these demands. The consumption of caffeine, a bitter alkaloid found in a number of plant sources, is a widespread and normalized cultural adaptation in Western life. The degree to which caffeine has become normalized contributes to the fact that caffeine consumption is regularly overlooked in American medical diagnostic settings. A review of current and past research in pharmacology paints a picture of the complex interactions of culture and biology, illustrating how aspects of culture such as diet, consumption patterns, and the use of can mediate drug metabolism commonly prescribed medications and other drugs. Caffeine provides an intriguing example of how human biological variation stems from more than genetics, and indeed entails a biological reality partially created by culture.

Although it seems that coffee has found its way into American cultural life by way of choice, the globalization of coffee was as equally economically driven as it was culturally. The world's most widely used stimulant is unique in the fact that we are often exposed continuously throughout our lifespan (Mitchell et al. 2014). Caffeine-containing products are important commodities, while the demands of modern working life and academic achievement encourage the usage of an easily accessible quick fix for fatigue. The rewards may be enticing, yet the risks of this quick fix are *not* equitably distributed among all groups. Caffeine's stimulating properties can pose a problem for those with anxiety disorders, sleep disorders, cardiovascular conditions, and gastrointestinal disorders (Lara 2010; Juliano, Anderson & Griffiths 2011; Ogawa & Ueki 2007; Rihs, Muller & Baumann 1996). Thousands of cases of caffeine poisoning are reported each year in the United States. While caffeine consumption is a relatively homogenous behavior, with 85% of the population drinking it daily (Mitchell et al. 2014), the effects achieved are not universal.

The impact of biological variation has been partially elucidated since genetic markers have been identified that mediate responses to caffeine. Polymorphisms in adenosine receptors have been shown to result in varied responses to the same dosage of caffeine (Childs 2008), while additional variation stems from the levels of hepatic enzyme CYP_{1A2}, responsible for metabolism (Grant, Tang & Kalow 1983; Kalow & Tang 1991). Thus, what may be uplifting for one person may be anxiety provoking for the next, depending upon the genes that code for adenosine receptors and hepatic enzymes. In the context of a population with an 18.1% prevalence rate of anxiety disorder (NIMH 2012) and 50-70 million Americans with sleep or wakefulness disorder (CDC 2014), it is

important to investigate how caffeine use can be adaptive in some biological and cultural contexts, while being maladaptive for some.

Writing and research typical of student life require sustained attention and focus for hours on end, with a dose of creativity and analytic thought. Students are acutely aware of the cognitive demands of academic life, and unsurprisingly most are looking for an edge. College students have been shown to have higher levels of caffeine consumption than the general population, the reasons for which may be a mix of recreational, functional, and social. The options in our cure-for-everything world are seemingly many, but in reality few stimulants are both readily accessible and culturally acceptable like caffeine.

Prescription stimulant use has risen, and is partially culturally accepted, but accessing these controlled substances through a medical professional can prove to be a challenge. A favorite stimulant of prior decades, nicotine, is fairly accessible, yet reductions in American tobacco usage through aggressive public health measures have co-emerged with a lack of acceptability. Caffeine, on the other hand, is found on nearly every street corner, from vending machines to coffeehouses. Accepted as a generally safe substance, it has become not only a performance enhancer for a specified purpose, but also one of the most habitually used substances in the world. This stimulant of choice, caffeine, functions by antagonizing the inhibitory neurotransmitter adenosine, which is released when cells are fatigued. Although many see coffee drinking as filling up the fuel tank for the day, a more apt neurological metaphor is that we are cutting the brain's brake lines before heading downhill.

An apparent challenge faced by a nation living life without brakes is that although many have adapted to living life in the fast lane, more than a few of us are going to crash. Just as automobile accidents are sometimes unavoidable, pushing the body beyond its limits through stimulant use can have unintended consequences that can range from a minor mishap of jitters, to a state of intoxication requiring hospitalization. These responses are concerning in regards to physical discomfort and suffering, the potential lapse in productive responsibilities, as well as the medical encounters that they may warrant. As public health doctrine dictates, prevention is only possible once risk factors have been identified.

The option to disengage from caffeinated modern life may also require sacrificing the ability to work beyond what the body permits. In the competitive world of careers and academics, however, the choice to return to baseline may give an advantage to those who can better handle the constant stimulation. Health beliefs regarding caffeine are important to investigate, but the addictive properties of the substance must also be considered in its cultural context. The physiological reaction of chemical dependency certainly plays a role, but there is also a cultural dependency on caffeine reflected in the meanings attributed to the substance. The body may "request" caffeine through invoking withdrawal effects of fatigue and headache, but the cultural mind also demands participation when faced with aggressive advertising, as well as more passive means of encouragement, such as socially-sanctioned coffee breaks.

Consumption is physiological, is fueled by biology, if you will, but it is also filtered through our lens of culture. The consequences of American cultural dictates around coffee drinking are real, subjective experiences; for many, the caffeine-rush is the

best part of the morning, or the welcome palliation throughout the work day. Both metaphorically and literally, our nation "runs on" coffee. The biological reality, however, proves to be far more complex and nuanced than what the easy, pleasurable cultural voice suggests. Understanding biological variation in relation to caffeine culture can provide insight into both behavioral risks and benefits, elucidating how the substance can best be used safely and in what context.

ANTHROPOLOGICAL THEORY

BIOCULTURAL MEDICAL ANTHROPOLOGY

The prevalence of caffeine consumption has warranted a great deal of pharmacological and psychological research on the subject. There have also been a number of important historical, economic, and cultural accounts of specific caffeinated products. Anthropological studies, however, have not looked extensively at caffeine in various cultural contexts. Anthropology embraces human diversity in both culture and biology, examining not only what makes us the same, but also how our particular cultural context informs our behavior and subsequent biology. The biocultural perspective has provided an illuminating insight into other food types, such as Andrea Wiley's work on milk consumption and lactase impersistence. An integration of information on human biological variation and cultural subsistence patterns allows for a more complete picture of a drug or food. This biocultural perspective considers evolutionary adaptive functions, while perspectives on political economy can inform the power relations inherent in the cultural integration of a particular practice.

While caffeine use is global and often persists throughout an individual's lifespan, the effects of caffeine are far from universal. Variation in responses to caffeine are important to understand when considering how and why caffeine is so heavily utilized despite many users experiencing adverse effects. Biological variation has become increasingly important in medical anthropology as the knowledge of human genetics continues to deepen. While anthropology has long looked at the importance of genetic changes dating back millions of years, more recent forays into biological variation include epigenetics, the study of gene expression, and pharmacogenomics, the study of the role of genes in drug response.

The context of caffeine consumption has shifted in recent years. While American tobacco consumption has declined, pharmaceutical drug use has grown considerably. The metabolic effects of this on a population level needs to be considered, as the proportion of the population with accelerated metabolism and breakdown of caffeine is decreasing. If pharmaceutical drugs are capable of slowing caffeine metabolism, this could also pose a potential risk for adverse effects.

The cultural framing is clear and persistent. Modern academic and working life imposes strict time constraints and high demands of physical or cognitive labor. It stands to reason that we are all under some form of pressure to be energetically productive, but what we don't see are the differences under the skin. There is no external indication (outside of a clinical laboratory) of exactly how active the metabolic CYP_{1A2} enzymes are in relation to anyone else, except via personal experiences.

Despite our embrace of stimulant beverages, fatigue remains rampant, and exhaustion a status symbol, indicating to those around us just how much of ourselves we are constantly contributing. Thus, desire to self-medicate with a readily available and sensorially satisfying beverage can trump the observation of biological needs such as hunger and sleep. We override individual biological needs through collective cultural adaptations, constantly seeking to sync up to others' levels of stimulation and engagement in order to progress toward group goals.

Critical medical anthropologist Merrill Singer writes that "...medical anthropology appeared to offer a useful bridge connecting symbols to selection, acculturation to adaptation, ethnography to evolution, thereby allowing for the retention of a unified anthropology" (Singer 1993:93). CMA explores the implications of medical

issues at the macro-micro level, including individual experience and behavior, the ways in which social conflict and oppressive experience are somatized or embodied in illness, and how illness serves as an arena for both resistance and political conscientization (1993:105). Disease cannot be perceived apart from a cultural context (Pfifferling 1981:198). Singer provides a contrast to biocultural anthropology, reframing adaptations as "social adjustments to the consequences of oppressive sociopolitical relationships" (1993:115). Critical medical anthropologist Merrill Singer and biocultural anthropologist Andrea Wiley have an extensive discourse regarding their theoretical orientations, in which Wiley responds to claims that biocultural anthropology ignores sociopolitical context.

> The goal of much biocultural research on health is to assess the adaptive significance of cultural patterns insofar as they affect health. It is recognized that such patterns may become maladaptive precisely because they have evolved under historical conditions that no longer prevail" (Wiley 1992:224).

Wiley notes that different foods are a particularly appropriate focus of a biocultural perspective, since they are biological substances that exist in a "fluid cultural matrix" (Wiley 2011:7) which influences whether or not we consume them. This culturally-informed ingestion of a biological substance is then integrated into our physiology, with varying lengths of effects depending on other biological and cultural factors. This biological integration is then reflected back into culture, in the form of "cultural ideas, policies, and economic supports for the foods we desire" (Wiley 2011:7).

A good example is milk consumption by humans. While cultural ideas of milk may portray dairy as wholesome, good, and nutritious for all, Wiley provides a biological contrast to this. Lactase is the enzyme responsible for breaking down lactose, and levels

of lactase decrease after early childhood for most people. People with Northern European ancestry, however, have adapted to dairy consumption throughout the lifespan, showing lactase persistence. While milk may be good for those with lactase persistence, it makes those with lactase impersistence ill. Wiley deems the promotion of milk as good for all as an expression of bio-ethnocentrism. Bio-ethnocentrism is an expansion of the anthropological term ethnocentrism, meaning interpreting one's response to substance as standard and normal, and others' responses as abnormal and pathological (Wiley 2011).

Just as responses to milk can change over time due to variations in enzymes, so can individual responses to caffeine. The variation at hand is not limited to *between* individuals, but also exists *within* individuals (Kalow and Tang 1991; Kasuba et al. 1998). The factors responsible for variation include endogenous factors such as genetics and hormonal changes during pregnancy, as well as a number of exogenous factors such as various medications, cigarette smoking, and dietary factors. These endogenous and exogenous factors are woven throughout the cultural matrix of caffeine consumption, resulting in varied physiological and subjective effects. What we put into our bodies is culturally informed, and these culturally informed decisions impact our biology.

A number of theoretical questions must be addressed to contextualize the anthropological relevance of this thesis. How can we attempt to capture consciousness of biology for analysis? What theorists can provide a framework for investigating complex questions about the human experience? Through the creation of the APA Caffeine Disorders, a delineation between "ordered" and "disordered" experience has been drawn. How does one theorize the disordered body, a body that defies cultural expectations of acceptable behavior, response, or appearance? How does the concept of risk relate to

order and disordered bodies? While many fields pose postmodern inquiries into bodily experience and subjectivity, medical anthropology often seeks to understanding the lived experience of suffering. Disorders represent a desire to categorize and provide a semblance of structure to the experience of suffering. The observance of suffering and pain elicits empathy or discomfort, ultimately driving theoretical inquiries to not just understand suffering itself, but into how future suffering can be avoided. The shared concept of risk thus takes on a particular relevance in the health sciences as well as social sciences, although the body itself may be conceptualized differently by biologists, biomedical physicians, and social scientists (Frankenberg 1993:220).

Byron Good contends that studying disorder is an essential aspect of studying subjectivity (2012). What is deemed disorder is that which threatens social order. Studying disorder "bridges the individual and the societal, linking the madness of the state and of individuals, collective and individual memories, repressions, and remembering" (Good 2012:518). The point of paying particular attention to disorder is to see the reflection of "the establishment of very particular political, moral, and epistemic *orders"* (Good 2012:518). Looking at disorder through subjectivity provides increased understanding of "the lived experience of persons caught up in complex, threatening, and uncertain conditions of the contemporary world" (Good 2012: 519).

THEORIES OF RISK

Uncertainty of experience partially accounts for what Mary Douglas discusses in her later works, which is that some risks are selected and emphasized, while others are ignored (1992). Although risk analysis may utilize quantitative analysis, the application of knowledge is largely politicized. Discourse on risk is politicized because the work carries connotations that go beyond mere probability. Although the knowledge itself may fall within our expectations of "science," the *application* of knowledge is largely sociocultural. Douglas details three aspects of risk in questions; "In sum, substantial disagreement remains over what is risky, how risky it is, and what to do about it," illustrating how risk is constructed through social processes (1982:1). The lack of direct translation from knowledge production to application is readily apparent in regards to caffeine. The politicization of the application of knowledge means that risks are minimized, and rewards emphasized and in some cases, exaggerated.

Douglas contends the social body constrains the way we perceive the physical body, yet in his book *Body Thoughts* Andrew Strathern argues "we do not need to suppose here that 'the social' directly constrains 'the physical,' since both meet and are articulated in 'the cultural'—i.e., the realm of attribution of meanings to events and processes" (1996:21). The social body and the physical body, while important to consider, are reintegrated and observable in the culturally-informed locus of experience.

EXPERIENCE

Studying the experience of consciousness is a complex endeavor, but particular theoretical orientations offer useful analytic frameworks. Phenomenology has been defined in anthropology as "the study of things as they appear in our lived experiences"

(Desjarlais & Throop 2011). Phenomenological anthropology has sought to order the human experience through grounding theory in "close examinations of concrete bodily experiences, forms of knowledge, and practice" (2011:90). Subjectivity is informed by temporal relationships, and is inherently embodied, meaning the body is more than an object but also our locus of experience. The scope of reality, however, extends beyond our capacity for conscious experience, meaning that we are always orienting our attention towards particular aspects of reality while ignoring others. On an individual level, this selective attention replicates Douglas' understanding of the social selection of risks. This conception of experience acknowledges there can be a great deal of ambiguity, uncertainty, and indeterminacy to consciousness.

In Margaret Lock's review of the history of anthropological theories of the body, she concludes that the shift in thinking marked by Mary Douglas and others "stimulated a fundamental reformulation of the problem of the body as one of semiosis, in other words, how the body functions as both a 'transmitter' and 'receiver' of information, in turn a function of the positioning of the individual in society" (1993:136). The consequence of both being and having a body, as Lock claims, is that "subjectivity and its relation to biology and society cannot be ignored" (1993:136). This leads to the concept of the mindful body.

The question of usefulness has been raised in regard to the conceptualizing bodies as mindful. Strathern advocates for the application of the concept to the study of mental illness. He states that "Once we recognize that there is a mental component to all bodily states, and conversely, a physical component to all mental states, the boundary between mental and other illnesses disappears" (1996:4). This acknowledgement of the physical

component of mental states is crucial to understanding psychological disorders not merely to be constructed by patterns of thought, but are informed by physiological mechanisms.

A contrast to the mindful body is the biomedical conceptualization of the body as an object. Michel Foucault's works have contributed substantially to the application of the postmodern perspective to mental illness, the structure of knowledge, and the strength of biopower. The 'medical gaze' proposed by Foucault is one that objectifies the body for analysis by another. The implications of this, however, extend beyond practical clinical application, and reflect inequitable power given to those in the position of objectification. That which is within the field of knowledge is subject to manipulation. Biological reductionism poses a threat to the humanized body, one that is a locus of experience, according to phenomenology's mindful body, rather than simply an observable object.

While the birth of modern medicine is commonly associated with human scientific progress towards perfect and timeless objectivity, Foucault argues that sets of understanding about the world, or *epistemes,* are situated in particular sociocultural historical contexts reflecting unequal power relations. Margaret Lock writes that Foucault's works have "profoundly shaped the anthropological understanding of hierarchy, one in which the relationship of power to knowledge is made explicit" (1993:139).

Biomedical categories have more recently fallen under anthropological scrutiny, although Lock reminds us that the differences between subjective experience of illness and taxonomies have long been acknowledged by medical anthropologists. Byron Good proposes a concept of a semantic illness network "in which popular illness categories are

interpreted as part of congeries of words, metaphors, and images" (2012:141). Anthropological inquiry has also found that personal distress is systematically reconfigured into the "decontextualized signs and symptoms of biomedicine" (Good 2012:141). Although this study uses biomedical categories of symptoms, the inclusion of illness narratives provides adequate qualitative data to supplement the context missing from biomedical categories of experience.

Anthropologists have also looked to the sick role as a cultural performance of sorts, Lock's example being "nerves" as a means through which those without overt power "flex their muscles" (1993:142). A performance approach to sickness is said to have the "potential to foreground the sickening social order, while paying attention to body semiosis and individual distress" (Lock 1993:143). Susan DiGiacomo has called for the Westernization of anthropology. She calls for the "voice of the individual sufferer to be accorded analytical status," to which Lock reflects "most anthropologists working on the body would agree" (1993:143). We are now at a point where the decontextualized static biomedical body is being deconstructed in order to reflect sociocultural context and subjectivity. DiGiacomo's call for the accordance of analytical status to the voice of sufferers is particularly apt to application in psychiatry, where suffering exists beyond the view of the observer.

PSYCHIATRY AND PHARMACEUTICALS

The theoretical issues surrounding the nature of the relationship between the body and mind, and the subject and object, are further explicated in anthropological analyses of Western psychiatry and psychology. Vieda Skultans looks at this complex relationship in her collection of essays *Empathy and Healing,* begging the question, "Why should

Western psychiatry have acquired an intellectual immunity from its social surroundings?" (2007:101). Anthropologists have recently turned their attention to Western psychiatry as a means of cultural analysis, delving into topics such as psychoanalysis, the construction and deconstruction of disorder, and the role of psychiatric pharmaceuticals in contemporary life.

Mark Nichter and Nancy Vuckovic set forth an "Agenda for an Anthropology of Pharmaceutical Practice" in 1994, outlining ten themes of inquiry for future studies. Two themes are particularly relevant to this thesis, including changing perceptions of health in the face of proliferation of pharmaceuticals, and the evaluation of side effects versus intended actions of medications. Sjaak van der Geest writes that pharmaceuticals not only bring about changes in the body, but also act as ritual symbols. "The 'charm' of medicines for anthropologists is first of all that they epitomize the complexity of culture and allow us to capture that complexity in an attractive and convincing metonym" (van der Geest 2006:314). Similarly, caffeine provides an object of analysis that not only alters human physiology, but comes to both reflect and represent complexity of human culture.

II. CULTURAL CONTEXT

SOCIOCULTURAL HISTORY OF CAFFEINE

Caffeine consumption is undoubtedly an aspect of contemporary American dietary practices, but it has a long preceding history of human use. Caffeine is a type of phytochemical known as an alkaloid, a diverse class of nitrogen compounds that are found in a wide number of plants serving various protective purposes. The adaptive value of caffeine for plants is that it wards off insect grazing (Etkin 2006:10). It is unique in the fact that it is found in a wide variety of plant species, providing an indigenous source across the globe in various plants. Although many plants contain alkaloids, only a relatively small selection of compounds are readily sought by humans for their psychotropic properties. Because of human's unique relationships to these plants in the form of domestication, harvesting, transporting, selling, and consuming, these plants take on a social identity as well. Caffeine emerged embedded in a context of stimulated social intellectualism. In its various global contexts, caffeine is used simultaneously as a recreational drug, a medicinal substance, and a food. The most globalized sources of caffeine include coffee, tea, caffeinated sodas, and energy drinks.

How did caffeinated plants become identified as useful and integrated into the cultural norm of behaviors? Anthropologist Nina Etkin teases apart the factors impacting food preference and selection. Our "organoleptic" sensory experiences are not only a response to plant's phytochemicals, but are also integrated with subjective interpretation as well. The experience of a food or medicine is thus not just the presence of a sensory

stimuli, but also an expression of the "interrelations among polysensory and cognitive factors that are influenced by genetics, age, sex, diet, circumstances of health (including medication), individual and group experiences, and cultural (re)constructions of the meanings and measure of organoleptics" (Etkin 2006:30). Due to varying properties and mechanisms-of-action, our responses to food/medicines can be immediate or more far removed, in what Etkin refers to as a proximal-distal continuum (Etkin 2006:33). At the proximal end, she notes that food that elicits a relatively fast reaction such as bitterness is usually quickly judged. At the distal end of the spectrum, however, foods may become more ingrained in cultural knowledge than in immediate sensory experience. The bitterness of coffee, for example, is overcome partially through cultural habituation, and partially with the co-administration of sugar. Etkin contends that appetite is thus not only biologically constructed, but also "culturally reconfigured into appetites called cuisines, which represent complex cycles of pattern and social process" (Etkin 2006:36). Food is partially evaluated via biological mechanisms and cultural appetites, but other impressions of food stem from social order involving identity, status, authority, and reciprocity (Etkin 2006:36). Food extends beyond the sensory, and inscribed with meanings about who we are, and where we stand in relation to others.

Each source of caffeine changed the cultural landscape in some manner; the stimulant brought about culturally and economically significant gathering places of consumption through the formation of coffeehouses, teahouses, the café, and soda shops.

COFFEE

"Coffee is a material substance, but culture infuses coffee with social and symbolic meanings" writes anthropologist Catherine Tucker (2011:6). Coffee drinking

expresses cultural values, forms individual identity, and reinforces social ties between us. Coffee culture can be seen in the discourses, rituals, and meanings associated with coffee. Most caffeine sources are consumed primarily at their place of origin, with the exception of coffee—in which major consuming nations are far from the sites of production. The emergence of the coffeehouse also marks a unique cultural life of coffee—one that "can recreate and symbolize the global influence of Western coffee culture while expressing the uniqueness of a specific locale or cultural context" (Tucker 2011:9).

Caffeine from *Coffee arabica* was originally consumed via the leaves and fruit in Ethiopia (Etkin 2006; Courtwright 2001). The most well-known origin story of coffee is that of Khaldi's dancing goats, recorded in the 1671 *Discurso sobre a salvberrrima bebida chamda cahve, ov café* by the monk Antonius Faustus Nairon (Satin 2011). It was said that in the Ethiopian Highlands, a goat herder by the name of Khaldi found his goats dancing about in the midst of the night after eating berries off of an unknown bush. The herder brought back the berries from the bush, which though were bitter and unpleasant to chew, did afford him the energy to remain focused during extended prayer. The story continues through the accidental discovery of roasting and brewing the seeds of the berries, with the final product being portrayed as a miraculous discovery for both work and prayer. The origin story integrates the psychoactive effects of the substance as observed in the animals, the development of preparation for human consumption, and the integration of the psychoactive substance into cultural life.

The regular practice of roasting the beans of coffee berries emerged around 1470 in nearby Yemen, potentially affording an alternative to *khat* (*Catha edulis*) (Courtwright 2001; Morton 2011:91). The high concentration of caffeine, a bitter alkaloid, necessitates

roasting in order to afford palatability. The Maillard reaction is responsible for the changes that occur when green coffee beans are roasted. When the beans are heated, the carbonyl group of the sugar reacts with amino acids in a non enzymatic browning (Morton 2011:68). The drink spread throughout Arabia as coffeehouses found their way into the cultural landscape. Smoking of tobacco was also common in coffeehouses, encouraging further caffeine consumption through the secondary effect of increasing the rate caffeine is metabolized out of the body. Morton writes of the complex relationship between Islam and coffee, being useful for long nights of prayer, but also contributing to the potentially seditious gatherings of coffeehouses which were a source of competition for the attention of followers. Coffee then faced repeated cycles of being condoned and condemned by religious and political leaders.

Although coffeehouses have existed for over 500 years, Tucker suggests they have faced rapid expansion due to globalized consumer culture, aesthetic appreciation of quality coffee, as well as the emergence of the internet café (2011:3). Intellectual endeavors have been noted to pair well with caffeine. The first coffeehouse in England was strategically opened in Oxford in 1650, marking the earliest cultural integration of caffeination and higher education. Early coffeehouses were called "penny universities" where one could receive great intellectual stimulation for the small price of a cup of coffee. Since its earliest uses, caffeine has been used as a social lubricant. Yet unlike alcohol, it is workplace and daytime appropriate. Molecular biologist Morton Satin reflects on this in his book *Coffee Talk,* "…coffee relaxes people enough to feel comfortable talking with one another while keeping thoughts clear and focused" (2011:25).

French novelist Honore de Balzac was known for his excessive coffee consumption, and wrote of Italian composer Gioacchino expressing coffee as an "affair" which lasts just long enough to compose an opera. In "The Pleasures and Pains of Coffee" Balzac also discusses the ways in which coffee can be used to further intellectual pursuits, escalating to "a horrible, rather brutal method that I recommend only to men of excessive vigor, men with thick black hair and skin covered in liver spots, men with big square hands and legs shaped like bowling pins." His suggestion was to consume a thickly brewed cold coffee on an empty stomach.

> The coffee finds nothing else in the sack, and so it attacks these delicate and voluptuous linings; it acts like a food and demands digestive juices; it wrings and twists the stomach for these juices, appealing as a pythoness appeals to her god; it brutalizes these stomach linings as a wagon master abuses ponies; the plexus becomes inflamed; sparks shoot all the way up to the brain. From that moment on, everything becomes agitated. Ideas quick-march into motion like a battalions of a grand army to its legendary fighting ground, and the battle rages.
> (Honore de Balzac, Translated by Robert Onopa 1996:275)

As evidenced in Balzac's recommendation of this concoction to be only consumed by the most masculine of men, coffee became a source of expressing particular ideas about gender. This was further revealed in the satirical 1674 *Women's Petition against Coffee*.

Coffee in the New World "did not serve as centers of intellectual endeavor but focused more on the needs of specific classes and the individual trades" (Morton 2011:133). Coffee consumption did not gain mass popularity until the American Revolution, something Morton attributes partially to anti-British sentiments. British attempts to limit colonist's access to coffee were successful only until the early 1800s, when the U.S. gained increased access to coffee from Brazil.

The United States represents about 20 percent of the world's total coffee intake, and is the world's largest coffee consuming nation. Per capita consumption is highest in Finland, Norway, Iceland, Denmark, Switzerland and Sweden, all of which exceed 3 cups per capita, compared to the 1.6 cups per capita in the United States (Tucker 2011). United States population size, economic power, consumer culture, and preference for coffee played a role in shaping the global demand for coffee. Coffee has found its way into home life, learning life, working life, and social life. It has permeated every aspect of life, conforming to specific cultural contexts and uses.

The early modern coffeehouse has been heralded as "incubators of liberal and revolutionary ideas" (Courtwright 2001:20) that attracted wide-awake intellectual banter and progress. The theme of progress and awakening, in both their physical and metaphorical forms, is reflected in coffee culture. In its earliest uses, coffee beans were used to create a lard paste for use during long hunting trips--a pattern of usage shifted to the modern workplace in the form of brewed beans. Coffee found prevalence in Europe by the mid seventeenth century through the same model of distribution used in the Middle East—the coffeehouse. Caffeine's stimulatory effects helped both hunters and modern office workers bring home the proverbial, and literal, bacon by reducing fatigue. In America in the 1970s, it took the average American "just 30 seconds of work to pay for a cup of coffee" (Courtwright 2001:22). Coffee is reflected in other aspects of culture such as music, from Bach's "Coffee Cantana," to Ella Fitzgerald's "Black Coffee."

TEA

The history of tea may be more than 5,000 years old but the earliest recorded origin story is that of China's third century mythical emperor Shen Nung marked the discovery of tea when leaves from *Camellia sinensis* purportedly blew into a pot of boiling water. Tea's earliest uses are seemingly quite medicinal, with early blends including ginger and citrus (Etkin 158). Cultural meanings extended beyond medicinal properties, as "the ancient Chinese herbalists' and healers' search for soul substance lay the seeds of Taoist thought, which would elevate tea from simple remedy to nothing less than sacred beverage and elixir of immortality" (Hohenegger 2006:9).

Colonialism played a large role in extending access to tea across the globe, while tea plantations served to be quite profitable in the British and Dutch colonies of Indonesia, Ceylon, and India (Etkin 2006:159). Tea was increasingly affordable after 1713 when the British East India Company established direct trade with Canton (Courtwright 2001:22). As tea was globalized, it was also ritualized in its usage in specific local contexts. Teahouses were also initially a male-dominated scene, similar to that of coffeehouses in gender inequality.

Variations in tea types are created through variations in harvest times and fermentation processes. White tea is made by harvesting leaves early, while green tea is harvested later. Both white and green tea are steamed after harvest, whereas black and oolong tea go through a process of fermentation. Tea is grown in over twenty-five countries and is found in more than 2000 varieties (Etkin 2006:160). The medicinal value of green tea has been recognized in not only traditional Chinese medicine but also the countries that trade routes expanded access to. Tea contains compounds other than caffeine known as flavonoids that may alter how caffeine affects the body. These

antioxidants have been found to be protective against cancer, high blood pressure, and various other conditions. Tea has become increasingly popularized in the United States in the past decade. Primarily in the form of iced tea, it has provided a welcome alternative throughout the 21st-century decline in soft-drink consumption.

CAFFEINATED SODA

The addition of caffeine to other beverages was not possible until the ingredient was extracted from its natural plant sources. In 1819 Friedleib Ferdinand Runge extracted caffeine from coffee beans under the request of the poet Goethe (Morton 2011:76). As was the case with coffee, caffeine was added to the newfound creation of soft-drinks in conjunction with sugar to mask the bitterness of the alkaloid. The Coca-Cola Company is largely responsible for the prevalence of bubbly, sugar-laden caffeinated beverages. Medical doctor Harvey Wiley, later known as the "Father of the Pure Foods and Drug Act," took Coca-Cola to court in 1911 under the accusation that caffeine was a substance too dangerous for children to be unlabeled and marketed, resulting in a halving of the caffeine content (Courtwright 2001:26). The globalization of Coca-Cola began in World War II, when the drinks were distributed to United States military stations across the world. Soda is good business because in it you are selling two addictive substances: sugar and caffeine. The cost of production is low, but the cultural value created from aggressive corporate branding means that people are willing to pay large mark-ups on a penny's worth of caffeine and sugar.

AMERICAN PATTERNS IN CAFFEINE CONSUMPTION

The previous estimation of U.S. caffeine consumption per capita was 120 mg/day, with 53% of this coming from coffee consumption (Knight et al. 2004). The most recent consumption study found this average is now higher at 165/mg day (Mitchell et al. 2013). The study by Mitchell et al. (2013) recruited a representative sample of 37,602 participants to complete a weeklong beverage record. The study found that approximately 85% of the U.S. population consumes caffeine on a daily basis, with most of this caffeine coming from coffee (64%). While coffee intake has increased, carbonated soft drinks (CSDs) consumption has been on the decline. In 1999 carbonated soft drinks accounted for 29% of caffeine consumption, while current rates reflect CSDs accounting for 17% of U.S. caffeine consumption. Rates of caffeine from tea have remained stable, however, perhaps reflecting the newfound preference for green tea, which has a lower caffeine content.

Caffeine intake generally increases with age. The Mitchell et al. study found a surprisingly high rate of 43% of children ages 2 to 5 years of age being exposed to caffeine regularly, while those over the age of 65 had a nearly 100% rate of caffeine consumption. The highest consumption level was found in the age range from 50 to 64 years of age. It was found that men consumed more total caffeine than women, but when accounting for body weight, this effect was reversed. 10% of participants reported using energy drinks, which accounted for only 4.3% of caffeine consumption. This perhaps suggests that while these products are widely available, they are more likely to be used on an occasional basis, whereas coffee is more likely to be used habitually. Additional research by Norton et al. (2011) and Liberman et al. (2012) suggests that energy drinks are more likely to be used by particular subsets of the population, such as college students

and military personnel. 42% of college undergraduates reported usage of the drinks, accounting for an average of 53 mg of caffeine per day (Norton et al. 2011). A similar percentage (39%) of military personnel report using energy drinks (Lieberman et al., 2012)

Personality traits may also play a role in seeking a caffeine-rush. Penolazzi et al. conducted research that suggests caffeine intake is higher for males, older people, cigarette smokers, as well as those with higher scores of impulsivity, sensation seeking, and a facet of Reward Sensitivity (2012). Earlier research found a positive correlation between caffeine consumption and extroversion (Landrum 1992).

U.S. CAFFEINE POISONING REPORTS

Reports to local poison centers in the United States concerning caffeine are relatively common, with thousands of cases of overdose reported every year. Comparatively speaking, caffeine cases reported in the Poison Control Centers' National Poison Data System (2012) are close to but below the number of poisonings reported for methamphetamines (3,847) and heroin (3,978), the difference of course being the severity of outcomes. In 2012, 3,401 cases of caffeine overdose were reported. These were primarily reported in younger groups, which may reflect that concerned parents are more likely to report to poison control centers than adults who have overdosed. 925 caffeine overdose cases were reported in children under the age of 5, 105 cases were 6-12 year olds, 377 13-19 year olds, and 915 cases over the age of 20. 1,420 cases were unintentional, while 671 are categorized as intentional. No outcome data was available for 398 cases, while 450 case outcomes were classified as minor, 304 classified as moderate, three classified as major, and one death was reported.

In 2012, there were 957 Energy Drink poisonings containing caffeine of any source, including coffee-derived caffeine, and other plant sources. Other plant sources of caffeine include guarana, a more concentrated source of caffeine than coffee, derived from the plant *Paullinia cupana*, found in Brazil. Other additives to energy drinks include kola nut (*Cola acuminate*) of African origin, and yerba mate (*Ilex paraguariensis*) found in South America. 422 of energy drink overdoses were deemed unintentional, 155 intentional, and 8 unknown. There were 1,369 energy drink poisonings reported from energy drinks containing synthetic caffeine only (without guarana, kola nut, tea, yerba mate, etc.). Of this group, 666 of the poisonings were unintentional, while 168 were intentional. Unknown energy drinks and the ever-expanding category of energy products accounted for 663 and 368 cases, respectively. For unknown energy drinks, 270 cases were unintentional and 103 intentional. For unknown energy products, 164 cases were unintentional and 57 unintentional.

The combination of ethanol and caffeine represents a smaller segment of reports to poison control centers. A total of 218 ethanol and caffeine overdoses were reported, but the pattern of intentionality is reversed; the 50 intentional poisonings outweigh the 23 reported unintentional cases. Outcomes were also more severe for the combined ethanol and caffeine poisonings, with 3 of the cases yielding a rating of "major," while most of the outcomes reported for energy drinks alone were minor to moderate. A concern that will likely arise in future reports is deaths due to synthetic caffeine powder, often sold over the internet in bulk. In 2014, the FDA issued a warning to consumers that caffeine powder played a role in the death of teenager Logan Stiner in Ohio on May 27th, 2014, and should not be used due to the ease of accidental overdose. Caffeine powder is

dangerously concentrated, currently unregulated, and while the FDA warns consumers to steer clear of the powder, they also note to file a report if experiencing adverse effects.

RISK AND REGULATION OF CAFFEINE PRODUCTS

Vulnerable populations, namely pregnant women and children, have been the driving factor in regulatory changes around caffeine. While the safety of the substance is generally accepted for most adults, the widespread prevalence of caffeine became a point of concern when considering its differential effects on pregnant women and children. Another concern regarding particular younger subgroups is that caffeinated products are available without age restriction, a topic also mentioned in relation to the few well-publicized deaths of teenagers who consumed caffeine powder, pills, or energy drinks and suffered fatal heart attacks.

In 1978, the consumer group Center for Science in the Public Interest filed a petition to the FDA requesting warning labels on caffeinated products. This prompted research into the effects of caffeine consumption during pregnancy, which found decreased skeletal growth in animals birthed from mothers given the equivalent of two cups of coffee a day, while high doses resulted in more severe disfigurements such as missing toes in rodent studies (FDA Report on Caffeine 1980). In 1980, the Food and Drug Administration voiced its first concerns regarding caffeine consumption and health effects. Animal studies under the direction of Thomas Collins suggested that caffeine consumed during pregnancy could lead to birth defects, yet the application of this information to humans was deemed "inconclusive" by FDA commissioner Jere Goyan, leaving the nation with a relatively vague warning of danger, at some level, for some specific groups.

The concern from physicians was that this information may actual be *harmful* to women who had already been warned to stay away from alcohol and smoking, because this additional restriction would make women feel guilty for being responsible for infant defects (FDA 1980). The coffee industry also considered these conclusions on caffeine risks to be premature, and inapplicable to humans due to differences in how humans and rats metabolize caffeine. A number of epidemiological studies at the time, however, suggested there may a relationship between caffeine consumption and birth defects in human populations as well.

In 1989 the FDA limited the caffeine in over-the-counter medications to 200 mg per dosage. Added caffeine in beverages is limited to 0.02% of total liquid content. The amount of caffeine is not required to be disclosed on packaging, but the presence of added caffeine must be listed in the ingredients list. The Dietary Supplement Health and Education Act (DSHEA) of 1994 resulted in dietary supplements being unregulated, meaning there are no requirements to disclose the amount of caffeine in dietary supplements.

2002 marked the first year of major production of products containing both alcohol and caffeine (Caffeinated Alcoholic Beverages, or CABs), with usage peaking between then and 2008 when sales increased 67-fold (Report to Congress on the Prevention and Reduction of Underage Drinking, 2011). In 2010, the FDA issued warning letters to manufacturers producing products combining caffeine and alcohol in beverages after evidence suggested these products put people at risk of dangerous health effects and behaviors (Benac 2011). These caffeinated alcoholic beverages (CABs) are

malt or distilled-spirit based drinks with an average alcoholic content of 12 percent, often sold in large cans containing around four standard servings of alcohol (FTC 2010).

In 2010, the United States Centers for Disease Control and Prevention reported that caffeine in combination with alcohol masks the impression of intoxication without actually altering blood alcohol level. Binge drinking was found to be three times more likely among CAB consumers in relation to those who do not mix caffeine and alcohol. The behavioral effects of these beverages also had dramatic implications for the health and safety of young women. Research indicated that drinkers of alcohol and energy drink combinations were twice as likely to be taken advantage of sexually, to take advantage of someone else sexually, and to ride with an impaired driver (O'Brien et al. 2008).

Due to the evidence of the danger to youth behavioral health and safety, a number of actions have been taken to reduce the availability of CABs. In May of 2007, twenty-nine State Attorneys requested Anheuser-Busch halt production of a product called Sypkes, which was voluntarily pulled off the market. In August of 2007, thirty SAGs sent a letter to the Alcohol and Tobacco Trade and Tax Bureau to request an investigation of CABs promotional claims. In June of 2008, Anheuser-Busch signed an agreement to remove caffeine and stimulants from their beverages and to avoid marketing future CABs. In December of 2008, MillerCoors also signed an agreement to remove caffeine from their beverages and to refrain from producing CABs in the future. In September of 2009, the Co-Chairs of the National Attorneys General Youth Access to Alcohol Committee sent a letter to the commissioner of the FDA requesting the removal of CABs from the marketplace after summarizing the health risks associated with consumption.

Pressure from the Federal Drug Administration, the Federal Trade Commission, and the Alcohol and Tobacco Tax and Trade Bureau resulted in all four major producers of CABs pulling their products off the market. This reduced the availability of premixed alcohol and caffeine, but does not prevent people from mixing caffeine and alcohol of their own volition, or requesting a mixed cocktail in bars. Ferré and O'Brien (2011) suggest the dangers of mixing alcohol and caffeine are due to the fact that by blocking the adenosine A1 receptors, caffeine negates the somnogenic and ataxic effects of alcohol.

Caffeine has recently found its way into all kinds of food products, ranging from gum and mints to waffles and water. An inhaler-type product called Aeroshot went on the U.S. market in 2012 that caught the attention and criticism of Democratic Senator Chuck Schumer of New York, who issued the following statement:

> The AeroShot caffeine-inhaler is being marketed as a party enhancer. It can facilitate excessive drinking and its effects have never been examined by independent regulators to determine their impact on the human body and in combination with alcohol, especially with adolescents
> (Anderson 2012:35)

This prompted a review from the FDA that soon followed with a warning letter similar to that sent to producers of caffeinated alcoholic beverages. While particular products have been subject to scrutiny, regulatory agencies have been supportive of moderate levels of caffeine intake. As of 2013, the FDA has advised the American public that caffeine consumption up to 400 mg a day is considered safe. This value reflects the recommendations of Health Canada issued six years prior in 2006 (Health Canada 2010; Benac 2011).

III. BIOLOGICAL BASIS OF INQUIRY

Research on the biological effects of caffeine typically focus on either the pharmacodynamics or pharmacokinetics of the drug. Pharmacodynamics is understood as how a drug acts on the body, which in the case of caffeine would be the mechanism of action on adenosine receptors in the brain. Although pharmacodynamics may account for some variation in caffeine responses, what is more directly related to cultural factors is the pharmacokinetics of the drug, defined as what the *body* does to the *drug* (Benet 1984:199). Pharmacokinetics includes how the drug is absorbed, distributed, metabolized, and ultimately excreted. The metabolism of caffeine is readily studied by pharmacologists largely for reasons other than understanding caffeine as itself. The reason for the prevalence of studies investigating the factors that impact caffeine metabolism is the fact that caffeine can be used as a tool for measuring the activity of hepatic enzymes responsible for drug metabolism. One particular enzyme accounts for 95% of caffeine metabolism, meaning that by measuring metabolic ratios excreted in urine, one can with some certainty determine how active this particular enzyme is.

PHARMACODYNAMICS

Caffeine's molecular structure is a methylxanthine. It functions primarily by blocking inhibitory adenosine, but also by inhibiting phosphodiesterase and increasing cyclic adenosine monophosphate (Pohler 2010). Since caffeine readily crosses the blood-brain barrier, it has the potential to affect the regulation of endogenous neurotransmitters. The complex web of neural structures as well as the interactions between

neurotransmitters and receptors leaves room for a number of points where exogenous drugs can disturb natural balances. Caffeine consumption causes up-regulation of 5HT, $5HT_2$, nicotinic, muscarinic, GABA receptors, and A1 adenosine receptors (Ribeiro & Sebastiao 2010) as well as down-regulation of B-adregenic receptors (Paton & Beer 2001). In addition to the large role played by adenosine receptors, it is also likely that the dopamine system plays a role. The adenosine receptors associated with caffeine are also related to dopamine D_1 and D_2 receptors. This interaction takes place "by antagonizing the actions of adenosine, caffeine acts indirectly to potentiate dopaminergic signaling" (Childs et al., 2008). These changes mean that even if caffeine is metabolized out of the body in a matter of hours, it can take from days to weeks for neurotransmitter regulation to normalize.

Studies have recently shed light on genetic differences in receptors that mediate the effects of caffeine. Adenosine receptor A_{2A} and dopamine receptor D_2 polymorphisms have been isolated as genetic mediators of caffeine's anxiogenic effects (Childs et al., 2008). Individuals with the A_{2A} T/T genotype, previously linked to panic disorder, also report higher anxiety levels after consuming 150 mg of caffeine.

Caffeine increases alertness and energy by reducing sleepiness and fatigue. It also has an effect on mood and level of arousal. The effects of caffeine on mood are found at fairly low doses, from 20-30 mg for some individuals, while 50-100 mg is sufficient to elicit a mood change for most. Caffeine-drinkers have been found to have a lower risk of suicide and fewer depressive symptoms (Lara 2010). Other positive effects of caffeine include enhanced alertness, reduced fatigue, improved performance in simple tasks requiring vigilance (Attwood, Higgs, & Terry 2007; Glade 2010; Lara 2010).

Regarding preference, individuals who choose caffeinated beverage over a placebo report are more likely to report positive effects, while those who choose placebo are more likely to experience adverse effects to caffeine (Lara 2010). Adverse effects with scientific support include impaired sleep, enhanced anxiety, increased blood pressure, and worsening of psychiatric symptoms (Juliano, Anderson & Griffiths 2011; Ogawa & Ueki 2007; Rihs, Muller & Baumann 1996). A study by Kristjansson et al. (2013) found caffeine consumption to be associated with violent behaviors and conduct disorder in children, with the effect being significantly stronger for boys than for girls.

A 2012 study by Renda et al. found significant increases in both systolic and diastolic blood pressure after administering caffeine. Further genetic testing of polymorphisms found the ADORA2A TT variant to be associated with greater increases in systolic blood pressure (Renda et al. 2012), the same gene found to be associated with caffeine sensitivity and panic disorder. Increased startle-responses to neutral and unpleasant stimuli was found in response to caffeine for the ADORA2A TT variant, with the effect being predominant in females (Domschke et al. 2012). It was also noted, however, that almost all of the female participants had been using oral contraceptives, which may have influenced the outcomes of the study. Of a sample of 110 participants, 53 participants had the TT genotype, while 57 had the CC/CT (non-risk) genotype.

After being absorbed into the bloodstream and brain quite rapidly, caffeine is then metabolized in the liver. Within the liver, hepatic enzyme CYP_{1A2} is responsible for metabolizing caffeine into paraxanthine, theobromine, and theophylline (Paton & Beer, 2001). These metabolites are also active stimulants, which may prolong stimulant effects beyond initial breakdown of methylxanthine. An additional level of complexity is added

by the discovery that the kinetics of caffeine is non-linear in nature. This means that metabolic pathways can become saturated at relatively low levels of consumption, and plasma concentrations no longer climb steadily in proportion to increased consumption. Instead, plasma concentrations and half-life increase exponentially with doses as low as 250-500 mg (Paton & Beer, 2001).

PHARMACOKINETICS

The enzyme responsible for metabolizing caffeine is part of a family of hemoproteins found mostly in the liver known as the Cytochrome P450 enzymes. The particular isoenzyme is CYP_{1A2}, which happens to be susceptible to changes caused by a number of endogenous and exogenous factors (Priller, Unger & Holzgrabe 2005:157). Exogenous factors include cigarette smoke, diets that include cruciferous vegetables such as broccoli, the consumption of grilled meats, and pharmaceutical drug administration. Endogenous factors that impact CYP_{1A2} activity include body weight, genetics, and liver disorders. These various factors act as either inducers or inhibitors of the enzyme, which in turn impact how quickly or how slowly the drug is broken down and excreted from the body.

Health psychologist and stress expert Jack E. James has written one of the most comprehensive resources on caffeine research in *Understanding Caffeine: A Biobehavioral Analysis* (1997). In a discussion of caffeine pharmacology and toxicology, James notes that there has been no systematic assessment of drug interactions between pharmaceutical drugs and caffeine. However, the drugs that have been noted to alter caffeine metabolism have been relatively well studied, with replicable results being published in the scientific literature.

A particularly common family of pharmaceutical drugs that alters caffeine metabolism is oral contraceptives. Oral contraceptives containing ethinyl estradiol have been shown to significantly prolong the elimination of caffeine through inhibiting CYP_{1A2}, with oral contraceptive users showing metabolic ratios that were 2.8 times higher than women not taking oral contraceptives (Granfors et al. 2005). Oral contraceptives are designated as a well-demonstrated moderate inhibitor of CYP_{1A2} in a "Med-Psych Drug-Drug Interactions Update" by Osterheld, Cozza and Sandson (2008). Jack E. James reviewed a number of studies that were published before the time of his publication (1997), after which James states this inhibition of caffeine metabolism should necessitate a "decrease in caffeine intake if significantly increased plasma caffeine levels are to be avoided" (28). This rise in plasma levels can ultimately result in caffeine toxicity.

It is unlikely any women who begin taking oral contraceptives would know of this effect. What James is stating as a necessary change in behavior is not accompanied by any sort of systematic way of educating women and prompting a change in consumption patterns. This inhibition of caffeine metabolism in oral contraceptive users has been demonstrated experimentally for over thirty years (Patwardhan et al. 1980), yet continues to be knowledge privy to those reading scientific journals. A simple discussion with the prescribing physician informing women of this interaction effect would be a step towards a more comprehensive system of wellness that makes an active effort to limit potential side effects.

Beyond women's reproductive health, there are other pharmaceuticals that impact CYP_{1A2} levels in both men and women. Some SSRIs have been found to alter CYP_{1A2}

activity, Fluvoxamine being an extremely potent example. Fluvoxamine, commonly known as Luvox, inhibits the enzyme that metabolizes caffeine to such an extent that the half-life of caffeine is increased from an average of 5 hours to 56 hours (Culum-Merdek et al. 2005). Fluvoxamine is prescribed not only for depression, but also for anxiety disorders. This interaction effect thus poses a potential threat to the psychological well-being if the patient is not informed of the changes in their metabolism of caffeine while on the drug. The significantly extended half-life of caffeine means the potential for accidental caffeine intoxication is increased if they continue to follow their regular consumption patterns.

Table 1: Examples of CYP_{1A2} Inducers and Inhibitors

CYP_{1A2} Inducers	**CYP_{1A2} Inhibitors**
montelukast, penytoin, tobacco smoke, moricizine, omeprazole, phenobarbital, lansoprazole	ciprofloxacin, enoxacin, fluvoxamine, methoxsalen, mexiletine, oral contraceptives, phenylpropanolamine, thiabendazole, zileuton, acyclovir, allopurinol, caffeine, cimetidine, Daidzein, disulfiram, Echinacea, famotidine, norfloxacin, propafenone, propranolol, terbinafine, ticlopidine, verapamil

(Food and Drug Administration, Drug Development and Interactions, 2011)

CYP_{1A2} enzyme levels have recently been the focus of attention of not only studies in pharmacology, but also those studying nutrition. Although the enzyme is important in drug studies since it acts to metabolize and aid in the elimination of substances from the body, CYP_{1A2} has also been identified as the site of activation for many environmental carcinogens. Researchers in nutrition are thus looking for ways to modulate levels of the enzyme as a way to protect against the oxidative effects of breaking down procarcinogens. Many dietary factors have since been identified as modifying CYP_{1A2} levels, particularly in regards to types of vegetables consumed. Food

choice and consumption is a vital aspect of culture, varying from group to group and individual to individual. These dietary factors thus constitute some of the cultural factors resulting in variation in responses to caffeine.

Cruciferous vegetables induce CYP_{1A2} activity in humans. This family of vegetables includes broccoli, cauliflower, brussels sprouts, cabbage, and bok choy. The induction of CYP_{1A2} was evaluated through measuring changes in caffeine kinetics, which were apparent following a 12 day period of consuming cruciferous vegetables (Murray et al. 2001). Apiaceous vegetables on the other hand, such as carrots and celery along with many plants used as seasoning, have been found to be CYP_{1A2} inhibitors.

CAFFEINE DISORDERS

Abnormal responses to caffeine have been categorized by the American Psychiatric Association as Caffeine-Related Disorders, a subset of clinical syndromes defined as Substance-Related Disorders in the DSM-IV. The inclusion of these clinical syndromes is followed by the admission that prevalence rates have not been established, making the process of inclusion and exclusion of symptoms unclear. Various caffeine-related disorders are included: *caffeine intoxication*, *caffeine-induced anxiety disorder*, *caffeine-induced sleep disorder*, *caffeine withdrawal*, and *caffeine-related disorder not otherwise specified*. The diagnostic criteria make the distinction that individuals must exhibit at least five of the listed symptoms, and that these symptoms must not be better explained by another disorder, such as an anxiety disorder.

The considerable degree of subjectivity involved in the diagnosis of mental disorders means that diagnostic criteria often leave a great deal of room for interpretation. Caffeine consumption often goes unquestioned in diagnostic settings. It would also be

neglectful to ignore the economic forces at play, particularly in light of the tight grasp the pharmaceutical industry has gained on American psychiatry. The caffeine industry and pharmaceutical drug industry are both fueled by the billions of dollars provided by our collective consumption, and avoidance of either pharmaceuticals or caffeine is without economic advantage. Therefore, despite the addition of these diagnostic categories regarding caffeine, various forces contribute to their general disregard.

CAFFEINE INTOXICATION

Caffeine Intoxication is one of the caffeine disorders included in the APA DSM-V and World Health Organizations ICD-10. Symptoms include restlessness, nervousness, excitement, insomnia, flushed face, diuresis, gastrointestinal disturbance, muscle twitching, rambling flow of thoughts or speech, tachycardia or cardiac arrhythmia, periods of inexhaustibility, and psychomotor agitation. Criteria for diagnosis include recent consumption of caffeine, five or more off the listed symptoms, and impairment in functioning that is not explained by another disorder. Articles published in the field of nursing note that caffeine intoxication "may manifest itself in many ways and is often difficult to distinguish in the presence of a vague patient history or chief complaint" (Pohler 2010).

High doses of caffeine may result in a hyperadrenergic syndrome causing seizures and cardiovascular instability. Patients have been reported to often present with nausea and emesis as well as psychological effects such as nervousness and sleep disturbances. Symptoms of more concern include hypokalemia, hypomagnesemia, hyposphatemia, and hyperglycemia. Seizures are also a possibility. Differential diagnosis includes acute respiratory distress syndrome, hyperthyroidism, anxiety disorder, sleep disorder, bipolar

disorder, and substance abuse (Pohler 2010). Suggested treatment for caffeine intoxication in the nursing literature primarily focuses on controlling the previously described symptoms. Antacid is suggested for gastritis, metoclopramide or ondansetron for emesis, and diazepam or lorazepam for anxiety or seizure activity.

Caffeineism is a syndrome thought to result from chronic consumption of caffeine and physiological dependence on the substance. Symptoms of caffeinism include nervous irritability, tremulousness, muscle twitching, sensory disturbances, tachypnea, palpitation, flushing, arrhythmias, diuresis, and gastrointestinal disturbances. Pohler notes that patients may present with generalized anxiety or depression. "Because many do not view caffeine as addictive, patients may not think to provide a careful caffeine history" (Pohler 2010).

In withdrawal from caffeine, the most common symptom is a headache. Duration of withdrawal can range from two days to one week, and has been reported in adolescents as well as adults. It is suggested that healthcare practitioners take special care to consider caffeine consumption when treating patients with hypertension, diabetes, gastroesophageal reflux disease, or irritable bowel syndrome. NPs are advised to taper patients' caffeine consumption down over time. "Patient education plays a key role in clinical practice. Promoting moderation, counseling on the acute adverse effects, as well as imparting an understanding of the addictive properties of caffeine is essential" (Pohler 2010).

A study of individuals seeking treatment for caffeine dependence found an average of 548 mg daily caffeine consumed, with the most common primary source of caffeine being coffee (Juliano et al. 2012). Criteria met for substance dependence criteria

were withdrawal (96%), persistent desire or unsuccessful attempts to control use, and use despite knowledge of physical or psychological problems caused by caffeine (87%). Most common reasons for wanting to modify caffeine use were health-related (59%) and not wanting to be dependent upon caffeine (35%).

CAFFEINE-RELATED FATALITIES

While caffeine-related fatalities remain relatively rare, case studies reveal death by caffeine is possible in the presence of a heart condition, or through overdose (Holmgren, Norden-Pettersson & Ahlner 2003). The cause of death is often ventricular fibrillation, while other toxic effects include vomiting, agitation, altered consciousness, and arrhythmias. Overdose may be accidental in some cases, but is often intentional, and sometimes suicidal in nature. The potential for overdose via caffeinated beverages is less likely to be fatal, but the availability of caffeine pills poses a greater danger for suicide risk. A study in Sweden compared the risk of fatal caffeine intoxication before and after the implementation of restrictions on the quantity of tablets available for sale. Thelander et al. (2010) found the sales restrictions resulted in statistically-significant reductions in fatal caffeine intoxication, suggesting that regulatory measures can be useful in preventing overdose.

IV. RESEARCH METHODS

The research methods of this thesis were approved by the Institutional Review Board of FAU prior to data collection, included in Appendix E. Although the original study design included both digital survey methods and face-to-face ethnographic interviews, data saturation was reached via the online survey methods. The online surveys yielded many lengthy, often multi-paragraph responses to the short-answer questions, providing a rich pool of qualitative data to supplement the quantitative statistical analyses. Digital ethnography is a relatively new, yet rapidly expanding tool utilized in social science research. The benefits of digital research include access to participants unbounded by the restraints of time and geography, ease of referrals, and anonymity of participants. Most notably, an increased richness of intimate data disclosed in free-response has been noted by many researchers (Miller & Slater 2000; Murthy 2008).

One hundred participants were recruited to complete the survey, with the only excluding factors being over 18 years of age and living in the United States. Two separate but linked digital surveys were used to collect quantitative and qualitative data on caffeine consumption, perceptions, and effects. The survey was conducted through PsychData.com, allowing for informed consent and encryption of data to protect the anonymity of participants. Participants were free to skip any questions they did not feel comfortable answering, but there were few missing values and all surveys were finished to completion. Participants were recruited through the posting of flyers, email

announcements, and personal referrals. Data collection took approximately two weeks of advertising and recruitment.

In the primary survey, participants were asked a number of questions regarding demographics, consumption patterns, perceptions and beliefs, tolerance and sensitivity, motivations for consumption, poly-drug use, and encounters with medical professionals. At the completion of the primary survey, participants were asked if they have experienced multiple cases of adverse reactions to caffeine. The answer "No" lead to the end of the survey, while "Yes" redirected to a secondary survey consisting primarily of free-response questions regarding adverse reactions. These two surveys were linked via an identification code, so that participants' responses to the second survey could be linked to the data provided in the primary survey. A complete copy of the survey questions can be found in Appendix A and B.

Data analysis was conducted using IBM SPSS Statistics Desktop 22.0 for quantitative statistical analysis. The survey responses were uploaded to a SPSS data file directly from the PsychData server. No identifying information was retained from any participants, and upon upload to SPSS, identification codes were changed to randomly generated pseudonyms. SPSS was used to tabulate frequencies, conduct independent samples t-tests, one way ANOVAs, and correlations.

Most responses were accurately labeled and coded in SPSS in accordance with the survey questions, with the exception of questions with lists directing to "select all that apply." These multi-selection checklist-type questions were recorded in the PsychData dataset as individual variables coded as "Checked" or "Unchecked." These variables were re-coded to reflect "Yes" or "No" for each of these variables. A number of variables

were transformed via formulas to provide more useful data. Total number of cups for each caffeine source was transformed into an estimate of average caffeine consumption in milligrams. The formula for transforming this variable multiplied the number of cups by the average caffeine content of these beverages (Coffee = 135 mg, Black tea = 50 mg, Green tea = 30 mg, White tea = 15 mg, Caffeinated soda = 30 mg, Energy drinks = 80 mg). The total number of adverse effects is also a calculated variable that tabulated the number of effects selected from the three sets of symptoms. The three sets of symptoms reflect the APA diagnostic criteria for Caffeine Intoxication (A1), reported adverse reactions in the pharmaceutical database (A2), and a selection of symptoms derived from a search of online discussion boards (A3).

Narrative authors were assigned pseudonyms and the narratives were reviewed for common themes. Qualitative data was then grouped to either clarify patterns in the quantitative data output, or in relation to general usage patterns and perspectives. Particular attention was paid to narratives of hospitalizations, worsening of psychiatric symptoms, explanatory frameworks regarding overdose, motivations for consumption and context of effects.

V. RESULTS

STATISTICAL ANALYSIS

The results of the study and analysis will be explained through describing the participant characteristics, presenting the statistically significant associations, and presenting illness narratives of those who have reported repeated cases of adverse reactions to caffeine. Quantitative analysis consists of frequencies, t-test, correlations, and One-Way ANOVAs using SPSS.

The characteristics of participants are listed in Table 1 on page 47, shown in number of participants rather than percentage. Totals of less than 100 are due to questions skipped by participants. Pertinent trends and findings to note include more female participants than male, a high percentage of participants between the ages of 21 and 30, and a relatively high average daily dosage. The percentage of young participants is likely due to recruitment on a college campus, with 41.2% of participants reporting to be students.

Table 2. Characteristics of Sample Population

Gender	**Female**: 55 **Male:** 43	
Age Range	**18-20:** 6 **21-30**: 54 **31-40**: 11	**41-50**: 5 **51-60**: 18 **61-70**: 3
Working Status	**Full-Time:** 52 **Part-Time**: 29 **Non-Working:** 14	
Student Status	**Student**: 40 **Non-Student**: 57	
Caffeine Attitudes	**Positive**: 59 **Mixed:** 25 **Negative:** 13	
Daily Dosage	**Average:** 454.75 mg **Range**: 0 – 1,200 mg	
Adverse Effects	**Average**: 7.2 symptoms **Range**: 0 – 32 symptoms	
Knowledge of Caffeine-Related Disorders	6 out of 100 participants	

Table 3. Frequencies of Adverse Effect Symptoms

Restlessness	50%
Diuresis	49%
Insomnia	47.9%
Excitement	47.4%
Anxiety	41.7%
Gastrointestinal disturbance	37.5%
Tachycardia or cardiac arrhythmia	32.3%
Nervousness	31.3%
Diarrhea	29.2%
Psychomotor agitation	28.1%
Rambling flow of thoughts and speech	26%
Nervous system stimulation	24%
Lightheadedness	24%
Muscle twitching	22.9%
Feelings of Overstimulation and Panic	20.8%
Nausea	20%
Dizziness	20.8%
Inability to Concentrate	17.7%
High Blood Pressure	10.4%
Chest Pain	10.4%
Flushed face	10.4%
Photo-sensitivity	9.4%
Periods of inexhaustibility	8.3%
Vomiting	4.2%
Weakness	4.2%

Italicized Symptoms are APA Diagnostic Criteria. Bolded Symptoms are from Pharmacological Data.

The APA diagnostic criteria reflected the most commonly reported adverse effects, but some symptoms from the pharmacological data such as anxiety and diarrhea were also fairly common. The most commonly reported adverse effect experienced was restlessness, with half of participants reporting this effect. Participants were also likely to experience diuresis (49%), insomnia (47.9%), and excitement (47.4%). An important distinction to consider in relation to the APA criteria is that participants were more likely to report feeling anxiety (41.7%), which is not currently an APA symptom, than nervousness (31.3%).

Table 4. Significant Associations to Number of Adverse Effects

Associations to Adverse Effects	Significant	Non-Significant
Tolerance	$p < .001$, $F(2,92) = 7.57$	
Student Status	$p < .001$, $t(47.643) = 3.531$	
Sensitivity	$p < .01$, $F(2,92) = 5.696$	
Attitudes	$p < .05$, $F(2,91) = 4.307$	
Prescription medications	$p < .05$, $t(44.857) = -2.419$	
OTC medications	$p < .05$, $t(45.991) = -2.262$	
Perceived overindulgence	$p < .05$, $t(83) = 2.392$	
Dosage		$p > .05$, $r(93) = .062$
Gender		$p > .05$, $t(93) = -.408$
Tobacco		$p > .05$, $t(36.423) = -1.271$
Alcohol		$p > .05$, $t(88.999) = -1.811$

A statistically significant association was found between the number of adverse effects experienced and a number of variables, including self-reported tolerance, sensitivity, attitudes towards caffeine, perceptions of overindulgence, student status and usage of prescription or OTC medications. No significant association was found for daily dosage, gender, or tobacco or alcohol usage.

TOLERANCE

A one-way ANOVA yielded significant variations in the average number adverse effects according to reported tolerance level ($p < .001$, $F(2,92) = 7.57$). Participants chose

from three levels of tolerance: Intolerant, Relatively Tolerant, and Extremely Tolerant. Equal variances are assumed due to the non-significant results for Levene's test of homogeneity of variances ($p > .05$). The extremely tolerant level was defined to participants as the ability to consume large doses with no adverse effects. Extremely Tolerant participants had an average of 5.2353 adverse effects reported (SE = .9759), the lowest number of effects for of all tolerance levels. Relative Tolerance was defined as the ability to consume low to moderate doses with no adverse effects. Relatively Tolerant participants reported an average of 6.4 adverse effects (SE = .6898), slightly higher than the extremely tolerant participants. Post-hoc tests reveal this difference was not statistically significant ($p > .05$). Intolerance was defined as experiencing adverse effects at relatively low doses. Intolerant participants had much higher number of adverse effects reported, the average being 11.7222 (SE = 1.7939). Tukey post-hoc tests revealed the variation in means to be significant between the Intolerant and Relatively Tolerant groups, as well as the Intolerant and Extremely Tolerant group ($p < .05$), but not between Extremely Tolerant and Relatively Tolerant. These results suggest that self-defined intolerance may be a useful indicator of relative risk for adverse effects in response to caffeine, but that a two-level scale is adequate.

SENSITIVITY

Sensitivity level was also found to have a significant association with the average number of adverse effects reported according to a one-way ANOVA ($p < .01$, $F(2,92) = 5.696$). While the Tolerance variable reflects the perceived threshold for *adverse effects*, the Sensitivity variable reflects the perceived threshold for *stimulation*. Three levels of sensitivity were described for participants, including Not Sensitive, Relatively Sensitive,

and Extremely Sensitive. The Not Sensitive group was defined as not responsive to low or moderate doses (M = 4.56, SE = .87002), Relatively Sensitive is defined as responsive to moderate doses (M= 7.2449, SE = .75847), while Extremely Sensitive (M = 10.2381, SE = 1.666) is defined as very responsive to low doses. Tukey post-hoc tests reveal that the statistically significant difference in adverse effects reported is between the Not Sensitive and Extremely Sensitive groups. The differences between Relatively Sensitive and Extremely Sensitive were not significant, nor were the difference between Not Sensitive and Relatively Sensitive.

Explanatory models for perceived sensitivity to caffeine were evaluated via selection of factors perceived to impact personal response to caffeine. The highest frequency of explanatory factors involved was for tolerance, with 58.3% of participants reporting they believe this plays a role in their relative sensitivity to the stimulating effects of caffeine. 29.2% of participants believe metabolism plays a role, 28.1% selected weight as a contributing factor, 26% selected genetics, 15.6% perceive gender as a contributing factor, while diet and stress level received only 13.5% of responses each.

ATTITUDES

One-way ANOVA results found attitudes towards caffeine were found to be associated with the number of adverse effects experienced ($p < .05$, $F(2,91) = 4.307$). There is no way to discern the direction of causality of these associations, but it is likely there is some degree of bidirectional influence. Do negative perceptions of caffeine produce a recall bias that influences participants to remember and report more adverse effects? Or does experiencing the adverse effects result in negative perceptions of the substance? Both may play a role, and further research on the relationship between

attitudes concerning caffeine and adverse effects to the substance could provide further evidence to elucidate the directionality of causality. Perceived overindulgence also yielded significant variation in sample means of adverse effects ($p < .05$, $t(83)= 2.392$).

Most participants (n= 58) reported having a Relatively Positive relationship with caffeine. This group had the lowest average number of adverse effects reported at 5.7759 symptoms (SE = .6582). Interestingly, the group with the highest average number of adverse effects was not the Negative group, but the Mixed or Ambivalent group. The 24 participants who reported being Mixed or Ambivalent about caffeine had an average of 9.6667 (SE = 1.0541). The 12 participants who reported having a Primarily Negative relationship to caffeine reported an average of 7.75 adverse effects (SE = 2.37769).

What accounts for the elevated adverse effects reported by the Mixed or Ambivalent group? Post-hoc tests determined the significant difference in means to be between the Positive and Mixed/Ambivalent Group, while the difference between Negative and Mixed and Negative and Positive were not statistically significant. This may suggest that people who have a negative perception of caffeine will avoid caffeine consumption, and thus not experience as many adverse effects as those who are conflicted and continue to consume caffeine.

To further investigate the relationship between attitudes and consumption levels, a one-way ANOVA was conducted. Significant differences in the average daily dosage of caffeine were found according to attitudes toward the substance ($p<.001$, $f(2,94)=7.082$). Participants reporting a Primarily Negative relationship to caffeine had the lowest levels of caffeine consumption at 268.4615 mg (SE = 54.60342). Participants reporting a Mixed or Ambivalent relationship consumed more caffeine at an average of 432.8 mg (SE =

51.13306). Those who reported a Primarily Positive relationship to caffeine showed the highest level of consumption at an average of 518.8983 mg (SE = 27.5958). Post-hoc tests reveal the difference between caffeine consumption level for Primarily Positive and Primarily Negative was significant at $p<.05$. These findings support the hypothesis that having a negative perception of caffeine leads people to consume less caffeine than those who feel more favorably towards the substance. Those who are conflicted (Mixed/Ambivalent), however, continue to consume levels similar to levels of those who feel Primarily Positive towards caffeine, despite adverse effects experienced.

STUDENTS

Student status was also found to be associated with difference in adverse effects average. The average number of adverse effects experienced is 10, significantly higher than the average of 5.33 adverse effects in non-students. Equal variances not assumed, these differences are significant at the $p < .001$ level. As will be shown in the following section, students are also more likely to consume higher levels of caffeine than non-students.

Table 5. Significance of Associations to Daily Dosage

Association to Daily Dosage	Significant	Non-Significant
Attitudes	$p < .001$, $f(2,94)=7.082$ **Positive:** 518.89 mg **Ambivalent**: 432.80 mg **Negative**: 268.46 mg	
Gender	$p < .05$, $t(74.26) = -2.162$ **Female**: 417.91 mg **Male**: 523.02 mg	
Student Status	$p < .05$, $t(95) = 2.515$ **Student**: 535.88 mg **Non-Student**: 417.19 mg	
Tobacco	$p < .01$, $t(93) = -2.832$ **Smoker**: 570.55 mg **Non-Smoker**: 425.74 mg	
Sensitivity	$p \leq .01$, $f(3,92) = 3.984$ **Extremely Sens**.: 351.9 mg **Relatively Sens**. : 468.6 mg **Not Sens.** : 570.2 mg	
Tolerance	$p < .05$, $f(2,92) = 3.718$ **Extremely Toler.**:488.2 mg **Tolerant** : 503.3 mg **Intolerant:** 339.4 mg	
Perceived overindulgence		$p > .05$, $t(84)= .193$
Working Status		$p > .05$, $f(94,3) = .370$
Adverse Effects		$p > .05$, $r(93)= .062$
Pharmaceutical Use		$p > .05$, $t(93) = -.640$

DAILY DOSAGE

While attitudes, tolerance, and sensitivity to caffeine were found to be associated with variations in adverse effects and consumption levels, there was no direct correlation between average caffeine consumption and the number of adverse effects experienced ($p > .05$, $r(93)= .062$). One of the major assumptions perpetuated in the caffeine literature is that caffeine intoxication and overdose should be evaluated in regards to

dosage. The lack of apparent correlation suggests dosage may not be the sole determinant of adverse effects, but may be moderated through other variables. The lack of correlation between dosage and adverse effects may also be due to a measurement error—daily dosage may not reflect periods of increased consumption that lead to adverse effects. Further investigations could use alternate research methods such as daily logs of caffeine consumption and adverse effects, which would provide increased data validity.

OVERINDULGENCE

In order to evaluate whether exceeding regular consumption levels leads to adverse effects, an independent-samples t-test was conducted to determine if reported overindulgence was associated with increased adverse effects frequency. 70 participants reported having consuming more caffeine than they feel they should have, while 15 reported not having exceeded their healthy limit. The Overindulged group showed an average of 8.174 adverse effects (SE = .76707), while those who felt they have Not Overindulged had a much lower average of adverse effects at 4.0667 (SE = .91790). This difference is statistically significant at the .05 level, $t(83) = 2.392$.

Is reported overindulgence related to increased consumption levels, or due to individual variations in sensitivity and tolerance? Another independent samples t-test did not reveal statistically significant differences in the average milligrams of caffeine consumed based upon reported overindulgence, $t(84)= .193$, $p>.05$. This likely indicates that instances of overindulgence would not be reflected in an estimate of average daily dosage.

Table 6. Drugs Co-Administered with Caffeine

Alcohol	62.1%
Prescription Medications	31.6%
Over-The-Counter Medications	31.6%
Tobacco	28.4%

CO-ADMINISTRATION OF OTHER DRUGS

Another major hypothesis of this research study was that the co-administration of caffeine with other drugs may alter the experienced effects. Evidence was found for an interaction effect between caffeine and pharmaceuticals, both prescription and over-the-counter. These results were not found for co-administration of alcohol or tobacco, however. The increased adverse effects when using pharmaceuticals and caffeine may be partially explained by the pharmacological evidence for impaired drug metabolism, and may also be partially explained by the health conditions being treated with pharmaceuticals. A larger-scale study could control for other health-related variables, in order to determine if this effect is due to the characteristics of people taking pharmaceuticals, or if the effect is due the pharmaceuticals themselves.

An independent samples t-test was used to determine if prescription pharmaceutical drug use versus nonuse resulted in differences in the average number of adverse effects. Levene's Test for Equality of variances is significant ($p=.026$); equal variances are not assumed. On average, the 30 participants reporting prescription pharmaceutical drug use experienced a significantly greater number of adverse effects to caffeine ($M= 9.5667$, $SE= 1.26553$) when compared to the 64 non-pharmaceutical users ($M= 6.1250$, $SE= .64952$). This difference is significant at $p<.05$, $t (44.857) = -2.419$. The effect size is calculated at $r = .3397$, representing a medium-sized effect.

A similar pattern was found for over-the-counter pharmaceutical usage. An independent-samples t-test found participants reporting co-administration of caffeine and over-the-counter medications had a significantly higher average number of adverse effects (n= 30, M = 9.4, SE= 1.24808) than those who did not report usage of OTC medications (n = 64, M = 6.2031, SE = .663). This difference is significant at the $p<.05$ level, $t(45.991) = -2.262$. The calculated effect size is medium, $r = .3164$.

An independent samples t-test found tobacco users, on average, also show a higher average adverse effects reported (n= 26, M=8.3538, SE=1.40979), than nonsmokers (n= 68, M=6.6765, SE=.65772). This difference is not significant ($p>.05$), but represents a small effect size $r=.206$, $t(36.423) = -1.271$. Another independent samples t-test was used to evaluate the effect of alcohol consumption on average number of effects reported. Participants who consumed alcohol in conjunction with caffeine on average reported a higher number of adverse effects (n= 58, M = 7.9828, SE = .92177) than non-drinkers (n=36, M = 6.0, SE = .59094). This difference was not significant $p>.05$, $t(88.999) = -1.811$. The calculated effect size was small ($r = .1884$).

All co-administered drugs investigated reported higher averages of adverse reactions, but not all of these differences proved to be statistically significant. Prescription pharmaceutical usage was associated with the highest average of adverse effects, followed by OTC pharmaceutical use. Despite participant perceptions that will be detailed in the following section, co-administration with alcohol does not seem to result in a significant increase of adverse effects. While previous variables in question suggest consumers are fairly adept at assessing their own tolerance and sensitivity, perceptions of the effects of co-administered drugs seem to run counter to the trends in association

found via statistical analysis. Although adverse effects are elevated in this group, participants do not seem to be consciously aware of this effect, which may have important clinical implications.

Table 7. Motivations for Consumption Frequencies

To Wake Up	63.9%
To Enjoy the Taste	63.9%
To Feel Energized	50.5%
To Remain Alert	50.5%
To Be More Productive	48.5%
To Get Through Work	46.4%
To Better Concentrate	38.1%
To Feel More Motivated	37.1%
Out of Habit	34%
To Write for Work or School	25.8%
To Study	23.7%
As a Social Activity	21.6%
To Feel Happier	20.6%
To Stay Up Late	18.6%
Avoidance/Relief of Headaches	18.6%
To Be More Outgoing	11.3%
To Eat Less	10.3%
To Counteract a Sedative Substance	9.3%

HEALTH BELIEFS AND MOTIVATIONS

The motivations for consuming caffeine are both sensory and behavioral. The primary effects desired are to wake up and enjoy the taste, which reflects the pattern of morning consumption reported by most participants. There could be a multitude of reasons why people need assistance to awaken in the mornings, some possibilities including poor sleep, chemical dependency on caffeine, or adherence to a work or school schedule that is out of sync with circadian rhythms. Other related desired effects include feeling energized and alert. The most commonly reported motivations for consumptions are sensations and feelings, some of which may serve to induce or assist behavioral changes to meet specific goals. These outcome-related motivations include increasing productivity, motivation, concentration, and getting through work. The senses and feelings of awakening, alertness, and energy serve to overcome lapses in motivation and concentration and meet productive goals.

Table 8. Participant's Health Beliefs about Caffeine

Unhealthy or unsafe for children	77.3%
Dehydrating	68.2%
Avoid if feeling anxious or nervous	65.6%
Avoid if you have a sleep disorder	62.2%
Unhealthy or unsafe for pregnant women	60.2%
Avoid if you have a heart condition	52.3%
Raises blood pressure	50%
Alleviates depression	28.9%
Unhealthy or unsafe for the elderly	23%
Avoid if you have a mental disorder	14.4%
Protective against Alzheimer's disease	14%
Worsens depression	12.2%
Shorter life-span	10.2%
Longer life-span	8%
Protective against Parkinson's disease	6.8%

The health beliefs surrounding caffeine are important to investigate when considering that lay-person knowledge can vary considerably from biomedical knowledge. Individual beliefs concerning caffeine are not only a reflection of acquired scientific knowledge, but shared cultural values and expectations. Most people will not spend a significant amount of time researching caffeine, but our shared experiences and values play a role in creating group consensus regarding the usefulness and potential harm that may arise from a drug.

The most commonly held belief about caffeine is that it is unhealthy or unsafe for children (77.3%), despite the fact that many American children are exposed to caffeine regularly. Another health belief is that caffeine is dehydrating (68.2%), and although caffeine is a mild diuretic, it has not been found to increase risk of dehydration in most cases. Participants also believe that caffeine should be avoided if you are feeling anxious or nervous (65.6%) or if you have a sleep disorder (62.2%).

Some of these health beliefs are reflected in reported reasons for avoiding caffeine, including avoiding caffeine to sleep better, which was the most common reason for 64.5% of participants. Other top reasons for avoiding caffeine include relaxation (27.8%) and the avoidance of adverse effects (26.8%). In relation to other health concerns, 18.6% of participants have avoided caffeine. While 50% of participants reported believing caffeine raised blood pressure, only 9.3% report actively avoiding the substance to lower blood pressure.

QUALITATIVE DATA ANALYSIS

While self-identified tolerance and sensitivity were found to be associated with varied levels of adverse effects, tolerance and sensitivity can change over time. Participants note various ages of onset of symptoms, from teenage to middle age. The severity of reactions ranged considerably, from being unable to sleep after drinking coffee at a church dinner, to cases of hospitalizations after an overdose. Some participants report responses to extremely high doses of caffeine, while others report a change in response to chronic consumption over time. The context of consumption was largely academic, athletic, or social in nature. The adverse effects mentioned in narratives did include APA diagnostic criteria such as restlessness, but also mentioned other symptoms such as paranoia, temporary hearing loss, aggression, and other emotional and physiological symptoms.

MEDICAL ENCOUNTERS AND HOSPITALIZATIONS

Eleven participants reported they discussed adverse reactions to caffeine with medical professionals, and two cases of hospitalizations were also reported. Reasons for not disclosing adverse reactions to caffeine seem to reflect particular meanings associated

with medical encounters—if the cause is seemingly obvious, relatively short-lived, and not life-threatening, a consultation with a doctor is deemed unnecessary. One participant felt that if she had disclosed her reaction to caffeine, "I think they would have laughed at me" (Celia).

Some, however, did include medical professionals in their negotiations with caffeine and health. One participant reported their allergist was the first to recommend the elimination of caffeine, which the patient then passed along this knowledge to his primary care physician, ENT, and another allergist, who "haven't explicitly said so but seem to agree it could be valid" as a factor in the patients' chronic headaches (Dayna). Other medical encounters included doctors advising patients to limit or avoid coffee, chocolate, or caffeine in general. As shown in the narratives below, caffeine consumption often emerges in the patient-practitioner dialogue in relation to a co-existing medical condition such as high blood pressure, sleep disturbances, or an anxiety disorder

"My Heart has Never Felt the Same"

Two participants provided narratives of hospitalizations following severe adverse caffeine reactions. Isaac has mixed attitudes towards caffeine, while Keith has a primarily negative attitude towards caffeine. Isaac is a student in his twenties who works part time and consumes an average of 420 mg caffeine daily with 11 adverse effects experienced. He found himself in the emergency room after a night of drinking alcohol followed by coffee consumption, and was treated with potassium and other medications.

> **Isaac:** Went to the hospital because I consumed too much coffee on an empty stomach after a night of alcohol consumption and felt very sick, vomiting, shaking, etc. This is the first time caffeine made me feel very sick.

Keith is slightly younger, between 18 and 20 years of age, and consumes similar levels of caffeine (400 mg) but has experienced the most adverse effects of any participant at 32 symptoms.

> **Keith:** I consumed an entire pack of NoDoz pills, 16 pills at 200 mg each. 3200 mg of caffeine. I became very energetic, then had cotton mouth, then felt very dizzy with an extremely high heart rate. I sat down, about an hour after consumption, and saw stars, the room started getting fuzzy so I told a friend to drive me to the E.R. I was given I.V. fluids, nausea medication, and heart relaxers. I threw up multiple times and was cold and shaky. I stayed up about six hours after going to the hospital. I was shaking and cold and weak.

How did Keith and Isaac change their behaviors following these hospitalizations? Isaac's specific changes in consumption were specified as "I just keep in mind the level of dehydration, I have tried to drink less soda in general (I prefer water nowadays) as well as green tea as opposed to coffee. This does not mean however that I don't drink soda or coffee ever I just figure my body reacts better to tea." However, this alteration did not effectively minimize adverse reactions, as Isaac writes that consuming less caffeine "worked until I begin having terrible adverse reactions even to small doses." Keith also writes of a subsequent sensitization to caffeine, "I feel better with caffeine except now because every time I have any I end up feeling like I'm going to die about 6-8 hours later."

> **Keith:** One night I had been on a week long tolerance break and I consumed 600 milligrams of caffeine. 8 hours later, I woke up with extremely rapid and weak heart rate, calm breathing, and severe dizziness. My heart also skipped beats and added some occasionally. This lasted an hour or more. It eventually went away but ever since then, even if I have a small amount of caffeine, 200 milligrams or more, I experience severe withdrawal-like symptoms about 6-8 hours later usually lasting 1-2 hours. Every time I would be just about to fall asleep, I would lose conscious control of my heart rate and it would skyrocket

or skip beats or stop, my body would tingle and go numb and I would start slipping out of consciousness. Also my entire body would occasionally spasm. My heart has never felt the same.

The extremity of Keith's situation informs his suggestions for future research, being the only participant to suggest studying how caffeine reactions can result in death. Other narratives were less extreme in severity, and largely occur in an academic, social, or athletic context. Caffeine's noted effects on energy, attention, and motivation are the likely reasons for application of the drug to these contexts. The following narratives are of participants who utilized caffeine to fulfill academic goals and obligations.

ANXIETY, AGITATION, AND AGGRESSION IN ACADEMIA

Ryan and Hunter are both males in their 20s who consume caffeine on a daily basis and report a primarily positive relationship to the substance. Ryan works full-time and consumes an average of 150 mg caffeine daily, while Hunter is a student who also works full-time and consumes an average of 330 mg caffeine daily. Ryan and Hunter both consume caffeine in order to increase focus, one in a social academic setting of a lecture, and the other in the solitary academic activity of grading papers. Ryan, surrounded by others in a lecture hall, recalls his experience as that of extreme anxiety, while Hunter describes his feeling as agitation and a lack of focus.

Ryan: I drank two bottles of Nos energy drink before a lecture. I experienced an irregular heartbeat and extreme anxiety. Almost had to walk out of class.

Hunter: …bought a couple of caffeinated beverages to keep me going through the night to finish grading as many papers as I could. From continuing to chug the energy drinks I began to feel minute muscle twitches, then my eyes began to race through the words on paper at a quicker pace. Soon I became agitated and began to lose focus

While the distinction between agitation and anxiety may not be entirely clear, both states suggest hyperarousal that impairs functioning. Hyperarousal in social context may be interpreted as anxiety, while hyperarousal in solitude may be interpreted differently, as agitation in this case.

Ryan writes that he did indeed change his consumption patterns after repeated reactions, “I cut out energy drinks, switched from coffee to black tea, and stopped taking caffeine pills.” When asked if he felt better without caffeine, he said “It depends on how much sleep I've had. If I'm tired, caffeine makes me feel better. If I'm not tired, I don't take caffeine in the first place, so I'm not sure whether I'd feel better or worse under those circumstances.” Hunter, however, contrasts this response by classifying his reaction as a minor occurrence that resulted in him becoming “more weary of how much caffeine I consume instead of drinking it freely like water or juice,” but did not drastically alter patterns of consumption. Hunter’s classification of his experience as agitation did not warrant remedy, while Ryan’s anxiety was something he took steps to actively avoid. Ryan also suggested the following advice to fellow caffeine consumers:

> **Ryan**: I'd like people to know that they should keep track of their consumption so they have a good sense of what's normal for them and never to exceed that amount by too much--say, more than 50%. That way, they'll know if something they're about to drink has way more caffeine than they're used to and can avoid an adverse reaction

Aggression was another term used to describe the hyperarousal state elicited by caffeine. Jacob, a male in his 60s with a primarily negative relationship with caffeine, reported consuming 24 cups of coffee a day studying for four final exams, which resulted in him forgetting his textbooks under the seat. This level of consumption impaired his

ability to think straight, although he was "awake, but non-productive." He writes of the effects of more than 8 cups a day being different than that of low doses. The undesirable attentional and psychological effects he mentioned were that he "became aggressive and grumpy. Lost analytical focus. Lost sleep which led to more coffee. Downward spiral."

Jacob's narrative is enlightening for a number of reasons. He contextualizes his consumption in that he increased his dosage for an explicit purpose, yet recognizes the paradoxical effects of overdose. Although his original intentions were to increase his focus, his consumption at a high level made concentration more difficult. He also acknowledges maladaptive patterns in his consumption, noting that it contributed to a cycle of sleep deprivation that was hard to break. Excess stimulation may be interpreted or experienced as anxiety, agitation, aggression, or other expressions of emotion in particular contexts. Later in life, Jacob faced a period of insomnia due to work-related stress and excess caffeine consumption. He consulted with a medical professional, which resulted in his reduction of caffeine use. He switched to decaf, herbal brews, or green tea, noting he experienced better sleep, felt more refreshed upon awakening, and more productive.

CAFFEINE AS AN APPETITE SUPPRESSANT

Caffeine's appetite suppressant effects may be an unintentional side effect, or a characteristic intentionally utilized for weight loss. While Jacob primarily avoids caffeine, he uses it strategically to "lose last 10 lbs with minimal diet changes" on a weight-loss plan. His understanding of caffeine is that in low doses it does not cause permanent harm, allowing for short-term usage to achieve a particular outcome such as weight loss, as in this case. He also finds "caffeine's effects on blood circulation might be good on a short

term use basis." His perception of caffeine follows an acute/chronic distinction, because despite his usage for weight loss, he also feels that caffeine "depresses immune system, adversely affects heart rate, creates more stress, reduces overall productivity." The acute versus chronic dichotomy plays a role in meanings associated with the drug, expressly communicated in his comment on caffeine research that "studies should always include short term versus long term effects."

He recommended a book on caffeine and handed out fifty copies to peers and colleagues. He found that "most people are too dependent on their morning coffee 'routine' to give it up entirely." He also questions the health value of decaffeinated coffee and some health findings, suggesting a fairly complex knowledge base as well as a healthy degree of skepticism of existing systems of knowledge, and a desire to spread knowledge within his social sphere.

CAFFEINE-DRUG COMBINATIONS

Prescription Medications

One of the strongest associations found in this study was the difference in mean number of adverse effects for those simultaneously taking prescription medications (Sig .026). Those not taking pharmaceuticals had an average number of 6.1250 adverse symptoms, while the 31.6% of participants reporting co-administration of caffeine and pharmaceuticals reported an average of 9.5667 adverse symptoms. Participants' reflections on the effects of co-administration suggest that most are not acutely aware of any interactions between caffeine and pharmaceuticals.

A synergistic effect was noted with Adderall, resulting in a state described as "JACKED" (Logan). Research on this drug combination suggests that caffeine potentiates the toxic effects of amphetamine-related drugs, increasing risk of seizures and tachycardia (Frau et al. 2013). One participant noted an intolerance for caffeine while on birth control pills. These two participants are the exception, however, as others were skeptical or unsure of any potential interaction. Other participants expressed "I don't believe consuming caffeine with medications had any effect" (Lara). Another potential confounding factor in identifying an interaction effect was also noted, Caitlyn writing "I think I've been taking these medications in conjunction with caffeine so long that I no longer can tell if there is a reaction." Long-term pharmaceutical administration is a daily reality for many Americans, so the ability to discern the body without the drugs is nearly impossible without a frame of reference.

Over-The-Counter Medications

Most participants noted no known interaction effect between over-the-counter medications and caffeine, with one notable exception. Meredith reported symptoms of paranoia following a cycle of daily coffee consumption and use of Benadryl as a sleep aid during a period of unemployment, high stress, and Irritable Bowel Syndrome. Her account is informative for a number of reasons, but particularly shows how a behavior that may have been adaptive at one point in one's lifespan may become maladaptive under changed circumstances. Under steady employment, drinking coffee was a necessity for Meredith to perform. The use of Benadryl as a sleep aid was also beneficial in this context, when given a strict schedule of sleep and wakefulness. When the behavior of drinking coffee was carried over into a period of unemployment, however, the excess stimulation fed worries and anxiety in the absence of other activities. Since coffee drinking was not a previous exasperator of anxiety in the prior context, it is unlikely that most would consider altering their consumption patterns after decades of utilization. The resulting paranoia was likely partially a biological reaction of stress and chronic caffeinism contributing to psychosis, but also a reflection of conflicting experiences and cultural values as well.

Caffeine is a drug inexplicably tied to work in all its shapes and forms, and exists within boundaries of external expectations: it is expected that you turn in a report on Friday, it is expected by your employer that you will not be dozing off at your desk in the morning, and in turn consumers expect for caffeine to at least partially help attain these goals. Without the boundaries of work or school expectations of performance, the structure of the caffeinated experience may be lost. Stimulus without structure can be

thrilling if you are having a good time, but may also be chaotic and overwhelming in the face of pressure. Drinking caffeine outside of its working context may result in conflicting expectations and experiences. The expectation is that coffee will help the woman remain wakeful and alert while job hunting or provide relief from chronic boredom, but she finds the actual lived experience of the drug to be feelings of panic and anxiety. The dissonance between expectation and experience leads to a sense of distrust, manifest in a paranoid perspective of the world around.

"Red bull vodka makes me go CRAZY"

Alcohol was the drug reported to be most used in conjunction with caffeine (62.1%). Participants expressed specific expectations and experiences of how caffeine and alcohol elicit a different response than when used separately. Some report no difference or no memory of the effects. Hunter noted a synergy of depressant and stimulant effects, while Lara thought the effects of both substances were amplified. Gerald expressed a similar observation, writing that coffee enhanced the drinking experience.

In some cases, additional adverse effects were noted with the combination of alcohol and caffeine (Dayna and Brandy). Other observations included a perception of alcohol "numbing" the effects of caffeine (Marrianne) and becoming intoxicated at a slower rate (Jillian). Logan, who also reports using caffeine in conjunction with prescription stimulants, writes "Red bull vodka makes me go CRAZY."

Many parallels were drawn between caffeine and alcohol consumption, both directly and indirectly. It was often noted that caffeine should not be consumed on an empty stomach and is not healthy for the perceived vulnerable such as children and the

chronically ill. Participants express that it is important to know personal limits of safe consumption, yet stories of overdose were common. These are all sentiments expressed of alcohol as well, and the phenomenon of binge drinking seems to apply to caffeine as well. While binge drinking alcohol is an attempt to have as much uninhibited fun as possible, binging on caffeine serves to extend alertness and productivity as long as possible. Both patterns of usage, however, entail pushing the boundaries of dosage to the point of illness or adverse effect. While this process of exceeding personal limits may later help establish boundaries of normality in future instances, binging may also be a pattern that repeats itself in the face of external stressors.

Tobacco

28.4% of participants reported using caffeine with tobacco. Tobacco usage was found to be significantly associated with higher mean milligram caffeine consumption, but not with an increased number of adverse effects. Despite this, many participants reported a perceived interaction effect, such as increased dizziness (Marianne), energy, and psychomotor agitation (Zachary). While the use of tobacco products has decreased in the United States in past decades, there remains a significant proportion of the population who smokes. Smoking has been clearly identified as an inducer of the CYP_{1A2} enzyme that metabolizes caffeine, which explains why smokers in this study were found to consume higher levels of caffeine than non-smokers.

Marijuana

Four participants self-disclosed their usage of caffeine with marijuana. A study by Sousa et al. (2013) found an association between the adenosine and cannabinoid systems in the brain. This association results in caffeine potentiating THC, increasing cognitive

impairment. The reflections on this combination included feeling "enlightened by the coffee and the other thing" (Alan), reasons for co-administration including "because it let me enjoy the mind altering affects of marijuana without the negative affects of being tired and hungry" (Keith), and "Alcohol and marijuana both make me tired, so I need more caffeine to reach the desired level of wakefulness" (Ryan). The effects of co-administered caffeine and marijuana may be a particularly important question to answer in the United States, as marijuana becomes more readily available through legalization in some areas.

Sugar

In addition to the previously discussed caffeine-drug combinations, a graduate student in his twenties attributes his adverse experiences to the combination of caffeine and sugar. Chris works part time, consumes around 610 mg of caffeine daily, and mentions both academic and fitness-related goals of consumption. Initially, his pattern of consumption was increased in response to the increased work-load of graduate studies, but soon found his coffee with sugar and cream would make him shake, induce headaches, a rapid heart-rate, and caused difficulties in concentration. He altered his pattern of consumption for fitness goals by removing the additives to coffee, concluding "Sugar is the devil here (I think)." Chris also has actively attempted to inform those around him of his experiences with sugar and caffeine, noting he has encountered "disbelief, enlightenment, skepticism, outright rejection. Most commonly, however, I have encountered enlightenment."

While most participants attribute their response to dosage, some like Chris identify particular combinations or sources of caffeine as being especially troublesome. When asked if he had discussed caffeine with a medical professional, Chris mentions a

family history of high blood pressure and the factors constructing his knowledge of caffeine, which included self-experimentation of consumption up to 12 cups of coffee. Chris integrates and negotiates information from his family, physician, and self-experience to draw conclusions about the relative risks of caffeine consumption.

Chris provides a number of other insights and points of comparison regarding his experiences with caffeine consumption. His ideas surrounding the subject are described in great detail over several pages in total. His experiences of adverse effects, experimentation into causal factors, and attempts at altering consumption patterns have contributed to the depth of his observations. Despite high consumption levels, Chris did not experience any withdrawal effects when stopping consumption. He contrasts his apparent lack of addiction to caffeine to his psychological addiction to video games, writing "I get anxious and chronically bored at my life and surroundings when I do not play games in a week. I have never felt any kind of drastic change from withdrawal of ANYTHING else in my life."

EFFECTS OF CONTEXT ON PSYCHOLOGICAL OUTCOME

Effects on psychological state vary widely between participants, from feelings of being uplifted and energized to feelings of anxiety, agitation, and paranoia. Ezra is in his twenties and has a primarily positive relationship with caffeine, regularly consuming a fairly high daily dosage of 810 milligrams. Even someone with a relatively high tolerance such as Ezra is capable of experiencing dramatic adverse effects such as paranoia in response to overdose. Ezra reports one time that he drank eight Monster energy drinks, resulting in feeling "paranoid, light headed, tachycardia, and nausea." Overdose may occur for participants with low tolerance for caffeine, but also for participants with high tolerance during periods of high stress or illness, or in co-administration with other substances.

Meredith was also on the extreme end of the adverse effect spectrum, yet she also suggested some of the most well-informed information about what she learned and what should be studied. She writes that she learned that metabolites of caffeine can have "combined effects with various substances and that they may have a higher stimulant effect," being the only participant to mention knowledge of caffeine metabolism. She also writes that researchers and physicians "need to look at diet, all medications and caffeine consumption when diagnosing panic disorder or other mental disorders," suggesting an understanding of the multiple causes of her psychological distress and the necessity to address these factors in a diagnostics. She also, however, identified her experience as "too extreme" to share with others beyond family. The stigma of mental illness persists, even in the era of widespread psychopharmacological treatment. It is improbable that Meredith is the sole individual who has had caffeine consumption contribute to a serious deterioration in mental health, but she is one of the few who has shared her story. Case

studies as well as larger studies in psychiatric journals provide support for the role of caffeine in precipitating psychosis, delusions, and paranoia (Whiting 2011; Ciaparelli et al. 2010; Broderick & Benjamin 2004). The necessity of research where participants are secure in their anonymity is highlighted by Meredith's case—it may be the only means through which these stories can be safely told.

Paranoia was at the far end of the spectrum of hyperarousal, in which rational thought patterns are disrupted. Anxiety, shakiness, and more rarely, excitement, were more likely to be reported. Increased arousal may be interpreted as excitement depending upon context. For Logan, who reports combining caffeine with Adderall in order to feel "JACKED," he first noticed his positive strong reaction to caffeine after "Going CRAZY at my baseball parrtyyyy hay hay hay" The light-hearted tone of this statement suggests that a positive social context gives caffeinated stimulation an entirely different meaning. "Going crazy" at a party is socially acceptable, whereas paranoia and anxiety are more likely to be seen as pathological, disordered experiences, requiring remedy.

Negotiations between expectations of a positive "pick-me-up" and experiences of adverse effects are complex and constantly evolving due to changing life circumstances, occupations, demands on attention, changing biology, and other contextual factors. Jillian writes of caffeine's positive effects on her mood, while her physician deems the physiological effects on her heart rate dangerous. This splitting between the desirable psychological state and the undesirable physiological state is perhaps a factor in Jillian's mixed attitude towards caffeine; she feels positively about the effects on mood, but worries about the toll caffeine may take on her heart. Jillian's story illustrates how advice from medical professionals is negotiated with personal experience.

> **Jillian**: I never drank caffeine until the past year or so. After consuming I would experience a rapid heart rate and hyped up persona. I enjoyed feeling awake and ready to conquer my day however my doctor became concerned as my heart rate would become too rapid after consumption and has recommend I refrain from drinking caffeine

While caffeine is primarily discussed in relation to mental state for some participants, others focused on the relation of caffeine to headaches. For some, coffee is seen as a preventative agent against headaches, while also being acknowledged as the potential originating source. Connie writes, "I have had a rapid heart beat, in the am after consuming more than 3 cups of coffee. If I do no have coffee in the morning I get headaches, or withdrawal symptoms." The simplest solution is to continue administration to avoid withdrawal symptoms, but some participants report actively eliminating caffeine in order to achieve long-lasting relief from chronic headaches.

> **Dayna**: In 2008 when I was having multiple headaches a week and lots of sinus related issues. Eliminating caffeinated beverages helped alleviate the headaches, but since then I have also had to eliminate chocolate as I believe it was causing headaches as well. However with the caffeinated beverages the headaches were often more immediate, with chocolate it seems to be that daily prolonged exposure results in an increase in my headaches over time

Caffeine was frequently related to the health and conditions of the heart, stomach, and the head. Concerns of chronic effects were primarily directed towards effects on the heart, while acute adverse effects were attributed to eating on an empty stomach or while under stress.

LESSONS IN OVERINDULGENCE AND OVERDOSE

Energy drinks, caffeine pills, and coffee were the most likely to be targeted as "risky" sources of caffeine to be avoided. Dosage was the most commonly attributed risk factor in adverse reactions, with 21 of the 29 participants in the secondary adverse reaction survey attributing their experiences to consuming too much caffeine, and 71 participants in the primary survey reporting overindulgence at some point. Justine and Sophia are two cases that will be compared and contrasted in order to understand the meanings attributed to these encounters.

> **Justine**: The first time I had an adverse reaction to caffeine, I tried to drink an 18 oz Red Bull before volleyball practice in high school. My heart started beating irregularly and much too fast, I started sweating and shaking. My vision started to black out around the edges and my hearing went in and out. I was worried that I had given myself a heart attack. I've never intentionally ingested that much caffeine in such a short time span again.
>
> **Sophia:** My worst experience was drinking a grande Frappuccino from Starbucks that had five shots of espresso. I drank it on an empty stomach and about half an hour later I started to feel strange. My heart started to race a little, I was hot and cold at the same time, and I couldn't keep my hands steady, they just kept shaking. Never made that mistake again.

Justine and Sophia both reach similar conclusions in their narratives; they target a particular source of caffeine as excessive in dosage, and emphasize that they have learned their lesson and will not make the same mistake again. This was a particular pattern noted in female narratives, where the identification of errors in judging dosage both arise from personal decisions while also informing future decision-making. While both women are in their twenties and share a primarily positive perspective of caffeine, they differ in other variables that may contribute to their varied consumption levels.

Justine is a student and part-time worker, and consumes considerably more caffeine on a daily basis (625 mg) than Sophia (160 mg) who works full-time but is not a student. When asked if she feels better without caffeine, Sophia writes, "On that day, yeah. But overall in life it depends. I don't rely on caffeine to function, but some days I just need a little pick me up to get through the day. This is usually less than once a week. So most days I do feel good without and others I feel better with consumption in moderation." Sophia exhibits a nuanced and contextualized understanding of the drug. She likens caffeine to alcohol, in which a little may make you feel good, but if you exceed your limits you simply end up feeling ill. Her suggestion for further research highlights her ability to hold contrasting expectations and perceptions of the substance.

> **Sophia:** I would like them to study the effect caffeine has on individuals of different moods. Like does someone respond differently to caffeine when they are happy versus when they are sad

Justine, who noted an adverse reaction to a Red Bull before a high school sporting event, concluded that "Red Bull is really, really bad for you." She now prefers to "get caffeine solely through coffee. I've found that the excessive sugar in soda and energy drinks makes me feel horrible and completely overshadows the positive effects of caffeine." Here, she expresses similar sentiments on sugar as Chris, the participant who identified the sugar and cream in his coffee as the source of adverse effects. Justine came to this conclusion after personal experience and doing research on the internet, but is open to adapting her consumption patterns in light of new information, requesting "I would like to know the safest way to consume caffeine."

CHANGING CONSUMPTION PATTERNS

Although a few participants have cut caffeine out of their diets entirely, most reflected the position of Brandy, who finds it is "hard to avoid caffeine completely" despite claims of no difficulties reducing consumption. Another participant reported "I am not sure I went through the typical withdrawal symptoms, but it was difficult to change my habit of having coffee at work in the morning" (Dayna). The most commonly reported pattern of altered consumption is that of gradual reduction or transition to drinks with lower caffeine content. A few also note that consuming caffeine on a full stomach also mitigates adverse effects. Reflections upon whether participants feel better without caffeine often indicate varied primary motivations for usage. Some evaluate "feeling better" by comparing levels of wakefulness, while others emphasize productivity, and some consider the emotional and motivational impact.

CONSTRUCTING CAFFEINE KNOWLEDGE

48% of participants reported using internet searches to learn more about caffeine, with 14.8% utilizing online discussion boards, and 14.8% reading books on the subject. The primary response to adverse reactions to caffeine is not to consult a doctor or pick up a book, but to do an internet search. Two participants mentioned a book called *Caffeine Blues* by Stephen Cherniske. Most participants report having told others of their experience, while a few with extreme or mild reactions felt the experience was better kept private. Some participants noted uncertainty and controversy in caffeine literature.

> **Celia:** You can find any answer you want such as caffeine is good for you, or it is bad for you. There seems to be a lot of controversy.
>
> **Ryan:** The literature on caffeine seems kind of uncertain. Too much is clearly bad, but as far as I can see there isn't really a consensus on the health effects of small doses.

The current research on caffeine seems to provide more questions than answers for some participants. In the face of uncertainty in health outcomes, there is an emphasis on personal responsibility to monitor your own consumption and self-define normality. The patterning of consistency of experience is something seen in many health-promoting behaviors such as following a consistent sleep pattern, avoiding binge drinking and eating, and so forth. The solution to uncertainty is thus then to structure one's own experience based on available subjective knowledge.

Participants' suggestions for further caffeine research were closely related to their personal experiences, including investigating causes of overdose, the most beneficial and safest uses for caffeine. Some do not feel that caffeine needs to be further investigated, but "If new drugs arise, caffeine should he studied with reaction to that drug due to the availability of caffeine" (Ezra). What we know to be fairly certain is that new pharmaceuticals enter the market every year, and most of these are not studied for interaction effects with caffeine.

While we may not know the health effects of caffeine for every individual around us, we can moderate our own consumption to at least provide a sense of control over outcomes. Ways of moderating own consumption include switching preference for caffeine source, with the most common switch being to tea-drinking or avoiding sugar and caffeine combinations (energy drinks, sweetened coffee beverages, carbonated soft drinks).

VI. CONCLUSION

Statistically significant results were found to support that participants' risks of caffeine intoxication are not equitably distributed. Narratives of adverse reactions provided insight into motivations for consumption, meanings attributed to caffeine, and detailed first-hand accounts of overdose. Trends that may be dangerous for consumers include high rates of mixing caffeine with alcohol and other drugs, which is often associated with increased adverse outcomes. Illness narratives also revealed that adverse reactions to caffeine can be serious, and in some cases may lead to hospitalizations or a deterioration of mental health. Other findings of concern include intentional overdosing on forms of concentrated caffeine, such as caffeine pills, which further indicates that products such as synthetic caffeine powder can be easily misused and result in hospitalization or death.

Limitations of this study warrant further research into these inquiries, including specifying particular medications that are associated with increased adverse effects from caffeine. A more accurate method of evaluating daily caffeine consumption would be to have participants keep a record of consumption over a week, which may reduce response rates but would be possible to do through online survey tools. Since the development of this study, a number of caffeine-related questionnaires have been developed and tested for reliability and validity (Huntley & Juliano 2012; Irons et al. 2014; Juliano et al. 2012). In the future, use of standardized questionnaires may increase the predictive validity of study designs, and allow for better comparison between studies. In terms of

anthropological inquiries into caffeine consumption, it would be relevant to study other motivations for consumption and avoidance, such as religion.

Although caffeine's effects have often been trivialized due to widespread use and relative safety compared to other drugs, attention to this stimulant is warranted for a number of reasons. The landscape of consumption is constantly shifting, exposing new risks and rewards of consumption as technologies, life circumstances, regulations, and patterns of other drug usage change. Furthermore, it should not be assumed that those who deal with insomnia, anxiety, and other psychiatric disorders are necessarily avoiding caffeine. The marketing of caffeinated products on college campuses should warrant concern in light of the findings that students are particularly likely to take caffeine consumption to extremes in responses to heavy workloads. Caffeine usage is a coping mechanism widely utilized to meet the demands of modern life, and while it serves to help us function in accordance with a schedule, it is also used to elicit positive feelings such as motivation and refreshment, while also satisfying the taste for something sweet.

The aroma of coffee may be alluring, and in some cases, deceiving, as intended and unintentional effects extend beyond the initial embrace of a warm cup. This remedy to a night of restlessness and reprieve from the workday is enticing to many, including those with conditions that may be exasperated by caffeine consumption. While caffeine consumption will likely always be left at the discretion of the individual consumer, a number of steps can be taken in order to ensure the risks of caffeine are minimized in relation to public health concerns such as emergency room visits, psychiatric and sleep disorders, and cardiovascular health.

The addition of caffeinated products to the marketplace has received increased criticism from the FDA in response to caffeine-related fatalities in the past decade. A commonly held health-belief found in this thesis is that caffeine is unhealthy or unsafe for children. This perception is supported by research finding increased risk of conduct disorder in children consuming caffeine, as well as by the young ages of many overdose cases. While caffeinated beverages and medications are regulated by the FDA, supplements remain a grey area under current regulatory loopholes. The unrestricted access to caffeine products to all ages also means that children who are predisposed for psychiatric disorders, sleep disorders, or cardiovascular problems may readily consume caffeine before these conditions are known.

A point well-raised by a participant concerning the effects of pharmaceutical use on caffeine is that when taking a substance for years on end, there is no way to discern how life would be without it. Separating effects of a disorder or disease from the intended or unintended effects of a medication becomes increasingly difficult when substances are multiplied and use is chronic. In regards to child health, it also must be considered that if caffeine consumption starts early in life, identifying it as a causal factor in disorders becomes more difficult. Caffeine consumption in children is often through soft-drinks, beverages which offer no positive benefit to health.

Recommendations for safe usage of caffeine include reducing or avoiding consumption while using other drugs or while experiencing psychiatric symptoms. A mechanism for moderating consumption used by many participants was switching to alternate forms of caffeine, such as switching from energy drinks to coffee and from coffee to tea. Tea consumption also affords the benefits of other compounds such as L-

theanine, which is thought to act as a calming agent. Healthy and safe use of caffeine requires listening to the body and achieving a controlled balance between rest and stimulation. Caffeine consumption can prove to be an adaptive pattern of behavior in response to stress, but for some, caffeine provides more stress than it relieves.

APPENDICES

APPENDIX A: PRIMARY SURVEY QUESTIONS

How would you describe your current relationship with caffeine?	Primarily Positive Mixed or Ambivalent Primarily Negative
Gender	Male/Female/Prefer Not to Answer
Student	Yes/No
Working	Full-time/Part-time/Not Working
Age Range	18-20, 21-30, 31-40, 41-50, 51-60, 61-70, 71-80, 81-90, 91-100
How often do you consume caffeine?	Daily/Few Times a Week/Weekly/Few Times a Month/Rarely/Never
On a typical weekday, at which times of day do you consume caffeine?	Morning/Afternoon/Evening
How many 8-ounce (1 cup) servings of the following drinks do you consume on weekdays?	Drop-down selection for cups of coffee, black tea, green tea, white tea, caffeinated soda, energy drinks
Do you consume caffeine on weekends?	More, Less, Same, None
In the past year, have you changed your consumption patterns?	More, Less, Same, None
What are your reasons for consuming caffeine?	Multi-selection checklist. Wake up, remain alert, better concentrate, be more productive, feel motivated, enjoy taste, eat less, habit, avoidance or relief from headaches, social activity, feel happier, feel energized, study, get through work, write reports,
Do you ever avoid caffeine?	Yes/No
Do you ever avoid caffeine for the following reasons:	Sleep better, more relaxed, better handle stress, health concerns, adverse effects, avoid addiction or dependence, do not like taste, more appealing non-caffeinated options
How do you feel without caffeine?	No difference, tired, irritable, unfocused, sad, more frequent headaches, healthier, more relaxed, better than with caffeine, worse than with caffeine
How sensitive do you feel that you are to the stimulating effects of caffeine	Extremely sensitive (very responsive to low-doses), Relatively sensitive (responsive to moderate doses), not sensitive (not responsive to low-moderate doses)
Why do you think you are sensitive or insensitive to caffeine?	Tolerance, genetics, weight, gender, diet, stress-level, other
How tolerant to caffeine do you feel that you are?	Extremely tolerant (can consume large doses with no adverse effects), tolerant (can consume low to moderate doses with no adverse effects), intolerant (can experience adverse effects at relatively low doses)
From the following list, have you experienced any of the symptoms below following caffeine consumption	Restlessness, excitement, flushed face, diuresis (increased urination), nervousness, insomnia, tachycardia or cardiac arrhythmia (elevated heart-rate or irregular rhythm), gastrointestinal disturbance, periods of inexhaustibility, muscle twitching, rambling flow of thoughts and speech, psychomotor agitation
From the following list, have you experienced any of the symptoms below following caffeine consumption	Dizziness, nausea, high blood pressure, diarrhea, nervous system stimulation, anxiety, tremors, photo-sensitivity
From the following list, have you experienced any	Trouble breathing, chest-pain, weakness,

of the symptoms below following caffeine consumption	lightheadedness, vomiting, feeling of a lump in the throat, blurred vision, inability to concentrate, racing heartbeat, upset stomach, numbness or tingling, confusion, disorientation, feelings of over-stimulation and panic
If you selected any previous adverse effects, why do you think you felt this way?	Free response
Have you consumed caffeinated beverages in conjunction with	Alcohol, tobacco, prescription medications (including oral contraceptives), over-the-counter medications, other (please specify)
If yes, do you feel the effects of caffeine were altered by the other substance? How did you feel?	Free response
Do you think caffeine can play a role in mental health? Do you agree with any of the following statements?	Caffeine can alleviate depression, Caffeine can make depression work, caffeine should be avoided if you are feeling anxious or nervous, caffeine should be avoided by those with mental disorders, caffeine should be avoided by those who suffer from sleep disorders and insomnia, caffeine does not play a meaningful role in mental health
Have you heard of any of the caffeine-related disorders in the American Psychiatric Association's DSM-5?	Yes/No
Which Caffeine-Related Disorders have you heard of?	Free response
Do you think caffeine plays a role in overall health? Do you agree with any of the following statements?	Caffeine lowers blood pressure, Caffeine raises blood pressure, People with heart conditions should avoid caffeine, caffeinated beverages are dehydrating, caffeinated beverages are hydrating, caffeine consumption prevents Alzheimer's and dementia, caffeine consumers live longer, caffeine consumers have shorter life-spans, other
Who do you think should consume caffeinated beverages? Do you agree with any of the following statements?	Caffeine is unhealthy or unsafe for children Caffeine is healthy and safe for children Caffeine is unhealthy or unsafe for the elderly Caffeine is healthy and safe for the elderly Caffeine is unhealthy or unsafe for pregnant women Caffeine is healthy and safe for pregnant women
Have you ever consumed more caffeine than you feel that you should have?	Yes/No
How much caffeine do you feel is healthy to consume?	Free response
Do you recall a medical professional ever asking about your caffeine consumption?	Yes, frequently Yes, but rarely No I don't remember
The last time you were prescribed a medication, did the doctor consult with you about the following?	Your use of caffeine Your diet Other medications you may be taking Interaction effects Safety of the drug
Have you had multiple adverse reactions to caffeine?	Yes: Redirects to Secondary Survey No: End of Survey

APPENDIX B: SECONDARY SURVEY QUESTIONS

When do you first remember having an adverse reaction to caffeine? Please describe your experience	Free response
What do you believe caused this response? Select any factors you think may have played a role	Too much caffeine, age, genetic predisposition, body-weight, pregnancy, child-birth, diet, illness, medication use, other
Did you report your response to a medical professional?	Yes/No
If you didn't consult a physician, what led you to decide not to? If you did, what response did you receive?	Free response
Did you avoid caffeine following your adverse reactions? Did you encounter any difficulties changing your consumption patterns?	Free response
Did you feel better without caffeine?	Free response
Did you seek information about caffeine on your own? Through which of the following means did you seek information?	Internet searches, online discussion boards, local library, other
If yes, what did you learn?	Free response
Have you learned anything about caffeine that has changed your understanding of the substance or your own body?	Free response
Did you tell other people about your adverse reactions to caffeine? Have you encountered anyone with similar experiences? Did you encounter any disbelief?	Free response
What would you want others to know about your experiences with caffeine?	Free response

APPENDIX C: MULTIPLE ADVERSE REACTION SURVEY PARTICIPANTS

Dayna, F (N)	31-40	Yes, Not working	0 mg	5
Sarah, F (N)	51-60	No, Full-time	0 mg	7
Ryan, M (M)	21-30	No, Full-time	150 mg	11
Sophia, F (P)	21-30	No, Full-time	160 mg	8
Micah, M (M)	31-40	Yes, Part-time	270 mg	4
Hunter, M (P)	21-30	Yes, Full-time	330 mg	16
Connie, F (P)	51-60	No, Full-time	540 mg	6
Brandy, F (N)	51-60	No, Full-time	340 mg	3
Jillian, F (M)	21-30	No, Part-time	270 mg	13
Lily, F (M)	21-30	No, Full-time	330 mg	13
Eugene, M (M)	41-50	No, Full-time	330 mg	11
Marjorie, F (P)	51-60	No, On Disability	360 mg	9
Jacob, M (N)	61-70	No, Part-time	370 mg	6
Keith, M (N)	18-20	Yes, Not working	400 mg	32
Meredith, F (M)	51-60	No, Full-time	405 mg	6
Zachary, M (P)	21-30	Yes, Part-time	405 mg	2
Isaac, M (M)	21-30	Yes, Part-time	420 mg	12
Logan, M (P)	21-30	Yes, Not working	420 mg	17
Kayla, F	21-30	Yes, Full-time	550 mg	24
Bella, F (N)	21-30	No, Full-time	575 mg	10
David, M (M)	21-30	Yes, Full-time	595 mg	8
Chris, M (P)	21-30	Yes, Part-time	610 mg	5
Justine, F (P)	21-30	Yes, Part-time	625 mg	11
Celia, F (P)	21-30	Yes, Part-time	660 mg	17
Jackie, F (P)	21-30	Yes, Full-time	690 mg	7
Mya, F (M)	31-40	Yes, Full-time	770 mg	7
Toby, M (P)	21-30	Yes, Part-time	810 mg	27
Ezra, M (P)	21-30	Yes, Part-time	810 mg	13

All names are pseudonyms to protect the anonymity of participants

29 participants, 1 removed due to error
Positive: 12, Mixed: 9, Negative: 6, No data: 1

Salina removed (no adverse reactions)

Salina (M)	21-30	No, No work	220 mg	9

APPENDIX D: PRIMARY SURVEY PARTICIPANTS

Males

Pseudonym	Age Range	Student and/or Working?	Average daily milligrams	Adverse Effects
John (N)	21-30	Yes, Part-time	0 mg	No data
Thomas (P)	21-30	No, Not working	90 mg	5
Ryan (M)	21-30	No, Full-time	150 mg	11
Raymond (M)	31-40	No, Full-time	180 mg	6
Douglas (P)	18-20	Yes, Part-time	240 mg	6
Felix (M)	No data	No data, Part-time	260 mg	No data
Kevin (M)	21-30	No, Full-time	270 mg	6
Micah (M)	31-40	Yes, Part-time	270 mg	4
Mark (N)	41-50	No, Full-time	330 mg	7
Hunter (P)	21-30	Yes, Full-time	330 mg	16
Eugene (M)	41-50	No, Full-time	330 mg	11
Jacob (N)	61-70	No, Part-time	370 mg	6
Keith (N)	18-20	Yes, Not working	400 mg	32
Samuel (P)	21-30	No, Full-time	405 mg	4
Trent (M)	51-60	No, Full-time	405 mg	7
James (P)	41-50	No, Full-time	405 mg	1
Zachary (P)	21-30	Yes, Part-time	405 mg	2
Brendan (P)	21-30	Yes, Part-time	405 mg	6
Logan (P)	21-30	Yes, Not working	420 mg	17
Isaac (M)	21-30	Yes, Part-time	420 mg	12
Pierce (M)	21-30	No, Full-time	420 mg	2
Jerry (N)	21-30	Yes, Not working	435 mg	1
Liam (P)	21-30	Yes, Full-time	480 mg	9
Michael (P)	21-30	No, Part-time	535 mg	4
Gerald (P)	21-30	No, Full-time	540 mg	3
Freddy (M)	51-60	Yes, Full-time	540 mg	6
David (M)	21-30	Yes, Full-time	595 mg	8
Brian (P)	51-60	No, Full-time	600 mg	1
Ben (P)	31-40	No, Full-time	610 mg	0
Chris (P)	21-30	Yes, Part-time	610 mg	5
Jason (P)	31-40	No, Full-time	610 mg	7
Robert (P)	18-20	Yes, Not working	640 mg	4
Steven (P)	41-50	No, Full-time	690 mg	3
Chester (P)	31-40	Yes, Full-time	735 mg	4
Stephan (P)	51-40	No, Full-time	795 mg	6
Toby (P)	21-30	Yes, Part-time	810 mg	27
Ezra (P)	21-30	Yes, Part-time	810 mg	13
Nicholas (M)	21-30	Yes, Not working	875 mg	19
Justin (P)	51-60	No, Full-time	910 mg	2
Frank (P)	31-40	No, Not working	910 mg	2
Tyler (P)	21-30	Yes, Part-time	1015 mg	2
Noah (P)	18-20	Yes, Part-time	1020 mg	1
Alan (M)	21-30	Yes, Part-time	1220 mg	19

All names are pseudonyms to protect the anonymity of participants

Females

Pseudonym	Age Range	Student And/Or Working?	Average Daily Milligrams	# Adverse Effects
Dayna (N)	31-40	Yes, Not working	0 mg	5
Sarah (N)	51-60	No, Full-time	0 mg	7
Helen (N)	51-60	No, Part-time	0 mg	7
Debbie (P)	21-30	No, Full-time	150 mg	3
Tracy (M)	18-20	Yes, Not working	150 mg	4
Sophia (P)	21-30	No, Full-time	160 mg	8
Flora (P)	21-30	No, Full-time	200 mg	8
Nancy (P)	51-60	No, Part-time	200 mg	0
Salina (M)	21-30	No, No work	220 mg	9
Maria (M)	21-30	No, Full-time	220 mg	13
Caitlyn (P)	21-30	Yes, Part-time	250 mg	9
Jillian (M)	21-30	No, Part-time	270 mg	13
Brooke (P)	51-60	No, Full-time	270 mg	9
Lois (P)	21-30	No, Full-time	270 mg	5
Lily (M)	21-30	No, Full-time	330 mg	13
Julie (P)	21-30	Yes, Part-time	330 mg	11
Lynn (N)	61-70	No, Full-time	340 mg	10
Brandy (N)	51-60	No, Full-time	340 mg	3
Isadora (M)	51-60	No, Full-time	340 mg	7
Karen (N)	21-30	No, Full-time	340 mg	0
Amanda (M)	31-40	Yes, Part-time	340 mg	14
Dixie (N)	21-30	Yes, Full-time	360 mg	5
Marjorie (P)	51-60	No, On Disability	360 mg	9
Marianne (P)	31-40	No, Full-time	370 mg	6
Joy (P)	21-30	No, Full-time	370 mg	2
Lena (P)	61-70	No, Full-time	405 mg	1
Diana (P)	21-30	Yes, Not working	405 mg	12
Meredith (M)	51-60	No, Full-time	405 mg	6
Ellie (P)	51-60	No, Part-time	405 mg	4
Rosie (P)	21-30	No, Part-time	405 mg	1
Veronica (P)	21-30	No, Full-time	420 mg	0
Lara (P)	21-30	No, Freelance	465 mg	5
Olivia (P)	51-60	No, Part-time	465 mg	0
Regina (P)	41-50	No, Full-time	485 mg	9
Maggie (P)	21-30	Yes, No work	495 mg	4
Jennifer (P)	21-30	Yes, Part-time	505 mg	4
Sandra (P)	21-30	No, Full-time	505 mg	5
Kelly (M)	21-30	No, Full-time	510 mg	5
Connie (P)	51-60	No, Full-time	540 mg	6
Isabelle (P)	51-60	No, Full-time	540 mg	7
Kayla	21-30	Yes, Full-time	550 mg	24
Jackie (M)	21-30	Yes, Part-time	555 mg	22
Bella (N)	21-30	No, Full-time	575 mg	10
Trisha (P)	21-30	No, Full-time	590 mg	4
Florence (P)	31-40	No, Full-time	610 mg	1
Veronica (P)	18-20	Yes, Part-time	610 mg	No Data
Justine (P)	21-30	Yes, Part-time	625 mg	11
Celia (P)	21-30	Yes, Part-time	660 mg	17
Wendy (P)	51-60	No, Full-time	675 mg	4
Maria (P)	21-30	Yes, Part-time	690 mg	7

Jackie (P)	21-30	Yes, Full-time	690 mg	7
Cheyanne (P)	21-30	No, Full-time	705 mg	3
Regina (P)	21-30	Yes, Not working	770 mg	3
Mya (M)	31-40	Yes, Full-time	770 mg	7
Tammy (M)	21-30	Yes, Part-time	775 mg	8

All names are pseudonyms to protect the anonymity of participants

APPENDIX E: IRB APPROVAL

FAU
FLORIDA ATLANTIC UNIVERSITY

Institutional Review Board
Mailing Address:
Division of Research
777 Glades Rd., Bldg. 80, Rm. 106
Boca Raton, FL 33431

Tel: 561.297.0777 Fax: 561.297.2573

http://www.fau.edu/research/researchint
Michael Whitehurst, Ed.D., Chair

DATE:	February 19, 2014
TO:	Mary Cameron, PhD
FROM:	Florida Atlantic University Social, Behavioral and Educational Research IRB
IRBNET ID #:	497854-2
PROTOCOL TITLE:	[497854-2] Variation in Responses to Caffeine
PROJECT TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	February 19, 2014
EXPIRATION DATE:	February 18, 2015
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # *B7*

Thank you for your submission of Amendment/Modification materials for this research study. The Florida Atlantic University Social, Behavioral and Educational Research IRB has APPROVED your *New Project*. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

- This study is approved for a maximum of **120** subjects.
- It is important that you use the approved, stamped consent documents or procedures included with this letter.
- ****Please note that any revision to previously approved materials or procedures, including modifications to numbers of subjects, must be approved by the IRB before it is initiated.** Please use the amendment form to request IRB approval of a proposed revision.
- All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All regulatory and sponsor reporting requirements should also be followed, if applicable.
- Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.
- Please note that all research records must be retained for a minimum of three years.
- **This approval is valid for one year.** A Continuing Review form will be required prior to the expiration date if this project will continue beyond one year.

If you have any questions or comments about this correspondence, please contact Elisa Gaucher at:

Institutional Review Board
Research Integrity/Division of Research

Florida Atlantic University
Bldg. 80, Rm. 106
Boca Raton, FL 33431
Phone: 561-297-0777

* Please include your protocol number and title in all correspondence with this office.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within our records.

APPENDIX F: CONSENT FORM

Consent to Participate in Research Study

Title of Research Study: Variation in Responses to Caffeine

Investigator: Carlyn Porter (M.A. student) under the supervision of Dr. Mary Cameron, Professor of Anthropology at Florida Atlantic University.

Purpose: Caffeine is the most widely used drug in the world, yet the actual effects of the substance can vary between individuals. The aim of this anthropological study is to better understand motivations for caffeine consumption, cultural meanings given to the substance, the frequency of adverse effects experienced, and potential reasons for varied responses.

Procedures: To participate in this study, you will complete a survey about how much caffeine you consume, how it makes you feel, and your viewpoints on various topics related to caffeine. Depending upon your responses, the survey may range from 33-44 questions of various formats. The survey will take approximately 15 to 30 minutes, depending upon your length of response. You are free to skip any question that makes you uncomfortable or you do not wish to answer. In order to protect your privacy, please do not include any identifying information in your short-answer responses.

Risks: Risks in this study are minimal, given the anonymous nature of this online survey. PsychData surveys utilize Secure Survey Environment (SSE) technology to ensure the privacy of your responses after submission. No identifying information will be requested or stored that could reveal your identity as a participant. You will encounter questions about how caffeine affects your mental and physical well-being. If any of these questions make you uncomfortable or cause distress, please press "Continue" to advance to the next question.

Benefits: The major benefit of this study is a greater understanding of the variety in responses to caffeine. This is necessary knowledge to prevent future adverse reactions to caffeine.

Data Collection and Storage: All data collected is confidential and anonymous. Survey data is encrypted using Secure Socket Layer (SSL) technology to ensure the privacy of both survey questions and responses. After transmission, data is securely stored on the PsychData server. All data analysis done by the investigator will be done on a password-protected computer in a locked office. Data will be permanently deleted from servers and local storage three years after the completion of this study.

Contact Information: For related problems or questions regarding your rights as a research subject, contact the Florida Atlantic University Division of Research at (561) 297-0777. For other questions about the study, please contact the faculty advisor (Dr. Mary Cameron: mcameron@fau.edu) and investigator (Carlyn Porter: cporte16@fau.edu).

Consent Statement: I have read the information describing this study. All my questions have been answered to my satisfaction. I am 18 years of age or older and freely consent to participate. I understand that I am free to withdraw from this study at any time without penalty. I have printed a copy of this consent form for my records. By clicking "Continue" below, I am giving my consent to participate in this research study.

Do you agree to participate in this research study?

1. Yes, I consent
2. No, I do not consent

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