THE ROLE OF MOTIVATIONS FOR USE IN THE ASSOCIATIONS BETWEEN INTERNALIZING PSYCHOPATHOLOGY AND CAFFEINE CONSUMPTION

by

COREY FREDERICK DOREMUS

A thesis submitted to the

Graduate School-Camden

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of Master of Arts

Graduate Program in Psychology

Written under the direction of

Naomi R. Marmorstein

And approved by

Naomi R. Marmorstein

Kristin August

Lauren Daniel

Camden, New Jersey

May 2018

ABSTRACT OF THE THESIS

The Role of Motivations for Use in the Associations between Internalizing Psychopathology and Caffeine Consumption

By COREY FREDERICK DOREMUS

Thesis Director:

Naomi R. Marmorstein

There were two specific aims of this study. First, it sought to replicate previous research exploring links between caffeine consumption and certain types of internalizing psychopathology. Second, it examined whether motivations for caffeine use account for links between caffeine consumption and internalizing psychopathologies. For both of these aims, total weekly caffeine consumption, caffeine consumption frequency, and caffeinated beverage choice were examined. The sample for this study was 194 undergraduates (mean age=19.8, SD=3.5; 47% male; 51% white, 19% African-American, 13% Hispanic or Latino, 12% Asian, 5% other), and data were collected using self-report questionnaires. Previous findings indicating positive associations between depressive symptoms and increased caffeine consumption were replicated. Both Self-Medication and Dependence motivations for use significantly mediated the association between depressive symptoms and caffeine consumption, both in total weekly consumption amount and caffeine use frequency. Energy and Enjoyment

motivations were not significant mediators. Associations between depressive symptoms and more frequent tea consumption, adjusting for all other caffeinated beverage types, were also found. Panic symptoms were not found to be significantly associated with any beverage choice, total caffeine consumption, or caffeine consumption frequency. While causality cannot be drawn from these findings, they serve as a useful knowledge base to inform future longitudinal studies.

Introduction

Internalizing psychopathologies such as anxiety and depression have been shown to be associated with a wide range of disparate externalizing behaviors, such as conduct disorders and substance abuse. Specifically, depression and anxiety have been found to have significant positive associations with consumption of psychoactive substances, such as alcohol (Novak, Burgess, Clark, Zvolensky, & Brown, 2003; Kushner, Sher, Wood, & Wood, 1994) nicotine (Novak et al., 2003) and illicit drugs (Weiss, Griffin, & Mirin, 1992). In many substance use studies distinct consumption patterns have been linked with specific motivations (e.g., heavy alcohol drinkers being motivated by 'personal/drug effects' and light drinkers motivated by 'social' effects in Graham (1988)).

Caffeine, as a legal and popular stimulant, is used daily by up to 80% of adults in the United States (Shohet & Landrum, 2001) and up to 70% of the adolescent population (Bryant, Ludden, & Wolfson, 2010). Caffeine consumption is especially prevalent among young adults (Frary et al., 2005) although little is known about the motivations driving young adult caffeine use frequency and caffeinated beverage choice. Heavy caffeine consumption has also been linked to many potential negative correlates, such as substance abuse (Terry-McElrath, O'Malley, & Johnston, 2014), alcohol dependence (Arria et al., 2011), and prescription stimulant abuse (Woolsey et al., 2014); evidence to date is unclear whether these links apply across beverage types or only to energy drinks. As research into the possible driving mechanisms behind caffeine use is lacking, an examination of larger factors of motivation is necessary and useful.

Literature Review

This review of the literature covers three related topics in sequence. First, it summarizes the literature on the association between caffeine consumption and internalizing psychopathology, specifically depression and panic anxiety. Second, it examines the extant literature on caffeine use motivations. Third, it presents the uncertainty surrounding the association between caffeine use, these motivations, and psychopathology.

Caffeine consumption has been associated with various mood and cognitive enhancing effects, such as increasing arousal and alertness (Quinlan, Lane, Moore, Aspen, Rycroft, & O'Brien, 1999; Brice & Smith, 2002), enhancing positive mood and happiness (Smith, Sutherland, & Christopher, 2005; Warburton, 1994), and increased concentration (Silverman & Griffiths, 1992). In most laboratory studies, a dose of caffeine was administered to participants as a single bolus (usually a capsule) in a dosage above what is commonly consumed in a single beverage. While these studies were overwhelmingly of an experimental nature in a laboratory setting, the cognitive and mood effects observed have been linked to real world consumption habits through studies of lower dose repeated ingestion (which is typical of an average consumer) such as in Brice and Smith's examination of "realistic consumption" effects (2002). It was found that the typical consumption patterns of multiple low doses of caffeine had very similar effects as the experimental single high-dose protocol which is over represented in the literature. Through linking common consumption habits with well documented and controlled experimental outcomes, it is possible to extend the sterile laboratory findings to realistic situations.

Associations between type of caffeinated beverage consumed and psychopathology have also been explored in a variety of studies across diverse populations. Daily or frequent tea consumption was found to be associated with significantly lower levels of depression and depressive symptoms (Hintikka, Tolmunen, Honkalampi, Haatainen, Koivumaa-Honkanen, Tanskanen, Viinamäki, 2005; Dong, Yang, Cao, Gan, Sun, Gong, Yang, Yin, & Lu, 2015), with potential pathways for this association being both the caffeine content of tea and the secondary components such as polyphenols. Coffee consumption is also associated with decreased depressive symptoms (Wang, Shen, Wu, & Zhang, 2016). Therefore, across beverage types, caffeine consumption has consistently been associated with decreased depressive symptoms, which is potentially due to the mood elevating and arousal increasing effects of caffeine.

The association between panic anxiety disorders and caffeine consumption appears to be straightforward. There exists a body of evidence that individuals suffering from panic disorders are hypersensitive to caffeine (Nardi et al., 2007; Lee, Cameron, & Greden, 1985), stemming from either a physiological sensitivity to caffeine or a predisposition to interpret the effects of caffeine consumption as being more intense. A model which proposes a combination of these effects by Totten & France (1995) utilized physiological measurements such as blood pressure, skin conductance, and cardiac interbeat interval as well as an assessment of subjective anxiety in groups with and without nonclinical panic. Individuals who exhibited both clinical and nonclinical panic displayed a dramatically increased anxiety response compared to the non-panic group after ingesting caffeine. These associations were also found in a study by Nardi et al.

(2007), wherein individuals exhibiting both panic and performance social anxiety disorders were found to have a significantly increased anxiety response to caffeine compared to both individuals in control conditions and those with generalized anxiety disorder. These findings are indicative of the common psychophysiological model of panic anxiety, wherein individuals suffering from panic anxiety are more sensitive to both arousal cues and more likely to interpret such arousal as threatening, leading to a catastrophic response (Totten & France, 1995). Their findings support a combination of both heightened subjective response and physiological response, working in an additive nature to manifest as significant anxiety. The model proposed by Totten and France builds upon established findings, such as the 1992 study by Beck and Berisford, which found that individuals who exhibited panic anxiety were far more likely to misinterpret somatic arousal sensations as catastrophic and as a result displayed a drastic increase in their levels of subjective anxiety. Regardless of the proposed model, many studies found increased anxiety response to caffeine consumption, such as Lee, Cameron, and Greden (1985) wherein individuals with panic anxiety reported being more sensitive to caffeine's anxiogenic and somatic effects, leading to decreased caffeine consumption by these individuals. It is informative to note that the established direction of effect for panic anxiety symptoms is directly opposite to the effect observed for depressive symptoms, indicating the multifaceted nature of caffeine on mood and interactions with psychopathology. Again, the literature supports an association and proposes a potential model for the consumption patterns observed, but does not address the motivational structure that contributes to and potentially shapes this association

Motivations

While most of the current research has focused on the associations between overall level of caffeine consumption and presence of depressive or panic symptoms, there is little research examining one of the desired aims of the present study: the underlying motivations for caffeine consumption. The most widely known study of caffeine use motivations examined use motives for only coffee and tea (Graham, 1988). Graham's study employed a modified alcohol use motives scale tailored for both coffee and tea consumption, with 18 final items in the measure. These items were factor-analyzed and a four factor model emerged, with Graham naming these factors 'Sociability' and 'Beverage' (Social and beverage choice factors), and 'Stimulant' and 'Relief' (Personal Effects). Graham ultimately found that the best predictor for consumption were the beverage (r^{coffee}=.46, r^{tea}=.50) and relief (r^{coffee}=.44, r^{tea}=.40) motives, while dependence was most reliably predicted by stimulant (r^{coffee}=.38, r^{tea}=.57), relief (r^{coffee}=.52, r^{tea}=.50), and beverage (r^{coffee}=.37, r^{tea}=.41) motives (Graham 1988). Graham connected the associations of different motivations with different outcomes to the earlier work in alcohol use motivations from where she adapted her measure.

Building upon Graham's work, Irons et al. developed and validated the Caffeine Motives Questionnaire (Irons et al., 2014). During development of this measure, previously identified associations between caffeine consumption and both depressive symptoms and anxiety symptoms were replicated. Irons et al. also conducted repeated factor analyses, determining several major factors into which caffeine motivations can be classified, specifically negative affect relief,

cognitive enhancement, reinforcing effects, and weight control (Irons et al., 2014).

Despite the above studies, there is little research into caffeine use motives in general and even less regarding the role of such motivations in the association between caffeine consumption and internalizing disorders. There are several studies that have examined the role of caffeine use expectancies in the context of depression (Leibenluft, Fiero, Bartko, Moul, & Rosenthal, 1993), and general performance and mood (Dawkins, Shahzad, Ahmed, & Edmonds, 2011), and these studies found that the expectation of having consumed caffeine had similar effects on depressive symptoms, performance ability, and mood as having actually consumed caffeine. While these studies examined one aspect of the complex association between caffeine and depression and mood, they did not assess the motivations for caffeine use, only the impact of the related expectancies regarding use. During the development of the Caffeine Motives Questionnaire (CMQ), positive and significant associations were found between all assessed motivational factors and depressive symptom scores (Irons et al., 2014), indicating the need for further examination of this association. It was found that although both the global score derived from the CMQ and each of the motivational factor scores were associated with depressive symptoms, raw caffeine consumption was not strongly associated with depressive symptom scores. The factors most highly associated with depressive symptoms were "negative affect relief" and "reinforcing effects", indicative of emotional (mood-based) and nonemotional (physiological or cognitive based) coping respectively (Irons et al., 2014).

Goals and Hypotheses

The goal of the present study was to assess and describe motivations for caffeine use, and to assess potential mechanisms driving the observed associations between caffeine use and psychopathology present in the literature. To accomplish this goal, the presence of anxiety and depressive symptoms were assessed through established measures. The frequency of caffeine consumption through common caffeinated beverages (coffee, tea, soda, and energy drinks) and potential motivators for the consumption of each beverage were identified. A factor analysis was conducted to group motivators into larger functional groups, and the associations between these groups and the assessed psychopathologies were examined. Hypotheses regarding associations between caffeine consumption and internalizing symptoms, the role of motivations for use in these associations, and beverage choice patterns will be presented in this section.

It was hypothesized that the previously identified associations between caffeine consumption and depression and panic anxiety were to be replicated. Specifically, depressive symptoms were expected to be associated with increased caffeine consumption while panic anxiety was expected to be associated with decreased caffeine consumption. Alternatively, due to the mood-elevating effects of regular caffeine use, it is possible that individuals who demonstrate high levels of caffeine consumption will be effectively masking depressive symptoms and the association between consumption and depressive symptoms will be reversed,

meaning that lower levels of depressive symptoms would be linked to higher caffeine consumption.

It was hypothesized that motivation for use will at least partially account for the established associations between caffeine use and depressive symptoms. Specifically, it was hypothesized that after accounting for some use motivations, specifically self-medication and dependence, the associations between caffeine use and depressive symptoms would become non-significant. It is hypothesized that the association between panic symptoms and caffeine consumption will not be significantly mediated by motivations for use.

In addition to this, it was hypothesized that beverage choice patterns will be distinct for each of the examined psychopathologies. Due to the differences in typical caffeine content of each beverage type and the underlying assumption that caffeine consumption is a major driving factor in these choices, it was believed that significantly different beverage choices will be associated with each psychopathology. Specifically, we expected that coffee and tea would be associated more strongly with higher depressive symptoms, while the associations between depressive symptoms and both soda and energy drinks would be of a much lesser magnitude as the literature supports strong taste preferences for these beverage types.

It is also believed that higher incidences of panic attack (such as having had panic attacks, and greater number of past-year panic attacks) will be associated with decreased consumption across all caffeinated beverages. Due to the literature supporting physiological exacerbation of panic anxiety by caffeine,

it is hypothesized that use motivations will not significantly explain this association.

Methods

Participants

Participants were drawn from the Rutgers-Camden psychology department subject pool (N=194), and were thus college-aged (mean age=19.8, SD=3.5; 47% male, 51% white, 19% African-American, 13% Hispanic or Latino, 12% Asian, 5% other). The present research protocol was approved by the IRB of Rutgers University.

Procedures

All students taking Introduction to Psychology or Research Methods were invited to participate, and as these students were enrolled in a class and received credit for participating, a separate assignment was offered in place of participation. Students completed a self-report questionnaire which included the measures discussed in this study, namely the CES-D, PAQ-IV, and CCQ (with additional CMQ questions).

Measures

Predictor Variables

The independent variables chosen are the presence and severity of depressive symptoms and the presence and severity of panic anxiety symptoms.

To assess the presence and severity of depressive symptoms, the Center for Epidemiologic Studies Depression Scale (CES-D) was utilized. The CES-D is a self-report questionnaire comprised of 20 items, focusing on the frequency of depressive symptoms over the past week. These items were adapted from other measures which have been well-validated (Radloff, 1991). Within the CES-D,

several symptoms of depression are represented by multiple questions, with symptoms including feelings of worthlessness and guilt, depressed mood, feelings of hopelessness and helplessness, sleep disturbance, psychomotor retardation, and loss of appetite (Radloff, 1977). Items include such symptoms as 1) I felt that everything I did was an effort, 2) I felt fearful and 3) I thought my life had been a failure. Participants respond to these items with how frequently they have felt this way in the past week, with the attached score in brackets (Rarely or not at all <1 day [0], Some or a little of the time 1-2 days [1], Occasionally or a moderate amount of time 3-4 days [2], and Most or all of the time 5-7 days [3]). The responses are scored and the sum total is used to interpret the results, with higher scores representing the presence of more depressive symptoms. The presence of depressive symptoms were treated as a continuous variable ranging from low to high values and corresponding to the summed score of the CES-D. The CES-D has been applied to college samples, such as in a study conducted by Radloff in 1991 wherein the CES-D was utilized in several separate samples, including junior high school students, high school students, college students, and there were no specific age trends found (Radloff, 1991). The CES-D was found to have high internal consistency (α=.85), moderate test-retest reliability (r=.59 at 8 weeks, r=.49 at 12 months), and was correlated with both interviewer ratings for depression (r=.49 and r=.53) and other depression measures, such as the Lubin Scale (r=.51), the Bradburn Negative Affect scale (r=.60) and the Langner Scale (r=.54) (Radloff, 1991). As depressive symptoms are complex and present differentially, these moderate correlations affirm the validity and reliability of the CES-D to assess the presence of depressive symptoms. Out of 194 participants,

193 answered at least 90% of the items (mean score= 15, median = 14, SD=9.33, range = 0-60).

The Panic Attack Questionnaire IV (PAQ) was used to assess the presence and severity of panic anxiety symptoms. The PAQ was designed to assess the presence of panic attacks, which may occur without the presence of panic disorder, which sets this measure apart from many other panic anxiety measures. It contains retrospective questions regarding frequency, duration, severity, and controllability of panic attacks across several different time periods (past week, month, year). The PAQ also tasks respondents with describing the duration, severity, and controllability of their typical, worst, and most recent panic attacks. The PAQ contains detailed descriptions of common panic attack symptoms, and asks respondents to compare their experiences with these descriptions. Due to the many factors that can both instigate and indicate panic attacks, both psychological and physiological, the questions cover a wide array of symptoms. These symptoms include panic cognitions (such as catastrophizing) and rapid heart rate (Whittal, Suchday, & Goetsch, 1994). The two items of interest for this study were those that concern whether or not the participant has ever experienced a panic attack (n=62, 31.9 % of total sample) and, if so, the number of panic attacks that they have experienced in the past year on a 1-10 scale (n=62, mean=3.10, median=2.50, SD = 2.58 range=0-10). These two items were used for analysis as none of the participants responded to having more than ten panic attacks in the past year, and the number of past-year panic attacks will be treated as the participant's "panic attack score". The PAQ has been utilized in many different sample populations, and has been validated against accepted measures

such as the Panic Disorder Severity Scale and has been shown to significantly predict the outcomes of clinician-led interview measures. The PAQ was also found to significantly predict 81% of the variability of Panic Disorder Severity Scale scores (assessed concurrently) (R^2=0.81, F=7.39, p<0.001) (Norton, Zvolensky, Bonn-Miller, Cox, & Norton, 2007). The Panic Disorder Severity Scale (PDSS) is a measure designed to assess the presence and severity of panic disorder, consisting of seven items. The PDSS showed high internal consistency (Cronbach's alpha=0.88), and showed significantly higher mean scores for individuals with diagnosed panic disorder (mean=12.4, SD=5.4) than in individuals without panic disorder (mean=6.1, SD=6.0) (Shear et al. 2001).

Mediating Variable

The mediating variable of motivations for caffeine consumption was assessed via the CCQ. The preeminent measure for the quantification of a respondent's caffeine consumption, the Caffeine Consumption Questionnaire by Landrum (1992), was developed and utilized without prior measures against which to compare its validity. This questionnaire was designed to be accessible to the average respondent, so the questions asked about typical daily consumption of various caffeinated beverages. Landrum's CCQ was utilized and adapted ad-hoc in many studies to determine the extent of caffeine use for individuals in a range of studies, but mainly to determine the potential role of caffeine use in predicting various types of substance abuse (such as in Arria et al., 2011, Woolsey et al., 2014). In a study that was conducted to assess the reliability and validity of the CCQ, a slightly modified CCQ (in order to use it as a 7-day diary measure) was developed and compared with both the standard CCQ and a salivary caffeine

concentration assay. A telephone interview that included the CCQ was conducted and following this interview the diary version of the CCQ was completed by participants. After this period, participants completed the traditional retrospective version of the CCQ and underwent a salivary assay. It was found that results from the interview, 7-day version, and the traditional CCQ were correlated significantly with the salivary assay (r=.61, r=.68, and r=.83, respectively) (Addicott, Yang, Pfeiffer, & Laurienti, 2009). The correlation between all versions of the CCQ and physiological measure supports the validity and reliability of the CCQ in measuring caffeine consumption. While there exists some earlier work on caffeine motivation, principally Kathryn Graham's 1988 study which uses ad hoc measures (developed from alcohol dependence scales), Landrum's CCQ was (and is) the most widely utilized measure for assessing caffeine consumption in an individual. The original CCQ was designed to assess the amount of caffeine ingested by the respondent in an average day, and did not assess motivations behind this consumption.

Items from the Caffeine Motives Questionnaire (CMQ) (Irons et al., 2014) were also used. In order to assess motivations to consume caffeine, 15 items regarding typical caffeine use outcomes are answered on a 5 point scale. For example, the item "I choose to ingest caffeine to feel more alert" has possible answers of "I never drink caffeine for this reason"[0], "I rarely drink caffeine for this reason" [1], "I sometimes drink caffeine for this reason" [2], "I often drink caffeine for this reason" [3], and "I always drink caffeine for this reason" [4]. It is likely that participants who are motivated by the same motivational factor may

respond in slightly different ways to any individual item, and many items are believed to assess similar functional factors.

Outcome Variables

The dependent variables of caffeine consumption frequency (number of days caffeine is consumed per week) and beverage choice (determined by total number of servings of each beverage per week, calculated by multiplying the number of days per week that beverage is consumed and the number of drinks consumed on a typical day) were measured with the CCQ, and the dependent variable of total caffeine consumption quantity per week was calculated by combining the quantities of each beverage consumed weekly. As the CCQ utilizes questions that ask about typical caffeine consumption over the course of a week, it provides an accurate picture of caffeine consumption, and helps to overcome the fact that individuals are typically unaware of the amount of caffeine in their normal diet (Frary, Johnson, & Wang, 2005).The frequency of caffeine consumption is a continuous variable, ranging from 0 to 7 days per week. The possible options for beverage choice were determined by total weekly servings of each beverage, and include coffee (n = 189, mean =2.86, median = 0.00, SD=5.11), soda (n = 182, mean = 4.55, median = 1.00, SD = 7.19), tea (n=192, mean = 1.97, median = 0.00, SD = 5.05), and energy drinks (n = 191, mean = 0.99, median = 0.00, SD = 2.67), and were treated as continuous variables, ranging from low to high use of each beverage type. Preliminary analysis determined that the coffee and soda beverage choice variables needed to undergo a logarithmic transformation due to skew, and values which exceeded three standard deviations from the mean were excluded in analyses (n=4 for coffee,

n=6 for soda). The frequency of caffeine consumption weekly was operationalized as a continuous variable ranging from low consumption to high consumption. As the general consumption trends (such as zero, low, moderate, and high consumption) are of interest in this study, treating the responses as a continuous variable increases both the accuracy and utility of these variables.

Statistical Analyses

Descriptive analyses were conducted to ensure that statistical assumptions such as normality were not violated. The tables presented in the final appendix (Table 1 through Table 5) present the results of these analyses. Furthermore, as a relatively small proportion of the sample endorsed panic symptoms, a log transformation of the data plus a constant (1) was used to preserve the proportion which responded zero panic attacks. To be thorough, the tables of the panic analyses without the addition of the constant are provided in the appendix (Tables 23-26), and represent only the participants who have had a panic attack, not the entire sample.

To evaluate the replication of previous findings regarding psychopathology and caffeine consumption, correlations were conducted between the independent variables (symptoms of psychopathology) and the dependent variables of caffeinated beverage consumption frequency (days per week beverage is consumed) and level of beverage use (measured in total weekly servings consumed). If depressive symptoms were found to have a positive correlation with consumption frequencies and use levels and panic anxiety symptoms were found to have a negative correlation with consumption frequencies and use

levels, the first hypothesis (i.e., replicating previous research) would be supported.

As many of the assessed motivations are functionally similar, it is likely that some of them represent different facets of a single underlying latent variable, such as the clear energy motivations of both “To combat drowsiness” and “To stay awake.” Due to this inter-item association, a factor analysis, using Varimax rotation, was conducted. This analysis suggests that a four-factor model (Energy, Self-Medication, Dependence, and Enjoyment) is the best fit for these motivations. Through a detailed analysis of both the commonalities between individual items and their nature in the larger context of all items, discrete motivational factors were derived and examined. Utilizing a factor analysis helps to reveal the underlying structure of the items and their responses, and provides a clearer sense of the association between motivations and the other variables of interest.

Finally, the effect of motivations for use on any significant association between psychopathology and caffeine consumption was assessed using the PROCESS macro (Hayes, 2012) and SPSS, with each motivation factor being analyzed in separate models. If it was found that some motivations for use function as a mediator in this model of the association between psychopathology and caffeine consumption, the second hypothesis (i.e., that some motivations for use will act as a mediator in the association between psychopathology and caffeine use) would be supported.

In order to evaluate the association between beverage choice and psychopathology, partial correlations were conducted, assessing the association

between each beverage and psychopathology while controlling for the other beverage choices. If a clear pattern emerged between psychopathology and specific beverage choice, the third hypothesis (i.e., that each specific beverage type will have a distinct association with psychopathology) would be supported.

Results

Internalizing symptomatology and caffeine use levels and frequency

Tables 2 and 3 contain the means, standard deviations, and frequencies of the variables for caffeine use frequency (n=177) and weekly consumption amount (n=185), and tables 1 and 4 contain these descriptives for CES-D scores (n=193) and panic attack scores (n=190), respectively. The CES-D was found to have high reliability in this sample (20 items, α=.868) and the PAQ-IV was similarly reliable in this sample (14 items, α=.857). For each variable, any values which exceeded three standard deviations from the mean were excluded from analysis. Tables 7 and 8 contain correlation analyses between internalizing symptoms and overall caffeine use. Bivariate correlations between CES-D scores and caffeine use frequency, CES-D scores and total weekly caffeine consumption, panic attack scores and caffeine use frequency, and panic attack scores and total weekly caffeine consumption were conducted separately. CES-D scores were significantly and positively correlated with both caffeine use frequency (n=185, r=.194, p=.008) and total weekly caffeine consumption (n=177, r=.164, p=.029). Panic attack scores (number of past-year panic attacks) were found to not be significantly associated with caffeine use frequency (n=181, r=.180, p=.106) nor total weekly caffeine consumption (n=173, r=.083, p=.280). Repeating these analyses using only the subset of participants who had experienced at least 1 panic attack in the past year (n=62) (Tables 24 and 25) yielded a similar pattern of results: associations with both caffeine use frequency (n=52, r=.028, p=.842)

and total weekly caffeine consumption (n=52, r=-.041, p=.772) being non-significant.

Factor analysis of caffeine use motivations

The results of the factor analysis of caffeine use motivations are presented in Table 6. Varimax rotation was utilized to maximize differences between factors. A four factor model emerged, with the factors being 'Energy' (5 items), 'Self-Medication' (4 items), 'Dependence' (4 items), and 'Enjoyment' (2 items).

Mediation analysis of motivations for use

To analyze the role of motivations for use in the association between depressive and panic symptoms and caffeine consumption, a model was analyzed using symptoms (CES-D) as the independent variable; caffeine consumption (total weekly consumption) as the dependent variable, and motivations (factors resulting from factor analysis) as a mediating variable. Another model was also analyzed with caffeine use frequencies (in days per week) as the dependent variable. Analyses were conducted using the PROCESS macro (Hayes, 2012) and each motivation factor was analyzed using a separate model. Mediation analyses were not conducted for panic symptoms because no significant associations were found between panic and total weekly caffeine consumption or caffeine use frequency.

Table 9 presents the correlations between the motivations for use factors and total weekly caffeine consumption. All motivations for use were significantly associated with total consumption, with Energy (n=177, r=.317, p=.000), Self-

Medication (n=176, r=.217, p=.004), Dependence (n=176, r=.270, p=.000), and Enjoyment (n=175, r=.279, p=.000). Tables 10-13 present the results from these mediation analyses, which were conducted utilizing 5000 bootstrap samples. Analyses indicated that depressive symptoms were a significant predictor of self-medication motives (b=.091, SE=.024, p<.001, 95% CI [.043, .139]) and that self-medication motives were also a significant predictor of total caffeine consumption (b=.657, SE=.273, p<.05, 95% CI [.119, 1.195]). The direct effect of depressive symptoms became non-significant when self-medication motives were incorporated into the model (b=.139, SE=.091, p>.1, (95% CI [-.041, .318]). The indirect effect of this model was .059 (95% CI [.015, .136]). A similar result was found for dependence motives, wherein depressive symptoms were a significant predictor of dependence motives (b=.075, SE=.029, p<.05, 95% CI [.018, .133]) and dependence motives were a significant predictor of caffeine consumption (b=.746, SE=.223, p=.001, 95% CI [.305, 1.186]). This model was also found to have a non-significant direct effect of depressive symptoms on caffeine consumption (b=.139, SE=.088, p>.1, 95% CI [-.034, .312). The indirect effect size for this model was .056 (95% CI [.014, .128]). The models for both energy and enjoyment motives were found to not have significant mediation and are presented in tables 10 and 13.

Table 14 presents correlations between motives for use and caffeine use frequency. Each motivation was significantly associated with caffeine use frequency, with Energy (n=185, r=.482, p=.000), Self-Medication (n=184, r=.353, p=.000), Dependence (n=184, r=.353, p=.000), and Enjoyment (n=183,

r=.380, p=.000). The results of the mediation analyses are presented in tables 15-18. Depressive symptoms were a significant predictor of Self-Medication motives (b= .111, SE= .025, p=.000 95% CI [.063, .159]) and Self-Medication motives were a significant predictor of caffeine use frequency (b= .369, SE=.083, p=.000, 95% CI [.206, .533]). While CES-D scores alone were significantly associated with caffeine use frequency, the direct effect present in this model was non-significant (b=.035, SE= .029, p= .227, 95% CI [-.011, .092]). The indirect effect for this model had a size of .041 (95% CI [.019, .072]), A similar result was found for dependence motives, with depressive symptoms being predictive of dependence motives (b= .106, SE=.029, p<.01, 95% CI [.048, .164]) and dependence motives significantly predicting caffeine use frequency (b= .262, SE= .069, p<.01, 95% CI [.126, .399]). This model had a non-significant direct effect of depressive symptoms on caffeine use frequency as well (b=.053, SE= .028, p= .065, 95% CI [-.003, .109]). The indirect effect size for this model was .028 (95% CI [.013, .049]). Energy and Enjoyment motivations for use were not significant mediators and are presented in tables 15 and 18.

Beverage choice

Bivariate correlations were performed to examine associations between internalizing symptoms and total weekly servings of each beverage type, the results of which are presented in tables 19 and 20. Partial correlations were then conducted to assess the association between depressive symptoms and the total weekly servings consumed of each beverage type (controlling for the other beverages), and likewise for panic attacks and beverage type. Tables 21 and 22

present the results of these analyses. Increased tea consumption was found to be significantly associated with higher depressive symptoms ($r=.558$, $p<.05$). Other beverages were not found to be significantly associated with depressive symptoms. Consumption of each specific beverage was found to not be significantly associated with panic symptoms.

Discussion

The current study aimed to describe the nature of the associations between internalizing symptoms and caffeine use. The associations present in the literature were partially replicated in this study, and the mediating role of motivations for use in these associations was examined. It was found that the expected positive associations between depressive symptoms and caffeine use were present, however the negative associations between panic symptoms and caffeine use were not. Instead, no significant associations between panic symptoms and caffeine consumption were found. In addition, this study added to the literature by identifying the mediating role of Self-Medication and Dependence motive factors in the association between depressive symptoms and caffeine use, both in total weekly caffeine consumption and caffeine use frequency. Energy and Enjoyment motives were not found to serve a mediating role in this association. As panic symptoms were not significantly correlated with total weekly caffeine consumption or caffeine use frequency, a mediation analysis was not appropriate. While depressive symptoms were found to be significantly associated with tea consumption, panic symptoms were not found to be significantly associated with any specific beverage choice.

These findings partly support hypothesis 1 (a replication of depressive symptoms being positively associated with caffeine consumption and panic attacks being negatively associated with caffeine consumption). While the association between depressive symptoms and caffeine use present in the literature was replicated, the associations between panic anxiety and caffeine use

were not observed. Depressive symptoms were positively associated with caffeine consumption, both in total servings (n=177, r=.164, p=.029) and frequency (n=185, r=.194, p=.008). Panic attack scores were not significantly correlated with total caffeine servings nor caffeine consumption frequency. It is possible that this is due to the relatively low number of participants who endorsed panic attack symptoms (n=62). While this number may be similar to other studies which found this association (such as Lee, Cameron, & Gredden, 1985 which had n=43 and found this decreased consumption in a sample of medical inpatients), the participants in the present study self-endorsed panic symptoms instead of being clinically diagnosed with such symptoms. This may lead to an artificial inflation of reported panic symptoms, negatively impacting the results. As the sample studied was comprised of current college students (and therefore relatively high-functioning) it is likely that individuals with severe panic symptoms may not be represented, as these symptoms can be debilitating to daily functioning.

Potential covariates which were not examined include sleep (both in quality and amount) and the presence of medical conditions, both of which are potentially confounding. If a large proportion of the sample was getting poor quality sleep (or low amounts of sleep), it could inflate their caffeine consumption as they attempt to combat the drowsiness associated with poor sleep hygiene. This would obviously impact the accuracy of these analyses as a covariate that is unaddressed would distort associations. The presence of prescription medication or medical disorders could likewise influence these

associations, as decreased caffeine consumption could be recommended for issues such as heart conditions or pregnancy. Controlling for these variables (or excluding such individuals from analysis) would allow for a more accurate analytical base.

The results of this support a mediation model, as the incorporation of motivation factors 'Self-Medication' and 'Dependence' both rendered the direct effect of depressive symptoms on caffeine consumption non-significant in their separate models. While this result supports the hypothesis that these motivations serve as mediators in this association it is important to note that this was a cross-sectional study, so causation cannot be examined. As it is unlikely that caffeine consumption causes depressive or panic anxiety symptoms and illogical that it causes motivations for its own use, it is likely that the variables function as they are represented in the models presented. While these analyses are limited by the cross-sectional nature of the study, they are an important step towards understanding the nature of these observed associations and can serve as a useful basis for future research. As there is little current research examining these motivations for use in the literature, this study can help to fill in the dearth of knowledge in this area and support future longitudinal studies. It's believed that Self-Medication and Dependence motives for use were significant in this sample due to the wide array of positive physical and emotional outcomes of caffeine use, such as elevated mood and the calming effect caffeine has for some individuals. The knowledge that caffeine can be used to "help depression/anxiety" is necessary for endorsing these motives on the questionnaire, so it is likely that

individuals are at least somewhat aware of such effects and seek caffeine, and this would impact individuals who experience depressive symptoms more strongly than the general population. Amelioration of depressive symptoms, even temporarily as is the case with caffeine consumption, would be a concern for such individuals. Dependence also has a strong physiological component and can be partially explained through the relief of negative symptoms of caffeine withdrawal. Regular ingestion of caffeine creates a physical dependence to the point of causing unpleasant withdrawal symptoms upon abstinence of caffeine use, and these symptoms can be alleviated by ingesting caffeine (Dawkins et al., 2011; Brice & Smith, 2002). It is likely that alleviation of caffeine withdrawal symptoms (such as headaches and irritability) is driving the Dependence motive for use's association with caffeine consumption in individuals with depressive symptoms as some of these withdrawal symptoms mirror depressive symptoms (lack of energy, poor focus, and irritability specially). Energy use motivations could be partially explained by the aforementioned covariate of sleep quality, in that poor sleep quality may differentially impact the need to seek energy in caffeine. This would explain why Energy use motivation was not a significant mediator, and could be an avenue for further study. Energy use motives may also impact individuals both with high, low, and no depressive symptoms in the same manner, and individuals who are in this depressive population may experience similar Energy use motives as the general population. Enjoyment motives are tied to the parts of the beverage that are not caffeine, and encompass a wide range of motivations for beverage choice. With such a wide variety of caffeinated drinks available in contemporary society it's likely that some beverage choices are purely

based on taste and not caffeine content, and this consideration would be the same for individuals with depressive symptoms and individuals without such symptoms.. This would explain the lack of significant mediation with this motive. Furthermore, Energy and Enjoyment motives may just not impact individuals with depressive or panic symptoms differentially than the general population, and this would likewise explain the lack of mediation.

These results partially support hypothesis 2 (that depressive symptoms and panic symptoms would have distinct beverage choice associations), as tea was associated with depressive symptoms but no specific beverage choices were significantly associated with panic symptoms. This may be due to caffeine itself being the reason behind consumption, regardless of beverage. It is unclear why tea might be specifically associated with depressive symptoms, however tea consumption has been associated with decreased depressive symptoms in the elderly (Niu et al., 2009; Pham et al., 2014), and components of tea have been linked to decreased depressive symptoms (Murakami et al., 2008). It is possible that individuals experiencing depressive symptoms choose tea over other beverages due to the stress-relieving effects of the components of tea, or due to the increased skin temperature and skin conductance which accompanies tea drinking (Quinlan, Lane, & Aspinall, 1997).

Limitations

There are several factors which must be considered when interpreting these findings. One potential issue facing this study is that respondents may not have realized they had been consuming non-caffeinated beverages when they responded that they were consuming caffeine (such as drinking a non-caffeinated soda and believing it contained caffeine), impacting the accuracy of their responses and the subsequent analyses. Attempts to mitigate this were made, both in instructing participants to only answer regarding caffeinated beverages, having a separate item for decaffeinated coffee and tea, and asking what type of soda they typically drink (as some varieties do not contain caffeine). Despite this possibility, self-report caffeine consumption amounts have been found to be very similar to caffeine consumption amounts measured via salivary assay (Addicott et al., 2009), which speaks to the accuracy of self-report. A second limitation would be that these questionnaires do not account for the vast variety of caffeinated beverage types within categories, such as coffee. Depending upon method of brewing, size of beverage, and specific beverage (latte vs espresso for example) there is tremendous variability within caffeine content of these different beverages. Utilizing the frequency as an independent variable alongside number of servings is an attempt to combat this issue, although it is difficult, if not impossible, to entirely alleviate these concerns. This issue could potentially explain why panic anxiety was not significantly associated with caffeine consumption, as inaccurate responses would distort the analysis. As noted, cross-sectional mediation analyses are not ideal, however it is believed that the lack of

existing research in this area and the need to explore potential future avenues of research justify its use in this case. Although causality cannot be drawn from these results, they serve as a useful stepping stone.

Conclusion

Although caffeine is consumed by the majority of the world's population on a daily basis, caffeine use has mostly been studied in the context of a correlate with an undesired outcome. Few studies have sought to understand the motivations driving caffeine consumption, and examining these motivations is vital due to the dearth of research in this area and the potential future avenues of inquiry which arise from having such a framework.

The present study examined the role these motivations for use play in the established associations between caffeine use and internalizing psychopathologies utilizing cross-sectional data. Previous research detailing positive associations between depressive symptoms and caffeine consumption was replicated. The most salient findings were that self-medication and dependence motives for use significantly mediated the relationship between depressive symptoms and caffeine use, both in frequency of use and total weekly consumption. Understanding the motivations for use which are associated with increased consumption is important for future research into this area, as such an understanding can help to illuminate other associations within caffeine use. To better understand these associations, longitudinal studies which examine motivations for use are necessary and can be informed by the present study. Understanding motives for use may lead to research which increases public knowledge of the withdrawal symptoms of caffeine use, and could lead to healthier consumer behavior. As caffeine is so undeniably popular and pervasive in contemporary culture, gaining insight into factors which influence its use has

myriad implications for future research. As caffeine is not recommended for several medical conditions, such as hypertension (Pincomb et al., 1996) and pregnancy (Weng, Odouli, & Li, 2008), understanding the underlying forces driving caffeine consumption can be useful in interventions designed to reduce consumption in these populations. In populations afflicted by depression it is likely that interventions aimed at replacing the self-medication via caffeine use with another therapeutic technique could prove beneficial to these individuals.

Appendices

A. **The Caffeine Consumption Questionnaire (CCQ)**. (Landrum, 1992), modified with motive questions from the **Caffeine Motives Questionnaire (CMQ).** (Irons et al., 2014)

These next questions ask about drinks that may contain caffeine. In the left-hand column under "Days", write how many days per week you normally consume the item (answer from 0 to 7 days per week). In the right-hand column under "Servings", indicate how many servings of each item you consume on a *typical* day on which you have that drink (for example, if you have two 12-ounce cans of Coca-Cola, enter a 2 in the "Servings" box for Coca-Cola). A serving is a cup (6-8) ounces of coffee or tea, or a typical can of soda or energy drink.

Drink	Days (0-7)	Typical number of Servings
a. Caffeinated Coffee		
b. Decaffeinated Coffee		
c. Caffeinated Tea		
d. Decaffeinated Tea		
e. Caffeinated Soda		
f. Decaffeinated Soda		
g. What type of soda do you typically consume?		
h. Energy Drinks		

Questions from the CMQ:

Below is a list of reasons that one might choose to ingest caffeine. Please read them carefully and circle the answer that corresponds to how likely you are to consume caffeine for these reasons:

Possible responses for all motivations are:

I never drink caffeine for this reason

I rarely drink caffeine for this reason

I sometimes drink caffeine for this reason

I often drink caffeine for this reason

I always drink caffeine for this reason

I choose to ingest caffeine:

a. To feel more alert
b. To help me concentrate
c. Because I like the taste of caffeinated beverages
d. To help deal with stress in my daily life
e. To help deal with anxiety
f. To help deal with depression
g. To combat drowsiness
h. To help me focus my attention
i. Because I like the "jolt" of energy rush that I feel

j. To help me relax or calm down

k. To stay awake

l. Because I like the buzz feeling caffeine gives me

m. As a social pastime

n. Because I crave caffeine

o. Because it puts me in a better mood

B. **The Center for Epidemiological Studies Depression Scale (CES-D).** (Radloff, 1977)

Below is a list of some of the ways you may have felt or behaved. Please indicate how often you have felt this way *during the past two weeks* by circling the appropriate answer.

Possible responses for all items are:

Rarely or None of the time (Less Than One Day)

Some of or a Little of the Time (1-2 Days)

Occasionally or a Moderate Amount of the Time (3-4 Days)

Most or All of the Time (5-7 Days)

a. I was bothered by things that usually don't bother me.

b. I did not feel like eating; my appetite was poor.

c. I felt that I could not shake off the blues even with help from my family or friends.

d. I felt I was just as good as other people.

e. I had trouble keeping my mind on what I was doing.

f. I felt depressed.

g. I felt that everything I did was an effort.

h. I felt hopeful about the future.

i. I thought my life had been a failure.

j. I felt fearful.

k. My sleep was restless.

l. I was happy.

m. I talked less than usual.

n. I felt lonely.

o. People were unfriendly.

p. I enjoyed life.

q. I had crying spells.

r. I felt sad.

s. I felt that people disliked me.

t. I could not get “going.”

C. The Panic Attack Questionnaire IV (PAQ-IV). (Norton et al., 2012)

These next questions ask about panic attacks. A panic attack is the sudden onset of intense fear or terror, often associated with feelings of impending doom that is not a result of a real danger. Some of the most common symptoms experienced during an attack are: dizziness, shortness of breath, chest pain or discomfort, and trembling or shaking. A panic attack differs from feelings of fear, anxiety, or worry that build up over time, and also differs from moderate feelings of fear or anxiety. Rather, it involves quick hitting feelings of extreme terror or fear.

a. Have you ever had one or more panic attacks? (circle 1)

Yes No

If you circled "yes" above, please answer the questions below. If you circled "no", please skip to the next section

How many panics attacks have you had…

b. In the past year? 0 1 2 3 4 5 6 7 8 9 10

Table 1

Descriptive Statistics for Depressive Symptoms

CES-D Scores				
	Mean (SD)	Median	Range	% Above Clinical Cutoff (16)[a]
Score	15.16 (9.33)	14.00	0-60	41.75

N=193

[a]*(Radloff 1977)*

Table 2

Descriptive Statistics for Caffeine Use Frequencies

Caffeine Use Frequency by Beverage (days/week)						
Beverage Type	n	Mean (SD) use frequency	Median use frequency	Range of use frequency	% of total sample reporting any use	% of total sample reporting 6-7 days/week use
Coffee	189	1.74 (2.37)	0.00	0 - 7 days	46.11	13.5
Tea	192	0.99 (1.92)	0.00	0 - 7 days	29.69	5.7
Soda	184	2.17 (2.31)	1.00	0 - 7 days	65.41	13.2
Energy Drinks	191	0.54 (1.16)	0.00	0 - 5 days	63.35	0.0

Note: Use frequencies are in number of days per week (0= 0 days/week)

Table 3

Descriptive Statistics for Caffeine Consumption Amounts

Consumption Amounts by Beverage Type (servings/week)				
Beverage Type	n	Mean (SD)	Median	Range
Coffee	189	2.86 (5.11)	0.00	0 – 25
Tea	192	1.97 (5.05)	0.00	0 – 35
Soda	182	4.55 (7.19)	1.00	0 – 42
Energy Drinks	191	0.99 (2.67)	0.00	0 – 20.00

Note: Log-transformed values were used in analyses

Table 4

Descriptive Statistics for Panic Attack

Panic Attack Responses				
	n	Mean (SD)	Median	Range
Panic Attacks per Year	190	.82 (1.703)	0	0 - 10

Note: 131 participants (65.2 % of the total sample) reported having never had a panic attack and log-transformed values were used in analyses. Scale is the number of panic attacks over the past year

Table 5

Descriptive Statistics for Motivations

Responses to Motivations for Consumption				
Motivation	n	Mean (SD)	Median	Range
To feel more alert	194	1.75 (1.42)	2.00	0 - 4
To help Concentrate	194	1.28 (1.34)	1.00	0 - 4
Like the taste of caffeinated drink	193	2.41 (1.43)	3.00	0 - 4
To deal with stress	194	0.60 (1.05)	0.00	0 - 4
To help anxiety	194	0.43 (0.89)	0.00	0 - 4
To help depression	194	0.29 (0.49)	0.00	0 - 4
To combat drowsiness	194	1.88 (1.57)	2.00	0 - 4
To focus attention	194	1.45 (1.41)	1.00	0 - 4
Like the 'jolt' of energy	194	0.96 (1.29)	0.00	0 - 4
To help relax calm	193	0.63 (1.09)	0.00	0 - 4
To stay awake	194	2.02 (1.56)	2.00	0 - 4
Like the buzz	194	0.62 (1.12)	0.00	0 - 4
Social pastime	193	0.93 (1.18)	0.00	0 - 4
Crave caffeine	193	0.62 (1.09)	0.00	0 - 4
To be put in a better mood	194	0.81 (1.22)	0.00	0 - 4

Note: Values used are based on the following scheme: I never drink caffeine for this reason [0], I rarely drink caffeine for this reason [1], I sometimes drink caffeine for this reason [2], I often drink caffeine for this reason [3], I always drink caffeine for this reason [4].

Table 6

Caffeine Use Motives

Factor Loadings				
Item	Factor 1	Factor 2	Factor 3	Factor 4
Feel more alert	**.874**	.088	.170	.103
Help Concentrate	**.809**	.273	.188	.033
Combat Drowsiness	**.888**	.120	.156	.048
Focus Attention	**.798**	.274	.230	.084
Stay Awake	**.887**	.067	.183	.077
Deal with Stress	.288	**.787**	.242	.135
Help Anxiety	.171	**.850**	.249	.092
Help Depression	.113	**.855**	-.027	.007
Help Relax/ Calm	.088	**.557**	.467	.132
Like the 'Buzz'	.261	.253	**.701**	-.063
Crave Caffeine	.081	-.024	**.724**	.379
Causes a Better Mood	.235	.436	**.666**	.196
Like the 'Jolt'	.424	.138	**.701**	-.052
Like the Taste	.318	-.006	.145	**.730**
Social Pastime	-.079	.216	.056	**.803**

Table 7

Correlations between Internalizing Symptoms and Total Weekly Caffeine Consumption

Internalizing Measures	n	Pearson r	Significance
CES-D Scores	177	.164	.029
Past Year Panic Attacks	173	.083	.280

Note: Log-transformed values were used in Panic analyses

Table 8

Correlations between Internalizing Symptoms and Caffeine use Frequency

Internalizing Measures	n	Pearson r	Significance
CES-D Scores	185	.194	.008
Past Year Panic Attacks	181	.180	.106

Note: Log-transformed values were used in Panic analyses

Table 9

Correlations between Caffeine Use Motivations and Total Weekly Caffeine Consumption

Motive for Use	n	Pearson r	Significance
Energy	177	.317	.000
Self-Medication	176	.217	.004
Dependence	176	.270	.000
Enjoyment	175	.279	.000

Table 10

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Energy Use Motivation on Total Weekly Caffeine Consumption

Predictor	Motivation for Use: Energy			Total Weekly Caffeine Consumption		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	-.0122	.056	.828	.199	.084	.018
Energy	---	---	---	.509	.113	.000
Constant	8.416	.961	.000	3.53	1.72	.0418

Note: n=177

Table 11

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Self-Medication Use Motivation on Total Weekly Caffeine Consumption

Predictor	Motivation for Use: Self-Medication			Total Weekly Caffeine Consumption		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	.091	.024	.0002	.139	.091	.129
Self-Medication	---	---	---	.657	.273	.0169
Constant	.491	.418	.242	7.38	1.51	.000

Note: n=176

Table 12

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Dependence Use Motivation on Total Weekly Caffeine Consumption

Predictor	Motivation for Use: Dependence			Total Weekly Caffeine Consumption		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	.075	.029	.011	.139	.088	.115
Dependence	---	---	---	.746	.223	.001
Constant	1.77	.502	.0005	6.46	1.53	.000

Note: n=176

Table 13

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Enjoyment Use Motivation on Total Weekly Caffeine Consumption

Predictor	Motivation for Use: Enjoyment			Total Weekly Caffeine Consumption		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	.022	.018	.231	.199	.080	.0138
Enjoyment	---	---	---	1.21	.333	.0004
Constant	3.03	.313	.000	3.42	1.7	.0461

Note: n=175

Table 14

Correlations between Caffeine Use Motivations and Caffeine Use Frequency

Motive for Use	n	Pearson r	Significance
Energy	185	.482	.000
Self-Medication	184	.353	.000
Dependence	184	.309	.000
Enjoyment	183	.380	.000

Table 15

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Energy Use Motivation on Caffeine Use Frequency

Predictor	Motivation for Use: Energy			Caffeine Use Frequency		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	.027	.054	.6115	.069	.025	.006
Energy	---	---	---	.259	.035	.000
Constant	7.93	.945	.000	2.242	.521	.000

Note: n=184

Table 16

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Self-Medication Use Motivation on Caffeine Use Frequency

Predictor	Motivation for Use: Self-Medication			Caffeine Use Frequency		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	.111	.025	.000	.035	.029	.227
Self-Medication	---	---	---	.369	.083	.000
Constant	.275	.434	.528	4.206	.485	.000

Note: n=183

Table 17

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Dependence Use Motivation on Caffeine Use Frequency

Predictor	Motivation for Use: Dependence			Caffeine Use Frequency		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	.106	.029	.0004	.053	.028	.065
Dependence	---	---	---	.262	.069	.0002
Constant	1.504	.519	.0042	3.799	.494	.000

Note: n=183

Table 18

Model Coefficients for Mediation Analyses of Internalizing Symptoms and Enjoyment Use Motivation on Caffeine Use Frequency

Predictor	Motivation for Use: Enjoyment			Caffeine Use Frequency		
	Coeff.	SE	p	Coeff	SE	p
CES-D Scores	.027	.017	.118	.059	.027	.028
Enjoyment	---	---	---	.627	.118	.000
Constant	2.951	.302	.000	2.44	.589	.0001

Note: n=182

Table 19

Correlations between CES-D scores and Beverage choice

Beverage	n	Pearson r	Significance
Coffee	84	.085	.443
Tea	57	.291	.028
Soda	118	.124	.180
Energy Drinks	46	-.218	.145

Note: Beverage choices were log-transformed prior to analysis

Table 20

Bivariate Correlations between Panic Attack scores and Beverage choice

Beverage	n	Pearson r	Significance
Coffee	83	.081	.466
Tea	55	.274	.403
Soda	116	-.040	.669
Energy Drinks	44	.097	.532

Note: Beverage choices were log-transformed prior to analysis

Table 21

Partial Correlations between CES-D scores and Beverage choice

Beverage	Pearson r	Significance
Coffee	.412	.162
Tea	.558	.047
Soda	.220	.470
Energy Drinks	-.498	.083

Note: Each beverage was analyzed separately and other beverage choice options were controlled for; Beverage choices were log-transformed prior to analysis

Table 22

Correlations between Panic Attack scores and Beverage choice

Beverage	Pearson r	Significance
Coffee	.197	.518
Tea	.314	.296
Soda	.021	.945
Energy Drinks	-.085	.782

Note: Each beverage was analyzed separately and other beverage choice options were controlled for; Beverage choices were log-transformed prior to analysis

Table 23

Descriptive Statistics for Panic Attack

Panic Attack Responses				
	n	Mean (SD)	Median	Range
Panic Attacks per Year	62	3.10 (2.58)	2.50	0 - 10

Note: 131 participants (65.2 % of the total sample) reported having never had a panic attack and log-transformed values were used in analyses. Scale is the number of panic attacks over the past year

Table 24

Correlations between Internalizing Symptoms and Total Weekly Caffeine Consumption

Internalizing Measures	n	Pearson r	Significance
Past Year Panic Attacks	52	-.041	.772

Note: Log-transformed values were used in Panic analyses

Table 25

Correlations between Internalizing Symptoms and Caffeine use Frequency

Internalizing Measures	n	Pearson r	Significance
Past Year Panic Attacks	52	.028	.842

Note: Log-transformed values were used in Panic analyses

Table 26

Correlations between Panic Attack scores and Beverage choice

Beverage	Pearson r	Significance
Coffee	.492	.400
Tea	.534	.354
Soda	.316	.605
Energy Drinks	-.275	.655

Note: Each beverage was analyzed separately and other beverage choice options were controlled for; Beverage choices were log-transformed prior to analysis

References

Addicott, M. A., Yang, L. L., Peiffer, A. M., & Laurienti, P. J. (2009). Methodological considerations for the quantification of self-reported caffeine use. *Psychopharmacology*, *203*(3), 571-578.

Arria, A. M., Caldeira, K. M., Kasperski, S. J., Vincent, K. B., Griffiths, R. R., & O'Grady, K. E. (2011). Energy drink consumption and increased risk for alcohol dependence. *Alcoholism: Clinical and Experimental Research*, *35*(2), 365-375.

Beck, J. G., & Berisford, M. A. (1992). The effects of caffeine on panic patients: Response components of anxiety. *Behavior Therapy*, *23*(3), 405-422.

Brice, C. F., & Smith, A. P. (2002). Effects of caffeine on mood and performance: a study of realistic consumption. *Psychopharmacology*, *164*(2), 188-192.

Bryant Ludden, A., & Wolfson, A. R. (2010). Understanding adolescent caffeine use: connecting use patterns with expectancies, reasons, and sleep. Health Education & Behavior, 37(3), 330-342.

Dawkins, L., Shahzad, F. Z., Ahmed, S. S., & Edmonds, C. J. (2011). Expectation of having consumed caffeine can improve performance and mood. Appetite, 57(3), 597-600.

Dong, X., Yang, C., Cao, S., Gan, Y., Sun, H., Gong, Y., & Lu, Z. (2015). Tea consumption and the risk of depression: A meta-analysis of observational studies. *Australian and New Zealand journal of psychiatry*, 0004867414567759.

Frary, C., Johnson, R., & Wang, M. (2005) Food Sources and Intakes of Caffeine in the Diets of Persons in the United States. Journal of the American Dietetic Association. Issue 2.

Graham, K. (1988). Reasons for consumption and heavy caffeine use: Generalization of a model based on alcohol research. *Addictive behaviors*, *13*(2), 209-214.

Hayes, A. F. (2012). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford Publications.

Hintikka, J., Tolmunen, T., Honkalampi, K., Haatainen, K., Koivumaa-Honkanen, H., Tanskanen, A., & Viinamäki, H. (2005). Daily tea drinking is associated with a low level of depressive symptoms in the Finnish general population. *European journal of epidemiology*, *20*(4), 359-363.

Irons, J. G., Heinz, A. J., Bassett, D. T., Correia, C. J., Babson, K. A., Boden, M. T., & Bonn-Miller, M. O. (2014). Development and Initial Validation of the Caffeine Motives Questionnaire. *Journal of Caffeine Research*, *4*(2), 49-55.

Kushner, M. G., Sher, K. J., Wood, M. D., & Wood, P. K. (1994). Anxiety and Drinking Behavior: Moderating Effects of Tension-Reduction Alcohol Outcome Expectancies. *Alcoholism: Clinical and Experimental Research*, *18*(4), 852-860.

Landrum, R. E. (1992). College students' use of caffeine and its relationship to personality. *College Student Journal*, *26*(2), 151-155.

Lee, M. A., Cameron, O. G., & Greden, J. F. (1985). Anxiety and caffeine consumption in people with anxiety disorders. *Psychiatry research*, *15*(3), 211-217.

Lee, M. A., Flegel, P., Greden, J. F., & Cameron, O. G. (1988). Anxiogenic effects of caffeine on panic and depressed patients. The American journal of psychiatry, 145(5), 632.

Leibenluft, E., Fiero, P. L., Bartko, J. J., Moul, D. E., & Rosenthal, N. E. (1993). Depressive symptoms and the self-reported use of alcohol, caffeine, and carbohydrates in normal volunteers and four groups of psychiatric outpatients. *American Journal of Psychiatry*, *150*, 294-294.

Murakami, K., Mizoue, T., Sasaki, S., Ohta, M., Sato, M., Matsushita, Y., & Mishima, N. (2008). Dietary intake of folate, other B vitamins, and ω-3 polyunsaturated fatty acids in relation to depressive symptoms in Japanese adults. *Nutrition*, *24*(2), 140-147.

Nardi, A. E., Lopes, F. L., Valença, A. M., Freire, R. C., Veras, A. B., de-Melo-Neto, V. L., & Zin, W. A. (2007). Caffeine challenge test in panic disorder and depression with panic attacks. *Comprehensive psychiatry*, *48*(3), 257-263.

Niu, K., Hozawa, A., Kuriyama, S., Ebihara, S., Guo, H., Nakaya, N & Sasaki, S. (2009). Green tea consumption is associated with depressive symptoms in the elderly. *The American journal of clinical nutrition*, *90*(6), 1615-1622.

Norton, P. J., Zvolensky, M. J., Bonn-Miller, M. O., Cox, B. J., & Norton, G. R. (2008). Use of the Panic Attack Questionnaire-IV to assess non-clinical panic attacks and limited symptom panic attacks in student and community samples. *Journal of Anxiety Disorders*, *22*(7), 1159-1171.

Novak, A., Burgess, E. S., Clark, M., Zvolensky, M. J., & Brown, R. A. (2003). Anxiety sensitivity, self-reported motives for alcohol and nicotine use, and level of consumption. *Journal of anxiety disorders*, *17*(2), 165-180.

Pham, N. M., Nanri, A., Kurotani, K., Kuwahara, K., Kume, A., Sato, M & Mizoue, T. (2014). Green tea and coffee consumption is inversely associated with depressive symptoms in a Japanese working population. *Public health nutrition*, *17*(3), 625-633.

Pincomb, G. A., Lovallo, W. R., McKey, B. S., Sung, B. H., Passey, R. B., Everson, S. A., & Wilson, M. F. (1996). Acute blood pressure elevations with caffeine in men with borderline systemic hypertension. The American journal of cardiology, *77*(4), 270-274.

Quinlan, P., Lane, J., & Aspinall, L. (1997). Effects of hot tea, coffee and water ingestion on physiological responses and mood: the role of caffeine, water and beverage type. *Psychopharmacology*, *134*(2), 164-173.

Quinlan, P. T., Lane, J., Moore, K. L., Aspen, J., Rycroft, J. A., & O'Brien, D. C. (2000). The acute physiological and mood effects of tea and coffee: the role of caffeine level. *Pharmacology Biochemistry and Behavior*, *66*(1), 19-28.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement*, *1*(3), 385-401.

Radloff, L. S. (1991). The use of the Center for Epidemiologic Studies Depression Scale in adolescents and young adults. *Journal of youth and adolescence*, *20*(2), 149-166.

Shear, M. K., Rucci, P., Williams, J., Frank, E., Grochocinski, V., Vander Bilt, J., & Wang, T. (2001). Reliability and validity of the Panic Disorder Severity Scale: replication and extension. *Journal of Psychiatric Research*, *35*(5), 293-296.

Shohet, K., & Landrum, R. (2001) Caffeine Consumption Questionnaire: A Standardized Measure for Caffeine Consumption in Undergraduate Students. Psychological Reports, Issue 89, pgs 521-526.

Silverman, K., & Griffiths, R. R. (1992). LOW-DOSE CAFFEINE DISCRIMINATION AND SELF-REPORTED MOOD EFFECTS IN NORMAL VOLUNTEERS. *Journal of the experimental analysis of behavior*, *57*(1), 91-107.

Smith, A., Sutherland, D., & Christopher, G. (2005). Effects of repeated doses of caffeine on mood and performance of alert and fatigued volunteers. *Journal of Psychopharmacology*, *19*(6), 620-626.

Terry-McElrath, Y., O'Malley, P., & Johnston, L. (2014). Energy Drinks, Soft Drinks, and Substance Use Among United States Secondary School Students. Journal of Addiction Medicine. Issue 8, pgs 6-13.

Totten, G. L., & France, C. R. (1995). Physiological and subjective anxiety responses to caffeine and stress in nonclinical panic. *Journal of Anxiety Disorders*, *9*(6), 473-488.

Wang, L., Shen, X., Wu, Y., & Zhang, D. (2016). Coffee and caffeine consumption and depression: A meta-analysis of observational studies. *Australian & New Zealand Journal of Psychiatry*, *50*(3), 228-242.

Warburton, D. M. (1995). Effects of caffeine on cognition and mood without caffeine abstinence. *Psychopharmacology*, *119*(1), 66-70.

Weiss, R. D., Griffin, M. L., & Mirin, S. M. (1992). Drug abuse as self-medication for depression: An empirical study. *The American journal of drug and alcohol abuse*, *18*(2), 121-129.

Weng, X., Odouli, R., & Li, D. K. (2008). Maternal caffeine consumption during pregnancy and the risk of miscarriage: a prospective cohort study. American Journal of Obstetrics & Gynecology, 198(3), 279-e1.

Whittal, M. L., Suchday, S., & Goetsch, V. L. (1994). The Panic Attack Questionnaire: Factor analysis of symptom profiles and characteristics of undergraduates who panic. *Journal of anxiety disorders*, *8*(3), 237-245.

Woolsey, C. L., Barnes, L. B., Jacobson, B. H., Kensinger, W. S., Barry, A. E., Beck, N. C., ... & Evans Jr, M. W. (2014). Frequency of energy drink use predicts illicit prescription stimulant use. *Substance Abuse*, *35*(1), 96-103.