Caffeine, Physiological Arousal, and Mood: The Effects of Caffeine and Induced Mood on Brain Activity, Heart Rate, and Attitude Change

Kelly Coney

Department of Psychology
Rhodes College
Memphis, Tennessee

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This Honors paper by Kelly Coney has been read and approved for Honors in Psychology.

Dr. Jeffrey J. Sable
Project Advisor

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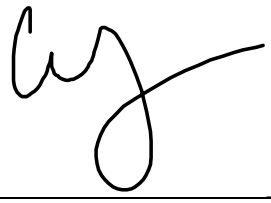
Dr. Bette Ackerman
Second Reader

_____

Dr. William Cunningham
Extra-Departmental Reader



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Dr. Natalie Person
Department Chair

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ABSTRACT

Caffeine, Physiological Arousal, and Mood: The Effects of Caffeine and Induced Mood on Brain Activity, Heart Rate, and Attitude Change

by

Kelly Coney

There is evidence that caffeine makes people more susceptible to attitude change, but what drives this effect is unclear. We studied the effects of caffeine and mood on attitude change, heart rate (HR), and brain activity (measured with electroencephalography—EEG). Participants received caffeine or a placebo and viewed positive, neutral, or negative pictures from the International Affective Picture System (IAPS), which are standardized for valence and arousal. Participants then read persuasive arguments for implementing senior comprehensive exams at a nearby institution. Attitudes about such exams were taken before the study and after the participant read the persuasive argument. EEG and HR were recorded before and after caffeine consumption and picture viewing. Unexpectedly, HR decreased in the caffeine condition and increased in the placebo condition, suggesting that withdrawal affects HR more than caffeine itself in caffeine users. Although the caffeine manipulation failed to produce an attitude change in this study, our HR findings suggest that previously reported caffeine-facilitated attitude change may actually have been due to relief from withdrawal effects that were present in the placebo condition. Also in the present study, negative IAPS images decreased self-reported mood, but there were no other effects on mood or arousal. In general, cognition-related brain activity increased (high alpha activity decreased and beta activity increased) after the persuasive argument, especially toward the back of the head. However, the caffeine and mood manipulations produced more complex interactions.

Caffeine, Physiological Arousal, and Mood: The Effects of Caffeine and Induced Mood on Brain Activity, Heart Rate, and Attitude Change

Caffeine is the most commonly consumed psychoactive substance in the world, and because of this, it has been a popular research topic. While many of its cognitive effects have been researched extensively, some of these effects are still unknown or poorly understood. One such effect that has surfaced in recent research is caffeine's effect on persuasion. While much research has been done on the separate areas of caffeine and persuasion, very little has been done investigating the link between them. Three articles--Martin, Lain, Martin and Mitchell (2005), Martin, Hamilton, McKimmie, Terry, and Martin (2007), and Mintz and Mills (1972), evaluated this relationship extensively and several articles related to the separate areas shed light on the possible mechanism behind this relationship.

Martin et al. (2005) found that after consuming caffeine, participants were more likely to be persuaded by arguments they initially opposed. Further research done by Martin et al. (2007) focused primarily on the cognitive aspects of caffeine consumption, such as enhancing 'vigilance', sustained attention, and more complex cognitive processes, as well as increasing alertness and clarity of thought. These articles are currently the only examples of research dealing exclusively with caffeine and persuasion in the literature. Mintz and Mills (1971) investigated effects of caffeine on persuasion; however, their research focused primarily on how attribution of arousal affects persuasion. Martin et al. (2005, 2007) framed their research question in terms of the Elaboration Likelihood Model, which describes a central, cognitive route of persuasion and a peripheral, emotional route of persuasion (Petty, Cacioppo, Strathman, & Priester,

2005). The current research on caffeine and persuasion suggests that caffeine affects the central route by enhancing cognitive processing. However, the research done by Mintz and Mills (1971) showed that caffeine's increase in physiological arousal can also affect persuasion in at least some circumstances, suggesting a peripheral route link. Caffeine also affects mood, which could be another way in which caffeine affects persuasion peripherally. Mintz and Mills' (1971) study and the fact that caffeine affects mood suggest that it may be possible for caffeine to affect both central and peripheral routes of persuasion under different circumstances. In addition to reviewing the previous research in this area, it would be beneficial to look more closely at physiological arousal and mood to better understand caffeine's effect on persuasion. Martin et al.'s (2005) research explained the cognitive connection between caffeine and persuasion; however, more information is necessary to determine to what extent and under what circumstances peripheral factors (mood and arousal) affect the relationship.

Martin et al. (2005) began investigating caffeine and persuasion because of the drug's many cognitive effects, such as increasing attention and arousal, improving memory, and facilitating information processing. All of these areas have been associated with persuasion, leading the researchers to suspect that caffeine may influence persuasion. For their first publication, Martin et al. (2005) randomly assigned participants to a caffeine or placebo condition and then presented them with counter-attitudinal arguments to evaluate persuasion. Participants were given a questionnaire to ascertain their position on voluntary euthanasia and abortion. The investigators looked for changes in attitudes reported towards the matter directly discussed in the argument they presented (euthanasia) and a matter that was indirectly related (abortion). Attitude change towards

both measures was significantly different between the two groups such that members of the caffeine group demonstrated more attitude change than those in the placebo condition. A second study reported in this article further demonstrated that only strong arguments resulted in attitude change for participants in the caffeine condition, suggesting that caffeine affects persuasion through enhancing cognition. The second experiment also involved preliminary measures of mood and physiological arousal (as determined by blood pressure). Mood measurements primarily evaluated stress related emotions and no significant results were found in analyses of this measurement. The researchers did find that physiological arousal, as well as self-reports of arousal, increased in the caffeine condition, but these were not correlated with persuasion. This study established a cognitive connection between caffeine and persuasion.

Martin et al. (2007) followed up on work from Martin et al. (2005). In this experiment the researchers investigated whether cognitive processing affected whether or not caffeine led to increased persuasion. This experiment randomly assigned participants to a distracter task condition that prevented participants from devoting any attention to the message presented. When cognitive processing was impaired, persuasion levels did not increase as when participants were given caffeine without a distracter task. When cognitive processing was enhanced or only a low distracter task was used, greater attitude change was apparent when compared to the placebo condition. This article also showed that caffeine consumption led to indirect attitude change, as determined by attitudes measured in terms of related but separate topics such as abortion, and that attitudes formed after caffeine consumption were resistant to counter-persuasion. These results further suggest that caffeine’s effect on persuasion is due to primarily to an increase in

cognitive functioning, including memory and increased attention, rather than from mood or physiological arousal.

However, previous research has connected both mood and physiological arousal to an increase in persuasion (Mintz & Mills, 1971; Christopher, Sutherland, & Smith, 2005; Sinclair, Hoffman, Mark, Martin, & Pickering, 1994). Mintz and Mills (1971) particularly looked at arousal induced by caffeine and its effect on persuasion and found a significant relationship. This study found that arousal and information about its source had a significant effect on attitude change. In this study participants were given caffeine and told it was either an analgesic or a stimulant. Those who were told it was an analgesic did not know that the drug would increase their physiological arousal while those who were told it was a stimulant did. Both conditions showed an increase in attitude change as compared to a group given a placebo; however, those who did not know it would increase physiological arousal showed a significantly higher level of attitude change compared to those who did not. While the physiological arousal induced by caffeine did affect persuasion, whether or not a participant knew what was causing their arousal also had a significant effect on persuasion. This suggests that caffeine does have the potential to affect persuasion peripherally, that is, through a means other than cognitive analysis. In the current study as well as in the Martin studies (2005, 2007), participants were aware that their participation might involve receiving caffeine.

Martin et al. (2005, 2007) approached the subject of caffeine and persuasion using the Elaboration Likelihood Model (Petty & Cacioppo, 1986). Viewing the relationship between caffeine and persuasion through this lens helps to clarify exactly how the drug is affecting cognition. The Elaboration Likelihood Model describes two routes of

persuasion, the central and peripheral routes (Petty, Cacioppo, Strathman, & Priester, 2005). Martin et al. (2005, 2007) implicated the central route of persuasion in the relationship between caffeine and persuasion. The central route involves critically analyzing persuasive arguments based on information presented and knowledge that one already has. The analysis of an argument in this manner is referred to as elaboration and is necessary for the central route of persuasion. Choosing the peripheral route of persuasion involves basing one's opinion on superficial aspects of the argument such as aesthetic cues, how informed the source seems (rather than how informed the source really is), and the emotions that the argument evokes (or seems to evoke). While Martin et al. (2005, 2007) provided evidence that caffeine affects the central route of persuasion, the possibility that caffeine may also affect the peripheral route in certain circumstances needs to be explored more fully. The research done by Martin et al (2005) involving emotion was limited and did not fully investigate mood's role in the persuasive process.

The Elaboration Likelihood Model also posits that people choose to use the different routes in different circumstances. In situations with high personal relevance, people are more likely to use the central route while in situations with low personal relevance they are more likely to use the peripheral route. While Martin et al.'s (2005, 2007) topic of choice, voluntary euthanasia, is typically of low personal relevance to a majority of the population, the fact that their opinions were being recorded by the experimenters may have caused the participants to view the argument as more personally relevant due to social desirability factors. People do not want to appear to take ethical dilemmas lightly. In strongly non-personal situations or situations that do not involve an ethical dilemma, caffeine may affect the peripheral route of persuasion. Since caffeine

has potential to affect the peripheral route of persuasion, more research needs to be done in this area to ascertain whether caffeine does or does not affect this route.

Since caffeine affects cognition, as well as emotional and physiological arousal, it is possible that caffeine affects both central and peripheral routes. Recent research by Cacioppo and Berntson (2007) suggests that cognition and emotion mutually affect each other; thus caffeine's cognitive and emotional effects may both play important roles in persuasion regardless of whether a participant uses the central or peripheral route. Emotions can motivate cognition and cognition can affect emotional state. Since caffeine affects mood, it is possible that the mood induced by the caffeine may also be affecting cognition. In the case of caffeine and persuasion, even if mood is not facilitating the use of the peripheral route, it may also be adding to the drug's effect on central route processing. This underscores the need to further investigate mood's role in the relationship between caffeine and persuasion.

The current experiment further investigated both mood and physiological arousal in the caffeine-based persuasion process. Mood was manipulated by presenting emotionally charged photographs of varying emotional valences (Bradley & Lang, 2007) and physiological arousal was measured by monitoring heart rate (HR). Additionally, cognitive arousal was monitored through electroencephalography (EEG). Previous research has shown that caffeine on its own tends not to have a significant impact upon heart rate, but that heart rate can increase in caffeine users experiencing withdrawal (Hoffer & Battig, 1994). Caffeine has also been shown to decrease alpha wave power and to shift activity toward higher frequencies within the alpha band. The alpha band is associated with relaxation while awake; a decrease in power in this band indicates a

possible decrease in relaxation. An increase in alpha frequency indicates an increase in cognition as the frequency band approaches the beta frequency. Caffeine is also associated with an increase in beta activity, which is associated with cognition, as well as its influence on alpha activity (Barry et al., 2005).

Mood is not associated with a persistent change in HR (Gomez et al., 2009). Mood has been found to influence EEG activity such that positive mood causes increased EEG activity in the frontal left portion of the head while negative mood causes increased EEG activity in the right frontal portion of the head (Cacioppo, 2004).

In the present study, we manipulated whether or not participants received caffeine, as well as whether they viewed positive, neutral, or negative images from in an attempt to affect mood. The topic about which we measured attitude change was undergraduate senior comprehensive examinations (Petty and Cacioppo, 1986).

We hypothesized that there would be a caffeine by mood interaction such that there was more attitude change concerning senior comprehensive exams in the caffeine condition than the placebo condition, with the exception of the caffeine/negative cell. We expected this group to show much less persuasion than any other cell due to the impact of negative mood upon persuasion. We predicted that both caffeine and mood would significantly affect mood and arousal, both self-reported and physiological, since previous research has shown caffeine consumption and mood can influence arousal (Christopher et al., 2005; Bradley & Lang, 2007).

We expected to see a main effect for caffeine in terms of arousal such that HR would increase in the caffeine condition but not the placebo condition. In terms of mood, we expected to see an increase in arousal in the positive and negative conditions, but not

the neutral condition (where the pictures were chosen to include only those with a low arousal score; Bradley & Lang, 2007). We also predicted that self-reported arousal would be positively correlated with HR. In terms of EEG data, we expected to see a decrease in overall alpha power, but a shift toward higher frequencies within the alpha band. Given that the participants would be cognitively engaged, we anticipated an increase in beta activity, as well (Barry et al., 2005).

Additionally, we expected to see shifts in EEG response depending upon mood condition such that participants in the positive mood condition would display high levels of left frontal activity while participants in the negative condition would display high levels of right frontal activity (Cacioppo, 2004). We also predicted a mood effect in EEG data such that participants in the positive and negative mood conditions (those with higher levels of arousal) would experience more beta activity than participants in the neutral condition.

Methods

Participants

The study involved 36 participants from a small liberal arts college in the mid-South region. The participants completed a pre-screening questionnaire that contained questions concerning daily caffeine intake, health conditions or medications that may interact with caffeine, and attitude towards senior comprehensive exams. The latter question was important because the persuasive message presented during the experimental session relates to this topic.

To reduce the personal relevance of the persuasive message, changes in policy were said to be taking place at a neighboring college, rather than the participants' own

institution. The target question about senior comprehensive exams was embedded in a questionnaire about multiple potential policy changes such as tuition increase, increased leniency in alcohol policies, and creating a student information center. Initial attitude was assessed with the prompt, “I believe the institution of senior comprehensive exams would be:” followed by a 9-point Likert scale, anchored with the terms ‘detrimental’ (1) and ‘beneficial’ (9; See Appendix A).

Participants without health problems that could be exacerbated by caffeine, who were moderate caffeine users (consuming 100-500 mg of caffeine per day), and were opposed to instituting senior comprehensive exams were selected for participation. Participants were said to be opposed to the institution of senior comprehensive exams if they responded with a “5” or lower.

Mood and Arousal Measures

Participants rated their mood and arousal, respectively, along 9-point Likert scales, ranging from negative (1) to positive (9). This was done at four points during the study: (1) the beginning of the experiment, (2) after the 40-min waiting period, (3) after viewing the mood-inducing images, and (4) after the persuasive message was presented.

Physiological Measures

HR and EEG were simultaneously recorded at specific points during the study for each participant. Baseline measures for EEG and HR were taken prior to caffeine consumption while participants watched a 15-min slide show depicting water scenes. The last 5 min of this were used as the HR and EEG baseline (Piferi, Kline, Younger, & Lawler, 2000). HR and EEG were also recorded immediately before and after presentation of the mood-inducing images. This thesis focuses on the change in

physiology between the baseline and the final measures. The middle measurements are not considered here.

HR. HR was acquired using a near-infrared finger-clip pulse oximeter and sampled at a rate of 500 Hz.

EEG. EEG was measured by placing gold scalp electrodes at F3, F4, P3, P4, and both mastoids (A1 and A2). A1 served as the online reference. Additional electrodes were placed above and below the left eye and near the outer canthus of each eye to record eye movements. A ground electrode was placed on the forehead. Impedances for all electrodes were 5 kΩ or below. Data were acquired using a Grass model 8-16 E amplifier system and digitized at 500 Hz using a DataWave electrophysiological recording system and SciWorks software (v. 5.1). Data was bandpass filtered online at 0.1-70 Hz, with a 60-Hz notch filter.

Procedure

A timeline of the procedure is shown in Figure 1. Participants were told this study would be used to explore the physiological and cognitive effects of caffeine. The experiment lasted for approximately 2 ½ hours. Participants were asked to abstain from drinking caffeine or alcohol for 12 hours prior to the experiment. They were not informed that the experiment was investigating the effects of caffeine on attitude change in order to avoid affecting their reactions to the persuasive argument.

Each participant completed an informed consent form, a demographic information form, and a mood and physiological arousal questionnaire at the beginning of the experiment (see Appendices C, D, and I). Each participant's weight was recorded at the beginning of the session. Each participant was randomly assigned to one of two dose

conditions (caffeine or placebo) and one of three mood conditions (positive, neutral, or negative). To allow time for the caffeine to take effect, there was a 40-min waiting period between the time participants were given either the caffeinated beverage or the placebo and the time they were shown the mood-inducing images.

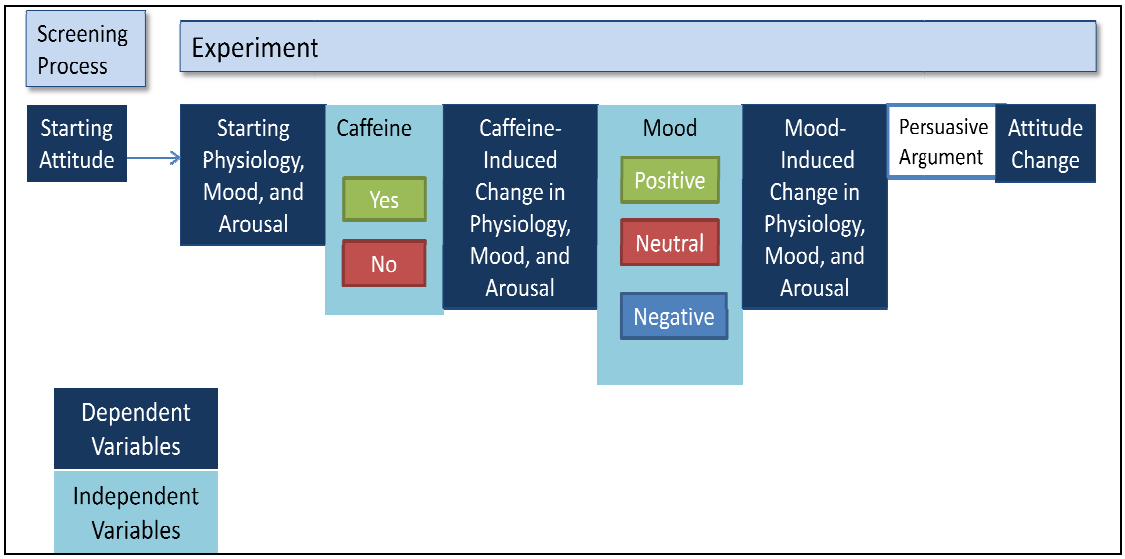

Figure 1. **Time line of procedure. Dark blue boxes indicate where physiological or behavioral measures were taken while light blue boxes indicate where the independent variables were introduced. The persuasive argument was given at the same time the mood-induced physiological change was measured.**

Caffeine manipulation. For participants in the caffeine condition, caffeine was administered by dissolving 200 mg of anhydrous caffeine in 10 oz. of orange juice. Participants were told they were receiving a glass of orange juice that may or may not contain caffeine. This is the typical dose in an over-the-counter caffeine pill as well as what is considered to be the optimum dose (Martin et al., 2007). The placebo group drank juice without caffeine.

Participants were given a working memory task to occupy themselves as they waited 40 min for the caffeine to take effect. Participants were explicitly told that these data would not be used in the experiment and the activity was only being used to pass time in an attempt to avoid the possibility of performance-induced anxiety.

Mood manipulation. Mood was manipulated by showing participants pictures from the International Affective Picture System (IAPS; Bradley & Lang, 2007). Exactly 150 pictures were chosen from the available images based on valence and arousal ratings. Fifty pictures rated 6.51 or higher in valence and above 5 in arousal were chosen for the positive condition, 50 pictures rated between 3.51 and 6.50 in valence and below 4 in arousal were chosen for the neutral condition, and 50 pictures rated below 3.50 in valence and above 5 in arousal were chosen for the negative condition. Erotic images were excluded from the positive condition and excessively gruesome images (mutilations and death) were excluded from the negative condition. Images were presented in random order as a slide show using SuperLab Pro. Each image was presented for 6 s, with 1 s between images.

Persuasive message. After viewing the IAPS pictures, participants were asked to read a paragraph outlining six strong arguments in support of requiring undergraduate senior comprehensive exams (see Appendix M). These arguments were taken from Petty and Cacioppo (1986). Since it has already been determined in previous research (Martin et al., 2007) that strong arguments are more effective than weak arguments in eliciting attitude change with caffeine, only strong arguments were used in this experiment. After reading the paragraph, students were asked to complete the attitude assessment questions used by Martin et al. (2005; Appendix K). The questions were anchored with the following word pairs: bad-good, unfavorable-favorable, foolish-wise, harmful-beneficial, ineffective-effective, and unconvincing-convincing. A follow up survey was sent at least one week after the experiment to determine the persistence of attitude change. The initial attitude assessment Likert scale (detrimental-neutral-beneficial) was used for this

measure as well. Attitude change was assessed as the difference between the initial attitude and the fourth (and final) Likert scale given directly after the persuasive argument was read.

Questionnaires. Six of Petty and Cacioppo's (1986) persuasive arguments in favor of instituting senior comprehensive exams were used as the persuasive argument (Appendix M). After reading the persuasive paragraphs and reporting their attitudes, participants completed the following items:

- Thought listing task: Participants were asked to list all of the thoughts that came to mind for 2 min. In later research these thoughts will be coded for message-congruency, or the amount of thoughts that relate positively to the persuasive argument.
- Argument recall task: The participants were provided with six blank boxes and asked to fill in as many of the arguments presented in the paragraph as they could remember. These tasks were used to measure the level of processing experienced by each participant (See appendix E).
- Caffeine identification question: Participants were asked if they believed they were given caffeine and how confident they are in their answer on a scale from 1 (very unsure) to 5 (very sure) (See appendix J).
- Need for cognition (NC) scale (Cacioppo, Petty, & Kao, 1984): This was given to identify whether subjects were high or low in NC. NC indicates to what extent a participant tends to analyze information (See Appendix G).

- Caffeine withdrawal effects inventory: This was given to determine if withdrawal contributed significantly to the findings (See Appendix H). Withdrawal symptoms included were taken from Juliano and Griffiths (2004).

Data Analysis

Psychophysiology. HR was averaged across time to determine an average HR for each of the three 5-min periods. Data from the scalp electrodes were mathematically re-referenced offline to the average of the mastoids (A1 and A2). Continuous EEG recordings were divided into 2-s epochs and each epoch was submitted to a fast-Fourier transform to determine brain activity across the frequency spectrum. For each of the three 5-min periods, data were averaged into three frequency bands: low alpha (8-10 Hz), high alpha (10-12 Hz), and beta (13-20 Hz). Difference values (i.e., change from baseline) were computed by subtracting the mean scores from the 5-min baseline period from the second and third acquisition periods. Here we report only change between the baseline and the third recording period (i.e., following the manipulation of *both* independent variables).

Data were analyzed using two-way (caffeine x IAPS condition for HR) and four-way (caffeine x IAPS condition x frequency band x electrode for EEG) ANOVAs. LSD post hoc analyses were used to determine significant differences between individual conditions. Pearson correlation analyses were also used to investigate correlations between heart rate and behavioral measures. The criterion for statistical significance was $p < .05$. Only data from 28 participants were re-referenced due to time constraints. From the re-referenced data, data from 25 participants was used for EEG analyses (three were excluded because of technical problems with the raw data). Data from 27 participants

were used for HR analyses. Data was excluded from the final analyses if sections of the recording did not register because the pulse oximeter failed to pick up HR or if there were technical problems with EEG data acquisition. Also, many of the more recent participants' data have not yet been analyzed due to time constraints.

Behavior. Behavioral data was collected through a combination of forms and SuperLab Pro. Data were analyzed using two-way between-subjects ANOVAs for caffeine and mood conditions' affect on attitude change, mood change, and arousal change. A paired-comparison *t*-test (comparing baseline to the final attitude measure) was used to determine if there was a change in attitude across all conditions. Pearson correlations were used to determine whether caffeine condition was significantly correlated with caffeine identification.

Results

Behavioral Data

Participants in all conditions rated comprehensive senior exams as more favorable after reading the persuasive arguments ($M = 6.53$, $SE = 0.33$) than before ($M = 3.56$, $SE = 0.23$; $t(35) = 8.95$, $p < .001$). However, there were no significant effects of caffeine ($F(1,30) = 2.63$, $p = .116$) or IAPS condition ($F(2,30) = 1.08$, $p = .353$). In the negative IAPS condition, the attitude change was 2 points *less* with caffeine than without (see Figure 2), but the interaction was not significant ($F(2,30) = .815$, $p = .452$).

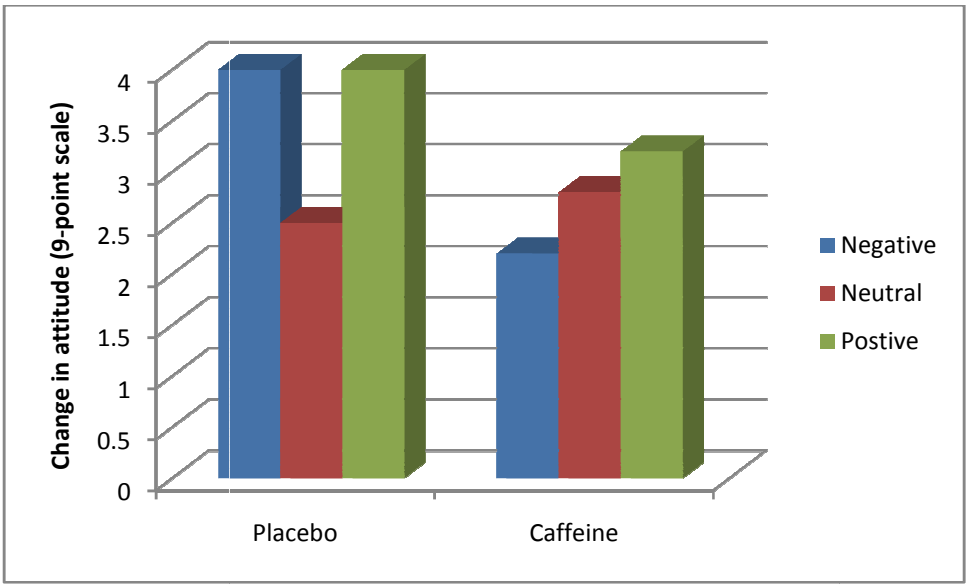

Figure 2. **Attitude change as a function of caffeine dose and mood condition.**

Participants in the negative IAPS condition showed significantly different mood change than the positive and neutral groups ($F(2, 30)= 5.34$, $p = 0.01$). Participants in the negative mood condition ($M_{neg}= -1.667$; $p < 0.01$) reported a significant decrease in mood compared to the positive ($M_{pos}= 0.500$; $p < 0.01$) and neutral ($M_{neu}= 0.417$; $p < 0.01$) conditions after viewing the IAPS images. Positive and neutral conditions were not significantly different (see Figure 3). Caffeine did not have a significant effect on self-reported mood ($F(1, 30) = 0.570$, $p = .456$).

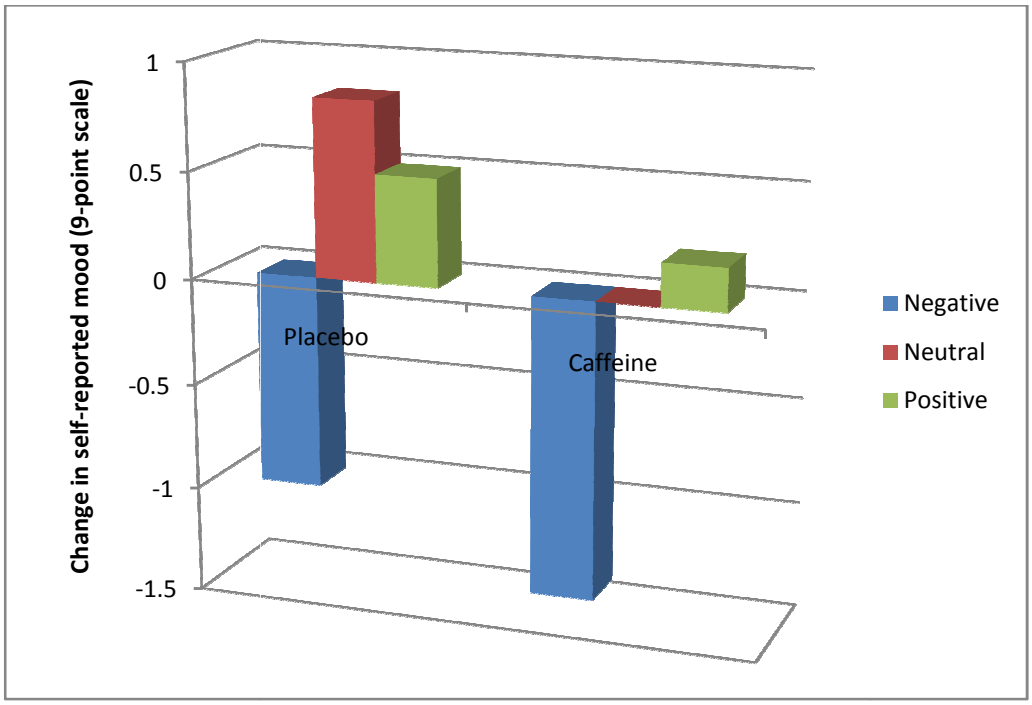

Figure 3. **Mood change as a function of caffeine dose and mood condition.**

Self-reported arousal was not significantly affected by caffeine ($F(1, 30) = 1.83$, $p = .187$) or IAPS condition ($F(2, 30) = 2.43$, $p = .105$). There was also no interaction between these two variables ($F(2, 30) = 0.237$, $p = .790$). However, participants were able to accurately identify whether or not they received caffeine, as shown by a significant correlation between participants' self-reported caffeine identification scores and caffeine group ($r = .415$, $p < .05$).

Physiological Data.

HR. In general, participants in the caffeine condition experienced a small *decrease* in HR ($M_{caffeine} = -1.54$; see Figure 4), but HR *increased* in the placebo condition ($M_{placebo} = 3.61$; $F(1, 20) = 6.77$, $p < .05$). IAPS condition did not have a significant effect on HR ($F(2, 20) = 2.08$, $p = .151$). Although it did not meet our criterion for statistical significance, there was a small to moderate negative correlation between HR change and participant self-report of physiological arousal. This suggests that

participants were relatively insensitive to their actual level of arousal (r = -0.378, p=.057). There was no significant IAPS condition by caffeine interaction.

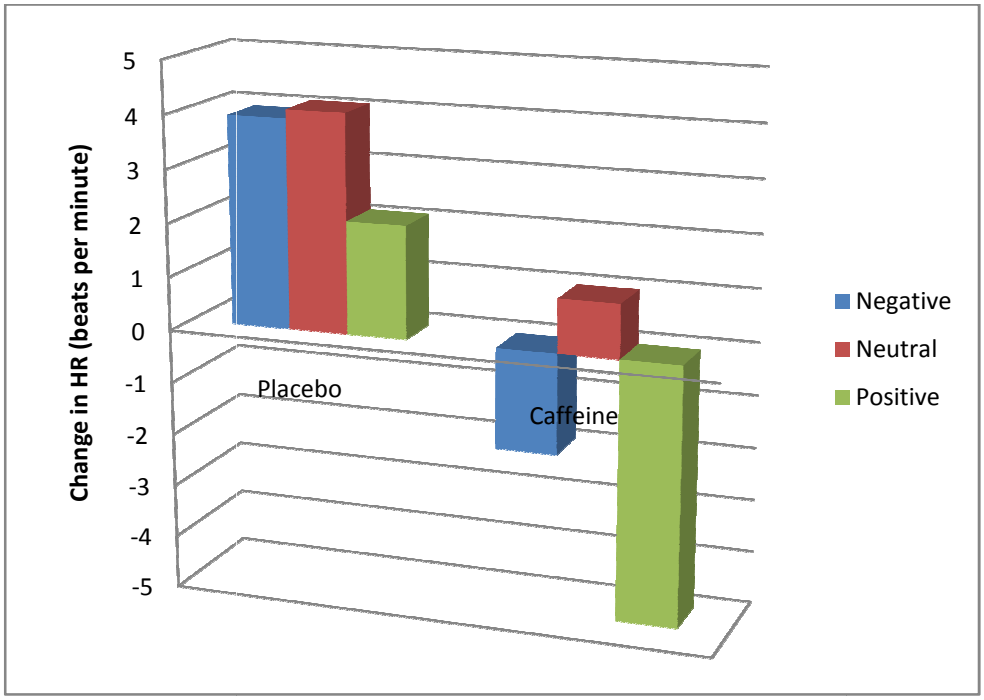

Figure 4. **Change in HR as a function of caffeine dose and mood.**

EEG. All EEG mean changes are shown in Figure 5. Overall, there was a relatively large decrease in high alpha activity, and a small increase in beta activity especially at the parietal electrodes (electrode x frequency band interaction (F(6, 12) = 6.93, p < .05; main effects for both electrode (F(3,66) = 20.05, p < .001) and frequency band (F(2,44) = 3.44, p < .05; see Figure 6).

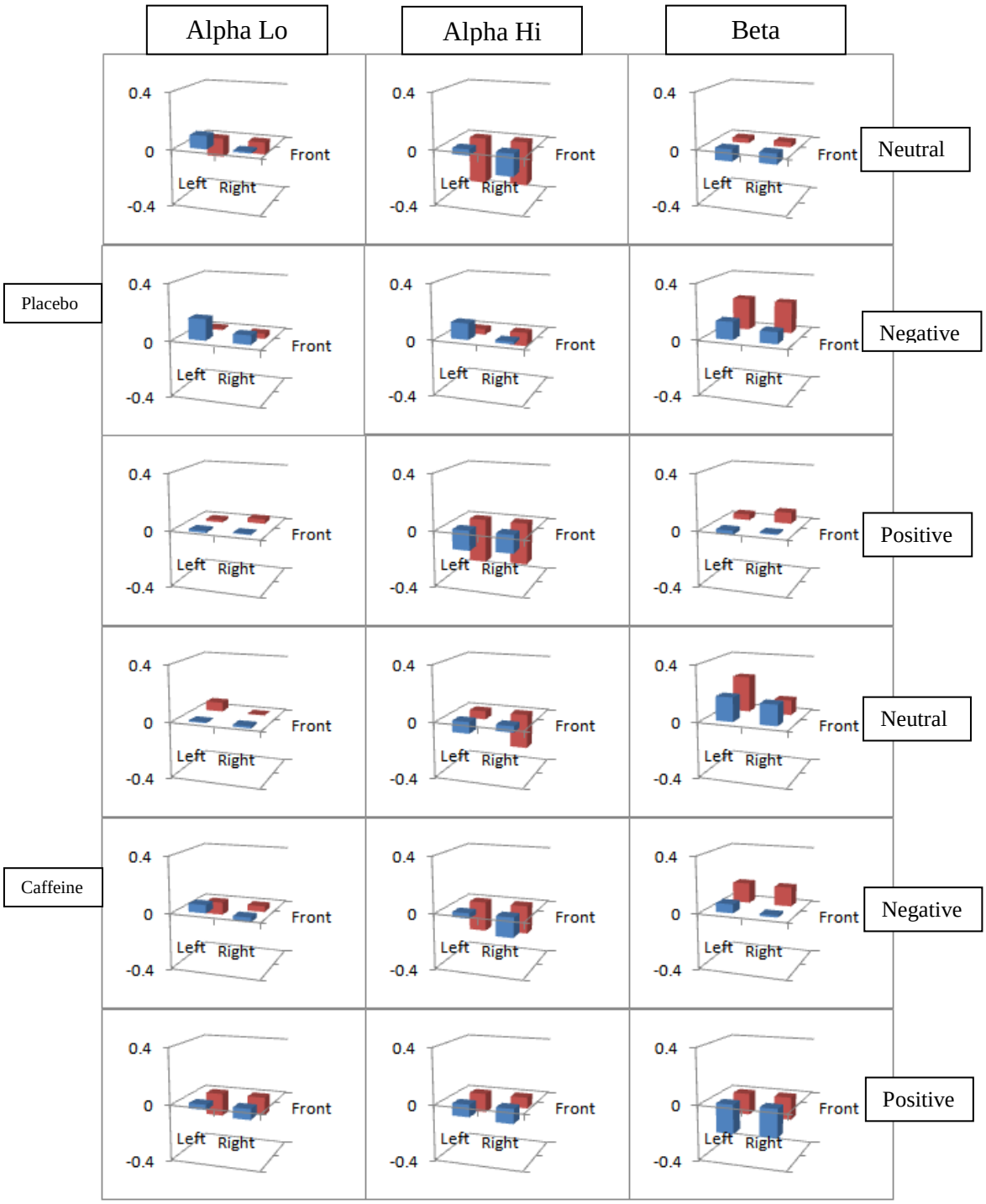

Figure 5. **Change in frequency band as a function of caffeine dose, mood, and electrode placement, units measuring EEG power in log µV.**

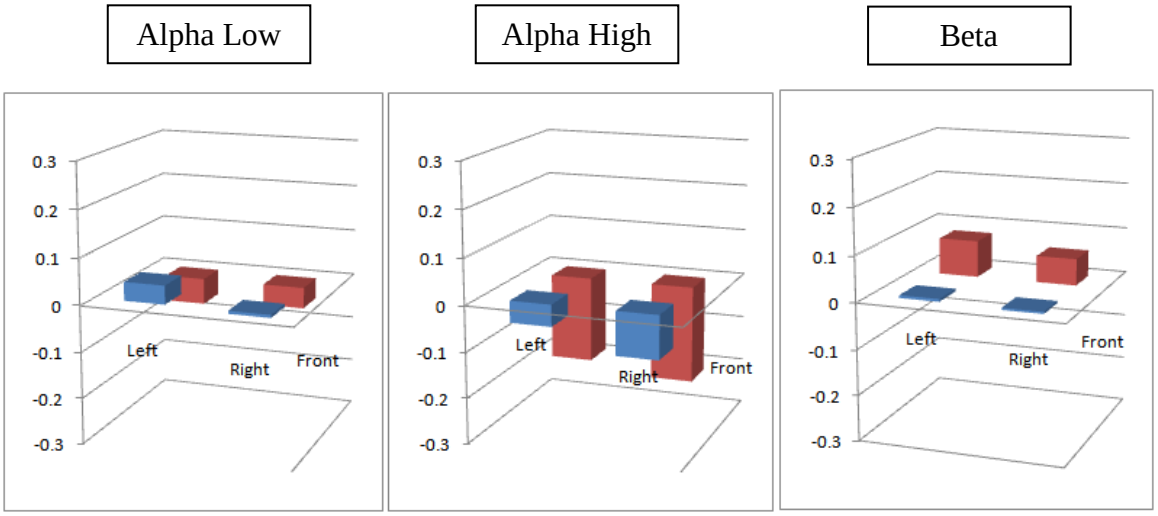

Figure 6. **Change in electrode activity as a function of frequency band, units measuring EEG power in log µV.**

Caffeine and mood interacted with frequency band (Figure 7; $F(6,66) = 2.81$, $p < .05$) and electrode (Figure 8; $F(4, 44) = 4.94$, $p < .05$), respectively. In Figure 7, one can again see the general pattern of EEG shift from high alpha to beta. However, there are exceptions to this pattern. Without caffeine, the negative IAPS mood group failed to show an alpha decrease, but a large beta increase was lacking in the neutral and positive IAPS groups. In the caffeine/positive IAPS group, EEG activity decreased in all three frequency bands. As shown in Figure 8, the caffeine/neutral condition produced a decrease in EEG power across electrodes and frequency bands. Additionally, the parietal electrodes in the placebo/negative condition showed a dramatic decrease in activity. The other conditions produced either relatively small changes in all electrodes or a change at a single site (i.e., caffeine/negative and placebo/positive).

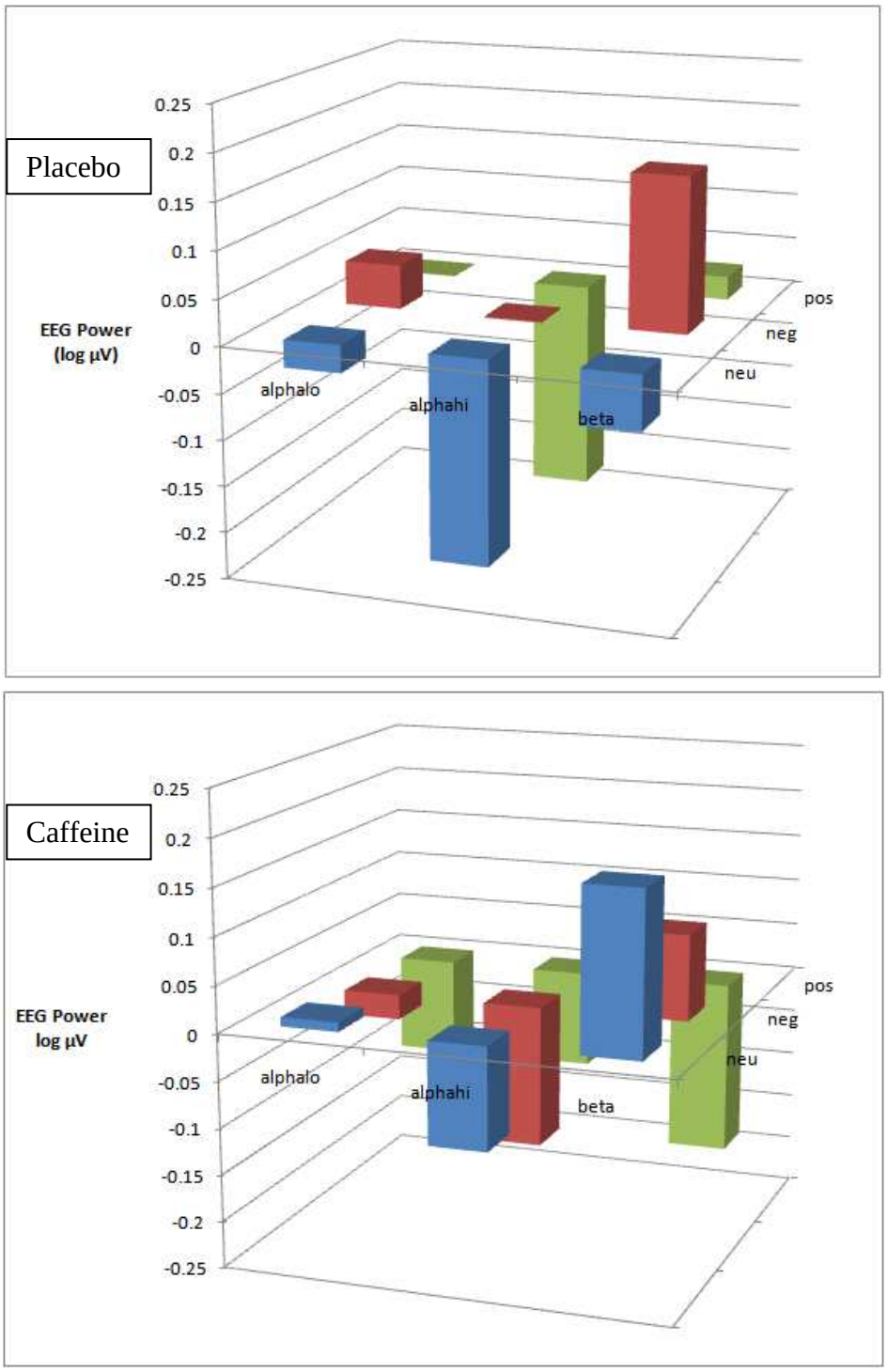

***Figure 7*. Change in frequency band as a function of caffeine dose and mood.**

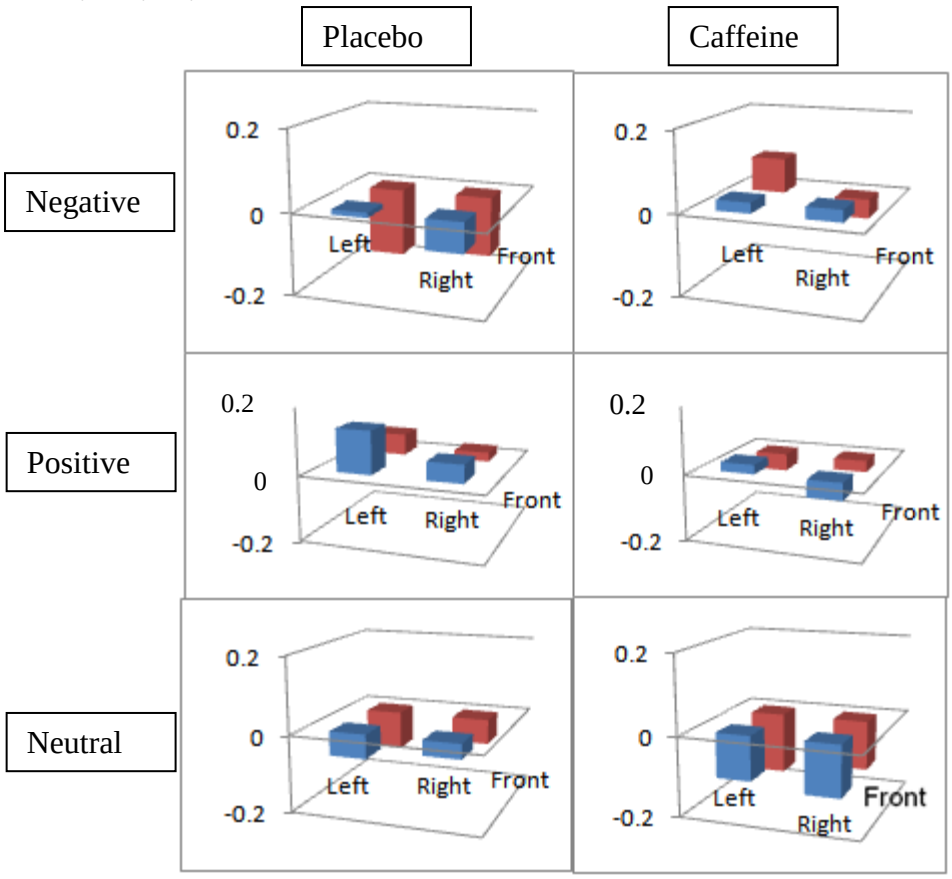

Figure 8. **Change in electrode activity as a function of caffeine dose and mood condition, units measuring EEG Power in log µV.**

Discussion

While the results of this study did not support the hypothesis that caffeine affects attitude change, an interesting HR effect indicates that withdrawal may be more common in caffeine research than previously thought. A decrease in HR in the caffeine condition and increase in the placebo condition indicate that participants in the caffeine condition may have experienced relief from withdrawal symptoms (and thus a decrease in HR) while those in the placebo condition became more agitated with the demands of the study. A significant effect of IAPS condition on mood was also found indicating that the IAPS may be used to induce negative mood in future research.

The HR data ran counter to what much of the literature has shown. Participants in the caffeine condition experienced a decrease in HR while those in the placebo condition experienced an increase in HR. However, it supports the findings of Hoger and Bradig (1994) who also found that habitual caffeine users who were kept from consuming caffeine experienced an increase in HR. This finding has been dismissed in the past due to lack of replication and the fact that increased HR was not reversed by re-administering caffeine. HR was not correlated with the withdrawal measure used in this study, but it is still feasible that withdrawal plays a strong role in this effect especially when paired with the findings from Hoger and Bradig. Participant feedback seemed to indicate feelings of irritability and fatigue during the experiment which may explain the increased HR in the placebo condition. It is also possible that participants attributed the increased HR and discomfort experienced to the situation. Since participants were able to tell to an extent which condition they were in, this may have influenced perceived withdrawal effects such that those in the placebo condition were more aware of their sustained lack of caffeine and became agitated, while those in the caffeine condition were able to tell they received caffeine and were more calm. Because this affected arousal measures counter to what would be expected, this raises questions of how much of an impact withdrawal or agitation effects have on caffeine research. It is possible that this potential withdrawal effect also accounts for the findings of the Martin et al. (2005 & 2007) studies. In this case caffeine would not be enhancing cognition but alleviating withdrawal symptoms, allowing those participants in the caffeine condition to think more clearly than those in the placebo condition.

Martin et al. (2005) found an overall mean attitude change of 4.60 in the caffeine condition and 3.41 in the placebo condition (also using a 9-point scale). In our experiment, although none of these were significantly different, mean attitude change on a 9-point scale for the positive condition was 3.60, for the neutral condition was 2.42 points, and for the negative condition was 2.92 points. In the caffeine condition, mean attitude change was 2.5 while in the placebo condition mean attitude change was 3.5. The mean differences in attitude change indicate that there was less attitude change in the caffeine/negative condition than in any other condition, while participants in the placebo/negative condition exhibited the same amount of persuasion as members of the placebo/positive group. While this pattern was not significant, it does suggest that with a larger data set there may be a caffeine by mood interaction such that caffeine and negative mood result in drastically lower rates of persuasion; however, more research will have to be done to substantiate this. While data is still being collected for this project, at the current time there are only 36 participants include in the behavioral data and 27-28 participants included in the psychophysiological data. An increased sample size may lead to more substantial and significant results.

Aside from sample size, there are several reasons that may explain why this sample did not exhibit the same patterns of persuasion as seen in Martin et al.'s studies (2005, 2007). To begin with, nearly all of the members of this sample had high Need for Cognition scores (over 55). If caffeine acts by means of the peripheral route of persuasion, this sample would already be less likely to use the peripheral route and caffeine would have a limited effect. If caffeine acts on the central route of persuasion, this sample is more likely to already use the central route of persuasion extensively and

an increase in cognitive capabilities might not make a large difference in their analysis of arguments. Determining whether Need for Cognition score are related to caffeine's effect on persuasion would further clarify if this affected the results.

The topic of senior comprehensive exams also has much less of an emotional aspect than Martin et al.'s (2005, 2007) argument about voluntary euthanasia. Since this argument was not as polarizing as that used in Martin et al.'s study, the overall process of persuasion may have been different in the two experiments such that caffeine has an effect on emotional arguments but is much less effective on more cognition-based arguments. If caffeine affects the central route of persuasion, increased ability to analyze an argument may have helped participants to overcome the emotional aspect of their initial decisions and pay more attention to the logical argument they were presented with in Martin et al.'s study. Or, the participants may not have found the issue in this study personally relevant enough to hold a strong position and were likely to be persuaded easily by a strong argument in any case. Also there may be a ceiling effect in caffeine's effect on persuasion. In a young, intelligent population, the cognitive boost that is reported to accompany caffeine may not be as high as it would be in an older population who are not at their peak of mental processing (J. J. Sable, personal communication). It is also possible that the participants in the caffeine group in the Martin et al. studies were not experiencing withdrawal symptoms and were therefore better able to concentrate on the arguments presented while the participants in the placebo group were distracted by their withdrawal symptoms and thus not as cognitively involved in the process.

We did find evidence to support the effectiveness of the ability of the IAPS to induce mood. While we only found a significant effect in the negative images condition,

this does substantiate the supposition that by choosing pictures from the IAPS based on valence and arousal ratings, it is possible to use these pictures to induce a mood. Those participants in the negative mood condition were found to have sustained a negative self-reported mood after being shown the IAPS slideshow with negative images. This may have only occurred in the negative condition because the most positively rated images, erotic images, were not shown due to their inappropriateness. In addition, participants reported that many of the positive pictures seemed 'dated', which may have detracted from their effectiveness. While the most negatively rated images—images depicting mutilation and death—were not used, the remaining negative images were perhaps more strongly valenced for these participants than their positive counterparts.

However, the IAPS did not seem to affect self-reported arousal. Positive and negative images were chosen based on having high or low emotional valence respectively and a reported arousal of over 5 (on a 9-point Likert scale). The neutral images were chosen for having relatively low emotional valence and low reported arousal (beneath a 3.5 on a 9 point scale). There was no indication that there was a difference between self-reported arousal between these conditions, although the finding that participants in the positive IAPS condition reported more arousal than those in the negative or neutral condition was borderline significant. However, due to the fact that HR, the physiological variable used to measure arousal, actually correlated negatively with self-reported arousal, self-reported arousal may not be a valid indicator of true physiological arousal. This may be due to the fact that participants did not fully understand what was meant by the term 'physiological arousal' (e.g., given that the study involved caffeine, they may have thought this question referred to more peripheral effects, such as shaking). There

was even less indication that HR was related to IAPS condition, suggesting that IAPS does not induce physiological arousal.

The EEG data did not indicate significant frontal shifts in EEG data that has been found to indicate emotional state (Cacioppo, 2004). Instead, we found more activity in the parietal regions. This may be due to the secondary nature of the mood manipulation relative to the primary cognitive task.

While no caffeine-induced persuasion was found in this experiment, the fact that HR ran counter to what traditionally occurs in such experiments indicates that withdrawal influenced the results. Since the same measures to protect against withdrawal effects were used in this study as in the Martin study (e.g., no one was used who consumed more than 500 mg of caffeine per day), the effectiveness of using this cutoff to prevent withdrawal effects is called into question. The fact that the IAPS slideshows could induce mood is significant in furthering the use of the IAPS images in research, potentially expanding the use of these pictures.

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Appendix A

SCREENING FORM

Please take a minute to answer the following questions. Your answers will remain confidential and anonymous. You will be assigned a participant number so your name will not be associated with this sheet. You are free to leave questions blank, but we will not be able to include you in our research if you choose to do this.

What is your age: (must be 18 years or older)

Are you pregnant or nursing? □ No □ Yes

Do you use any tobacco products (e.g., cigarettes, cigars, chew, snuff)? □ No □ Yes:

Do you use a nicotine patch or nicotine gum? □ No □ Yes:

Do you have any type of liver disease? □ No □ Yes:

Do you have any type of heart condition? □ No □ Yes:

Do you have any type of anxiety disorder? □ No □ Yes**:**

Do you experience dizziness and/or vertigo? □ No □ Yes:

Are you allergic to orange juice? □ No □ Yes:

Do you take any of the following prescription meds (not necessarily every day)?

□ No □ Yes Quinolones (ciprofloxacin—Cipro, norfloxacin—Noroxin)—these are certain types of antibacterial medications

□ No □ Yes Theophylline (dimethylxanthine, Quibron-T, Elixophyllin, Theo-24, Theo-Time, **TheoCap**?, Theochron, Uniphyl)—these are bronchodilators, medications used for the treatment of asthma

□ No □ Yes Ritalin (Methylphenidate), Adderall—these are medications for attention-deficit conditions

□ No □ Yes Dietary supplements and/or herbal teas containing Ephedra

□ No □ Yes Tizanidine (Zanaflex, Sirdalud)—this is a short-term muscle relaxant

Do you have normal hearing? □ Yes □ No:

If no, do you use a hearing aid? □ Yes □ No

CONTINUE TO PAGE 2
SCREENING FORM

page 2

In a typical day, how many of the following do you consume?

Regular coffee: Home Brewed _ cups

Starbucks etc __ and what size? tall grande venti

Cappuccino/Espresso: _ cups (shots)

Starbucks etc __ and what size? tall grande venti

Caffeinated tea _ cups

Caffeinated cola _ 12 oz cans

_ bottles, what size? 12 oz 16 oz 20 oz half liter

What type? (Coke, Dr. Pepper, etc)

Caffeine pill _

What brand? (**NoDoz**, etc)

Energy drink

What brand? (Monster, Amp, etc)

Anything else containing caffeine _ servings

What is it?

Alcohol (serving = 1.5 oz shot, 12 oz beer, 5 oz wine) servings

Would you be willing and able to abstain from all of these for 12 hours prior to research sessions?
□ Yes □ No

CONTINUE TO PAGE 3

SCREENING FORM

page 3

We will contact you if you qualify for our study and if we have an opening. Would you please provide a **first name only** and phone number or e-mail address where we may contact you?

Name: _ ***Phone and e-mail:***

Appendix B

INITIAL ATTITUDE FORM

Milsaps College is currently seeking members of other small liberal arts college to provide opinions on changes happening at the college. We are also asking our own students as well as alumni, but believe that students at similar institutions may have important opinions as well. Please report your opinions on the following issues involving college administration.

At this time, Milsaps *College is considering the implementation of senior comprehensive exams as mandatory for graduation for all students. Senior comprehenisve exams would measure students' competence at all levels of his or her selected major. In order to graduate, students must show that they have truly mastered their area of expertise.*

I believe the institution of senior comprehensive exams would be:

1 2 3 4 5 6 7 8 9

detrimental neutral beneficial

Due to the economic situation at this time, Milsaps is considering raising tuition to cover costs so the school will not lose important resources.

I believe a tuition increase would be:

1 2 3 4 5 6 7 8 9

detrimental neutral beneficial

The college is currently hoping to create a student services hub on campus where students can go to take care of all of their service needs in one convenient location:

I believe the creation of a student services hub would be:

1 2 3 4 5 6 7 8 9

detrimental neutral beneficial

Milsaps is currently looking to change its alcohol policy to allow students more freedom and responsibility in their drinking habits. Students will be allowed to drink in designated areas on campus if they are of the legal drinking age.

I believe changing the alcohol policy at Milsaps would be:

1 2 3 4 5 6 7 8 9

detrimental neutral beneficial

The college is currently in the preliminary stages of considering offering "pet-friendly" dorms. A small selection of the dormitories on campus will allow students to keep small pets (ex. cats, small dogs under 30 lbs, hampsters, etc). These dorms will have a slightly higher cost than other

dorms and will be separate from dorms that are not "pet-friendly" to reduce student exposure to allergens.

I believe the pet policy would be:

1 2 3 4 5 6 7 8 9

detrimental neutral beneficial

Appendix C

CONSENT FORM

How does caffeine affect mood, cognition, and brain activity?

This research is being conducted by Jeffrey Sable, Ph.D., who is affiliated with the Department of Psychology and the Neuroscience Program at Rhodes College. Students working with Dr. Sable will also be involved in conducting the study. We hope to better understand how caffeine influences our cognition and emotional responses.

Before the study, you will be given a short questionnaire with some simple questions about you. Please do not put your name on this questionnaire because no identifying information is to be associated with your answers. You will be arbitrarily assigned a participant number, which will allow us to match your questionnaire with your experiment data. You will also be weighed and your weight will be recorded on the questionnaire. This questionnaire will contain questions about medication and drug use because these may affect brain activity and/or interact with caffeine.

If you decide to participate, you will be asked to drink 6-12 ounces of orange juice. This may or may not contain caffeine. We will attach electrodes to your scalp to record brain activity, and to your face to record eye movements. Eye movements are measured because they produce much larger signals than brain activity, so we have to know when they happen in order to accurately measure brain activity. We will also be measuring heart rate which will involve placing your finger in a pulse oximeter (the finger clip they use at hospitals). We will clean the areas where the electrodes will be placed with a gentle exfoliant and alcohol pads. The electrodes will have a small amount of paste on them that ensures a good contact with your skin. Some of the electrodes will be held in place with surgical tape. We will only be recording activity, and we will not be delivering any to you (i.e., no shocks). During the study, you may be asked to do one or more of the following: (1) watch a slide show of relaxing pictures, (2) watch a slide show of a series of pictures that may have emotional content, (3) fill out questionnaires about what you are thinking and/or how you are feeling. One week after your in-lab session, you will be sent a brief follow-up questionnaire via e-mail. This will take less than five minutes to complete and is included in your 2.5 hours of research credit. Your responses may be recorded in the case of these questionnaires. Also during this study, we may ask you your thoughts and opinions about college policy issues at another institution. No risks are expected beyond those you would normally encounter in everyday life. The most likely source of any discomfort is when the surgical tape holding the electrodes is removed. This research could improve our understanding of how stimulants affect the brain, especially how they affect emotional response and cognition. However, we cannot guarantee that you personally will receive any benefits from this research. You will receive 2.5 hours of research participation credit for your involvement with this experiment. Your answers and other data will be assigned an arbitrary number that allows us to match it up, but any information that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. This signed consent form will be kept in a locked location, and only the experimenters will have access to it. Only your participant number will be associated with your data, and not your name.

Your participation is voluntary. Your decision whether or not to participate will not affect your relationship with Rhodes College or any other institution with which you may be affiliated. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time without penalty.

If you have any questions, please feel free to contact Jeffrey Sable, Ph.D., Assistant Professor and the responsible project investigator for this study. He can be reached by e-mail at sablej@rhodes.edu or by phone at (901) 843-3985. If you have questions regarding your rights

as a research subject, contact Nick **McKinney**, Ph.D., Chair of the Rhodes Institutional Review Board. He can be reached by e-mail at mckinneyn@rhodes.edu or by phone at (901) 843-3566.

Consent to participate: Your signature below indicates that you have read and understand the information provided above, that you willingly agree to participate, that you may withdraw your consent at any time and discontinue participation without penalty, and that you are not waiving any legal claims, rights or remedies.

Signature: **Date:** _____

Printed name:_____

Experimenter:_____

Appendix D

PARTICIPANT INFORMATION

Please DO NOT write your name on this form!

Have you consumed any caffeine during the past 12 hours? □ No □ Yes

If yes, please explain:

How many hours of sleep have you had in the last 24 hours? _

What have you had to eat today, and at approximately what time?

Have you taken or used any medications, herbal supplements, or other drugs or alcohol during the last 24 hours?

□ No □ Yes (please explain):

Age: _ ***Date of birth:*** _ Sex: □ Female □ Male

Height (in inches): ***Weight (in pounds):***

Years of education:

(e.g., high school grad = 12 years; high school graduate + 1 semester = 12.5)

Dominant hand (please check one): □ Left □ Right

Is English your first language? □ Yes □ No, my first language is _

How do you identify yourself ethnically (please check all that apply):

□ Decline to answer □ African American □ Hispanic □ Native American

□ Asian □ Pacific Islander □ Caucasian □ Other:

Are you pregnant or nursing (please check one)? □ Yes □ No

Do you take any prescription medication or herbal supplements, including a contraceptive, even if it's not every day (please check one and explain if requested)?

□ No.

□ Yes (please list all of them):

Do you have normal hearing (please check one)?

□ Yes.

□ No, I use a hearing aid in my left ear / right ear / both ears. (please circle one)

□ No, I am hard of hearing or have a hearing disorder (please explain).

□ Other (please explain):

Do you smoke or use other tobacco products (please check one)?

□ Yes, I smoke packs a day, on average.

□ Yes, I use other tobacco products (please explain): _

□ No.

Appendix E

Argument Recall Tast

Please try to recall in as much detail as possible the arguments you read in the preceding paragraph.

1.

2.

3.

4.

5.

6.

7.

Appendix F

We are now interested in everything that went through your mind during the procedure. Please list these thoughts, whether they were about yourself, the situation, and/or others; whether they were positive, neutral, and/or negative. IGNORE SPELLING, GRAMMAR, AND PUNCTUATION. You will have 2.5 minutes to write. Please be completely honest. Your responses will be anonymous. Please record your thoughts and ideas below.

Appendix G

Need for Cognition Scale

Note: All information identifying the nature of the scale and clues to reverse coding were removed before the measure was presented to participants.

Need for Cognition Scale (from Cacioppo, Petty, & Kao, 1984)

For each of the statements below, please indicate whether or not the statement is characteristic of you or of what you believe. For example, if the statement is extremely uncharacteristic of you or of what you believe about yourself (not at all like you) please place a "1" on the line to the left of the statement. If the statement is extremely characteristic of you or of what you believe about yourself (very much like you) please place a "5" on the line to the left of the statement. You should use the following scale as you rate each of the statements below.

1	2	3	4	5
extremely uncharacteristic of me	somewhat uncharacteristic of me	uncertain	somewhat characteristic of me	extremely characteristic of me

1. I prefer complex to simple problems.

2. I like to have the responsibility of handling a situation that requires a lot of thinking.

3. Thinking is not my idea of fun.**

4. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.**

5. I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.**

6. I find satisfaction in deliberating hard and for long hours.

7. I only think as hard as I have to.**

8. I prefer to think about small daily projects to long term ones.**

9. I like tasks that require little thought once I've learned them.**

10. The idea of relying on thought to make my way to the top appeals to me.

11. I really enjoy a task that involves coming up with new solutions to problems.

12. Learning new ways to think doesn't excite me very much.**

13. I prefer my life to be filled with puzzles I must solve.

14. The notion of thinking abstractly is appealing to me.

15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.

16. I feel relief rather than satisfaction after completing a task that requires a lot of mental effort.**

17. It's enough for me that something gets the job done; I don't care how or why it works.**

18. I usually end up deliberating about issues even when they do not affect me personally.

Note: **=reverse scored item

Appendix H

Withdrawal Scale

Please indicate if you experienced the following symptoms at any point during the experiment.
1. Headache

Yes No

If yes, would you describe it as:

Mild Moderate Severe

2. Tiredness/fatigue

Yes No

If yes, would you describe it as:

Mild Moderate Severe

3. Decreased alertness

Yes No

4. Decreased feeling of well-being

Yes No

5. Decreased activeness/less energy

Yes No

6. Difficulty concentrating

Yes No

7. Drowsiness

Yes No

8. Increased irritability

Yes No

9. Depressed mood

Yes No

10. Feeling of cloudy head/not clearheaded

Yes No

Appendix I

Mood and Arousal Scale

Rate your current mood on the following scale:

1 2 3 4 5 6 7 8 9

Negative (bad) Neutral Positive (good)

Rate your current arousal level on the following scale

1 2 3 4 5 6 7 8 9

Low Average High

Appendix J

Caffeine Identification Form

Do you believe you were given caffeine during this study?

yes no

How confident are you in your answer?

1 2 3 4 5

Not at all Somewhat Completely

Appendix K

Post-Message Attitude Measure

Please indicate your current feelings towards Senior Comprehensive Exams on the following scales:

1 2 3 4 5 6 7 8 9

bad good

1 2 3 4 5 6 7 8 9

unfavorable favorable

1 2 3 4 5 6 7 8 9

foolish wise

1 2 3 4 5 6 7 8 9

harmful beneficial

1 2 3 4 5 6 7 8 9

ineffective effective

Appendix L

Debriefing Form

The purpose of this study was to explore the relationship between caffeine, emotion, and information processing--particularly persuasion. Research has shown that the ingestion of caffeine can lead to an increase in persuasion (Martin et al. 2005, Martin et al. 2007). The previous research has determined that cognitve processing plays a strong role in this phenomenon but has not determined what effect physiological arousal and mood have. This research aimed to influence mood with emotionally charged pictures and monitored physiological effects associated with arousal. Milsaps College is not currently considering instituting senior comprehensive exams. This deception was used because when people are aware you are trying to influence persuasion, they may be more resistant than usual which would negatively affect our data. If you have any questions about this research please contact Kelly Coney (conka@rhodes.edu) or Jeffrey Sable (sablej@rhodes.edu).

Thank you for your participation

Appendix M

Persuasive Argument

Milsaps College is considering implementing senior comprehensive exams as a requirement for graduation. This means that all students will have to complete one final comprehensive test investigating students' knowledge in all levels of their intended major in order to earn their diploma. These tests will be challenging and must be passed in order to graduate. We would like to hear the opinions of students at a similar institution on this change. Please review our reasons for instituting this change listed below and let us know your honest opinions on this issue.

Graduate schools and law and medical schools are beginning to show clear and significant preferences for students who received their undergraduate degrees from institutions with comprehensive exams. As the Dean of Harvard Business School said: "Although Harvard has not and will not discriminate on the basis of sex or race, we do show a strong preference for applicants who have demonstrated their expertise in an area of studying by passing a comprehensive exam at the undergraduate level." Admissions officers of law, medical, and graduate schools have also endorsed senior comprehensive exam policy and indicated that students at schools without the exam would be at a significant disadvantage in the very near future. Thus, the institution of comprehensive exams will be an aid to those who seek admission into graduate and professional schools after graduation.

A study conducted by the Educational Testing Service of Princeton, New Jersey revealed that most of the Ivy League schools and several of the Big 10 universities have senior comprehensive exams to maintain their academic excellence. Professors at those schools who were interviewed recently said that senior comprehensive exams assured that only high quality and knowledgeable students would be associated with the university. This, of course, increases the prestige of current students, alumni of the school, and the university as a whole. The exams should be instituted to increase the academic reputation of the university. A national educator's publication recently predicted that within the next 10 years, the top universities would have the exam policy, and the weaker ones would not.

An interesting and important feature of the comprehensive exams is that it has lead to a significant improvement in the quality of undergraduate teaching in the schools where it has been tried. Data from the Educational Testing Service confirmed that teachers and courses at the schools with comprehensive exams were rated more positively by students after the exams than before. The improvement in teaching effectiveness appears to be due to departments placing more emphasis on high quality and stimulating teaching because departments look bad when their majors do poorly on the exam. For example at the University of Florida, student ratings of courses increased significantly after comprehensive exams were instituted.

One aspect of the comprehensive exam requirement that students at the schools where it has been tried seem to like is that all regular final exams for seniors are typically eliminated. This elimination of final exams in all courses for seniors allows them to better integrate and think about the material in their major area just prior to graduation rather than "wasting" a lot of time cramming to pass tests in courses in which they are really not interested. Students presently have to take too many courses in areas that are irrelevant to their career plans. The comprehensive exam places somewhat greater emphasis on the student's major and allows greater concentration on the material that students feel is most relevant.

Faculty members at universities with the comprehensive exams who were interviewed by researchers from the Carnegie Commission on Higher Education revealed that the comprehensive exams appeared to provide an incentive for students to study the material in their major area. A thorough study undertaken by the Department of Education at the University of Notre Dame showed that universities with comprehensive exams have resisted the trend of

declining scores on standardized achievement tests. Average scores on achievement tests for the universities with comprehensive exams have actually risen over the last five years.

Data from the University of Virginia, where comprehensive exams were recently instituted, indicate that the average starting salaries of graduates increased over $4000 over the two-year period in which the exams were begun. At comparable universities without the exams, salaries increased only $850 over the same period. As Saul Seigel, a vice-president of IBM put it in *Business Week*, “We are much quicker to offer the large salaries and executive positions to these kids because by passing their area exam, they have proven that they have expertise in their area rather than being people who may or may not be dependable and reliable.” Another benefit is that universities with the exams attract larger and more well-known corporations to campus to recruit students for their open positions. The end result is that students at schools with comprehensive exams have a 55% greater chance of landing a good job than students at schools without the exams.

I give permission for public access to my Honors paper and for any copying or digitization to be done at the discretion of the College Archivist and/or the College Librarian.

Signed_____

Kelly Coney

Date _____