Association of Caffeine Consumption with Class Participation among College Students

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Abstract

This correlational study examined the association of caffeine with class participation based on three aspects: the completeness of class notes, frequency of speaking and the alertness during class period measured by a self-report. It was hypothesized that caffeine consumption before class would predict higher score on the class participation level. A sample of sixty-six Emory University undergraduate students were conveniently chosen to participate and no significant correlations were found between caffeine intake and class participation. The findings failed to support the effect of caffeine on alertness and cognition.

Keywords: caffeine, class participation, alertness, college students

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Caffeine exists in many foods beyond just coffee, like sodas, chocolate, energy drinks, and pain relievers. It is hard to avoid caffeine in people's daily life. The wide consumption of caffeine makes research on effects of caffeine significant. A 1990 study indicated an 80% of the adult population drinks coffee in the United States (Benowitz, 1990). Nowadays, caffeine remains to be the most widely used drug (Franke et al., 2011). Many people drink coffee for the stimulating effects of caffeine on the central nervous system (Ferre, Ciruela, & Borycz, 2008). Sleep-deprived people reported the use of caffeine improves their vigilance, alertness and reaction time (Beaumont et al., 2005). College students reported the same reason for taking caffeine, believing caffeine consumption will improve their academic outcomes (Franke et al., 2011). Research has shown a particular prevalence of caffeine consumption among college students worldwide. Many college students, in fact 87.5% take caffeine for the purpose that it may enhance cognitive abilities (Franke et al., 2011). However, little is known about the actual effects of caffeine on academic performance. Research has shown that greater energy drink consumption is associated with a lower academic performance indicated by a low GPA (Champlin, Pasch, & Perry, 2016). However, this research only shows the correlation between caffeine and academic performance without indicating a causation because students with low GPAs may seek caffeine to help them keep up with the school work (Champlin et al.,2016). Much less is known about other substances in energy drinks that could possibly affect cognition.

As such, additional work is required to further investigate the association of caffeine with academic performance. Another study investigated the different effects of a placebo, coffee and energy drinks with caffeine being the primary ingredient on cognitive performance and

subjective feelings of energy and mood in young men and women. Neither caffeine nor the energy drink had an effect on improving cognitive performance or elevating mood (Bloomer, Majaj, Moran, & MacDonnchadh, 2015). If further research also shows a strong correlation between the intake of caffeine with low academic performance or no effect of caffeine on cognition, companies that produce and promote caffeine-containing products should be regulated because studies have shown other negative outcomes of consumption. For example, two studies found that alcohol dependence is correlated with the consumption of caffeine-containing drinks. They also found that people after caffeine intake are more likely to have risky behaviors due to a desire for sensation seeking (Arria et al., 2010; Miller, 2008). Nevertheless, not all scholars agree with caffeine being useless to cognition. Recent research suggests that a dose of 200-400 mg caffeine improves both vigilance and the executive control of visual attention in participants with low caffeine intake profiles, and a dose of 400 mg caffeine shortens reaction time and enhances alertness and vigilance in individuals with high caffeine intake profiles (Brunyé, Giles, Lieberman, Mahoney, & Taylor, 2010). The findings in the current literature have many conflicts and the current study tries to investigate the effect of caffeine and disentangle the controversy.

One way to further investigate the effect of caffeine on academic performance will be to investigate the correlation between class participation and caffeine intake. So far researchers have been focusing on the variance of GPA due to caffeine consumption, but GPA can be influenced by many factors such as work-status of the students, family relations, and students' majors, which are hard to rule out in a correlational study. Instead of looking at GPA directly, our study investigates class participation. Class engagement is potentially important because it could promote greater absorption of class material, which may improve GPA with other factors like students' effort remaining the same. Measuring class participation has an advantage over

measuring GPA: behavioral change can be clearly observed, which will be valuable in a study of caffeine's effect on academic performance.

Our study was designed with the purpose of determining if caffeine is associated with higher class engagement. Consistent with Brunyé et al. (2010) study, we hypothesized that if students drink caffeine-containing drinks prior to class, then they will participate more in class. Class participation was measured by a self-reported survey asking the completeness of class notes, frequency of speaking and the alertness during class period on a rating scale of one to five with the higher number representing higher class engagement. Participants were divided into two groups based on whether or not they had caffeine before class. Then a correlational analysis was conducted between the class participation score and their caffeine intake.

Method

Participants

Sixty-six undergraduate students (30 women, 21 men, 15 not indicated, M_{age}=19.6 years, age range: 17 -27 years, *SD*=1.72) were recruited from four different seminar classes using convenience sampling at Emory University.

Materials and Measures

Class Participation Survey. The class participation survey was designed by the researchers to investigate the correlation between class participation and caffeine intake. The survey included 7 statements regarding completeness of class notes, alertness, frequencies of vocal contributions during class and other distractive statements (see Appendix A). Participants responded on a 7-point scale ranging from *strongly disagree* to *strongly agree*; responses were scored from 0 to 6 where 6 indicated the highest level of agreement. The final score was calculated by the sum of items that were not distractive statements. The higher the score

indicated the higher a student's class participation level. Distractive statements were items 3, 4 and 7 regarding students' interests toward the seminar class, students' personalities, and students' level of sleep deprivation. The reliability of this measure was not identified because it was a pilot measuring instrument. Also, an interitem reliability test based on Cronbach's alpha coefficient was not required because the survey was a formative measure.

Caffeine Intake Survey. After participants completed the class participation survey, they were asked to self-report whether or not they consumed caffeine in the last eight hours before the class and whether or not they were regular caffeine consumers. Participants responded with yes or no and were separated into caffeine group and non-caffeine group based on their responses. Caffeine intake survey was proceeded after the class participation survey because the survey questions regarding the caffeine intake may introduce bias to the study by revealing the research purpose.

Procedure and Design

Participants were approached at 4 different seminar classes taking place around similar times of the day and were asked to take a survey at the end of their classes about their participation level. They were instructed to read and sign the Informed Consent Statement before proceeding to the survey questions. The two surveys took 5 minutes to complete and students finished the class participation survey first before completing the caffeine intake survey. Participants who took caffeine prior to class were grouped into a caffeine-intake group and participants who did not take caffeine prior were grouped into a non-caffeine-intake group. Class participation scores were compared between two groups to observe the correlation. Participants were not compensated, but were appreciated for their time and work at the end of the data collection.

Design

A cross-sectional, correlational study was designed to determine whether caffeine intake resulted in higher class participation level. Completeness of notes, alertness in class, and frequencies of vocal contributions in class were variables that were related to class participation level. An interitem reliability test based on Cronbach's alpha coefficient was not required in this study to proceed the measurement because the completeness of notes, the frequency of speaking and the alertness were three items that did not measure a single underlying variable. The combination of them measured the class participation level. An Independent Samples T-Test analysis was conducted to compare these class participation scores between the caffeine and non-caffeine groups.

Results

Overall Descriptive for Measures

See Table 1 for overall descriptive statistics of the variables analyzed in the study. The mean for participation scores of the group with caffeine intake was 3.22 (*SD*=0.927). The mean for participation scores of the group without caffeine consumption was 3.12 (*SD*=1.14). 38 subjects had caffeine consumption prior to the class and 28 subjects had no caffeine intake prior to the class.

Tests of Main Hypotheses

To examine the hypothesis that there is a positive correlation between caffeine consumption prior to the class and the participation level during the class, an independent samples t-test was used with a p-value of 0.05. There was no correlation found between caffeine intake and class participation scores. The group with caffeine intake (*M*=3.22*, SD*=0.927) scored

similarly to the group without caffeine intake (M=3.12, SD=1.14), t(51.012)=.381, p=0.705, (see Figure 1).

Discussion

This study investigated the effect of caffeine on students' class participation level. It examined the class participation level by measuring the completeness of notes, frequency of speaking and alertness level through a self-reported questionnaire. The hypothesis examined in this study was that if students drink caffeine-containing drinks prior to class, then they would participate more in class. This study is important because nowadays, caffeine remained to be the most widely used drugs due to the stimulating effects of caffeine on the central nervous system (Ferre et al., 2008). However, the actual effects of caffeine remained unknown on enhancing cognitive abilities. The past literature focused on the variance of GPA resulted from caffeine consumption. The current study investigates from a new angle—the class participation. This design helps to better observe the behavioral change and reduces the bias from the previous studies that focused on GPA, which potentially had many covariates influencing it.

Findings from this study failed to support the hypothesis and indicated no associations between caffeine consumption and class participation level. The means of the participation scores showed little difference between the caffeine and non-caffeine groups. The findings in this current study are different from those of Brunyé, Giles, Lieberman, Mahoney, and Taylor (2010), who found an effect of caffeine on shortening reaction time and improving alertness and vigilance in individuals. In that study, they found the effect of caffeine on shortening reaction time and improving alertness and vigilance in individuals (Brunyé et al., 2010). In the previous study, participants were given the highest dose of caffeine (400 mg) to find the significant effects (Brunyé et al., 2010). In the current study, most students might take a dose of 200 mg (amount of

caffeine in a regular cup of coffee commonly) and 200 mg would not be sufficient to produce the same effects. A previous study supported this current study indicating no effect of caffeine on improving cognitive performance and subjective feelings related to energy (Bloomer et al., 2015).

More importantly, participants also indicated the hours of sleep they had the night before the class and if they were regular caffeine drinkers. It was found that in the caffeine group, most participants were regular caffeine drinkers with lack of sleep. The relatively small dosage of caffeine they got from a cup of coffee might have been too little to promote a measurable effect.

Limitations

The current study had several limitations. Firstly, defining academic performance as class participation could be biased because personality variation would predict students' behaviors in class regardless of caffeine intake. A low-class participation rate does not always lead to a low GPA if a student with an introvert personality puts enough effort academically.

Additionally, the distribution in the sample size was unequal. There were ten more subjects in the caffeine group then in the non-caffeine group. This could account for the reason to the finding of no difference between two groups in participation scores. The subjects were recruited from three different psychology classes and one mathematics class using a convenient sampling method. The sample in this study did not represent the population of Emory University students well because the sample included mainly students with a psychology major. Those students may be more aware of the effect of caffeine and thus their self-report might be influenced by their own expectation.

Implications

The results of the current study did not support the claim about effects of caffeine on improvements on alertness and cognition advocated by companies that produce caffeine-containing products. This study suggests more careful regulation on promotion of caffeine-containing products because their effect is still debatable yet the withdrawal symptoms like headache, drowsiness, fatigue, trouble concentrating, mood disturbances, and flu-like symptoms were found in many caffeine users (Juliano and Griffiths, 2004).

Future Directions

Future research should focus on determining the impact of caffeine on physical performance during activity, because a large number of individuals use caffeine-containing products to aid their performance during sports.

A previous study indicated that the effects of caffeine on sleep parameters were measurable and consumption of caffeine sixteen hours prior to bedtime produced minimal effects on standard sleep parameters comparing to a dose administered 3 hours prior to bedtime (Drake, Roehrs T, Shambroom J, & Roth T, 2013). The current study did not take into account of the time interval between caffeine intake and having class. Future research should investigate if the effect of caffeine is short-termed.

The diverse implications for the function of central nervous system caffeine carries leads to the wide consumption of caffeine-containing products. Nonetheless, the beneficial effect of caffeine remains debatable and needs more evidence to support.

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Appendix A

Class Participation and Caffeine Intake Survey with Demographic Questions

Instructions:

This is a questionnaire that measures different feelings and behaviors during this class period. Listed below is a list of statements. Read through and circle the number that best matches your agreement or disagreement.

Age: Sex:

1=STRONGLY DISAGREE

2=DISAGREE

3=UNDECIDED

4=AGREE

5=STRONGLY AGREE

1. I spoke often during this class.

1 2 3 4 5

2. My class notes were very complete.

1 2 3 4 5

3. Today's class was very interesting.

1 2 3 4 5

4. I am active in all of my classes in general.

1 2 3 4 5

5. I stayed very awake in class today.

1 2 3 4 5

6. I was very focused during this class.

1 2 3 4 5

7. I got an over 7-hours sleep last night.

1 2 3 4 5

8. I had caffeine in the past 8 hours.

YES NO

9. I am a regular caffeine user. (at least a cup a day most of the days)

YES NO

Table 1

Independent t-test between Caffeine Consumption and Students' Class Participation Scores

Caffeine	N	Mean	Std. Deviation	t	Sig. (2 tailed)
Consumption	28	3.11	1.13	0.393	0.705
No consumption	38	3.21	0.92		

Note. N=sample size; T=Independent T-test; Sig=significance level.

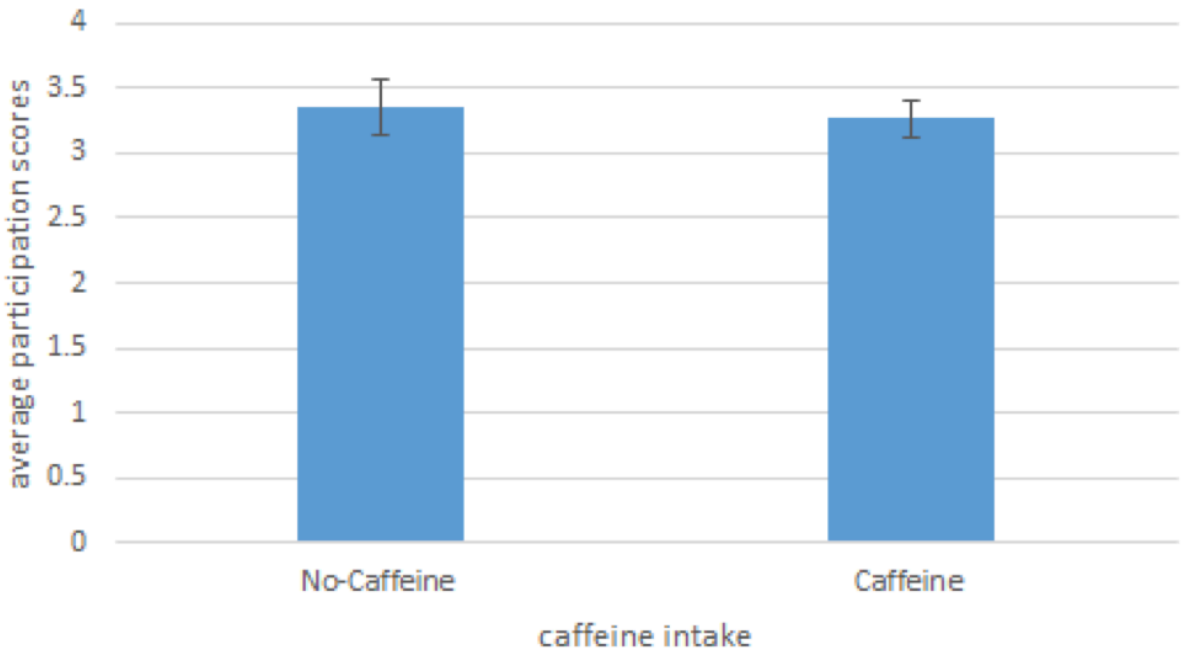

Figure 1. Mean Participation Level for caffeine consumption group and no caffeine consumption group. Error bar represents standard error of the mean for both groups.