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## A Longitudinal Analysis of Stress Among Incoming College Freshman

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### Abstract

**Objective:** 1) examine changes in stress during first semester among freshmen undergraduates; 2) identify predictors of stress (coping strategies, emotional states and quality of sleep).

**Participants:** 197 freshmen students were recruited for a 10-week study during first quarter (Oct-Dec, 2015).

**Methods:** Students completed weekly self-report surveys on stress, coping strategies, emotions, and quality of sleep. A General Linear Mixed-Model was used for analyses.

**Results:** Stress was elevated during examinations periods. Females reported a greater stress level than males. Increased stress level was significantly associated with lower sleep quality and greater negative emotions (fear, anger). Exercise was an effective stress coping strategy while other coping methods (Internet usage, meditation and self-isolation) were associated with higher stress. Social media usage did not influence stress level.

**Conclusions:** Future stress management programs for freshman need to consider gender differences and may focus on sleep, exercise and decreased general Internet usage.

### Keywords

Stress; Stress Coping; University Students; Social Media; Emotions; Sleep Quality

### Introduction

College is demanding, with one study finding that up to 75% of undergraduate students experience at least moderate stress<sup>1</sup>. The impact of stress is of particular concern for incoming freshmen. The American Freshmen National Norms Study found that freshmen have increased levels of stress and lower emotional well-being compared with other undergraduate students. Several studies have also reported that female undergraduate students experience a higher stress level compared with males and that certain academic

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majors (e.g., engineering, medicine)<sup>2</sup> are associated with higher stress levels<sup>3-6</sup>. The common sources of stress for undergraduate students include the transition to university<sup>7</sup>, academic performance pressure<sup>8</sup>, lack of sleep<sup>9</sup>, personal relationships<sup>10,11</sup>, and poor coping skills<sup>12</sup>.

Understanding the predictors of stress is important in order to help students adjust to the academic environment and for their overall well-being. Stress results in an array of negative outcomes for undergraduate students, ranging from poor academic performance and health<sup>13,14</sup>, increased depression levels<sup>15</sup>, increased alcohol use<sup>16</sup>, increased drug/psychostimulant use<sup>17</sup>, lowered self-esteem and self-worth<sup>4,18</sup>, and suicidal ideation<sup>19</sup>. Students who are able to better cope with their stress have improved academic performance, healthier eating habits, lower depression levels<sup>20</sup>, and improved mood<sup>21</sup>.

There has been a dramatic increase in Internet and social media use in the past decade<sup>22</sup>. The impact of Internet and social media use on undergraduate stress levels has not been adequately investigated, but insights have been gleaned in a variety of contexts. An important predictor of stress is time-management skills, and one of the leading negative influences on student time management is idle pursuits on the internet<sup>23,24</sup>. Also shifting are social norms and expectations of incoming freshmen students, who are turning more to online sources to cope with stress versus talking with friends or family<sup>25</sup>. Using social media platforms for positive interactions with friends has been shown to increase social capital and psychological well-being<sup>26</sup>. However, assuming that the internet and social media are used strictly for social networking purposes is confounded by the fact that students devote roughly 50% of their online activity to academic pursuits<sup>27</sup>. Moreover, even social media use tends to be linked to online research for academic purposes<sup>28</sup> and improved grades<sup>29</sup>.

Overall, there are multiple factors that can influence a student's stress level throughout the entire semester. Therefore, it is critical to gather longitudinal data on students' stress levels and stress coping strategies across the entire semester so that we may refine our understanding of predictors of stress. In this study, we used weekly surveys to examine a group of 197 freshmen students for 3 months during their first quarter at the University of California, Los Angeles (UCLA). Our objectives were 1) to examine how stress level is changed during the semester in University freshmen, and 2) to identify predictors of stress. The specific predictors of stress that were examined include coping strategies, emotional state, quality of sleep, Twitter usage. We hypothesized that stress level would peak during exam periods and higher stress level would be associated with poor coping strategies, emotional state, academic confidence, sleep quality and higher Twitter usage.

## Methods

The study protocol was approved by the UCLA Institutional Review Board (IRB). The research team provided all participants with a description of the study prior to recording in-person consent. Participants were incoming students at UCLA who were recruited as part of a 3-month study researching stress, sleep, and social media patterns of freshmen during their first quarter. The participants were recruited through advertisements on a Facebook page for the freshmen class and in-person on campus. Recruitment occurred during a 1-month period

from mid-September through mid-October 2015. To qualify for the study, students had to be: freshmen or first-year transfers, in their first semester at UCLA, younger than 21 years of age, and an active Twitter user (> 3 posts/wk). Twitter use was verified by study workers who reviewed each participant's public profile. The students' Twitter data were collected as part of a joint study that monitored social media habits and these data were downloaded at a later point to be used as a separate analysis.

Participants completed weekly surveys for this study and each weekly online survey was designed to be completed in less than 5 minutes. An additional demographic survey was included in the first week of the study and a longer exit survey was included in the final week of the study. For each successfully completed survey, the student received \$5 (U.S.). An additional \$5 incentive was awarded to participants who completed all four weekly surveys in a given month. Students who completed all weekly surveys received a total of \$75, which was distributed in the form of an online [Amazon.com](https://www.amazon.com) gift card.

## Measures

### Demographics.

Age, gender, race/ethnicity, and academic major were recorded.

### Weekly Survey.

Students completed an online self-assessment each week. The following wellness measures were rated on 5-point Likert scales:

- *Stressors*: Please rate the stressor according to how much stress it caused you in the following areas: classes/homework (academics), the need to make money, employment, family, friends, the need to fit in, and self-image. Response included: Extremely low stress (1), Low stress (2), Average stress (3), High stress (4), Extremely high stress (5). Overall stress is calculated through the mean score.
- *Ability to deal with stress*: "My methods of dealing with stress have been:" Response included: Very unhelpful (1), Unhelpful (2), Somewhat helpful (3), Helpful (4), Very helpful (5). Participants were asked to identify from a list that stress coping methods or activities that they used to cope with stress (Exercising, hanging out with friends or family, listening to music, going on the Internet, logging on to social media, engaging in sex, eating food, sleeping, reading books, participating in hobbies, meditation, isolating themselves, or going to party).
- *Quality of sleep*: "How was your quality of sleep?" Response included: Slept very bad (1), Slept bad (2), Average night of sleep (3), Slept good (4), Slept very good (5). Quality of sleep rated how well each student slept on average during the previous week.
- *Emotions (fear, anger, love, and joy)*: "How strongly did you feel these emotions?" Response included: Extremely low (1), Low (2), Somewhat (3),

Strong (4), Extremely strong (5). The emotions of anger, fear, love, and joy were chosen based on previous work by Ekman<sup>30</sup> and Parrot<sup>31</sup>.

### Twitter.

The total number of tweets was calculated for each participant as an objective measure for usage of a specific social media platform. All tweets for all participants were downloaded during the three-month study using Twitter's Rest API. If a user's account was private, study staff contacted the participant to request that they momentarily allow access to the account.

## Statistical Analysis

A linear mixed effects model was used to conduct a longitudinal analysis across 10 weeks of data. The self-reported level of weekly stress served as the dependent variable in all models (1 = minimal stress during the previous week, 5 = extreme stress during the previous week). The linear mixed effects model allowed for analysis of repeated measures and controlled for the high correlations between time periods<sup>32,33</sup>. Random effects were specified for the all observations and for the time periods. The reason for choosing this specification was because a student's initial stress level (i.e., the student's intercept) was related to how that student responded to stress over time (i.e., the student's slope with respect to time).

All analyses were conducted in RStudio version 0.99.489 (RStudio, Boston, MA, USA) using the lme4() package and maximum likelihood estimation.

## Results

Two hundred twelve students consented to participate in the study. Fifteen participants dropped out before the first round of data collection, leaving a sample of 197 freshmen students. The first week of data reported in this paper begins on the third full week of class. This paper discusses a 10-week period from week 3 of the first semester through final examinations.

The response rate was relatively high, with an average weekly response rate of 84% of students. In addition, 181 students (92%) completed the demographic survey. A breakdown of the number of observations is provided in a footnote to Table 1, but in total there were 1,550 observations across all 10 weeks of the study. No significant differences were found in demographics and outcome variables at the baseline between students who were missing at the end of the study and those who remained ( $p>0.05$ ).

Demographic characteristics are presented in Table 1. The most represented ethnicity was Hispanic (29.3%), followed by Asian (26.5%), White (21.6%), Black (11.6%), Multiracial (6.1%) and American-Indian (.5%). Most students (86%) had already declared a major in health sciences/biology (42.5%), social sciences/art (22.6%), science/math/engineering (12.7%), or business (8.3%).

When comparing the 181 freshmen students who completed the surveys to the general UCLA undergraduate population, the closest similarities were in gender (sample = 60.2% female; UCLA = 56% female) and average age (sample = 18.2 y; UCLA = 18.5 y).

However, there was a noticeably higher representation of Hispanic and Black students (sample = 29.3% and 11.6%, respectively; UCLA = 22.9% and 4.9%, respectively). Additionally, there was a higher representation of health science/biology students in the sample versus the undergraduate population (sample = 42.5%; UCLA = 29.3%)<sup>34,35</sup>.

### Stress level throughout the full semester

Self-reported level of stress experienced during the previous week served as the dependent variable in all models. The average reported stress level was 3.4 (SD = 0.99), implying that the typical freshmen student experienced higher-than-average stress. However, as can be expected during any academic semester, particularly the first semester of freshmen year, the average stress level varied throughout the 10-week period. Figure 1 depicts two distinct peaks in the average stress level: during mid-term examinations (mean = 3.57) and at the beginning of final examinations (mean = 3.95).

The stress model estimated in this paper (without any control variables/predictors) is as follows:

$$\text{Stress} \sim 1 + \text{Week} + (\text{Week} | \text{Student})$$

The model includes weekly self-reported stress levels as the outcome along with an intercept, time as a factor variable, and two correlated random effects for the students and the time periods. After running this regression, the variance (measured in standard deviations) in the mixed effect was 0.54 for the intercept and 0.08 for the slope, arguing that there was higher variability between students at the baseline and lower variability in how students experienced stress throughout the semester. Additionally, the two mixed effects estimates had a correlation of  $-0.59$ . This correlation indicates a relatively strong relationship between a student's baseline stress level and how that student experienced stress over time. A negative correlation implies that lower stress levels at baseline were related to higher stress levels later in the semester (Fig. 1). To test the significance of this relationship, the model was compared to a null model with uncorrelated random effects using a likelihood ratio test (LRT). The  $\chi^2$  statistic for the test was 8.777 ( $P = 0.003$ ), which indicated that inclusion of the correlated random effects in the model resulted in a significantly better fit.

The model with the full list of control variables is:

$$\text{Stress} \sim 1 + \text{Week} + \text{Female} + \text{Age} + \text{Ethnicity} + \text{Academic Major} + (\text{Week} | \text{Student})$$

To evaluate the significance of each variable, the full model was tested against a null model using an LRT. The only significant relationship was for female gender ( $\beta = 0.18$ ,  $P = 0.03$ ). The interpretation of the estimator was that female students have on average a roughly 0.2 higher stress level as compared with male students. The comparison group for ethnicity was composed of "other" students and multiracial students, while the comparison group for academic majors was composed of "undeclared majors."

## Predictors of Stress

Using the model listed above, multiple predictor variables were included individually as follows:

$$\text{Stress} \sim 1 + \text{Week} + \text{Female} + \text{Age} + \text{Ethnicity} + \text{Academic Major} + \text{Predictor Variable} + (\text{Week} / \text{Student})$$

Table 2 lists the regression output for the predictors. The most commonly cited stress coping methods were reading books (96%), listening to music (81%), or talking with friends (71%). Each row of Table 2 is a separate regression. Included in each row are the estimator, standard error, significance level, and Akaike Information Criteria (AIC) + Bayesian Information Criteria (BIC). Of all the methods for dealing with stress that were measured, only exercising was negatively related with student stress levels ( $\beta = -0.15$ ,  $SE = 0.06$ ,  $p < .01$ ). However, several stress coping methods were found to be positively related with higher levels of stress: using the Internet ( $\beta = 0.14$ ,  $SE = 0.06$ ,  $p < 0.05$ ), meditating ( $\beta = 0.15$ ,  $SE = 0.06$ ,  $p < 0.05$ ), and isolating one's self ( $\beta = 0.25$ ,  $SE = 0.05$ ,  $p < 0.01$ ). Interestingly, using social media as a stress coping method was not associated with higher levels of stress. However, the relationship between stress and tweets posted approached significance ( $\beta = 0.15$ ,  $SE = 0.08$ ,  $P = 0.06$ ).

The quality of sleep students reported in the previous week had the largest magnitude estimator ( $\beta = -0.35$ ,  $SE = 0.03$ ,  $p < 0.01$ ). Stress level was positively associated with student's weekly self-rating of fear and anger and negatively associated with the emotional state of love and joy. The change in emotions over the semester is shown in Figure 2. An important reference point is the spike in fear that occurred during final examinations in week 9, which was also the week with the highest mean level of stress. The lower AIC/BIC for quality of sleep and the emotional state of fear and anger indicate that these predictors were closely related to students' stress level (the low AIC/BIC for the quality of sleep variable is partially driven by a lower number of observations).

## Discussion

This longitudinal study examined the change in stress level during an entire semester in college students and identified key predictors of stress. We found that stress increased on average throughout the quarter and the increase in stress was related to academic events (e.g. tests, and exams). Similar to previous publications<sup>3-6</sup>, we found that female students experienced higher stress level than males. The high correlation between the mixed effects shows that a student's initial stress level can be informative in terms of their stress level later in the semester. That the correlation is negative argues that lower initial stress levels are correlated with a higher slope values, reflecting the general trend of higher stress levels throughout the semester. Interestingly, this correlation implies that students who started their freshmen year with higher stress levels experienced lower stress levels later in the semester. This is all suggestive of initial freshmen stress levels being potentially powerful predictors of stress later in the semester. This is a theme for future research, as this analysis did not disaggregate students according to baseline stress level.

Methods of stress coping are important for stress management. The coping method significantly associated with lower stress was exercise, yet there were three variables significantly related with higher levels of stress: Internet usage, meditating, and isolating one's self. The significant estimator for meditation shows that these estimators are not causal, but associative (i.e., the reading of the estimator should not be "meditation as a stress coping method increased stress on average by 0.14", but rather "stress was on average 0.14 higher for students who reported that they used meditation to deal with their stress"). This positive finding could be the result of students who identified themselves as suffering from high stress and who started meditating as a coping mechanism. Previous studies have showed that meditation is an effective stress-coping mechanism<sup>36</sup>; future research could explore the impact of meditation on stress levels in future weeks. Of note for the three stress coping methods (i.e. going on internet, meditating, isolation), is that these are arguably private actions. An argument that requires future investigation is that highly stressed students may not be seeking the social support needed to adequately handle their stress.

The most important variables for explaining stress in this study, both in terms of the magnitude of the estimators and the drop in AIC/BIC, were the quality of sleep and the level of fear. It has long been established that sleep is related to stress<sup>9</sup>, but the strength of our results highlights the importance of sleep and is a call for future research into freshmen sleep patterns. Fear has also been linked with stress in students<sup>12,37</sup>. Using the Transactional Model of Stress and Coping<sup>38</sup>, Robotham and Julian (2006) argue that stress in university students is the result of fear, an instinctual fight or flight reaction to the demands of the semester<sup>39</sup>. Visual evidence of this is provided in Figure 2, as fear tracked quite closely with stress over the course of the academic semester.

The results suggest several key implications. First, the school administrators and health care workers may use this information to allocate additional resources at specific times during the semester when students are experiencing high stress level. Second, our finding contributes to the existing literature by identifying several key coping strategies for students. This information can help health educators create new school programs (e.g. fear management) and health campaigns (e.g. promoting sleep) that aim to reduce stress in undergraduate students. Finally, this study helped generate future research questions in the area of perceived stress, Internet and social media use. Currently, some studies have reported that increased social media and/or Internet usage were associated with increased level of stress<sup>40,41</sup>, while other studies have found no effect from social media on stress<sup>42</sup>. The results from this study showed that using the Internet as a stress coping strategy was associated with a higher level of stress but this was not observed with social media usage. Thus, this suggests that Internet and social media usage may influence the person's perceived stress differently. There may be a need to distinguish general Internet usage from the specific types of social media used when examining perceived stress in future studies.

## Limitation

A limitation of this study was that participants had to be Twitter users. Potential participants were only admitted to the study if they tweeted a minimum of three times per week, which may have impacted the findings regarding Internet and social media usage. Our study was



overrepresented by black, Latino, and possibly multi-racial students as compared to the general UCLA undergraduate population—Twitter is more popular among blacks/Latinos, with 40% of black versus 29% of white 18- to 29-year-olds using the platform<sup>43</sup>. Additionally, there was a higher representation of students from health science–area majors as compared to the general UCLA undergraduate population. This study was part of a larger study in which students were able to use a fitness tracker for 3 months, which possibly attracted attention from students who identified as health science majors. Furthermore, this study was only one quarter in length. As freshmen students become more accustomed to academic life, their methods of dealing with stress might change over longer time-periods. Finally, this study used 5-point Likert scales rather than validated surveys to measure wellness outcomes.

## Conclusion

We found that the mean stress level was elevated during examination periods. Female students experienced a higher level of stress than male students. Higher stress level was significantly associated with lower sleep quality, higher emotions of fear, anger and lower emotions of love and joy. Finally, exercise was an effective stress coping strategy. The results of this study can have significant implications for health educators and school administrators in create new interventions that aim to help undergraduate students manage their stress.

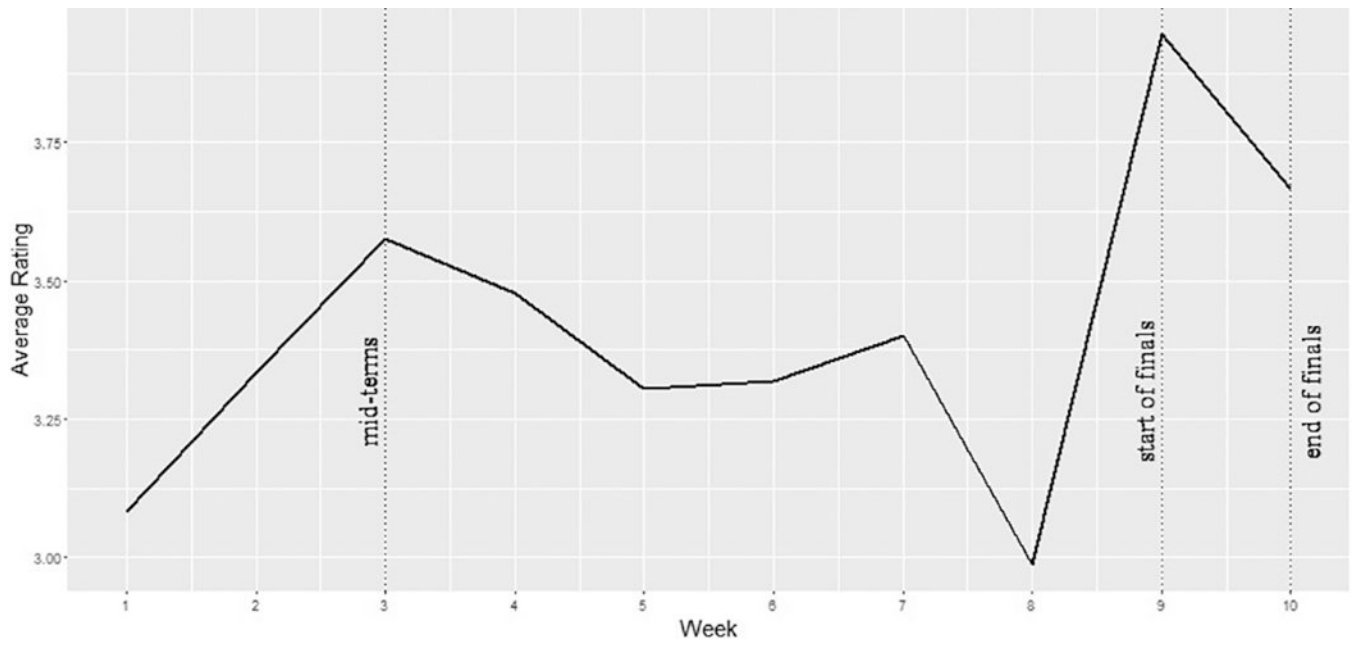
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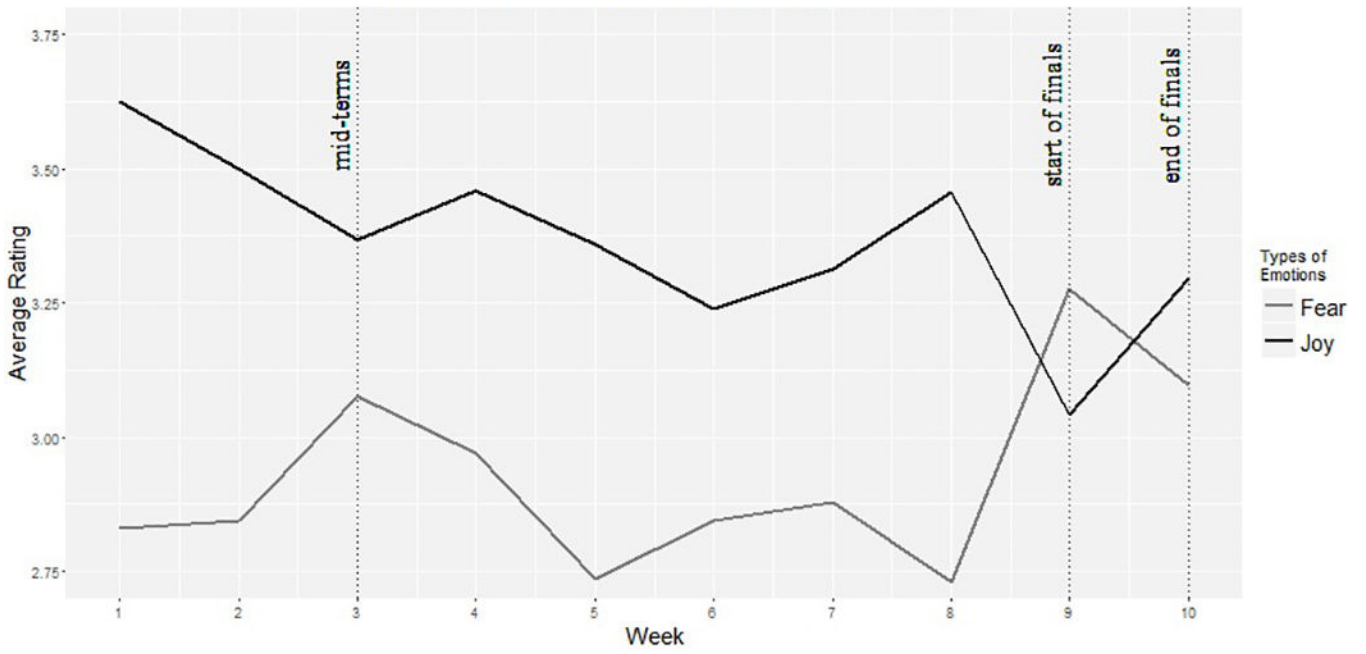
**Figure.1** -. Average Stress Rating Over Time

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**Figure.2** -. Average Emotion Rating Over Time

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**Table 1 –**

Demographic Characteristics of Freshmen Students at the University of California, Los Angeles During the Fall Quarter 2015 (n=181)\*

<b>Gender</b>	<b>Total</b>	<b>%</b>
Female	109	60.22%
Male	70	38.67%
Transgender	1	0.55%
Genderqueer	1	0.55%
<b>Ethnicity</b>	<b>Total</b>	<b>%</b>
Asian	48	26.52%
Black Non-Hispanic	21	11.60%
Hispanic	53	29.28%
White Non-Hispanic	39	21.55%
American Indian or Alaskan Native	1	0.55%
Multiracial	11	6.08%
Other	8	4.42%
<b>Age</b>	<b>Total</b>	<b>%</b>
17	5	2.76%
18	154	85.08%
19	16	8.84%
20	6	3.31%
<b>Average:</b>	18.1	
<b>School Major</b>	<b>Total</b>	<b>%</b>
Business	15	8.29%
Health Science/Biology	77	42.54%
Science/Math/ Engineering	23	12.71%
Social Sciences/Arts	41	22.65%
Undeclared	25	13.81%

\* Total Number of Observations across all 10 Weeks: 1550

Total Number of Observations by week: Week 1: 132, Week 2: 128, Week 3: 171, Week 4: 172, Week 5: 167, Week 6: 170, Week 7: 157, Week 8: 159, Week 9: 146, Week 10: 148

**Table 2 –**

Results from Multiple Linear Mixed-Models – Predictors of Stress for Freshmen Students at the University of California, Los Angeles During the Fall Semester 2015

Predictor of Stress	Coefficient	AIC	BIC
<b>Stress Coping<sup>1</sup></b>			
Exercise	-.15** (.06)	4096	4230
Friends	-.02 (.06)	4103	4237
Family	-.04 (.05)	4102	4236
Music	.08 (.07)	4102	4235
Internet	.14* (.06)	4097	4231
Social Media	-.03 (.05)	4103	4236
Sex	-.05 (.08)	4103	4236
Food	.06 (.05)	4102	4235
Slept	-.08 (.06)	4101	4235
Books	-.06 (.09)	4103	4236
Hobby	-.02 (.08)	4103	4237
Meditation	.14* (.06)	4098	4321
Isolated	.25** (.05)	4083	4216
Party	-.09 (.06)	4101	4234
<b>Emotional states<sup>2</sup></b>			
Anger	.24** (.02)	3979	4112
Fear	.32** (.02)	3874	4007
Love	-.08** (.02)	4083	4216
Joy	-.18** (.03)	4048	4182
<b>Quality of Sleep<sup>3</sup></b>			
	-.35** (.03)	3829	3962
<b>Twitter usage (Total Number of Tweets)<sup>2</sup></b>	.15(.08)	4108	4242

<sup>1</sup>: Number of Observations = 1543

<sup>2</sup>: Number of Observations = 1538

<sup>3</sup>: Number of Observations = 1491

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