

Coming of Age (Digitally): An Ecological View of Social Media Use among College Students

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ABSTRACT

We take an ecological approach to studying social media use and its relation to mood among college students. We conducted a mixed-methods study of computer and phone logging with daily surveys and interviews to track college students' use of social media during all waking hours over seven days. Continual and infrequent checkers show different preferences of social media sites. Age differences also were found. Lower classmen tend to be heavier users and to primarily use Facebook, while upper classmen use social media less frequently and utilize sites other than Facebook more often. Factor analysis reveals that social media use clusters into patterns of content-sharing, text-based entertainment/discussion, relationships, and video consumption. The more constantly one checks social media daily, the less positive is one's mood. Our results suggest that students construct their own patterns of social media usage to meet their changing needs in their environment. The findings can inform further investigation into social media use as a benefit and/or distraction for students.

Author Keywords

Social media; Facebook; computer logging; *in situ* study; college students

ACM Classification Keywords

H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces; K.4.m [Computers and Society]: Miscellaneous.

General Terms

Human Factors

INTRODUCTION

The rapid adoption of social media has shaped contemporary culture. In widespread use for less than ten years, social media has become broadly adopted with over two billion users worldwide [40] and with Facebook alone claiming 1.3 billion active users in a given month [41].

The largest cohort of social media users is the Millennial

generation. The Millennial generation, the largest in history (with over 80 million in the U.S. aged 19-33 years), is rapidly entering the workforce, and it is already reshaping cultural institutions with new communication and coordination habits. Specifically, the current generation of college-aged students (i.e., those approximately age 18-22) is the first college cohort to grow up with social media, and as a group is one of the heaviest users of social media [32].

This group's heavy use of social media raises many questions about how students incorporate social media into their lives and whether doing so supports or hinders students' broader social and academic development, as reflected by the ability to read deeply, think critically, and form authentic friendships. The influences of social media will likely permeate the workforce as college students graduate. For example, Gartner [10] predicts that social media will transform information work into activity that is less routine, hyper-connected, and with higher reliance on weak social links.

Considering the scale of social media adoption, the size of the Millennial cohort, and the potential for both users and media to transform social life and work, we feel that examining social media usage patterns could yield valuable insights into the utility and impacts of social media use on the workplace, in relationships, in social life, and on health and well-being. As a first step to begin to understand the phenomena brought about by social media, we focus on its use among college students.

To date, CSCW has examined a variety of aspects related to social media use such as social relationships [20], tie strength [11], credibility [27], enterprise use [24], and in signaling affect [1]. However, studies of social media use in CSCW have largely focused on the use of individual applications such as Facebook, Twitter, or Pinterest. Some exceptions include studying broad social media usage in the enterprise [13, 24]. Although Facebook continues to be the most widely used form of social media [29], social media use on the whole can by no means be characterized as commensurate with Facebook use. A range of social media sites such as YouTube, Twitter, Instagram, and Reddit, created primarily for social and/or leisure purposes, are also widely used by Millennials, and by college students in particular [29]. We therefore seek to widen the lens of investigation beyond any single social media site and

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consider the *entire ecology* of social media use, examining how young people use an assemblage of social media sites in their daily lives. Though the Millennial generation roughly includes those born after 1980, we focus on a particular sub-group, college students, because 1) compared to all Millennials this is a more homogeneous group, and 2) this enables us to compare our results with other studies of social media by college students [e.g., 1, 9, 15, 21].

We seek to provide an accurate and grounded understanding of both the extent and ways college students embed social media in their lives. Specifically, the goal of this study is to examine patterns of social media use in the aggregate and how these might be associated with students' characteristics and attitudes toward social media as a type of digital activity. We use a mixed methods approach of precision tracking with sensors and daily surveys to capture the data. This paper is part of a larger study investigating IT use and its impact on education among college students.

RELATED WORK: SOCIAL MEDIA USE AMONG COLLEGE-AGED MILLENNIALS

Although social media is a recent phenomenon, its use among the Millennial generation has been the subject of increasing study. The majority (90%) of those 18-29 year olds have a social media profile, and nearly all (97%) use the Internet [31, 32]. Of those in college, 96% use the Internet and 86% have created a social media profile [45]. Whereas Facebook use is predominant [29], other social networking sites (SNSs) and social networking apps also play a role; for example, Facebook, Instagram, and Twitter are among the top ten most used mobile apps by young people [29].

Social Media in College Life

Social media usage among college students is not only highly prevalent but also socially important as it can improve social fluency [4], increase college students' bridging and bonding social capital, and compensate for low self-esteem [9], anxiety, and shyness [7, 48]. Certain behaviors, such as one-to-one communication rather than broadcasting behaviors and simple actions such as "likes," are particularly important for developing social ties [3], as are profile enhancements [47] and the strategic displays of online relationships [46]. Social media use can also help maintain geographically distant friendships [43, 49], which may be particularly important among college students as they transition from high school to college and from college to careers. Participation in social media may help satisfy psychosocial needs during these times of change. For example, maintaining contact with high school friends through Facebook is associated with higher life satisfaction and perceived social support [23, 43].

Daily Social Media Use and Distractions

A recent survey of college students found that they spend more time online than studying [43]. Research on Facebook alone has found that college students spend an average range of 10-60 minutes daily, checking about 6 times a day

[12, 14, 15]. Unfortunately, time estimates of use based on self-reports can be unreliable. For example, studies show that self-reports of computer and Facebook usage overestimate time dramatically [6, 16].

Examining the frequency of usage may help identify how social media may be distracting or whether its use is associated with deficits in other areas. Survey studies of a range of users suggest that heavy and light users may be distinct groups. Heavy and chronic media multitaskers are significantly more susceptible to distractions from the environment [30] and social media app use can develop into problematic behaviors including overuse and interference with schoolwork [22]. Some users, however, are aware of social media as a distraction and alter their behaviors as a result. Baumer et al. [2] found that approximately 31% of the Facebook users they sampled had currently or previously deactivated or deleted their accounts, noting productivity issues and problematic behaviors. In a study on quitting Twitter for lent, Schoenebeck [36] found that concern for spending too much time on social media is one of the primary reasons why users took breaks from it. In addition to restricting site visits, some students chose not to use their device(s), forming a sort of *techno-resistance* [1]. Thus, for some students, social media, especially when used in combination with schoolwork, may pose a cognitive burden [30].

Social Media Use and Mood

Although social networks can be used to cope during stressful times, they can also increase stress [3]. For example, college students may feel pressured to quickly respond to social media notifications and to maintain a "constant connection" with peers [1]. For those who mainly consume SNSs content rather than use it to connect directly with friends and family, there may be negative effects on wellbeing and social capital [5].

Social media interactions may affect wellbeing and mood in other ways. A study of emotional "contagion" on Facebook suggests that status updates with emotional content can flow to other users [19]. As a population with high rates of SNSs adoption and use, college students may be especially affected. A study in the workplace found that higher duration of Facebook use was associated with more positive affect [24]; SNSs use might also have an impact on positive affect for college students.

Although a growing number of studies such as these have investigated social media use among college students, they have been based solely on self-reports, proven to be unreliable [6, 16], focused on a single social media application such as Facebook, or examined only smartphone usage. In contrast, we take an *ecological perspective* (i.e., across social media sites and devices) exploring the duration and frequency of checking social media, contrasting differences among heavy and light users, and assessing how patterns of use connect to mood. We use a mixed-methods approach of precision tracking on both

computers and smartphones along with daily surveys.

Our study thus makes the following contributions:

- To overcome the problems of unreliability with self-reports, we use precision tracking to determine exact measures of social media use.
- As most studies have focused on usage of a single social media site, we provide an ecological perspective of social media usage across sites and devices.
- Most studies generally treat college students as a single cohort in their social media usage. We examine patterns in heavy and light users and those that are younger and older.
- As results are unclear how social media may affect mood, we examine how social media usage is associated with mood.

RESEARCH QUESTIONS

Building on the research discussed, we are interested in identifying social media use patterns and their effect on mood. We address the following research questions

RQ1. *What are the habits of checking behavior of social media among college students?* Studies have reported that social media is a distraction from schoolwork [cf 25]. Recent research also reports that some college students have reduced or halted their time on social media due to it hindering their productivity [1, 2]. However, studies that measured amount of social media use have generally focused solely on Facebook use [12, 14, 15] or all online activity [43]. Given that people self-report that they use social media often [31, 45], it is an open question as to exactly how often and how frequently students check social media sites throughout the day. Checking behavior is important to study as it can be associated with frequent distractions from schoolwork. We investigate here the differences in people who check social media continually versus infrequently, including their perceptions of their use, and potential reasons for the checking habits.

RQ2. *Can we identify patterns and clusters of social media usage?* While Facebook is the dominant social media platform among college students [29], there are a myriad of other sites available. Again, studies that have examined college students' use of online media have generally focused on either Facebook or more broadly, the Internet. To our knowledge, no study has objectively tracked a range of actual social media usage. Examining social media use is important because social media as a whole (and not just Facebook) can provide information, social support, and entertainment as well as be a “break” from work. In this research question we examine whether we can find patterns of preferences for social media use. For example, those people who prefer Youtube may also prefer other content sharing sites such as Reddit. Others may prefer to use sites with more direct communication features. We may find that people show clear preferences for visiting social media sites that offer particular affordances. Our goal in this research

question is to see if we can identify an underlying structure of usage among social media sites, given the wide choices available to produce and consume user-generated content. If such a structure exists, this could potentially illuminate some of the information and social needs of college students, which would be useful for the design of social media sites.

RQ3. *Are differences in social media use associated with mood?* Because of the prevalent use of social media among college students, and because college life is a critical developmental experience [23, 43], we feel that it is important to examine whether social media use has an effect on mood. Prior research has found mixed results, with some results showing that social media increases negative affect and stress [5] and others finding increased positive affect [19] and lower stress with use [25]. These studies, however, relied on self-reports to gauge amount of social media use and have only looked at Facebook use. Again, social media use encompasses far more than Facebook. We will examine the relationship between mood and aggregate social media use.

METHODOLOGY

We conducted an *in situ* observational study at a large public university on the U.S. West Coast in the spring of 2013. Since our interest was in capturing fine-grained social media activity, we used a mixed-methods approach with automatic computer and phone logging as the primary method of data collection. In order to capture the context of students' life at school, their mood, and their perceptions and attitudes towards social media, we also used daily surveys and a one-time general survey on attitudes and demographic information. Data collection occurred over seven days, with logging done during all waking hours.

Participants and Procedure

Participants were recruited from various undergraduate classes, resident communities, and snowball sampling. In total, we collected data from 48 undergraduates, 27 males and 21 females. Due to the availability of monitoring software and its limitations, the study was restricted to students who used both Windows computers and Android phones. Students' ages ranged from 18 to 26 years (mean=19.6); and the median college year was sophomore. The average age when participants started using a computer was 9.4 years and using the Internet, 10.8 years. We divided their declared majors into STEM and non-STEM majors for further analysis according to NSF STEM classification [28]. Their self-reported GPAs ranged from 1.6 to 3.8.

On Day 1 of the study, participants visited a campus laboratory where the computer and phone logging software were installed on their devices. Students who also had desktop computers were given software installation instructions. Participants were instructed to continue to use their devices as usual. They were also sent a link to an online general survey on Day 1 and instructed to complete it before the end of the study (by Day 7). An online daily

survey was sent to the participants at 9PM for each day of the study and they were asked to complete it before going to bed. Semi-structured interviews were conducted on Day 7. Participants were asked about their general experiences during the study, their technology and social media habits, their various projects and responsibilities, and beliefs about how technology could affect stress, productivity, and mood. The interviews were on average 15 minutes long. In addition to quantitative analyses of logs and surveys, open coding, including descriptive and process codes, were used to identify key themes that emerged from these interviews [35]. Participants were paid \$100 for their participation.

Measures

Data were collected from 48 students from social media usage logs from their computers and phones and seven days of self-reported measures. We also monitored heart rate variability and used experience sampling to measure stress levels both objectively and subjectively. Since stress is not the focus of this paper, these measures are not presented. The following measures were used:

Social media logs. Participants' technology use was collected by an automatic logging program: Kidlogger (kidlogger.net). The software has Windows and Android versions, which were installed on participants' computer and phone, respectively. Kidlogger generated one log record each time a user opened a new window or switched between already open windows on a computer or phone. A window can be an application or a web browser tab. Each log record included the starting time and duration of the active window, the name of the application and a URL if the window was a web browser tab (including incognito or private browsing tabs), and idle time. Timestamps are accurate to the second. Only time spent in the window that was currently in use was measured. In other words, if a Word program was open in the background while the user was actively browsing Facebook in the foreground, our software only counted the time spent in Facebook.

Two coders independently categorized the computer logs of the top 421 most frequently visited URLs (each having at least 20 visits), based on the domain name of the website. The coders iteratively developed 10 website categories, with social media as one of the 10 categories, which were loosely defined as Internet-based applications that allow the creation and exchange of User Generated Content [18]. Out of the 421 URLs, there were disagreements in 34 of these URLs. After discussion, the coders reached consensus for all 421 URLs. For this paper, we only focus on the subset of computer logs that are marked as social media, which includes websites such as Facebook, Twitter, Tumblr, YouTube, and Livejournal. Wikipedia was excluded from the list as we believe that college students generally use it for non-leisure purposes, though the content of the site is collaboratively generated. Phone logs were annotated using the same coding scheme. Note that social media use on the phone includes both URLs (i.e., a user browsed a social

media site from a phone browser) and individual applications such as a Facebook or Twitter app. Our measures of social media usage were based on the combination of both computer and phone logs that were categorized as social media, described above.

Survey measures. We obtained demographic information along with students' study and technology use habits in the general survey. Table 1 summarizes the measures and the questions asked in surveys. In addition to demographics, we asked about GPA, students' course load, class standing. Using a Likert scale of 1-5, we asked a cluster of questions regarding feeling lack of control online and expectations for using social media. These questions on subjective attitudes were pilot tested among the research team and analyzed individually, thus we did not include validity test. An established workplace empowerment scale [26, 39] was adapted for college students. In order to measure overall mood, we deployed the PANAS scale [50], a well-validated mood measure that is comprised of two dimensions – positive and negative affect, each measured on a scale of 10 to 50. In an end-of-day survey, participants reported their daily mood using the PANAS, which was modified for a daily measure. Each day they also noted the classes they attended; on a Likert scale of 1-5, their perceived productivity, and how influenced they were by deadlines and work/study pressure.

RESULTS

Of 48 participants, two (one female, one male) were excluded from the analysis. For one participant, our logging software was blocked by anti-virus software on their computer. Another participant was noncompliant, using another personal computer without Kidlogger installed.

We collected a total of more than 1350 hours of computer logs from 46 participants, excluding computer idle time; and 412 hours of phone logs from 45 participants – due to technical difficulties, we could not download the logs from one participant's phone. Combining both computer and phone logs, we captured 471 hours of social media use and a total of 33,566 visits to social media. Of these, 393 hours and 78 hours of social media use are from computers and phones, respectively.

An Overview of Social Media Use

We first present an overview of daily social media usage by our sample. Table 2 shows average daily duration, average number of visits per day (frequency), and average duration per visit averaged over all users, averaged over all full days of logging. Participants in our sample on average spent over 1 1/2 hours daily on social media sites (median=1 hour 33 minutes). Participants also visited social media sites on average about 118 times daily (median = 90.5). Each visit was counted if there was a unique record of a social media site URL recorded in the logging program. When a user browsed a social media page (e.g., a Facebook news feeds) and was involved in relevant activities that did not cause a URL change (e.g., scrolling down the page, liking a status,

Measure	Explanation
General measures (self-reported from general survey)	
Demographics	Age, gender, class standing, major, GPA, year of adoption of SNSs, smartphone, and Internet
Course load	<i>How many credit hours (units) are you taking this term?</i>
Lack of control online	(1 = Strongly, 5 = Strongly agree) Distracted - <i>I feel that on the whole social media distracts me from what I need to do.</i>
	Behind schoolwork - <i>I feel that because I use social media so much I am falling behind my schoolwork.</i>
	Use SM less - <i>I would like to use social media less time during the day.</i>
	Addicted to Internet - <i>I feel that I am addicted to the Internet.</i>
Feeling of empowerment at school (Empowerment)	The overall Empowerment score is aggregated from these 12 questions, adapted from [26, 39]: 1) <i>The work I do at school is very important to me.</i> 2) <i>I am confident about my ability to perform well as a student.</i> 3) <i>What I do as a student has a large effect on the school where I am enrolled.</i> 4) <i>My school activities are personally meaningful to me.</i> 5) <i>I have a great deal of control over what happens at the school where I am enrolled.</i> 6) <i>I have significant autonomy in determining what work I do as a student.</i> 7) <i>I am self-assured about my capabilities to perform well in school.</i> 8) <i>I have considerable opportunity for independence and freedom in performing school work.</i> 9) <i>I have mastered the skills necessary to be a good student.</i> 10) <i>I have significant influence over what happens at the school where I am enrolled.</i> 11) <i>I can decide on my own how to go about doing my student work.</i> 12) <i>The school work I do is meaningful to me.</i>
PANAS	Measures positive (PANASPOS) and negative (PANASNEG) affect dimensions [50]. Scale of 10-50.
Expectations of using social media	(1 = Strongly, 5 = Strongly agree) Connect close friends - <i>I feel that I should maintain connections with close friends using social media</i>
	Connect acquaintances - <i>I feel that I should maintain connections with acquaintances using social media.</i>
	Maintain presence - <i>I feel that I need to maintain a presence on social media, i.e. that others are aware that I am active on social media sites.</i>
	Keep informed - <i>I feel that I need to keep current with the information posted on social media sites.</i>
Daily Measures (from end of the day survey)	
Daily PANAS	Measures positive (PANASPOS) and negative (PANASNEG) affect dimensions [50]. Scale of 10-50.
Productivity	How productive do you feel you were today? (1 = Not at all, 5 = Extremely)
Deadline	I feel that deadlines influenced me today. (1 = Strongly, 5 = Strongly agree)
Under pressure	I feel that I was under work/study pressure today. (1 = Strongly, 5 = Strongly agree)

Table 1. Summary of general and daily survey measures.

commenting on a status update), there was one record of Facebook in the log. But if the user clicked on a video or picture that took her to another site, then there was another Facebook record generated when she returned to Facebook. We considered the latter case as two Facebook visits. Switching from one Facebook page to another was also counted in our log as two visits since there was a URL change. Therefore, our estimate of frequency is likely an overestimate. The duration per each visit to social media was short, averaging slightly over one minute (median = 1 minute and 4 seconds).

For the 45 participants we obtained both computer and phone logs, 44 used social media sites on both devices, one used only their computer for social media. Based on a paired t-test, students spent more time on social media per

		Duration/ day	Visits/ day	Duration/ visit
Total SM	Mean	1:41:01	117.92	0:01:06
	Median (sd)	1:33:40 (1:06:21)	90.5 (101.21)	0:01:04 (0:00:35)
Facebook	Mean	0:49:34	52.32	0:01:06
	Median (sd)	0:39:48 (0:43:48)	31.5 (57.49)	0:01:05 (0:00:31)
Other SM	Mean	0:51:27	65.60	0:01:08
	Median (sd)	0:40:02 (0:45:53)	45.20 (71.38)	0:01:05 (0:00:41)

Table 2. Average daily duration, visits, and duration per visit averaged over all participants. Duration in h:mm:ss. N=46.

visit on phones (median=71.32 sec.) than computers (median=56.03 sec.), $t(43)=2.78, p<.01$). We did not find significant differences in social media use based on daily duration for full days, between genders, STEM and non-STEM majors, class standing, or weekday/weekend use.

General patterns of site usage

We present an overview of general patterns of different site usage. The top 10 social media sites in our sample, based on total hours of use observed, are shown in the left half of Table 3. Facebook and YouTube were the most popular social media sites; almost all of the participants in our sample used these two sites. However, Facebook is not the only site used; students tended to use multiple social media sites. Of the 10 most-used sites, participants used an average of at least 5 of them ($M=5.3, sd=2.12, min=1, max=9$) over the week of the study. Facebook was the primary social media site for 32 participants (in terms of time duration). Users who predominately use Facebook ($M_{Age}=19.34$) were significantly younger than other users ($M_{Age}=21$), $t(44)=-3.04, p<.005$) and were comprised of more freshmen and sophomores compared to other users who were mainly juniors and seniors ($\chi^2_{(1)}=4.44, p<.05$). In general, the mean age of lower classmen (i.e. freshmen and sophomores, $N=30$) was $M_{Age}=18.8, sd=0.71$; the mean age of upper classmen (juniors and seniors, $N=16$) was $M_{Age}=21.81, sd=1.72$.

Social media	# users	Avg. daily use* (h:mm)	Primary site usage			
			Continual	Infrequent	Heavy	Light
Facebook	45	0:49	9	4	7	6
YouTube	45	0:21		4		3
Reddit	20	0:20		2	1	1
Tumblr	32	0:07			1	
Instagram	24	0:09				
Twitter	22	0:09	1		1	
Weibo	1	3:00	1		1	
Imgur	27	0:02		1		1
Livejournal	3	0:12				
Google+	12	0:02				

Table 3. Average daily social media use. N=46. *Average daily use is calculated based only on users of the site.

RQ1. Habits of Checking Social Media

As table 2 shows, college students in our sample visited social media sites often, averaging an hour and 40 minutes per day. However, a measure of duration does not indicate how frequently students might be checking social media, which could potentially be interrupting other activities. To analyze frequency of checking over time, we first divided our total logged computer and phone time into 5-minute windows. We then computed a ratio between observed social media use and total computer and phone use in each 5-minute window (**SM ratio**). The ratio was computed by first flagging whether social media was used or not in the 5-minute window. Then, we examined overall the percentage of 5-minute windows of time where social media was used. This ratio gave us a measure of the spread of SM checking throughout the period of computer and phone use. A large value of the ratio indicates that someone's day was filled with frequent visits to social media sites. A small ratio value indicates that someone visited social media sites very infrequently relative to their total computer and phone usage. Note that the ratio does not take into account the *extent* to which one uses social media within the 5-minute

window; rather it gives us a measure of how temporally distributed one's social media use is compared to her overall computer and phone use. This measure thus provides us with an estimate of spread of social media use throughout the day.

For the 46 participants, the values of the SM ratios were normally distributed ($M=38.38\%$, $sd=18.38\%$, $min=2\%$, $max=77\%$). We then divided our sample into *continual checkers*: the top 25th percentile ($N=11$, $mean=62.9\%$, $sd=8.1\%$), and *infrequent checkers*: the bottom 25th percentile ($N=11$, $mean=15.9\%$, $sd=7.5\%$) of SM Ratios. Even though the absolute number of times visiting social media sites per day is likely to be an overestimate as discussed earlier, continual checkers ($M=237$, $sd=101$) visited social media pages daily more than six times as often as infrequent checkers ($M=39$, $sd=34$).

Next we explored the patterns of use, comparing whether continual and infrequent checkers visited the same sites. We found differences in primary social media sites used (see the right half of Table 3): continual checkers predominantly used Facebook (9 of 11 users) compared to infrequent checkers (4 of 11 users). The primary sites that infrequent checkers visited were content-focused sites of Youtube and Reddit.

Table 4 shows the results from the questionnaires, with the means and standard deviations of the entire sample shown in the far right column. We found age differences with continual checkers being mostly lower classmen whereas infrequent checkers were predominately upper classmen. Continual checkers revealed a lack of control of social media use: they agreed significantly more that it distracts them, that they were falling behind on schoolwork, they would like to use social media less, and feel addicted to use the Internet. Continual checkers also had significantly heavier course loads. Yet we found no difference in reasons for using social media. Continual and infrequent checkers

Variables	Heavy vs. Light social media use				Continual vs. Infrequent social media use				Total N=46 Mean (sd)
	Heavy	Light	t (df)	Sig.	Continual	Infrequent	t (df)	Sig.	
Class Standing	More freshmen and sophomores	More juniors and seniors	NA	*	More freshmen and sophomores	More juniors and seniors	NA	*	
Course load	14.8	13.6	1.264 (20)	N.S.	14.96	12.73	2.320 (20)	*	14.56 (2.98)
Distracted	3.82	3.18	1.328 (20)	N.S.	4.18	2.91	2.945 (20)	**	3.57 (0.98)
Behind_schoolwork	3.27	2	2.609 (20)	*	3.36	1.91	3.150 (20)	**	2.78 (1.23)
Use_SM_less	3.73	2.91	1.649 (20)	N.S.	3.91	2.73	2.298 (20)	*	3.26 (1.22)
Addicted_to_Internet	3.91	2.82	2.524 (20)	*	3.91	2.82	2.524 (20)	*	3.17 (1.32)
Maintain_presence	3.09	2.18	2.344 (20)	*	2.73	2	1.698 (20)	N.S.	2.50 (1.11)
Keep_informed	3.55	2.55	2.079 (20)	*	3.18	2.55	1.078 (20)	N.S.	2.83 (1.31)

Table 4. Demographics and questionnaire results for Heavy vs. Light social media users and Continual vs. Infrequent social media users. * = $p<0.05$, ** = $p<0.01$, * = $p<0.001$**

did not differ in their reported need to use social media for maintaining social relationships, maintaining a presence, or keeping current with information on social media. We found no differences in gender, major, GPA, overall mood, year of adoption of SNSs or a smartphone, or overall feeling of empowerment at school.

Thus, continual checkers are younger, favor Facebook more, and report having more of a lack of control with social media compared to infrequent checkers.

Heavy and light usage: duration of use

The SM ratio provided us with a measure of how often one checks social media; we compared the results with duration of use. We divided our sample into the top 25th percentile of duration spent on social media daily (heavy users: N=11, M=3 hours, 16 minutes) and the bottom 25th percentile (light users: N=11, M=25 minutes). The continual checkers and heavy users overlap with 5 people in common; infrequent checkers and light users overlap with 9 people in common.

We found the characteristics of heavy and light duration users to be similar to continual and infrequent checkers, see Table 4 (note there is substantial overlap in groups). The majority of both heavy and light users used Facebook as their primary social media site. Heavy users were more likely to be lower classmen while light users were more likely to be upper classmen ($X^2_{(2)} = 6.108, p < .05$). Similar to continual checkers, heavy users agreed significantly more that they were falling behind on schoolwork and that they were addicted to the Internet (see Table 1 for the questions). In contrast to continual checkers, heavy users agreed significantly more that they need to maintain a presence on social media and to keep informed with current information. No other differences were found.

Qualitative analysis: amount of usage and habits

The open-ended interviews also help shed light on students' habits of social media use. Consistent with our findings above, was a reoccurring theme during interviews that social media use was a practice with which people felt guilty or stressed about—particularly in relation to the amount of time spent on academic work. Some students felt that their use of social media interfered with their academic achievement: *"I wake up and it's the first thing I check and the last thing I look at before I go to sleep. I'm always on it even when I'm supposed to be studying"* (P15).

Interviews among upper classmen, reported growing away from intense social media use, which supports our age difference finding for heavy to light use and continual to infrequent checking of social media. Of these upper classmen, 8 mentioned that they had at least tried to curb their social media use, e.g., *"I'm not big on Facebook. Not anymore. I don't use it as much as other people, it's a distraction"* (P25); *"I tried to quit it before, but it's almost like a necessity because all my friends and my co-workers are on there"* (P19); *"I don't usually go on SM. I used to*

like a year ago. Not anymore. Too much of a hassle. I just found it more work than it's worth I suppose" (P41). Another student also mentioned that his impending graduation played a role in his moving from Facebook to other social media such as LinkedIn: *"it's kinda right there on my doorstep right now. I would say that it did change how much I use one social media over another"* (P27).

Also consistent with the quantitative results, continual checkers revealed concerns with their practice of social media use. As an illustration, one student reported: *"I spend most of my days overdosed. I spend most of my day on Reddit, YouTube, and Facebook"* (P35). Seven of the 11 continual checkers spoke about wanting an app that would prevent them from using the Internet or social media. However, one frequent checker also mentioned that there were benefits from switching between social media and academic work: *"It increases productivity, and it also increases distraction time. So it's a trade-off I feel"* (P18).

Continual checking: uncovering reasons

Participants described many reasons for why they used social media frequently throughout the day ranging from killing time to routine behavior. Many noted the desire to relieve boredom and pass the time: *"I usually just go on Facebook, Instagram, and Twitter. And then Foursquare too...If I'm bored, I'll just go on Twitter or something like that. Just to see if there's anything new"* (P33).

Continual checking was also noted as a way to avoid doing academic work: *"I do my studying and I have a monitor next to this one so I'll have a document on my large monitor. Then I have Facebook open on my other one. I would just multitask on it...Try to not think about doing homework"* (P7). One participant noted that he *"already hated doing homework"* (P36) and that social media was just one way to avoid it. Other students described social media use as normative and routine. For example, one female (P24) described her use of Facebook: *"It's like my job."*

RQ2. Patterns of Social Media Site Use

Our second research question addressed whether we could uncover a structure of preferences of social media site use. We conducted a factor analysis of daily duration of site use across users. Factor analysis is used to uncover an underlying structure among correlated variables. Our goal was to identify how social media sites cluster according to usage (e.g., do those who spend more time on Facebook also spend more time on Twitter?). Based on average daily duration per participant for the top 10 social media sites, we performed a factor analysis using a Varimax rotation. A scree plot revealed four factors, accounting for 61.9% of the variance. Table 5 shows the four factors and the social media sites that comprise them.

Factor 1 is comprised of Tumblr, Instagram, Twitter, and Livejournal. We interpret this factor as sites where users "follow" or subscribe to accounts that are of interest to

them to receive or post (micro)blog-like content. Because of the interest-based and content-focused nature of these communities, we infer that students use these types of social media to primarily stay informed and perhaps have an audience. *Factor 2* is comprised of one site: Google+. Google+ is different from other content-focused social media in that it focuses on customized content sharing to different social circles and integration with other Google services such as Hangouts (text and video chat) and email. *Factor 3* consists of only YouTube. In contrast with the other factor loadings, YouTube users consume video instead of text or images and socialize less with other users. *Factor 4* consists of Reddit and Imgur. Imgur began as an image hosting service inside of Reddit and later gained popularity as a stand-alone site. Content shared in Reddit and Imgur is often through memes or topic-based discussion. There is less relationship-driven communication in this factor compared with factors 1 and 2.

Facebook did not load onto these factors. However, Facebook had moderate weights in 3 factors, indicating that Facebook use occurs in conjunction with the other social media sites identified in these factors (shown in parentheses in table 5). The factor loading of Facebook in factor 4 was moderately negative, suggesting that students who spend more time on Reddit and Imgur are less likely to use Facebook. Reddit and Imgur use represents content-focused anonymous communication while Facebook use represents relationship-based communication that requires a real identity. The contrast suggests that different students might have different preferences for anonymity online.

Infrequent checkers are mostly associated with Factor 3 (Youtube and Facebook, seven participants) and Factor 4 (Reddit and Imgur, three participants); whereas continual checkers were more distributed over the factors: two continuous checkers did not belong to any factor group, indicating that they did not have site preferences, four chose Factor 1 (Tumblr, Instagram, Twitter, LiveJournal, and Facebook), and five chose Factor 3.

Thus, we uncovered a structure of preferences in social media use. While Facebook is used along with other sites, students tend to exhibit patterns of preferences for sites. For example, people who prefer one type of content-focused site such as Twitter, also prefer to use Tumblr, Instagram and. These results support the notion that people develop

Factors	Social media sites
1. Content-focused social sharing	Tumblr, Instagram, Twitter, LiveJournal, (<i>Facebook</i>)
2. Social networking for customized friend circles	GooglePlus, (<i>Facebook</i>)
3. Video streaming	YouTube, (<i>Facebook</i>)
4. Text and image-based entertainment and discussion	Reddit, Imgur

Table 5. Factor analysis results of social media usage

habits of social media use to some extent, i.e. habits of clustering usage of certain types of sites, which might indicate interest and utility of social media for college students.

RQ3. Social media use and mood

Our third research question examined the connection between mood and social media use. The PANAS scale measures mood in terms of two dimensions: positive and negative affect [50]. Independent t-tests showed no differences between continual and infrequent checkers in overall positive and negative affect.

Using a Linear Mixed Model (LMM) to model both fixed and random effects due to non-independence, we included each participant’s daily end-of-day PANAS positive affect score and daily PANAS negative affect score as the dependent variable for the two models, respectively. Given the exploratory nature of our study, we used relevant daily measures as independent variables, entered them by hand into the LMM, and chose the best fitting model based on the smallest BIC measure¹. The daily measures used included daily social media ratio (SM ratio, i.e. checking behavior), whether it was a weekday or weekend, how productive one felt, how much one was under the influence of a deadline, and work pressure. We controlled for gender, age, class standing, course load, and GPA, as these variables could affect mood.

The best fitting model for daily positive affect (Table 6) shows that, overall, daily SM ratio was *negatively* correlated with their daily positive affect. The more constant SM checking was, the lower the positive mood. There was a significant interaction between the SM ratio and how productive one felt that day. Specifically, the less productive a student felt that day, the more that continuous checking decreased the positive affect. With daily duration included in the model instead of daily SM ratio, the model produced a consistent result with similar BIC measure. Daily negative affect showed no association with social media use.

Qualitative analysis: Explaining social media use and mood
From the interview data, we identified two main themes: how social media use helps one de-stress, and how unintentional overuse could lead to bad time management

	β	F	df	P
Daily SM ratio	-0.141	17.98	(1,216)	<.001
Feeling productive x daily SM ratio	0.037	14.73	(1,199)	<.001

Table 6. Model for daily positive affect

¹ Schwarz’s Bayesian Criterion (BIC) is commonly used as the criterion to find the best fitting linear mixed model [37]. Models are chosen based on having the lowest score.

and low productivity, which in turn could negatively affect a student's mood.

Some students discussed using social media to improve their mood by taking their minds off work, as one freshman reported: *"If I get frustrated, I go on Facebook to relax and forget about the work"* (P43). Social media breaks offer stress relief because *"If I'm just looking at stuff casually I'll be more happy than if I'm studying for a midterm."* (P34) However, quite a few participants indicated that the effect of social media use on mood is, as P39 put it, *"for a short period of time"*. There seems to be a tension between temporary happiness and productivity in the long term, as P13's discussion pointed out: *"I think there's a difference between being happy and being distracted. I find that sometimes when I'm happy I'm not in a work mode."*

Since the daily PANAS measure was taken once at the end of the day, rather than immediately after each social media use, we think that the negative association between continual checking throughout the day and positive mood could be due to the accumulated effect of social media use on productivity. For example, one freshman commented: *"Sometimes I feel like I'll be on those SNSs or playing games, because I spent so much time on it, I'll have to work at night, and that increases my stress."* (P3) Another freshmen claimed that Facebook relieved stress yet was a distraction that negatively affected mood: *"Although Facebook de-stresses me, I feel like it's a waste of time for me to go on Facebook. When I see myself going like half an hour or more, I think that's just a distraction and it's not productive"* (P39). The quantitative and qualitative results together suggest the potential different temporal effects of social media use on mood.

DISCUSSION

Social media has been in widespread use for just over a decade, yet for college students, there is still little understanding of their patterns of use across sites. Our study provides several contributions that distinguish it from other studies of social media. First, rather than relying on self-reports of use, which tend to be unreliable [6, 16], we captured a fairly comprehensive picture of social media use with precision tracking methods of computer and phone usage over a seven day period, coupled with daily surveys and interviews. Second, while studies of online behavior generally focus on single social media sites, this methodology enabled us to examine *the array* of daily social media practices among college students. This is important since a focus on Facebook or any single social media site does not fully capture students' daily social media usage routine.

Social Media Use as A Habit

Our results revealed that students who constantly check social media did not report higher need or motivation to use social media, such as to maintain social relationships, maintain a presence, or keep current with information, compared to infrequent users. Rather, continual checkers

often reported feeling a lack of control. These findings point to a possible explanation of constant checking: the establishment of social media routines might not be driven by different social needs, but rather by a lack of self-discipline. Avoiding studying, passing time, and procrastinating were mentioned often in the interviews and point to a potential lack of self-control. This finding could partially explain why some people, despite their desire to change, find it difficult to break the pattern of continual checking. Habits can become ingrained and hard to break [51], an idea supported by the participants who mentioned that they wanted an app to prevent them from using social media when studying. As more research begins to address how to develop healthy social media use habits [36], understanding ways to discipline one's behavior might be a future research direction, in addition to identifying various social and information needs.

Our findings also found differences in the types of social media sites used by continual and infrequent social media checkers. Continual checkers primarily used Facebook whereas infrequent checkers primarily used content-focused sites such as Youtube and Reddit. Perhaps a need for social connection or the pressure to be available online [e.g., 1] was another motivation for the students who felt compelled to constantly check, even though continual checkers did not report so in surveys. On the other hand, information from content-focused social media sites does not require constant attention (as Facebook might), but rather, can be "batch processed."

We found that although most students used sites such as YouTube and Facebook, college students showed patterns of preferences across sites with some students favoring content-focused social sharing sites and others preferring information/video consumption or customized friends' circles for social networking. These results examining preference patterns support the notion that people cluster their usage of certain types of sites based on key features or affordances. This clustering might also indicate that college students are selective in their consumption of social media, targeting sites that fit their developmental needs for such things as intimacy and connection or independence and autonomy [42]. While we have labeled the factors based on the sites' affordances, it is possible that other underlying factors may lead people to cluster usage. For example, sites that are popular or trendy may be used in a cluster.

Our results reveal that the more constantly one checks social media daily, the less positive is one's mood. We have several explanations for this result. One explanation from the interviews is that social media could be perceived as a distraction in the context of a schoolwork environment, lessening students' opportunities to feel productive and successful in school. It is also possible that the content and interactions on social media could lessen positive moods, increasing social comparison and contributing to feelings of isolation. Also, as discussed earlier, lack of self-regulation

appears to be associated with constant use, and this awareness of social media as a distraction could negatively impact one's mood. Given that college students spend significant amounts of their waking hours using social media, it is important to identify the possible mechanisms connecting social media use with lower positive affect.

From the questionnaires and interviews, students report being aware of many of the benefits and deficits of the frequency and duration of their social media use. This awareness is key in the cultivation of self-regulatory skills for managing social media use. The data from our interviews suggests that some students, particularly upperclassmen, have engaged in purposeful activities to curb their social media use and suggests that some young Millennials are aware of the benefits and hindrances of social media use. Future studies could examine in more depth how students can develop self-regulatory strategies to use social media in a balanced way.

Shifting Needs in College

We found differences of social media use with age. Specifically, lower classmen were more likely to be continual and heavy users of social media, whereas upper classmen were more likely to be light and occasional users of social media. These findings expand on the results of Pempek et al. [33] who found that upper classmen used Facebook less.

There are several possible explanations for this pattern. Lower classmen are, for the most part, more recent arrivals to a new university community and thus have a greater need to develop social capital and to maintain connections with old friends. As such, they may spend a lot of time on social media to maintain these connections. Others have found maintenance of connections with family and friends from high school a main reason for using social networking sites [43]. Upper classmen, on the other hand, may feel a greater need to concentrate on their studies and for preparation for graduate school or careers. Thus they may cut down on their use of social media and shift toward informational (e.g., Reddit) or career network sites (e.g., LinkedIn) and away from Facebook. Interviews with upper classmen support this possible explanation. Research has found that attitudes, beliefs, critical thinking skills, and self-regulated strategies differ for younger and older college students (e.g., [17]). The shift in social media use might just be one that such differences are manifest. A cohort effect could also be a possible explanation for these findings. It is possible that these cohorts are simply different, and when these particular freshman and sophomores reach junior and senior status, they will continue to use social media, and Facebook, as much as they do now.

Social Media Use as A Situated Practice

Since we took a weeklong snapshot of students' social media use, we cannot interpret how social media use might change over time. For this reason, we now draw from the notion of situated action [cf 44] to help contextualize our

results of social media use. Situated action considers a person's actions in a real world setting, as a flow of ongoing activity. As opposed to a laboratory setting, we observed and tracked social media use of people in their real world environment of college life. This ecological approach enabled us to observe our participants' full range of social media activity as it unfolded over time and among other digital activities. Situated action gears its lens to how people react to the contingencies of their environment. Our data show that college students' daily lives are filled with brief and frequent social media visits. Students may thus gravitate to particular social media as a response to contingencies of the environment, such as checking social media updates while standing in line or waiting for a class to start, or internal needs that arise in the course of their day, such as needing a study break or seeking relief from stress. Coupled with their preferences for sites, checking behavior may have become a routine response to contingencies. For example, Facebook may offer social support or simple access to friends who are online, whereas YouTube may offer light humor or step-by-step instructions for study.

In general, people construct their own patterns of social media usage, revealed by our factor analysis of clusters of site preferences. We propose that people select those tools in response to situational needs that stem from social, academic, and environmental factors as they arise over the course of the day. Some people may have developed habits and even reliance on particular sites. Social media in all its forms is a flexible media, adaptable, with a range of affordances, and thus a good fit to meet contingencies that arise in young students' lives. To this end, as a situated practice, social media use may not accomplish long-term goals directly but may instead help young people to navigate through their current changing environments and experiences. Future research could address a more detailed examination of the relation of social media use to the real world environment.

Limitations

Although a first step toward a better understanding the ecology of social media use, our study was limited. First, our sample was small and drawn from one university. Therefore, it is possible that students at this university have unique traits that differentiate them from other students. Our sample was not particularly diverse in terms of race or income, and due to our logging software, we could only use participants who had PCs and Android phones. Given that race and income are related to device operating system [38], these underlying factors may contribute to individual differences. For example, some social apps may be used as an alternative to texting in order to save money, such as free texting and instant messaging apps like WhatsApp, Vine, or even Facebook instant messaging function. All of these issues contribute to our limited ability to determine what socioeconomic, cultural, and device-based factors might contribute to the types of social media sites that college

students choose. A longitudinal study over years might better be able to examine how this process of social media adoption occurs, what individual factors influence this process, and whether and to what effect social media use might change as students transition into the workforce.

CONCLUSION

The ecology of social media use includes more than just Facebook and entails numerous other sites, varying patterns of use, and different levels of integration into daily life, from continual checking to selective use and with contrasting perceptions on costs and benefits. Understanding the differences in how college students use and adapt social media to fit their socioemotional and academic needs is the first step toward determining how best to provide social computing systems that better fit these needs. Future research can build on our initial findings into how these young Millennials might engage with social media from a range of perspectives: from communication and distraction to site preference and regulating use.

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