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2017

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UNIVERSITY OF CALIFORNIA, MERCED

Social Media Use and Stress

A dissertation submitted in partial satisfaction of the requirements
for the degree of Doctor of Philosophy

in

Psychological Sciences

by

Holly Michelle Rus

Committee in charge:

Professor Jitske Tiemensma, Chair
Professor Jan Wallander
Professor Matthew Zawadzki

2017

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2017

Dedicated to all the Women of Science.

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ACKNOWLEDGEMENTS

My successful journey through graduate school would not have been possible without the many minds, hands, and hearts that helped along the way.

Dr. Jitske Tiemensma: Your guidance for the past three years has been more than I could have ever asked or hoped for. You took a risk on welcoming me into your lab, and I can't thank you enough for the way you shaped my graduate experience. You gave me the freedom and encouragement to pursue what excited me, and because of you, I will look back on these years with great fondness and a smile. I look forward to meeting you at conferences and eating at four different restaurants in one day just because we can.

Dr. Jan Wallander: You have provided generous support and guidance from the start of my graduate career. I thank you for your wisdom, kindness, and patience. Your passion for mentoring students is plain to see, and I am endlessly thankful that I was able to benefit from it.

Dr. Matthew Zawadzki: Thank you for always asking the hard questions. Thanks to you, my past three years have been full of fruitful and quality research. I appreciated your bold challenges, both in the classroom and in my own line of study.

PNE Labmates: Johnny and Amber, thank you for the feedback, permission to rant, and countless jokes. On top of our professional development, you helped make my graduate experience fun. I can only hope my future holds people like you who I can count as both colleagues and friends. Take care of the PNE Lab!

All of my Research Assistants: Without you, I wouldn't have any data to defend. You worked endless hours doing silly things for me, and I can't thank you enough. In particular, Donnoban, Camille, Kim, Ester, Ada, Vivian, Andrina, and Toby; your dedication and drive to go above and beyond was invaluable to my success. And I hope you forever remember how to count backwards from 1,687 by 13's.

Donnoban Orozco: You get your own line because you deserve it. Thank you for seamlessly blending professionalism and friendship. Your ability to exceed my expectations and handle anything I threw at you made working with you a joy. You will do amazing things, and I am so thankful for the privilege of having played a part in your training.

Arturo Durazo: My Graduate School Sherpa. Thank you for your brilliance, wit, and always calling it like it is. You helped me through some of the greatest challenges, and my life is forever improved because you are in it. Cheers to many more years, my friend.

Ashley, Patty, and Tenie: You Ladies are Gold. Thank you for the staircase therapy sessions, conference adventures, and many more years of friendship to come. You each bring an inspirational passion to your work and your lives. I am forever thankful our paths crossed in this bizarre place called Graduate School. Brunch anytime, and Sisters for Science.

Jennifer Mendiola: You were one of my first friends in graduate school, and it breaks my heart that you are gone. Thank you for your smile and your eagerness to celebrate everyone's accomplishments like they were your own. You are missed.

My Family: Thank you for your endless support through it all. And thank you for listening while I talk about things you don't understand.

James: My partner, my teacher, my friend. Your support and guidance mean more than I can say. Thank you for being my ear, my advocate, my confidant, and my faith. You challenge me in ways that keep me growing, and I never want to stop.

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<http://dx.doi.org/10.1016/j.chb.2017.06.004>
- Rus, H. M.**, Cameron, L. D. (2016). Health communication in social media: Message features predictive of user engagement on diabetes-related Facebook pages. *Annals of Behavioral Medicine*. 50, 678-689. doi: 10.1007/s12160-016-9793-9
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- Depaoli, S., **Rus, H. M.**, Clifton, J. P., van de Schoot, R., & Tiemensma, J. (*in press*). An introduction to Bayesian statistics in health psychology. *Health Psychology Review*. <http://dx.doi.org/10.1080/17437199.2017.1343676>.

- Tiemensma, J., Depaoli, S., Winter, S. D., Felt, J., **Rus, H.M.**, Arroyo, A. C. (*under review*). The Performance of the IES-R for Latinos and non-Latinos: Assessing Measurement Invariance. *PLOS One*.
- Calvi, J.L., Chen, F. R., Brann Brenson, V., Brindle, E., Bristow, M., De, A., Entringer, S., Heim, C., Hodges, E. A., Klawitter, H., Lupien, S., **Rus, H. M.**, Tiemensma, J., Verlezza, S., Walker, C., Granger, D. A. (*under review*). Measurement errors in salivary cortisol: A comparison within and between international academic-research laboratories. *BMC Research Notes*.
- Rus, H. M.**, Tiemensma, J. (*under review*). Social media use during crisis: How Users Turn to Facebook in response to campus violence. *Cyberpsychology, Behavior, and Social Networking*
- Rus, H. M.**, Tiemensma, J. (*under review*). Social Media Under the Skin: Facebook Use after Acute Stress Impairs Cortisol Recovery. *Frontiers in Psychology: Human-Media Interaction*.
- Rus, H. M.**, Tiemensma, J. (*under review*). Social Media as a Shield: Facebook Buffers Acute Stress. *Physiology & Behavior*.

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UC Merced graduate student looks at use of social media in health care. Merced Sunstar, May 13, 2015.
<http://www.mercedsunstar.com/news/local/education/uc-merced/article20872011.html>

SERVICE

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01/2013-08/2013	Graduate Student Representative <i>Graduate Research and Orientation Week Committee</i> University of California, Merced

GENERAL ABSTRACT

Social Media Use and Stress
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University of California, Merced, 2017
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Social media has become a pervasive form of communication, yet little is known about how use relates to stress. Previous research suggests a link between social media use and psychosocial variables such as self-esteem, depression, life satisfaction, and well-being. However, there is limited empirical knowledge concerning how social media use specifically influences and is influenced by stress, with a particular dearth of objective measurement. In a series of studies, this relationship was explored in both laboratory and natural settings. *Study I* aimed to assess the effect of Facebook use on psychosocial and physiological recovery from an acute social stressor (The Trier Social Stress Test). Participants ($n = 92$) were randomly assigned to use their own Facebook account or to sit quietly after the stressor. Those who used Facebook experienced prolonged physiological stress when controlling for gender and investment in the website ($p < .05$). *Study II* aimed to assess Facebook's effect on the stress response. Participants ($n = 100$) were randomly assigned to use their own Facebook account or sit quietly before the Trier Social Stress Test. Those who used Facebook before the acute social stressor experienced lower levels of psychosocial stress, physiological stress, and rated the stressor as less threatening when controlling for gender and emotional investment in the website (p 's $< .05$). *Study III* explored Facebook use in the wake of a natural stressor—campus violence. Participants ($n = 552$) reported using the platform more and in different ways than normal, with importance placed on seeking information, seeking social support, and expressing emotions. Further, users reported that these uses influenced short-term affective state. Together, results highlight the complex relationship between social media use and stress. Users appear to experience stress differently depending on the timing of social media use and stressor onset. Specifically, use *after* an acute stressor may inhibit stress recovery, while use *before* may limit stress intensity in the laboratory. Further, use in response to a natural stressor deviates from normal use, and may be beneficial for inducing positive affect. User characteristics and context of use appear to significantly influence the relationship between social media use and stress.

CHAPTER ONE

General Introduction

Social media has become a globally popular form of communication, with one in seven people worldwide using Facebook on a daily basis (fb.com). Since its launch in 2004, the site has evolved from being more than just a platform for maintaining ties with family and friends. Facebook now serves as a primary news source for many (Gottfried & Shearer, 2016) and plays a recognized role in a wide spectrum of settings; from romantic relationships (Rus & Tiemensma, 2017) to coping with public trauma (Vicary & Fraley, 2010). Behavioral scientists have taken great interest in understanding how constant communication with, and unprecedented access to one's social network impact psychological well-being across such diverse contexts. While many studies have identified links between Facebook use and constructs such as depression (Moreno et al., 2011), self-esteem, (Best, Manktelow, & Taylor, 2014), and life satisfaction (Nabi, Prestin, & So, 2013; Valenzuela, Park, & Kee, 2009), conflicting findings and subjective report limit conclusions. Given the pervasive popularity of Facebook, understanding its impact on well-being has become critical.

The website's continual evolution has made clear that using Facebook is not a single activity, but rather a dynamic combination of behaviors. Users may engage with text-, image-, audio-, or video-based content—often times simultaneously. Such varied uses have led to study of how different types of users may engage in different types of behavior. Some spend more time actively producing content compared to passively consuming it (Junco, 2013; Wilson, Gosling, & Graham, 2012). Others show more emotional investment in the website and place greater importance on its role in their lives (Ellison, Steinfield, & Lampe, 2007). As the site continues evolving, researchers continue developing tools to better understand how specific uses relate to user characteristics.

Specifically, user gender and investment in the website may be of particular importance when considering how use relates to well-being. Females are not only more likely than males to use Facebook (Anderson, 2015), but they may be more prone to feeling threatened over certain content (Rus & Tiemensma, 2017). Considering that females spend more time maintaining their social relationships in general (Eagly, 1987; Eagly & Wood, 1999), specific affordances of Facebook (e.g., high public visibility and constant access to one's social network) may be more valuable and therefore more influential for females. When exploring how Facebook relates to well-being, both gender and investment in the website must be considered as critical factors.

Although Facebook use and well-being have been explored in contexts such as depression, self-esteem, and life satisfaction, very limited research has examined the context of stress—in particular, laboratory stress. Considering Facebook use in this context provides opportunity for more precise study.

The body's stress response can be manipulated and objectively measured in the laboratory (Dickerson & Kemeny, 2004). Specifically, an acute social stressor, The Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) has shown to reliably induce both physiological and psychosocial stress in the majority of laboratory participants, and to be a valid and useful tool in psychobiological research (Birkett, 2011; Kudielka, Hellhammer, Kirschbaum, Harmon-Jones, & Winkielman, 2007). Markers of the hypothalamic-pituitary-adrenocortical (HPA) axis as well as the sympathetic-

adrenomedullary (SAM) system provide insight into the physiological experience of stress above and beyond what can be captured by subjective report. In addition, specific markers of each system (e.g., blood pressure and salivary cortisol) have been linked to negative health outcomes (Forouzanfar et al., 2017; Lundberg, 2005). Studying acute stress can aid in identifying mechanisms linking behavior to psychological, physiological, and physical health functioning (Dickerson & Kemeny, 2004). Understanding if and how Facebook may influence physiological processes may not only inform recommendation for use, but also clarify the potential consequences of what has become a daily activity for many.

While pairing Facebook use with acute laboratory stress can provide valuable insight, examining use in a natural environment can further establish real-world associations. Social media has become a primary source of communication in response to public emergencies (Hughes & Palen, 2009; Simon, Goldberg, & Adini, 2015). Stressors such as natural disasters (Houston et al., 2015; Merchant, Elmer, & Lurie, 2011), terrorist attacks (Cassa, Chunara, Mandl, & Brownstein, 2013; Simon, Goldberg, Aharonson-Daniel, Leykin, & Adini, 2014), and campus violence (Hawdon & Ryan, 2012; Mastrodicasa, 2008; Vicary & Fraley, 2010) have users turning to various platforms. However, little is known about what specific functions social media serves in such contexts, and even less is known about how use may influence well-being. Considering Facebook use in response to a natural stressor offers chance to understand the genuine and significant implications of a globally popular communication resource.

As social media continues evolving, so does the need to understand its impact on society, from individual to community levels. In a series of studies, the relationship between Facebook use and stress was explored. Study I (Chapter 2) examined how Facebook use affected recovery from an acute laboratory stressor. Study II (Chapter 3) expanded on Study I by examining how Facebook use influenced response to an acute laboratory stressor using the Social Self-preservation Theory as framework (Dickerson, Gruenewald, & Kemeny, 2004). Finally, Study III (Chapter 4) examined Facebook use in response to campus violence. Specifically, how users turned to the site for the purposes of seeking information, seeking social support, and expressing emotions, and how these purposes influenced acute affective state. Together, these studies aimed to advance understanding of how a widely adopted activity influences well-being in the contexts of laboratory and naturally occurring stress.

Each of the studies included college student samples. Although Facebook use is expanding to different age demographics, 18- to 24-year-olds remain the primary audience (Duggan et al., 2015). Examining Facebook use and well-being within this specific age group limits generalizability. However, given the exploratory nature of this research, sampling from the dominant demographic of users provided the greatest basis for guiding future study. Similarly, to maximize ecological validity, general Facebook use was explored. All participants were allowed to use Facebook without constraints or restrictions.

CHAPTER TWO

STUDY I

Social Media Under the Skin:
Facebook Use after Acute Stress Impairs Cortisol Recovery

Abstract

Social media's influence on stress remains largely unknown. Conflicting research suggests that Facebook use may both enhance *and* undermine psychosocial constructs related to well-being. Using novel experimental methods, this study examined the impact of social media use on stress recovery. Facebook users ($n = 92$, 49 males, mean age 19.55 $SD = 1.63$) were randomly assigned to use their own Facebook profile or quietly read after experiencing an acute social stressor. All participants showed significant changes in subjective and physiological stress markers during recovery. Participants who used Facebook experienced greater sustained cortisol concentration ($p < .05$) when controlling for gender and emotional investment in the website compared to controls. Results suggest that social media use may delay or impair recovery after experiencing an acute social stressor. This study is the first to incorporate objective physiological markers with subjective psychosocial measures in investigating the complex relationship between Facebook use and well-being.

Keywords: stress, cortisol, TSST, Facebook, social media use, well-being

1. Introduction

As social media continues reshaping modern communication, research strives to make sense of how the globally popular medium may influence well-being. The link between social media use (i.e., platforms such as Facebook, Twitter, and Instagram) and stress receives substantial public attention, and is often touted as a causal relationship. However, this relationship has not been experimentally investigated. Considering the widespread adoption of social media and its abundant presence in the daily lives of many, we aimed to test if social media can truly *get under the skin*.

Social media use now transcends major demographic variables including gender, age, race/ethnicity, and socio-economic status, with over 65% of adult internet users from each major category reporting use (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). Recently, the American Psychological Association identified a ‘constant checker’ profile of individuals (approximately 43% of Americans) who demonstrate an attachment to virtual forms of communication, including social media, at a level associated with higher stress levels (APA, 2017). In contrast, a report by the PEW Research Center found that frequent internet and social media use was *not* related to higher stress levels in general, but only when use increased awareness of stressful events in others’ lives (Hampton, Rainie, Lu, Shin, & Purcell, 2014). Given such discrepancies and the diversity of available social media platforms, considering a single platform can facilitate focused inquiry.

To date, Facebook remains the most popular social networking site, with over 1 billion worldwide users (fb.com) and 71% of online U.S. adults naming it as their preferred platform (Duggan et al., 2015). Use of the site remains as varied as it does popular. Approximately 44% of U.S. adults now report receiving their news from Facebook (Gottfried & Shearer, 2016), while research has also found that the site serves a starkly contrasted, but still valuable, utility in coping with campus violence (Vicary & Fraley, 2010). Several studies have examined potential associations between Facebook use and outcomes related to psychosocial well-being, many of which have provided mixed and sometimes conflicting results. For example, use has been associated with increased self-esteem (Best, Manktelow, & Taylor, 2014), general well-being (Kim & Lee, 2011), enhanced social support (Bender, Jimenez-Marroquin, & Jadad, 2011; Liu & Yu, 2013), and overall life satisfaction (Nabi, Prestin, & So, 2013; Valenzuela, Park, & Kee, 2009); just as well as with greater distress (Chen & Lee, 2013), induction of negative social comparison (Chou & Edge, 2012), and small detriments to general psychological well-being (Huang, 2010). One of the first studies to examine Facebook use and health found an association between online social integration and reduced mortality rate (Hobbs, Burke, Christakis, & Fowler, 2016); however, underlying mechanisms were not explored. Research has also shown that gender may play an important role in how Facebook influences well-being. Not only are females more likely to use Facebook (Anderson, 2015), they may be more susceptible to feeling threatened by specific information displayed on the site (e.g., McAndrew & Shah, 2013). Despite promising advances in understanding the impact of Facebook use on well-being,

subjective self-report and mixed findings limit conclusions from this small body of research.

To date, one of the few studies to objectively measure stress in relation to Facebook use found associations between site use and cortisol output in healthy adolescents (Morin-Major, Marin, Durand, Wan, Juster, & Lupien, 2016). Specifically, adolescents with larger networks showed greater cortisol release, while those who spent less time interacting with Facebook peers showed lower cortisol release over two days, suggesting a link between physiological processes and Facebook use.

As an objective marker of the body's physiological stress response, cortisol can expand our understanding of the impact of social media use on stress. Research has shown that a laboratory-induced stressor, The Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) can activate both the sympathetic-adrenomedullary (SAM) system and the hypothalamic-pituitary-adrenocortical (HPA) axis (Birkett, 2011). These two components of the body's stress response work together to manage stressful events, and biomarkers of each system, specifically salivary cortisol output, blood pressure, and heart rate, can be easily and non-invasively measured (Granger, Schwartz, Booth, Curran, Zakaria, 1999; Granger, Kivlighan, El-Sheikh, Gordis, Stroud, 2007; Hellhammer, Wüst, Kudielka, 2009; Nater & Rohleder, 2009). While many studies have focused on mechanisms that may *buffer* acute laboratory stress (e.g., Arch, Brown, Dean, Landy, Brown, & Laudenslager, 2014; Creswell, Welch, Taylor, Sherman, Gruenewald, & Mann, 2005; Inagaki & Eisenberger, 2016), fewer have looked at what may promote physiological recovery. An inability to properly recover from stress may compromise health and well-being through channels such as illness onset, delayed illness recovery, and psychosocial difficulties (Herbert & Cohen, 1994). Examining the effect of Facebook use on stress recovery will provide an objective—and unprecedented—look at how the increasingly popular activity may get under the skin.

To assess the effect of social media use on stress recovery, participants in the current study came into the lab believing they would be taking a survey on their Facebook use habits and providing physiological samples (i.e., saliva, blood pressure, heart rate) to assess well-being. All participants underwent an unexpected, acute social stressor before half were randomly assigned to log into their own Facebook account (experimental condition), and half sat quietly with neutral reading materials (control condition) for 30 minutes of recovery. We hypothesized that should social media truly get under the skin, participants who used Facebook immediately following an acute social stressor would show delayed physiological and psychosocial recovery compared to control participants (i.e., elevated and sustained salivary cortisol output, blood pressure, and heart rate as well as subjective stress measures). We also explored if people highly invested in Facebook may differ in recovery, and if this effect may relate to gender.

2. Materials and methods

2.1. Participants

Facebook users ($n = 112$ undergraduates) were recruited from a campus-wide participant pool system. Seven participants quit the study before or during the acute stress induction (see Procedure). Given our interest in stress recovery, participants who

maintained stable levels or showed a decrease in cortisol output concentration in response to the stress induction ($n = 10$) were excluded from analyses (i.e., they did not experience an increase in physiological stress and therefore did not experience recovery). Participants who reported current use of prescription medication containing cortisol, cortisone, or hydrocortisone were excluded from analyses ($n = 2$). One participant was identified as an extreme outlier for cortisol (i.e., score > 4 SDs above the mean) and was excluded from analyses.

Average weekly alcohol consumption within normal range was permitted, however the majority of participants (73.9%) reported zero consumption. Three participants reported current use of recreational drugs while one reported current use of tobacco products. Only 15.6% of female participants ($n = 7$; 4 control, 3 Facebook use) reported current use of hormonal contraceptives. Three participants reported current anxiety disorder diagnosis; however, none reported current use of anti-anxiety medication. No participants reported current diagnosis of post-traumatic stress disorder nor current use of anabolic steroids. None of these participants showed extreme scores on any outcome measure, nor did their stress response patterns widely diverge from the rest of the sample. Thus, all were retained in analyses.

The final sample of participants ($n = 92$; 43 females, mean age = 19.74 years, $SD = 1.51$, BMI = 27.31, $SD = 8.42$; and $n = 49$ males; mean age = 19.55, $SD = 1.63$, BMI = 21.56, $SD = 7.54$) identified as being Hispanic/Latino (44.6%), Asian/Pacific Islander (20.7%), biracial (14.1%), Caucasian (10.9%), or African American/Black (4.3%). The majority of the sample (68.5%) identified as first-generation college students.

All participants had an active Facebook account, provided informed consent, and were given course credit in exchange for participation. The University Institutional Review Board approved this study and all data collection complied with current APA ethical standards.

2.2. Procedure

The study consisted of each participant completing all procedures in a single, 90-minute laboratory session. All procedures took place within the same laboratory room where only the individual participant and experimenter were present (with the exception of the portion involving the TSST committee; see below). The experimenter (a female graduate student not involved in the TSST) explained that the study aimed to look at the influence of social media use on well-being. Participants were told that they would be answering questions about their Facebook use habits as well as providing measures of heart rate and blood pressure in addition to saliva samples. In the description provided by the online participant recruitment system, participants were told they would need to know their Facebook login information in order to participate in the study; however, participants randomly assigned to the Facebook use group did not know they would be using Facebook during the study until the moment the experimenter asked them to log into their own account (approximately 35 minutes into the study). Control participants never used their login information during the study. All participants were unaware that the study involved a stress task beforehand.

After the study was explained and informed consent collected, all participants completed baseline measures. Following, the experimenter left the room, and the

committee (see below) entered to conduct the TSST. The experimenter then returned, excused the committee, and instructed participants on how to proceed. During 30 minutes of stress recovery, participants randomly assigned to the experimental condition ($n = 42$) logged into their own Facebook account on the same laboratory computer used to complete baseline and follow-up measures (a laptop stored out of sight during the TSST). They were instructed to use Facebook as they wished with the exception of disclosing any information about their current participation in the study. Participants in the control condition quietly sat in the same room with optional reading materials (scientific journals and magazines). The experiment leader remained in the room with each participant during recovery in order to collect physiological samples and subjective stress measures; however, participants were instructed not to speak to the experiment leader during recovery. Salivary cortisol output, heart rate, blood pressure, subjective stress, and subjective well-being were assessed at baseline, and at eight, 20, and 45 minutes post-stressor onset (see Figure 1a for study timeline). After recovery (45 minutes post-stressor onset), all participants completed measures of changes in mood and reported the general influence of Facebook use on stress and well-being. In addition, participants in the experimental condition reported their Facebook activity during the recovery period and the immediate influence of Facebook use on stress, well-being, and mood. After the final saliva measure and follow-up questionnaire, all participants were debriefed about the study's true purpose of testing the effect of social media use on stress recovery.

2.2.1. Stress Induction and Physiological Measures

The TSST has shown to reliably induce acute stress in the majority of participants in numerous studies (Birkett, 2011). Specifically, it is known to induce a threat to social esteem and reliably induces an increase in cortisol and in negative self-related cognitions and emotions (Dickerson, Gruenewald, Kemeny, 2004; Dickerson & Kemeny, 2004). In the current study, approximately 20 minutes after arriving in the lab, participants were instructed to spend five minutes preparing a speech that could be used in an interview for their ideal job. They then spent five minutes performing the speech in front of a disapproving committee of three presumed experts in a small laboratory room. Participants then counted backward from 1,687 by intervals of 13 for three minutes. When mistakes were made, participants were told to begin again. To further induce stress, participants were video and audio recorded during the speech and math tasks. In addition, committee members wore white lab coats and carried clipboards to enhance the illusion of being experts. The committee always consisted of mixed-gender, undergraduate members (i.e., two males and one female, or two females and one male) who were present in the laboratory room only for the duration of the stress task.

2.2.1.2. Saliva samples

To control for natural cortisol fluctuations during the day (Kirschbaum & Hellhammer, 1989; Schultheiss & Stanton, 2009), all data were collected between 1:00 PM and 5:00 PM (i.e., each participant arrived for their 90-minute laboratory session at either 1:00 PM or 3:00 PM). To ensure quality of saliva samples and to avoid temporary elevation of cortisol levels (Schultheiss & Stanton, 2009), participants were instructed to refrain from eating, smoking, consuming caffeine, drinking beverages other than water,

brushing their teeth, or vigorously exercising in the 30 minutes before arriving for the study¹. All samples were collected using salivette collection tubes (Sarstedt Co., Nümbrecht, Germany). Participants placed a cotton roll under their tongue for 2 minutes of collection. To account for the natural fluctuation of cortisol in reaction to acute stress (Engert et al., 2011), saliva was collected at baseline, and at eight, 20, and 45 minutes post-stressor onset. Cortisol samples were immediately frozen and immunoassayed on site at a later date. All samples were placed in a -20° C freezer. Thawed samples were centrifuged and assayed in duplicate with a test volume of 25µL. A commercially available enzyme immunoassay kit was used without modifications to the manufacturer's recommended protocol (Salimetrics, State College, PA). Sensitivity ranged from 0.007 to 3.0 µg/dL. Intra-assay and inter-assay coefficients of variation were less than 15%.

2.2.1.3. Blood pressure and heart rate

Blood pressure and heart rate were simultaneously measured with an Omron 10 Series digital blood pressure monitor cuff placed around the non-dominant upper arm at baseline, eight, 20, and 45 minutes post-stressor onset.

2.2.2. Psychosocial Measures

2.2.2.1. Facebook use

The Facebook Intensity Scale (FBI) measures emotional connectedness to the site and integration of site use into the lives of users (Ellison, Steinfield, & Lampe, 2007). The nine-item scale asks participants to rate statements such as, "Facebook has become part of my daily routine," on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). The scale also measures number of Facebook friends as well as average daily time spent actively using Facebook over the past week. Intensity score is computed by averaging all items in the scale, with higher scores indicating higher intensity. Scale validity has not been established; however, the current sample showed moderate reliability (Cronbach's $\alpha = 0.77$).

The Facebook Activity Survey (Junco, 2012) measures frequency of specific activities within Facebook. Examples include frequency of posting status updates, sharing links, and sending private messages on a scale of 1 (never) to 5 (very frequently, 100% of the time). All participants reported their normal Facebook use habits at baseline. Experimental participants completed an adapted version of the survey regarding their specific use of the site during 30 minutes of recovery. In both cases, frequency of each activity was averaged across participants with higher scores indicating more frequent activity.

Participants were also asked which method they most commonly used to access Facebook (i.e., mobile app, website from a computer, or both). In addition, participants in the Facebook use condition were asked how using Facebook for 30 minutes in one sitting compared to their normal use (i.e., they normally use it less, the same, or more), if they did anything during these 30 minutes that they normally would not do, and if so, what

¹ Note that the first saliva sample was not collected until approximately 20 minutes after each participant arrived. Thus, participants had refrained from these activities for at minimum 50 minutes before saliva collection began.

they did. All questionnaire items assessing Facebook use and stress were asked during follow-up (i.e., *after* participants had undergone both the acute stressor and used Facebook if they were in the experimental condition). This was done in effort not to bias participants towards the study's true purpose.

Participants identified under which state they were most likely to use Facebook (lonely, bored, stressed, sad, or anxious) by rating their agreement on a 1 (strongly disagree) to 5 (strongly agree) scale for the item, "I find myself wanting to use Facebook most when feeling X" for each state. In addition, participants responded to the following statement: "Please rate how stressed using Facebook makes you feel in general," on a five-point scale ranging from 1 (not at all) to 5 (extremely). Participants also rated the following statements on five-point scales ranging from 1 (strongly disagree) to 5 (strongly agree): (1) "In general, I like to use Facebook when I am stressed", (2) "In general, using Facebook when I am stressed makes me feel *less* stressed", and (3) "In general, using Facebook when I am stressed makes me feel *more* stressed." Participants in the Facebook use condition were asked to select which statement they agreed with most after using Facebook for 30 minutes: (1) "Using Facebook made me feel *less* stressed", (2) "Using Facebook made me feel *more* stressed", or (3) "Using Facebook did not change my stress level."

2.2.2.2. *Mood*

The Positive and Negative Affect Schedule (PANAS; Watson & Clark, 1988) measured change in mood from baseline to follow-up. The 20-item scale consists of words describing 10 negative emotions and 10 positive emotions. Participants indicated on a scale of 1 (very slightly or not at all) to 5 (extremely) how they felt in the present moment for each emotion. Higher scores for each emotion indicated higher levels of positive or negative affect respectively. The well-validated scale (Crawford & Henry, 2004) showed high internal consistency for baseline ratings of positive affect (Cronbach's $\alpha = 0.89$) and negative affect (Cronbach's $\alpha = 0.79$), and for 45-minute post-stressor onset ratings of positive affect (Cronbach's $\alpha = 0.91$) and negative affect (Cronbach's $\alpha = 0.83$).

In addition, mood was directly assessed after recovery for those in the Facebook use condition with the following item: "Please indicate which statement you agree with most: (1) Using Facebook increased my positive mood, (2) Using Facebook increased my negative mood, or (3) Using Facebook did not change my mood."

2.2.2.3. *Well-being*

Subjective well-being was assessed at each saliva sample collection time point (see Procedure and Figure 1a) with a visual analog scale anchored at 'not well' and 'extremely well' for the statement, "What is your overall sense of well-being right now?" Participants responded by marking along a 15 cm line. Responses were measured and rounded up to the nearest millimeter, then converted to a 15-point continuous scale with higher scores indicating greater feelings of well-being. In addition, well-being was directly assessed after recovery for those in the Facebook use condition on a scale of 1 (not at all) to 4 (a lot) with the following item: "How much did using Facebook influence your sense of well-being either positively or negatively?"

2.2.2.4. *Subjective stress*

Subjective stress was assessed at each saliva sample collection time point with present-moment ratings of feeling tense and anxious with the items, “How tense/anxious are you feeling right now?” Each item was rated from ‘not at all’ to ‘extremely’ along the same visual analog scale as the well-being measure. The descriptive terms “tense” and “anxious” were used instead of “stress” for these items in effort not to bias participants to the true purpose of the study.

2.3. *Statistical Analyses*

Analyses were conducted using SPSS Version 24.0 (SPSS Inc., Chicago, IL, USA). Analysis of covariance (ANCOVA) with gender and Facebook Intensity (i.e. emotional connectedness to the site) as covariates was used to test the effect of Facebook use on acute stress recovery. To check the appropriateness of assumptions for the statistical analysis, the Kolmogorov-Smirnov test, histograms, and scatter plots were used. Analyses included mean change scores from baseline to 45 minutes post-stressor onset for positive and negative affect, mean change scores from eight to 20 minutes post-stressor onset for blood pressure and heart rate, and mean change scores from 20 to 45 minutes post-stressor onset for all other variables. A median split was applied to Facebook Intensity score, creating a dichotomous variable (low, high) for use as a covariate. Seven participants (3 in the Facebook condition, 2 males; 4 in the control condition, 1 male) were missing either the 20- or 45-minute saliva sample and thus were not included in final analyses. To account for skewness, cortisol measures were log-transformed before analyses. Unless otherwise noted, effect sizes are presented as partial η^2 , which represents the proportion of explained variance between the predictors and the outcome, with values of .01, .06, and .14 indicating small, medium, and large effect sizes, respectively (Cohen, 1988). Significance was set at $p \leq .05$.

3. **Results**

3.1. *Baseline Measures*

Independent-samples t-tests showed no significant condition differences on any measure of Facebook activity or on any baseline physiological measure (see Table 1a). Compared to control participants, participants in the Facebook use condition were more likely to report that using Facebook when stressed makes them feel less stressed, $t(90) = 2.06$, $p = 0.04$, 95% CI [-0.81, -0.02], $d = 0.34$. Participants showed no other significant condition differences on any item regarding the general influence of Facebook use on stress and well-being.

3.2. *Effect of Facebook use on Psychosocial Stress Recovery*

Fifty-two percent of the participants in the Facebook use condition identified the Facebook mobile app as their most common method of access, while 16.7% reported most commonly using the website on a computer, and 31% reported using both the mobile app and a computer to access Facebook equally. When asked what they did during 30 minutes of stress recovery, participants in the Facebook use condition identified passively scrolling newsfeed, viewing videos, and following links as the

activities they spent the most time doing. The majority of participants (66.7%) indicated that they normally spend less than 30 minutes using Facebook in one sitting. However, the majority of participants (66.7%) also indicated that using Facebook for 30 minutes did not cause them to engage in any activities during one sitting in which they normally would not. Participants who reported doing something they normally would not do because of the extended use time ($n = 14$) almost exclusively reported that they watched videos. When asked about the effect of Facebook use on mood, 54.8% of participants reported a positive change in mood, 14.3% reported a negative change in mood, and 31.0% reported no effect on mood during recovery. In addition, 59.5% reported that using Facebook made them feel *less* stressed, 7.1% reported feeling *more* stressed, and 33.3% reported experiencing no change in stress level as a result of using Facebook during recovery. Seventy-nine percent of participants reported that using Facebook changed their sense of well-being during recovery.

Participants in both conditions experienced similar changes in psychosocial stress during recovery with decreases in tension and anxiety and increases in well-being. There were no significant condition differences for tension $F(1, 91) = 1.56, p = .21, 95\% \text{ CI } [-0.29, 1.25], \eta^2 = 0.02$; anxiety $F(1, 88) = 0.004, p = 0.95, 95\% \text{ CI } [-1.01, 0.95], \eta^2 = 0.00$; or well-being $F(1, 91) = 0.33, p = 0.57, 95\% \text{ CI } [-0.49, 0.90], \eta^2 = 0.004$. Positive and negative affect were measured at baseline and follow up. While participants showed decreases in positive affect and increases in negative affect, there were no significant condition differences for either positive affect, $F(1, 91) = 2.50, p = 0.12, 95\% \text{ CI } [-4.78, 0.54], \eta^2 = 0.03$ or negative affect, $F(1, 91) = 0.053, p = 0.82, 95\% \text{ CI } [-2.20, 2.77], \eta^2 = 0.01$ when controlling for Facebook Intensity and gender (See Figure 2a for subjective stress markers).

3.3. Effect of Facebook Use on Physiological Stress Recovery

Preliminary analyses confirmed that all participants experienced physiological stress in response to the TSST (see Procedure). Participants showed a significant decrease in both blood pressure and heart rate from eight to 20 minutes post-stressor onset, indicating that recovery of heart rate and blood pressure occurred; however, there were no significant condition effects for systolic blood pressure $F(1, 91) = 0.16, p = 0.69, 95\% \text{ CI } [-3.60, 5.38], \eta^2 = 0.002$; diastolic blood pressure $F(1, 91) = 2.11, p = .15, 95\% \text{ CI } [-0.95, 6.13], \eta^2 = 0.023$, or heart rate $F(1, 91) = 0.105, p = 0.31, 95\% \text{ CI } [-1.65, 5.24], \eta^2 = 0.012$ when controlling for gender and Facebook Intensity score. Compared to control participants at baseline, participants in the Facebook use condition were more likely to report that using Facebook when stressed makes them feel *less* stressed (see Table 1a). However, compared to the Facebook use condition ($M_{\text{difference}} = -0.35, SD = 0.37$), control participants ($M_{\text{difference}} = -0.51, SD = 0.38$) showed a significantly greater decrease in cortisol concentration from 20 to 45 minutes post-stressor onset when controlling for gender and Facebook Intensity score², $F(1, 84) = 5.03, p = 0.03, 95\% \text{ CI } [0.21, 0.33], \eta^2 = 0.06$ (See Figure 2a). There were no significant condition differences at 20 minutes post-stressor onset

² Controlling for BMI and use of hormonal contraceptives did not change significant results.

Secondary to assessing the effect of Facebook use on stress recovery, we explored how both investment in the website and gender may influence recovery. Although sample sizes did not allow for testing interaction effects, descriptively, females in the Facebook use condition who reported high levels of Facebook Intensity showed the smallest reduction in cortisol concentration during recovery (See Figure 3a). That is, based only on descriptive mean differences, they remained the *most* stressed compared not only to control participants with high and low Facebook Intensity, and to males who used Facebook with high and low Facebook Intensity, but also compared to *females* who used Facebook with *low* levels of Facebook Intensity. A similar pattern was reflected when females ($M = 2.70$, $SD = 0.94$) were more likely than males ($M = 2.16$, $SD = 0.98$) to report that using Facebook when stressed makes them feel *more* stressed $t(90) = 2.65$, $p = 0.01$, 95% CI $[-0.93, -0.13]$, $d = 0.46$. This potential interaction between gender and investment in the website should be further explored.

4. Discussion

The present study provides the first objective evidence of how social media may affect stress. All participants experienced significant changes in subjective and physiological stress in response to an acute laboratory stressor; however, using Facebook inhibited physiological recovery. Specifically, participants who used Facebook during recovery showed sustained cortisol levels compared to control participants.

Given the mixed literature on Facebook use and well-being, several explanations for the present findings exist. Social Self-preservation Theory poses that the social self-preservation system (including the HPA axis) tracks one's surroundings for threats to social status or social esteem. When a threat is present, both cortisol and negative self-related cognitions and emotions increase (Dickerson, Gruenewald, & Kemeny, 2004). Given that Facebook use has been associated with social status and social esteem (e.g., Best, Manktelow, & Taylor, 2014; Ellison, Steinfield, & Lampe, 2011), it is possible that Facebook use could be viewed as a threat to self-preservation and may induce similar physiological effects. In the present study, participants who immediately engaged with their own Facebook profile after experiencing an acute social stressor sustained significantly higher levels of objective stress compared to control participants (i.e., their recovery from stress was delayed). This extended stress response may reflect an additive effect of physiological and psychosocial arousal in response to threats to self-preservation (i.e., both the acute social stressor *and* Facebook were perceived as threats; therefore, participants who experienced both showed prolonged stress responses compared to those who only experienced the acute social stressor). This relationship may be particularly true for females highly invested in the site.

Although interaction effects were beyond the scope of this study and not included in statistical analyses, based on descriptive mean differences, it appeared that females—particularly those more invested in the website—may be more susceptible to experiencing social media-induced stress. Not only were females more likely than males to report that using Facebook when stressed makes them feel *more* stressed, those more invested in the website showed greater evidence of a sustained stress response when using Facebook following acute stress. The present results coupled with findings

suggesting that females may feel more threatened by certain information on Facebook (McAndrew & Shah, 2013) highlight the need for studying how gender and investment in the site may influence well-being.

It is also possible that immediately engaging in a stimulating activity after experiencing acute stress may have reduced the likelihood of recovering from stress. All participants were at a heightened level of arousal at the beginning of recovery. Participants in the control condition were given the option to read or quietly sit whereas participants in the social media use condition immediately began using Facebook. Directly beginning another task may have sustained higher levels of physiological arousal. However, at baseline, a third of participants reported wanting to use Facebook most when feeling stressed and almost a third when feeling anxious. This suggests that use of Facebook may naturally occur under heightened levels of arousal.

Although using Facebook sustained cortisol, it had no effect on blood pressure or heart rate. This may have been due to the natural rapid recovery rate of these more acute markers (Linden et al., 1997). However, it is also possible that Facebook differently affects SAM activity (blood pressure and heart rate) and HPA activity (cortisol). Future work may benefit from including additional (e.g., salivary alpha-amylase) and more precise measurement of the SAM system.

Despite sustaining cortisol, Facebook did not sustain psychosocial stress. Those who used Facebook reported recovering as much as those in the control condition despite showing a sustained physiological stress response. This dissociation is consistent with findings demonstrating that the psychological experience of stress does not necessarily map on to a physiological response (e.g., Egloff, Wilhelm, Neubauer, Mauss, & Gross, 2002; Inagaki & Eisenberger, 2016; Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; Levi, 2016). In this specific context, this dissociation may aid in explaining mixed findings in the literature. For example, cross-sectional findings implicating associations between both Facebook use and enhanced well-being (Kim & Lee, 2011) *and* Facebook use and greater distress (Chen & Lee, 2013) may reflect a disconnection between what users experience and what they report. Although there were no significant effects of Facebook use on self-reported stress in this study, examining this relationship will remain important considering that the majority of participants in the Facebook use condition reported at baseline that using Facebook when stressed *reduces* stress.

While results suggest a link between social media use and stress, the implications for overall well-being are less clear. Given that roughly one in seven people on the planet use Facebook each day, understanding its relationship to both psychosocial and physiological processes is highly relevant. The context of acute stress provides valuable insight into how use of the site may influence users, especially given that a significant portion of users report not only *wanting* to use the site when stressed, but that using it when stressed actually *reduces* stress. Subjective stress reduction may in fact occur; however, our findings highlight the importance of also considering physiological stress recovery, particularly given the known associations between stress and negative health and well-being outcomes.

Despite these novel findings, limitations must be addressed. First, the majority of participants reported using the Facebook mobile app as the most common means of access. Use of the platform in such a context may have different implications for stress

recovery, particularly given that mobile use implies a mobile environment (e.g., perhaps being outdoors, in a public space, or even walking around). However, to best capture the effect of Facebook use on stress recovery in an experimental context, limiting platform access to a stationary laptop computer in a quiet room allowed us to rule out confounding factors potentially influencing arousal (e.g., other people, environmental noise, otherwise divided attention). Future work assessing mobile use of the platform will require careful control of many external environmental factors. In addition, the control condition involved a stimulating, yet neutral activity in effort to provide some level of arousal for all participants. However, we did not assess if participants normally read magazines when feeling stressed. Future work may benefit from including a third condition involving complete rest. As social media continues evolving, future work should consider how specific activities (e.g., posting photos, viewing videos, etc.) differently influence well-being. Similarly, the potentially variable impact of different text- and image-based platforms (e.g., Twitter, Instagram, and Snapchat) must also be considered. Finally, the broader social context of use must be acknowledged. For example, national and global-level events (e.g., the constant social media coverage of the contentious 2016 U.S. Presidential Election) may temporarily create an inherently stressful environment with otherwise undue consequences for well-being.

Although much work remains to be done, the present study provides the first experimental evidence that social media may in fact get under the skin. We show that when accounting for gender and investment in the website, using Facebook after facing an acute social stressor delays physiological stress recovery in terms of cortisol. That is, using Facebook when stressed sustains physiological stress. Future work must consider with greater precision, the influence of specific Facebook activities on both psychological and physiological well-being. Particular attention should be paid to user gender and investment in the website.

CHAPTER THREE

STUDY II

Social Media as a Shield: Facebook Buffers Acute Stress

Abstract

Facebook remains the most widely used social media platform. Research suggests that Facebook may both enhance and undermine psychosocial constructs related to well-being, and that it may impair physiological stress recovery. However, little is known about its influence on stress reactivity. Using novel experimental methods, this study examined how Facebook influences reactivity to an acute social stressor. Facebook users ($n = 100$, 52 males, mean age 19.50, $SD = 1.73$) were randomly assigned to use their own Facebook account or sit quietly before experiencing an acute social stressor. All participants showed significant changes in subjective and physiological stress markers in response to the stressor. However, participants who used Facebook experienced lower levels of psychosocial stress, physiological stress, and rated the stressor as less threatening (p 's $< .05$) when controlling for gender and emotional investment in the website compared to controls. Results suggest that Facebook use may *buffer* stress—in particular psychosocial stress—if used before experiencing an acute social stressor. This study is among the first to incorporate both objective and subjective measures in investigating the complex relationship between Facebook use and well-being.

Keywords: stress, cortisol, alpha-amylase, TSST, Facebook, social media, well-being

1. Introduction

As social media continues evolving, understanding its influence on well-being is becoming more important. Facebook remains the most popular social media platform, with over 1 billion worldwide users (fb.com) and 71% of online U.S. adults naming it as their preferred platform (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). Conflicting research suggests that Facebook may both enhance *and* undermine subjective psychosocial well-being (e.g., Chen & Lee, 2013; Chou & Edge, 2012; Liu & Yu, 2013; Cipresso, Serino, Gaggioli, Albani, Mauro, & Riva, 2015; Nabi, Prestin, & So, 2013). Limited research has taken an objective look at Facebook use and well-being (Mauri, Cipresso, Balgera, Villamira, & Riva, 2011; Morin-Major, Marin, Durand, Wan, Juster, & Lupien, 2016; Rus & Tiemensma, *under review*); and these studies suggest that Facebook can influence physiological outcomes, notably in the context of stress.

In an exploratory study, Rus and Tiemensma (*under review*) found that Facebook use delayed physiological stress recovery after experiencing an acute social stressor. The authors proposed the Social Self-preservation Theory (Dickerson, Gruenewald, & Kemeny, 2004) as an explanation for the sustained levels of elevated salivary cortisol output seen during Facebook use. The theory posits that the social self-preservation system activates cortisol release and an increase in negative self-related cognitions and emotions (e.g., embarrassment, shame) when a threat to the social self or social esteem is present. Participants in Rus and Tiemensma (*under review*) who used Facebook while recovering from an acute stressor (i.e., a threat to the social self) showed sustained levels of physiological stress compared to a control condition. Considering that Facebook use has been associated with constructs such as greater distress (Chen & Lee, 2013), induction of negative social comparison (Chou & Edge, 2012), and lower self-esteem in addicted and problematic users (Błachnio, Przepiorka, & Pantic, 2016), Rus and Tiemensma (*under review*) proposed that Facebook itself may be a threat to the social self. That is, Facebook *and* the laboratory stressor were perceived as threats, causing participants who experienced both to show a prolonged stress response.

As markers of the body's physiological stress response, both salivary cortisol output and salivary alpha-amylase (sAA) output can aid our understanding of Facebook's impact on stress. The hypothalamic-pituitary-adrenocortical (HPA) axis and the sympathetic-adrenomedullary (SAM) system work together to manage stressful events, and biomarkers of each component of the body's stress system, in particular cortisol (HPA), sAA, blood pressure, and heart rate (SAM), can be easily and non-invasively measured (Granger, Schwartz, Booth, Curran, Zakaria, 1999; Granger, Kivlighan, El-Sheikh, Gordis, Stroud, 2007; Hellhammer, Wüst, Kudielka, 2009; Nater & Rohleder, 2009; Rohleder, Nater, Wolf, Ehlert, & Kirschbaum, 2004). Research has shown that the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) can reliably activate both of these components of the body's stress system (Birkett, 2011; Rohleder et al., 2004). Given the evidence of Facebook's effect on acute stress *recovery*, this study aimed to assess how Facebook influences the acute stress response.

To assess the effect of Facebook on the stress response, participants in the current study came into the lab believing they would be taking a survey on their Facebook use habits and providing physiological samples (i.e., saliva, blood pressure, heart rate) to assess well-being. Participants were randomly assigned to either use their own Facebook

account (experimental condition) or to sit quietly with optional online reading materials (control condition) for 20 minutes before undergoing the TSST. Using the Social Self-preservation Theory as framework, along with the results of Rus and Tiemensma (*under review*), we hypothesized that Facebook would be a stressor itself (i.e., a threat to social self-preservation), and compared to the control condition, use would intensify response to an acute social stressor in terms of both physiological and psychosocial markers (i.e., elevated and sustained salivary cortisol output, sAA output, blood pressure, and heart rate, as well as subjective stress measures and task threat).

5. Materials and Method

5.1. Participants

Facebook users ($n = 111$ undergraduates) were recruited from a campus-wide participant pool system. Seven participants quit the study before or during the acute stress induction (see Procedure). Participants who reported current use of prescription medication containing cortisol, cortisone, or hydrocortisone ($n = 2$) or current use of anti-anxiety or anti-depressant medication ($n = 3$) were excluded from analyses. Participants identified as outliers (raw score >3 SDs above the mean) at each time point for cortisol or sAA were excluded from analyses for that given time point (i.e., their data was removed only for that measure). For cortisol, two participants were dropped from baseline, two from onset, three at the +20 marker, five at +45, and 7 at +60. For sAA, two participants were dropped at baseline, two at -13, one at onset, two at +8, and one at +20 (see Figure 1b for study timeline).

Average weekly alcohol consumption within normal range was permitted, however the majority of participants (75%) reported zero consumption. Twelve participants reported current use of recreational drugs while one reported current use of tobacco products. Twenty-five percent of female participants ($n = 13$; 3 control, 10 Facebook use) reported current use of hormonal contraceptives. No participants reported current diagnosis of post-traumatic stress disorder or current use of anabolic steroids. None of the above participants showed extreme scores on any outcome measure, nor did their stress response patterns widely diverge from the rest of the sample. Thus, all were retained in analyses.

The final sample of participants ($n = 100$; 48 females, mean age = 19.52 years, $SD = 2.02$, BMI = 23.00, $SD = 4.85$; and $n = 52$ males; mean age = 19.44, $SD = 1.48$, BMI = 25.26, $SD = 7.11$) identified as being Hispanic/Latino (46%), Asian/Pacific Islander (24%), Caucasian (15%), biracial (7%), African American/Black (4%), or Native American/American Indian (1%). The majority of the sample (66%) identified as first-generation college students.

All participants had an active Facebook account, provided informed consent, and were given course credit in exchange for participation. The University Institutional Review Board approved this study and all data collection complied with current APA ethical standards.

2.2 Procedure

The study consisted of each participant completing all procedures in a single, 120-minute laboratory session. All session occurred within the same laboratory room where only the individual participant and the experiment leader were present (with the exception of the portion involving the TSST committee, see below). The experiment leader (a male or female student not involved in the TSST) introduced the study and explained that it aimed to examine how social media use influenced well-being. Participants were told they would be providing measures of heart rate and blood pressure along with saliva samples, as well as answering questions about their Facebook use habits. When enrolling in the study, participants were told they would need to know their Facebook login information in order to participate. Participants randomly assigned to the Facebook use condition did not know they would be using Facebook during the study until the experiment leader asked them to log into their own account (approximately 20 minutes into the study). Control participants did not use their login information during the study. None of the participants were aware that the study involved a stress task beforehand.

Once the study was explained and informed consent collected, all participants completed baseline measures. Following, participants randomly assigned to the Facebook use condition ($n = 70$) logged into their own Facebook account on the same laboratory laptop used to complete baseline and follow-up measures. They were given 20 minutes to use Facebook as they wished with the exception of disclosing information about currently participating in the study. Control participants ($n = 30$) were provided optional reading materials via a digital magazine app on the same laboratory laptop. Available reading options were selected to be engaging but thematically neutral (e.g., gardening, popular science, travel, etc.). The experiment leader remained in the room with each participant to collect physiological samples and subjective stress measures; however, participants were asked not to speak to the experiment leader during this time. Following 20 minutes of Facebook use/control, participants completed a midpoint questionnaire assessing their activity during that time. Next, the experiment leader left the room and the committee (see below) entered to conduct the TSST. The experiment leader returned, excused the committee, and instructed participants on how to proceed. During 30 minutes of recovery, all participants had access to the digital reading materials provided during the control condition. Again, the experiment leader remained in the room with participants to collect measures; however, participants were instructed not to interact with him or her.

Salivary cortisol output, sAA output, heart rate, blood pressure, subjective stress, and threat to social self were assessed at baseline, approximately five minutes before stressor onset, eight minutes post-stressor onset, and 20 minutes post-stressor onset. Additional sAA, heart rate, and blood pressure measures were collected ten minutes into Facebook use/control (approximately 13 minutes before stressor onset). Additional cortisol, heart rate, blood pressure, subjective stress, and threat to social-self measures were collected at 45 and 60 minutes post-stressor onset (see Figure 1b for study timeline). Following completion of the follow-up questionnaire and final saliva collection, all participants were debriefed about the study's true purpose.

2.2.1. Stress Induction and Physiological Measures

The TSST is known to reliably induce acute stress in the majority of participants in numerous studies (Birkett, 2011). Specifically, it reliably induces an increase in cortisol and in negative self-related cognitions and emotions as well as induces threat to social esteem (Dickerson, Gruenewald, Kemeny, 2004; Dickerson & Kemeny, 2004). In the current study, after 20 minutes of Facebook use/control, participants were instructed to spend five minutes preparing a speech that could be used in an interview for their ideal job. Then, they spent five minutes performing their speech in front of a disapproving committee of three presumed experts in a small laboratory room. Next, participants counted backwards from 1,687 by intervals of 13 for three minutes. Each time a mistake was made, participants were told to start again. Participants were also video and audio recorded during the speech and math tasks. In addition, committee members wore white lab coats and held clipboards to enhance the illusion of being experts. The committee always consisted of mixed-gender, student members (i.e., two females and one male, or two males and one female). The committee was only present in the laboratory room for the duration of the stress task.

2.2.1.2. Saliva samples

All data were collected between 12:45 PM and 5:15 PM (i.e., each participant arrived for their 120-minute session at either 12:45 PM or 3:15 PM) in order to control for cortisol fluctuations during the day (Kirschbaum & Hellhammer, 1989; Schultheiss & Stanton, 2009). To avoid temporary elevation of cortisol levels and ensure quality of saliva samples (Schultheiss & Stanton, 2009), participants were instructed to refrain from eating, smoking, consuming caffeine, drinking beverages other than water, brushing their teeth, or vigorously exercising in the 30 minutes before arriving for the study¹. All samples were collected using salivette collection tubes (Sarstedt Co., Nümbrecht, Germany). Participants placed a cotton roll under their tongue for 2 minutes of collection. To account for changes in cortisol and sAA concentration in response to acute stress (Engert et al., 2011, Rohleder et al., 2004), saliva was collected at baseline, -13 minutes stressor onset, -5 minutes stressor onset, and eight, 20, 45, and 60 minutes post-stressor onset. All saliva samples were immediately placed in a -20° C freezer and immunoassayed at a later date. For cortisol, thawed samples were centrifuged and assayed in duplicate with a test volume of 25µL. A commercially available enzyme immunoassay kit was used without modifications to the manufacturer's recommended protocol (Salimetrics; State College, PA). Sensitivity ranged from 0.007 to 3.0 µg/dL. Intra-assay and inter-assay coefficients of variation were less than 15%. Salivary alpha-amylase was determined by kinetic assay (Salimetrics; State College, PA). Samples were run in duplicate, and diluted 1:200. Intra-assay and inter-assay coefficients of variation were less than 15%.

¹ Note that the first saliva sample was not collected until approximately 15 minutes after each participant arrived. Thus, participants had refrained from these activities for at minimum 45 minutes before saliva collection began.

2.2.1.3. Blood pressure and heart rate

Blood pressure and heart rate were simultaneously measured with an Omron 10 Series digital blood pressure monitor cuff placed around the non-dominant upper arm at baseline, -13 minutes stressor onset, -5 minutes stressor onset, and 8, 20, 45, and 60 minutes post-stressor onset.

2.2.2. Psychosocial Measures

2.2.2.1. Facebook Use.

The Facebook Intensity Scale (FBI) measures integration of site use into the lives of users and emotional connectedness to the site (Ellison, Steinfield, & Lampe, 2007). The nine-item scale asks participants to rate statements such as, “I feel that I am part of the Facebook community,” on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). The scale also measures number of Facebook friends as well as average daily time spent actively using Facebook over the past week. Intensity score is computed by averaging all items in the scale, with higher scores indicating higher intensity. Scale validity has not been established; however, the current sample showed moderate reliability (Cronbach’s $\alpha = 0.68$).

The Facebook Activity Survey (Junco, 2012) measures frequency of engaging in specific Facebook activities. Examples include frequency of posting status updates, tagging photos, and sending private messages on a scale of 1 (never) to 5 (very frequently, 100% of the time). All participants reported their normal Facebook use habits at baseline. Participants in the experimental condition completed an adapted version of the survey regarding their specific use of the site during their 20 minutes of use. In both cases, frequency of each activity was averaged across participants with higher scores indicating more frequent activity.

Participants were also asked which method they most commonly used to access Facebook (i.e., the mobile app, the website from a computer, or both). In addition, participants in the Facebook use condition were asked how using Facebook for 20 minutes in one sitting compared to their normal use (i.e., they normally use it less, the same, or more), if they did anything during these 20 minutes that they normally would not do, and if so, what they did.

All questionnaire items assessing Facebook use and stress were asked during follow-up (i.e., *after* participants had both used Facebook if they were in the experimental condition and undergone the acute stressor). This was done in effort not to bias participants towards the study’s true purpose.

Participants identified when they were most likely to use Facebook (i.e. when they were lonely, bored, stressed, sad, or anxious) by rating their agreement on a 1 (strongly disagree) to 5 (strongly agree) scale for the item, “I find myself wanting to use Facebook most when feeling X” for each state. Participants also responded to the following statement: “Please rate how stressed using Facebook makes you feel in general,” on a five-point scale ranging from 1 (not at all) to 5 (extremely). In addition, participants rated the following statements on five-point scales ranging from 1 (strongly disagree) to 5 (strongly agree): (1) “In general, I like to use Facebook when I am stressed”, (2) “In general, using Facebook when I am stressed makes me feel *less* stressed”, and (3) “In general, using Facebook when I am stressed makes me feel *more* stressed”.

stressed.” Participants in the Facebook use condition were asked to select which statement they agreed with most after using Facebook for 20 minutes: (1) “Using Facebook made me feel *less* stressed”, (2) “Using Facebook made me feel *more* stressed”, or (3) “Using Facebook did not change my stress level.” Control participants were asked the same set of items regarding the past 20 minutes (e.g., “Sitting quietly/reading made me feel *less* stressed”).

2.2.2.2. *Psychosocial Stress*

Subjective stress was assessed after each saliva sample collection (with the exception of the -13 measure) with present-moment ratings of tension, anxiety, insecurity, irritation, nervousness, timidity, fear, well-being, and mood. Each item (e.g., “How anxious are you feeling right now?”) was rated from ‘not at all’ to ‘extremely’ along a 15 centimeter visual analogue scale. Participants marked their response, and scores were rounded up to the nearest millimeter then converted to a 15-point continuous scale with higher scores indicating greater feelings of each state. Mood was also assessed immediately following Facebook use/control with the item “Please indicate which statement you agree with most: (1) Using Facebook/sitting quietly increased my positive mood, (2) Using Facebook/sitting quietly increased my negative mood, or (3) Using Facebook/sitting quietly did not change my mood”. Finally, well-being was assessed on a 1 (not at all) to 4 (a lot) scale with the following item: “How much did using Facebook/sitting quietly influence your sense of well-being either positively or negatively?”.

2.2.2.3 *Threat to Social Self Preservation*

State self-esteem was measured with the Social and Performance subscales of the State Self-Esteem Scale (SSES; Heatherton & Polivy, 1991) at four time points (baseline, -5 minutes stressor onset, 8 minutes post-stress onset, and follow-up). Participants responded to 14 items for present-moment feelings such as, “I feel confident about my abilities” from 1 (not at all), to 5 (extremely). Lower scores indicate lower stateself-esteem. The scale showed high internal consistency across the social ($\alpha = 0.85 - 0.93$) and performance subscales ($\alpha = 0.82 - 0.92$).

Finally, feelings of shame, humiliation, self-consciousness, embarrassment, and self-esteem were assessed at each saliva collection time point (with the exception of -13 minutes stressor onset) along the same visual analogue scale as the psychosocial stress items.

2.2.2.4. *Task Rating*

Three items assessed the difficulty, threat, and challenge felt during the acute stress portion of the protocol. All items were rated from ‘not at all’ to ‘extremely’ on a visual analogue scale (e.g., “How threatened did you feel during the task you just completed?”). Measurements were taken immediately following completion of the TSST.

2.3 *Statistical Analyses*

Analyses were conducted using SPSS Version 24.0 (SPSS Inc., Chicago, IL, USA). Students *t*-tests were used to compare the Facebook use and control conditions on

measures of general Facebook activity. Analysis of covariance (ANCOVA) with baseline, gender, and Facebook Intensity (i.e. emotional connectedness to the site) as covariates was used to test the effect of Facebook use on acute stress reactivity and recovery. Analyses included comparing group means at each post-stressor time point. Cortisol and sAA measures were log-transformed before analyses. Unless otherwise noted, effect sizes are presented as partial η^2 , which represents the proportion of explained variance between the predictors and the outcome, with values of .01, .06, and .14 indicating small, medium, and large effect sizes, respectively (Cohen, 1988). Significance was set at $p \leq .0$

3. Results

3.1. Baseline Measures

There were no significant condition differences on any measure of Facebook activity or on any baseline physiological measures (see Table 1b). Compared to Facebook use participants, control participants reported higher levels of baseline tension, $t(97) = 2.98$, $p = 0.004$, 95% CI [0.65, 3.23], $d = 0.49$; and lower levels of baseline self-esteem (as measured by the visual analogue scale), $t(98) = 3.31$, $p = 0.001$, 95% CI [3.04, 0.76], $d = 0.56$. Participants showed no significant condition differences on any other items.

Sixty-seven percent of participants in the Facebook use condition reported using the Facebook mobile app as their most common means of access, while 12.9% reported using the website from a computer, and 20% reported using both methods equally. Across conditions, the majority of participants identified wanting to use Facebook most when feeling bored, while a third reported wanting to use it most when stressed (see Table 1b). Facebook use and control conditions reported no significant differences on how Facebook use influences stress in general; however, participants in both conditions more strongly agreed that using Facebook when stressed makes them feel *less* stressed compared to more stressed.

3.2. Effect of Facebook Use on Psychosocial Stress

When asked what they did during their 20 minutes of use, participants in the Facebook use condition reported spending most time scrolling newsfeed without clicking anything, viewing videos, and viewing photos. Half of the participants in the Facebook use condition reported normally spending less than 20 minutes using Facebook in one sitting. However, 87% of participants reported that using Facebook for 20 minutes in one sitting did not cause them to engage in activities they normally would not. Those who reported doing something they normally would not ($n = 9$) described a range of activities including watching videos and passively scrolling newsfeed. When asked about the effect of Facebook use on mood, 60% reported no effect, while 34.7% reported a positive change and 5.7% reported a negative change. In addition, 40% reported no change in stress level as a result of Facebook use, while 48.6% reported feeling less stressed, and 11.4% reported feeling more stressed. Sixty-four percent of participants reported that using Facebook changed their sense of well-being during use. By comparison, control participants reported the following after reading/sitting quietly for 20 minutes: 50% reported no change in mood, 43.3% positive mood change, and 6.7% negative mood

change; 36.7% reported no change in stress, 53.3% reported less stress, and 10% reported more stress; 66.7% reported a change in well-being.

Participants in both conditions experienced similar changes in psychosocial stress in response to the stressor, with increases in tension, anxiety, insecurity, irritation, nervousness, timidity, and fear, and decreases in mood and well-being (see Figure 2b). There were no significant differences at any time point for nervousness, timidity, or fear (see Table 2b for condition means and standard deviations). At eight minutes post-stressor onset, Facebook use participants reported more positive mood compared to control participants, $F(1, 98) = 6.96$, 95% CI [-3.07, -.43], $p = .010$, $\eta^2 = .069$. At twenty minutes post-stressor onset, Facebook use participants also reported more positive mood compared to control, $F(1, 98) = 9.0$, 95% CI [-3.29, -.67], $p = .003$, $\eta^2 = .087$, while control participants reported higher levels of anxiety, $F(1, 98) = 9.25$, 95% CI [.67, 3.20], $p = .003$, $\eta^2 = .090$; insecurity, $F(1, 96) = 5.87$, 95% CI [.36, 3.61], $p = .017$, $\eta^2 = .060$; and irritation, $F(1, 99) = 7.75$, 95% CI [.57, 3.42], $p = .006$, $\eta^2 = .075$.

At 45 minutes post-stressor onset, Facebook use participants reported higher levels of positive mood, $F(1, 97) = 7.77$, 95% CI [-2.95, -.49], $p = .006$, $\eta^2 = .077$, and well-being, $F(1, 99) = 6.75$, 95% CI [-3.26, -.43], $p = .011$, $\eta^2 = .066$, while control participants reported higher levels of tension, $F(1, 94) = 9.29$, 95% CI [.63, 3.02], $p = .003$, $\eta^2 = .094$; anxiety, $F(1, 98) = 7.18$, 95% CI [.47, 3.14], $p = .009$, $\eta^2 = .071$; insecurity, $F(1, 98) = 7.81$, 95% CI [.50, 2.95], $p = .006$, $\eta^2 = .077$; and irritation, $F(1, 98) = 5.57$, 95% CI [.29, 3.41], $p = .020$, $\eta^2 = .056$.

At 60 minutes post-stressor onset, Facebook use participants reported higher levels of well-being, $F(1, 98) = 4.37$, 95% CI [-3.27, -.085], $p = .039$, $\eta^2 = .044$, while control participants reported higher levels of anxiety, $F(1, 99) = 5.09$, 95% CI [.14, 2.18], $p = .026$, $\eta^2 = .051$, and irritation, $F(1, 103) = 5.24$, 95% CI [.18, 2.43], $p = .024$, $\eta^2 = .05$.

3.2. *The Effect of Facebook Use on Physiological Stress*

Participants in both conditions experienced physiological stress in response to the stressor, with increases in heart rate and blood pressure (see Figure 3b). Compared to the Facebook use condition, control participants showed higher systolic blood pressure at eight minutes post-stressor onset, $F(1, 97) = 4.82$, 95% CI [0.62, 12.32], $p = .03$, $\eta^2 = .049$; at 20 minutes post-stressor onset, $F(1, 97) = 4.35$, 95% CI [0.19, 7.67], $p = .04$, $\eta^2 = .045$; and at 60 minutes post-stressor onset, $F(1, 98) = 5.25$, 95% CI [0.65, 9.12], $p = .024$, $\eta^2 = .053$. There were no significant condition differences for diastolic blood pressure or heart rate.

The majority of participants showed increases in salivary cortisol and sAA concentration in response to the stressor (see Figure 3b); however, there were no significant condition effects for either marker.²

3.3. *Effect of Facebook use on Threat to Social Self*

Participants in both conditions experienced similar changes in state self-esteem, with increases from baseline to stressor onset, decrease in response to the stressor, an

² Controlling for BMI and use of hormonal contraceptives did not change these results.

increase during recovery. Compared to control participants, Facebook use participants reported higher levels of state self-esteem (as measured by the SSES) immediately following the TSST (i.e., at 8 minutes post-stressor onset), $F(1,99) = 5.57$, 95% CI [-10.76, -0.93], $p = .020$, $\eta^2 = .055$. In addition, at 20 minutes post-stressor onset, control participants reported higher levels of embarrassment, $F(1, 97) = 4.92$, 95% CI [.18, 3.23], $p = .029$, $\eta^2 = .050$; shame, $F(1, 98) = 5.06$, 95% CI [0.19, 3.04], $p = .027$, $\eta^2 = .051$; and humiliation, $F(1, 99) = 5.39$, 95% CI [.31, 3.96], $p = .022$, $\eta^2 = .054$. At 45 minutes post-stressor onset, control participants reported higher levels of embarrassment, $F(1, 99) = 5.38$, 95% CI [.23, 2.89], $p = .022$, $\eta^2 = .054$; shame, $F(1, 98) = 3.70$, 95% CI [-0.41, 2.57], $p = .057$, $\eta^2 = .038$; and humiliation, $F(1, 98) = 7.55$, 95% CI [.52, 3.25], $p = .007$, $\eta^2 = .074$. At 60 minutes post-stressor onset, control participants also reported higher levels of shame, $F(1, 98) = 4.88$, 95% CI [0.13, 2.48], $p = .03$, $\eta^2 = .049$; and humiliation, $F(1, 99) = 4.26$, 95% CI [.49, 2.53], $p = .042$, $\eta^2 = .043$. See Figure 4b for condition change over time.

3.4. Task Rating.

Compared to the Facebook use condition, participants in the control condition rated the TSST as more threatening, challenging, and difficult, with a significant difference for threat, $t(101) = 2.83$, 95% CI [.78, 4.47], $p = .006$, $d = 0.58$.

4. Discussion

The present study builds on our understanding of how Facebook may affect the stress response. Participants experienced changes in subjective and physiological stress in response to an acute laboratory stressor; however, contrary to hypotheses, Facebook appeared to *buffer* stress. Specifically, participants who used Facebook before experiencing acute stress reported lower levels of psychosocial stress (tension, anxiety, insecurity, irritation; higher well-being and positive mood), lower levels of threat to social self-preservation (embarrassment, shame, humiliation; higher state self-esteem), and lower levels of physiological stress (systolic blood pressure) in reaction to the stressor and during recovery. In addition, participants who used Facebook before the stressor rated the stressor itself as less threatening. Group differences on many of these variables showed medium effect sizes, suggesting that Facebook use before stress may have a considerable impact on limiting the experience of stress.

The Social Self-preservation Theory (Dickerson, Gruenewald, & Kemeny, 2004) posits that threats to social self-preservation trigger both a neuroendocrine and psychosocial stress response. Based on the findings of Rus and Tiemensma (*under review*), we hypothesized that participants in the Facebook use group would show an intensified reaction to the TSST in terms of psychosocial and physiological stress markers given the additive effect of both Facebook and the TSST being threats to the social self. Given that we found the opposite (i.e., a buffering effect for Facebook use), several explanations must be explored.

Facebook use has been associated with feelings of increased self-esteem (Best, Manktelow, & Taylor, 2014), enhanced social support (Bender, Jimenez-Marroquin, & Jadad, 2011; Liu & Yu, 2013), general well-being (Kim & Lee, 2011), and overall life

satisfaction (Nabi, Prestin, & So, 2013; Valenzuela, Park, & Kee, 2009). Laboratory research has also shown that specific mechanisms such as self-compassion (Arch, Brown, Dean, Landy, Brown, & Laudenslager, 2014), affirmation of personal values (Creswell, Welch, Taylor, Sherman, Gruenewald, & Mann, 2005), and providing support to others (Inagaki & Eisenberger, 2016) can reduce both physiological and psychosocial reactivity to acute stress. Although the current study did not directly assess if participants engaged in any of these specific activities during Facebook use, given what is known about Facebook (e.g., it is a source for social support and is associated with self-esteem; Best, Manktelow, & Taylor, 2014; Liu & Yu, 2013), it is possible that such mechanisms facilitated the observed buffering effect. Future work may wish to include more specific measures assessing these potential underlying mechanisms.

Comparing these results to Rus and Tiemensma (*under review*) suggests that the timing and context of Facebook use influence its relationship with stress. That is, users who interact with Facebook in a neutral context (i.e., the current study) may reap psychosocial benefits from the platform's affordances, whereas interacting with Facebook in a stressful context (Rus & Tiemensma, *under review*) may turn the same content threatening. It is possible that activating the stress response before Facebook use primes users to feel stressed by their Facebook activity when they otherwise would not. Previous cross-sectional work has not accounted for context (e.g., emotional arousal or valence during use), which may in part account for conflicting findings concerning associations between Facebook use and well-being (e.g., Chen & Lee, 2013; Kim & Lee, 2011). Considering that in the current study, using Facebook before stress appeared to provide a boost to social self-preservation rather than a threat, manipulating emotional arousal or valence surrounding use could further clarify the relationship between stress and Facebook use.

Although Facebook buffered some measures of psychosocial stress, threat to social self, task threat, and systolic blood pressure, there was no effect for cortisol, sAA, heart rate, or diastolic blood pressure. Those who used Facebook experienced the same amount of physiological stress as control participants in terms of these markers. Similar to Rus and Tiemensma (*under review*), this dissociation between psychosocial and physiological stress is consistent with previous findings (e.g., Egloff, Wilhelm, Neubauer, Mauss, & Gross, 2002; Inagaki & Eisenberger, 2016; Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; Levi, 2016).

Studies looking at buffering laboratory stress have found mixed results for effect on cortisol. Specifically, affirming personal values buffers cortisol response (Creswell et al., 2015) while giving support to others does not (Inagaki & Eisenberger, 2016). As previously discussed, we did not collect data on participants engaging in these specific activities while using Facebook. However, it is possible that such behaviors negated a condition effect for cortisol. While Rus and Tiemensma (*under review*) found that Facebook affected HPA activity (cortisol) but not SAM activity (blood pressure and heart rate), the current study found the opposite. This discrepancy further suggests that Facebook may differently affect these two components of the stress system, and further work is needed to understand how. That only systolic blood pressure showed an effect for SAM system activity highlights the complicated relationship among physiological markers and the need for future research.

Despite these novel findings, limitations must be addressed. The control condition involved a stimulating, yet neutral activity in effort to provide some level of arousal for all participants. Future work may benefit from including a third condition involving complete rest. In addition, we did not collect specific information related to content viewed during Facebook use. Future work may wish to control for valence of content (e.g., positive or negative), particularly in light of the observed buffering effect.

5. Conclusions

The present study adds to the growing literature on Facebook use and well-being. In particular, it is one of the few studies to take an objective look at the relationship between a pervasively popular activity and both psychosocial *and* physiological outcomes. We showed that using Facebook before an acute social stressor buffers stress in terms of psychosocial and physiological measures. That is, using Facebook before stress can limit the experience of stress.

CHAPTER FOUR

STUDY III

Social Media Use During Crisis: How Users Turn to Facebook in Response to Campus Violence

Abstract

Social media has become an important resource during and after crises. Platform affordances such as real-time information sharing and broad network reach have potential to facilitate previously unprecedented communication among victims, witnesses, and social network members. However, little is known about how social media is used in response to campus violence. Facebook is commonly used to seek information, to seek social support, and to express emotion. Given the potential utility of such functions in the wake of trauma, the current study assessed the extent to which Facebook was used for these purposes in response to the acts of violence that occurred at the University of California, Merced in November of 2015, and how these uses related to Facebook user characteristics. Students ($n = 552$) reported on their uses of Facebook on the day of the attacks. The majority of students reported using Facebook more, and in different ways than normal in response to the events. Students who used the site in response to the events reported higher levels of social support, more use of the site in general, and higher levels of investment in the site compared to those who did not use the site (p 's $< .05$). Of those who used the site, 95.7% reported using it to seek information, 72% to seek social support, and 58.1% to express emotions. Students also reported short-term affective change in response to using the site for these specific purposes. Findings highlight the function of social media use in response to campus violence.

Keywords: Social media; Facebook; campus violence; trauma; computer-mediated communication

“[Social media] was the way I found out something horrible had happened. I was able to avoid campus thanks to Facebook. It was also beautiful to see all the support and love that people were showing to each other the day of and after the event. It was a way to stay connected with the whole campus during such a hard time.” –UC Merced student

1. Introduction

Social media’s capacity for instant connection and broad network reach holds great utility during public emergencies and natural disasters. Capabilities such as early recognition and reporting of emergency events (Cassa, Chunara, Mandl, & Brownstein, 2013), dissemination of preparedness information (Houston, et al.), collection of information from the public (Simon, Goldberg, & Adini, 2015), communication among emergency responders (Simon, Goldberg, Aharonson-Daniel, Leykin, & Adini, 2014), and promotion of community resilience (Taylor, Wells, Howell, Raphael, 2012) are now feasible on a large and virtual scale. As reliance on virtual forms of communication for seeking information during crises increases (Hughes & Palen, 2009; Mastrodicasa, 2008; Merchant, Elmer, & Lurie, 2011; Palen, Vieweg, Liu, & Hughes, 2009), understanding the function of a pervasive communication medium is paramount. Further, the importance of social support in promoting recovery after trauma (Cieslak et al., 2009; Hawdon & Ryan, 2012; Ruzek, Brymer, Jacobs, Layne, Vernberg, & Watson, 2007) and the benefits of emotional expression in the wake of traumatic events (Greenberg & Stone, 1992) highlight the importance of specifically examining social media in this context.

Facebook remains the leading social networking website with now over one billion daily active users (fb.com). In general, Facebook has shown to be an information source (Ellison, Steinfield, & Lampe, 2011; Park & Kee, 2009; Wise, Alhabash, & Park, 2010), a social support resource (e.g., Bender, Jiminez-Marroquin, & Jadad, 2011; Best, Manktelow, & Taylor, 2014; Liu, & Yu, 2013; Manago, Taylor, & Greenfield, 2012; Nabi, Prestin, & So, 2013; Wright, 2012), and an outlet for emotional expression (e.g., Lin, Tov, & Qiu, 2014; Moreno, et al., 2011; Qiu, Lin, Leung, & Tov, 2012). Limited research suggests that users may naturally turn to the website as a resource in the wake of campus violence (Hawdon & Ryan, 2012; Vicary & Fraley, 2010); however, less is known about how different types of users use the site, and how use may influence affective state in this context. The current study aimed to assess the extent to which the common Facebook functions of seeking information, seeking social support, and expressing emotions occurred in the wake of campus violence, how these uses related to user characteristics, and if these uses influenced short-term affect.

2. Materials and Method

2.1. Participants and Procedure

During the fall of 2015, the University of California, Merced closed off its campus after an undergraduate student (non-fatally) stabbed four victims before being shot and killed by campus police. Due to an ongoing federal investigation, data collection did not commence until five months after the events when the case closed. Students enrolled at UC Merced at the time of the attacks were contacted via the online campus research participation system and asked to complete a survey concerning their use of

social media on and after November 4, 2015. Students 18 years or older who identified as being Facebook users were invited to participate in exchange for course credit. Each completed an online survey assessing general Facebook use, perceptions of social support, and Facebook use in relation to the events. The study was approved by the University Institutional Review Board.

Participants ($n = 552$) averaged 19.78 ($SD = 1.92$) years in age. Seventy-three percent were female; 56% identified as Hispanic, 21.8% Asian/Pacific Islander, 8.4% Caucasian, 5.8% African American, 0.2% American Indian, and 7.6% as bi-racial or other. The sample was majority underclassmen with 39.8% freshmen, 25.1% sophomores, 17.1% juniors, and 15.6% seniors. Of the sample, 71.5% identified as being first-generation college students. At the time of data collection, the sample comprised 8% of the entire undergraduate population at the University of California, Merced.

2.2. Measures

The Facebook Intensity Scale (FBI) measures integration of the site into the lives of users (Ellison, Steinfield, & Lampe, 2007). The nine-item scale asks participants to rate statements such as, "Facebook has become part of my daily routine," on a five-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Intensity score is computed by averaging all items in the scale, with higher scores indicating higher intensity. Scale validity has not been established; however, internal consistency in the current sample was high (Cronbach's $\alpha = .86$).

The Facebook Connection Strategies scale measures uses of Facebook for building or maintaining social capital (Ellison, Steinfield, & Lampe, 2011). Three subscales identify the connection strategies of initiating social contact, social information seeking, and maintaining social capital. Sub-scale scores are averaged from items ranging from 1 (*not likely at all*) to 5 (*very likely*), with higher scores indicating more use of that connection strategy. Scale validity has not been established; however, internal consistency was moderate-to-high for each sub-scale (Cronbach's $\alpha = .79, .79, \text{ and } .87$, respectively).

The Facebook Activity Survey (Junco, 2012) measures frequency of specific activities within Facebook (e.g., posting status updates, sharing links). An adapted version measured both normal Facebook use and use in response to the events. For purposes of analyses, responses were categorized on a 1-to-3 scale of *never/almost never*, *sometimes*, and *often*. A modified version asked how much time participants spent doing the same list of activities in response to the events on a scale of 1 (*none of the time*) to 3 (*most of the time*). All activities were categorized as being active (e.g., *producing* content such as commenting on posts) or passive (e.g., *consuming* content such as viewing videos). Average amount of time spent engaging in active and passive activities was totaled for all participants before a ratio of time spent engaging in each type of behavior was calculated.

Participants reported the number of times on average that they log in to Facebook each day and the approximate duration in minutes of each login. Analyses including minutes of daily use included only participants who use Facebook on a daily basis (87.9% of the sample).

Participants reported if they used Facebook for *any* purpose in relation to the events. Those who did completed a modified Facebook Activity Survey. Following,

participants reported if they used the site to seek information, seek social support, or express emotions in relation to the events and how important they thought Facebook was for each of these purposes on a five-point scale ranging from *completely disagree* to *completely agree* (e.g., “Using Facebook to seek information about the events was important.”). Participants then reported if engaging in each of these activities caused them to feel sad, angry, comforted, confused, relieved, no effect, or other (e.g., “Using Facebook to find information about the events made me feel mostly X”). Finally, participants reported if viewing information on Facebook was upsetting, if they avoided using the site, if they used the site *more* than normal, and if overall, they found the site helpful or harmful during and after the events.

Social support was measured by the 12-item Multidimensional Scale of Perceived Social Support (Zimet, et al., 1988). Participants rated agreement with items such as, “I can count on my friends when things go wrong” from 1 (*very strongly disagree*), to 7 (*very strongly agree*), with higher scores indicating a higher level of perceived social support. The current sample showed high full-scale internal consistency (Cronbach’s $\alpha = .95$).

2.2. Statistical Analyses

Analyses were conducted using SPSS Version 24.0 (SPSS Inc., Chicago, IL, USA). Data are reported as means and standard deviations. Student’s *t*-test for between group comparisons were used. In case of non-normally distributed data and/or unbalanced group sizes, Mann-Whitney U tests were used. Significance levels were set at $p \leq 0.05$. Effect sizes are reported as standardized mean differences (*r* for non-parametric tests and *d* for all other tests). Confidence intervals were computed for parametric tests only.

3. Results

In response to the events, 80% ($n = 446$) of the sample reported using Facebook for *any* purpose (see Tables 1c and 2c for group breakdowns based on use). Of the full sample, 87.9% reported logging in to Facebook at least once per day for normal use. On average, participants reported logging in 3.83 ($SD = 4.08$) times per day, with responses ranging from zero to 50 times per day. Participants spent an average of 70.21 minutes ($SD = 106.86$) per day on Facebook, with responses ranging from zero to 1000 minutes of use.³ During normal Facebook use, the three most popular activities included using Facebook Messenger, viewing photos, and viewing videos, while the three most popular activities in response to the events included scrolling newsfeed without clicking anything, following links, and using Facebook Messenger.

Of the full sample, 8.2% reported spending more time engaging in active activities than in passive activities during normal use. Of the participants who used Facebook in response to the events, 96% reported spending more time engaging in active activities than in passive activities

³ Reports that exceeded the number of minutes in a day or indicated constant use of Facebook (i.e., “24 hours per day”), were treated as missing (3.6% of the sample).

Of the participants who used Facebook in the wake of the events 56% indicated that they used the site *more* than they normally would, while only 5.9% of the whole sample said that they avoided using the site. Further, of the participants who used the site, 37.7% agreed that viewing content on Facebook in the wake of the events was upsetting; however, 64.3% agreed that overall, Facebook was helpful, while only 8.1% agreed that it was overall harmful.

Participants who reported using the site for any purpose had higher ratings of social support compared to those who did not use the site, $U = 20142$, $p < .05$, $r = -0.09$. Participants who used the site also reported spending more minutes per day normally using the site, $U = 14800.5$, $p < .001$, $r = -0.23$, and scored higher on the Facebook Intensity Scale $t(549) = 8.76$, $p < .001$, $d = 0.76$, 95% CI [.57, .90]. Those who used the site scored higher on the Facebook Connections Strategy sub-scale of maintaining social ties, $U = 14843$, $p < .001$, $r = -0.26$, and on the seeking social information sub-scale, $t(549) = 5.49$, $p < .001$, $d = 0.47$, 95% CI [0.34, 0.72].

Of the participants who reported using Facebook for any reason in response to the events, 95.7% indicated that they used the site to seek information (e.g., to learn about campus safety, campus closure, details about the attacker and victims, and to check on the safety of friends/family). Across the sample, participants rated using Facebook to seek information as being important ($M = 3.72$, $SD = 1.55$). Participants who reported using Facebook to seek information ($n = 427$, $M = 4.04$, $SD = 0.94$) rated this purpose as significantly more important than participants who used Facebook but not for this purpose ($n = 18$, $M = 2.17$, $SD = 1.15$), $t(443) = -8.22$, $p < .001$, $d = 1.40$, 95% CI [-2.32, -1.42]. Of those who used Facebook to seek information, 35.8% reported that doing so caused them to experience negative emotions (anger, sadness, confusion), 34% reported experiencing positive emotions (relief, comfort), 23% reported no change in emotion, and 7.3% classified the effect as “other” (e.g., “scared”, “shocked” “informed”). Participants who used Facebook to seek information reported spending more minutes per day using the site in general, $U = 2223.5$, $p < .01$, $r = -0.12$, and scored higher on the Facebook Intensity Scale compared to those who used the site but not for this purpose, $t(444) = 3.20$, $p < .01$, $d = 0.56$, 95% CI [0.22, 0.91].

Of the participants who used Facebook for any purpose in response to the events, 72% reported using Facebook to seek social support (e.g., communicating with friends and family about the events). Across the sample, participants rated using Facebook to seek social support as being moderately important ($M = 2.71$, $SD = 1.19$). Participants who reported using Facebook to seek social support ($n = 319$, $M = 3.08$, $SD = 1.13$) rated this purpose as significantly more important than participants who used Facebook but not for this purpose ($n = 124$, $M = 2.17$, $SD = 1.03$); $t(441) = -7.80$, $p < .001$, $d = .70$, 95% CI [-1.14, -.68]. Of those who used FB to seek social support, 10.6% reported experiencing negative emotions as a result, 62.8% reported experiencing positive emotions, 24.1% reported no change in emotion, and 2.5% classified the effect as “other” (e.g., “knowledgeable”, “united”, “annoyed”). Participants who reported using Facebook to seek social support scored higher on the Facebook Intensity Scale compared to those who used the site but not for this purpose, $t(442) = 5.14$, $p < .001$, $d = .43$, 95% CI [.25, .55].

Of the participants who reported using Facebook for any purpose in response to the events, 58.1% reported using it to express emotions (e.g., sharing thoughts and

feelings about the events). Across the sample, participants rated using Facebook to express emotion as being moderately important ($M = 2.12$, $SD = 1.13$). Participants who reported using Facebook to express emotion ($n = 258$, $M = 2.66$, $SD = 1.11$) rated this purpose as significantly more important than participants who used Facebook but not for this purpose ($n = 186$, $M = 1.56$, $SD = 0.83$), $t(442) = 11.46$, $p < .001$, $d = .96$, 95% CI [.91, 1.29]. Of those who used Facebook to express emotion, 14.3% reported experiencing negative emotions as a result, 48.4% reported positive emotions, 34.9% reported no change in emotion, and 2.3% classified the effect as “other” (e.g., “fortunate”, “indifferent”). Participants who reported using Facebook to express emotions reported spending more minutes per day using the site in general, $U = 18462$, $p < .01$, $r = -0.14$, and scored higher on the Facebook Intensity Scale compared to those who used the site but not for this purpose, $t(442) = -4.05$, $p < .001$, $d = .32$, 95% CI [-.43, -.15]. Participants who used Facebook to express emotions were significantly older than those who did not, $t(441) = 3.54$, $p < .001$, $d = .32$, 95% CI [1.06, 0.30].

4. Discussion

Social media appears to serve a function in response to campus violence. While the majority of participants reported using Facebook in response to the events, students who were more invested in the website were even more likely to use it. Further, the majority of the sample reported using the site in response to the events more, and in different ways than they normally would otherwise. In comparison to normal use of the site, participants reported a reversal of type of activity. Specifically, of the participants who used the site, 6.6% reported normally engaging in more active than passive activities; however, in response to the events, 96% reported spending more time engaging in active activities. That is, use became *more* active in response to the events. The change in type of activity highlights Facebook’s function during public emergency, and suggests that users generate more content in this context.

Users turned to the platform as a resource for both information and social support, and as an outlet for emotional expression. Such uses may have been associated with short-term affective state. Participants described changes in emotion depending on use of the site. While seeking information led to similar rates of positive and negative emotions, seeking social support and expressing emotions led to more positive than negative emotions for the majority of users. Based on the likely outcomes of these intention-driven behaviors, seeking information is more plausibly conducive to negative emotion. That is, seeking social support and expressing emotions are more likely to result in positive affective change (e.g., feelings of relief or comfort from receiving social support or expressing emotions) whereas seeking information potentially lends itself to the distress of finding disturbing information. Although not captured by these data outside of retrospective self-report, it is possible that Facebook use after campus violence had an immediate effect on affective state—something in great need of further research.

4.1. Limitations and Future Directions

Although results provide important insight, limitations must be addressed. Due to extenuating circumstances, all questions about Facebook use were retrospectively asked

five months after the events. However, research suggests that social and physical proximity and personal involvement can enhance recall following a traumatic event (Curci & Luminet, 2006; Pezdek, 2003). In addition, research suggests that autobiographical memory (i.e., memory for location and activity when learning of a significant event) may actually *improve* after six months (Smith, Bibi, & Sheard, 2001). All participants in the current study being members of the University community and many being physically present on campus at the time of the events likely aided in accurately reporting Facebook use five months later.

Facebook appears to serve a role in seeking information, seeking social support, and expressing emotion in the wake of campus violence. Whether it be as extreme as finding life-saving information, or simply communicating with family and friends, users appear ready to turn to it as a resource despite the potential for negative consequences. That the majority of the sample reported using the site more than they normally would and in different ways in response to the events clearly highlights the need for further study. Understanding the potential of this existing resource during crises and what use may mean for acute and long-term well-being will continue to be important. Further, from a public health perspective, social media may serve as a tool for understanding how individuals and communities respond to trauma.

CHAPTER FIVE

General Discussion

Social media plays a role in the daily lives of many; however, little is known about how it influences well-being. Through a series of studies, the relationship between Facebook use and stress was explored, both in the laboratory and in a natural setting. Results highlight a complex relationship between social media use and stress. Users appear to experience stress differently depending on the timing of Facebook use and stressor onset. In the laboratory, use *after* an acute social stressor appeared to inhibit physiological stress recovery, while use *before* limited stress intensity. In a natural setting, users reported that using Facebook to seek information, seek social support, and express emotions in response to campus violence was beneficial, and generally resulted in more positive than negative emotions. Experience of stress was also associated with Facebook user characteristics including gender and investment in the website. Such findings have implications for the impact of social media use on well-being.

Facebook use appears to both buffer and exacerbate acute social stress. The Social Self-preservation Theory (Dickerson, Gruenewald, & Kemeny, 2004) posits that threats to the social self trigger negative self-related cognitions and emotions as well as a neuroendocrine response. Results of Study I suggested that Facebook itself may be perceived as a threat to the social self (i.e., participants experienced prolonged physiological stress when using Facebook during stress recovery, and as such, Facebook acted as a second stressor). Study II attempted to clarify these results by manipulating the experience of stress in relation to Facebook use. Contrary to hypotheses (i.e., Facebook would again act as a stressor and intensify the stress response), Facebook use before stress appeared to buffer stress. Specifically, participants who used Facebook showed lower levels of psychosocial and physiological stress, as well as reduced levels of threat to social self. In addition, they found the stressor itself to be less threatening compared to participants who did not use Facebooks before stress. Combined, these studies suggest that Facebook may act as a lens for interpreting stress. That is, use before or after a stressful event may alter how the same content and activities are perceived.

In order to mimic natural Facebook use, participants in both studies were instructed to use their own Facebook account however they wished. Considering that use was uncensored (with the exception of not disclosing information about being in the study), participants engaged with content they would normally consume outside of the lab. As such, the results of Studies I and II suggest that the effect of Facebook use on stress depends on *when* the site is used in relation to stress. It is possible that use of the site while stressed (i.e., Study I) primes users to perceive content as more stressful, while use before stress (i.e., Study II) makes the same content positive and promotes stress resilience. Given the highly varied abundance of Facebook content, it is also possible that users are more drawn to negative or stressful content when they are already stressed, which then sustains stress. In contrast, users may be drawn to more positive content when using Facebook in a neutral (i.e., not stressed) context, which then buffers stress. The discrepancies between Studies I and II highlight the need for further investigation into

how affective and physiological states influence consumption of Facebook content. This is of particular importance considering that a significant portion of participants reported wanting to use Facebook when stressed, and that doing so reduces stress.

Despite disparate findings, both laboratory studies highlighted the commonly observed discrepancy between the psychological experience of and physiological response to stress (e.g., Egloff, Wilhelm, Neubauer, Mauss, & Gross, 2002; Inagaki & Eisenberger, 2016; Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; Levi, 2016). Study I showed an effect for HPA axis activity (cortisol) but neither SAM activity (blood pressure, heart rate) nor psychosocial stress (tension and anxiety). Study II found an effect for psychosocial stress, threat to social self, task challenge, and SAM activity (systolic blood pressure), but not HPA activity. These dissociations demonstrate not only the need for further study, but also suggest that Facebook may in fact differently affect components of the physiological stress response. Future work will benefit from more precisely studying how specific Facebook activities influence specific components of stress.

Outside of the laboratory, Facebook appears to play a role in alleviating stress related to campus violence. Study III considered the specific functions Facebook served in the wake of a campus stabbing, and how these uses influenced short-term affective state. Participants reported that using the site to seek social support and express emotions (two common uses of Facebook in general) resulted in more positive than negative emotions. Considering that the majority of participants reported using Facebook for specific purposes in response to the events suggests that users do in fact turn to the platform as a resource in a natural, stressful setting. Understanding the implications of Facebook use in response to trauma needs further work, particularly in the area of psychological well-being. Given the results of Study I (i.e., Facebook use under stress inhibits stress recovery), use after trauma may have a similar effect. However, the more pragmatic purposes of use after trauma (e.g., to seek information or contact family members versus passively browsing content during normal use) may negate the negative psychosocial and physiological consequences of using the platform when stressed. Considering the reliance on social media during emergencies, understanding how widely adopted platforms such as Facebook may promote stress recovery, and even resilience, will continue to be important.

In conclusion, the relationship between Facebook use and stress is complex and dependent on user characteristics and context of use. Moving forward, research in this area will benefit from careful consideration of user characteristics (e.g., gender, age, investment in the website) as well as engagement in specific activities (e.g., consuming versus producing content). Males and females may engage with the site differently as well as value it in ways that differently affect stress and well-being. Given that females consume more social media in general (Duggan et al., 2015), exploring gender differences can help parse out more specific associations and better define what appears to be a very complex relationship. Similarly, as older audiences continue adopting social media (Duggan et al., 2015), assessing age as an influential component will highlight how Facebook impacts both younger and older users. Finally, examining investment in the website can show for which type of user Facebook may be most stressful or

beneficial. Casual versus committed users may experience the same content in ways that differently affect stress.

Outside of studying the specifics of user characteristics, of great importance is understanding the role that Facebook plays in the daily lives of many. Turning to the site when stressed may have negative implications for health outcomes. However, use of the site to boost resilience before a stressor may serve a beneficial purpose. In addition, as global communication continues evolving, social media will become a mainstay in response to public emergencies and disasters. Designing platform features with psychosocial well-being in mind will carry consequences for individuals and communities turning to virtual communication as a resource in response to environmental stressors.

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Table 1a. *Full Sample and Condition Values for Baseline and Facebook Use Measures.*

	Full sample	Control Condition	FB Condition
<i>n</i>	92	50	42
Females (<i>n</i>)	43	28	15
Age	19.64 (1.57)	19.88 (1.78)	19.36 (1.25)
FB activity			
FB friends	≤ 399	≤ 399	≤ 299
Years with FB account	≤ 5	≤ 5	≤ 5
Daily use (minutes)	≤ 44	≤ 44	≤ 44
FBI low intensity (<i>n</i>)	39	21	18
FBI high intensity (<i>n</i>)	53	29	24
Most common activities:	Liking posts, following links to other websites, viewing photos	Liking posts, following links to other websites, scrolling newsfeed without clicking	Viewing videos, viewing photos, liking posts
I find myself wanting to use FB most when feeling:			
Lonely	45%	44%	45%
Bored	92%	94%	90%
Stressed	32%	28%	36%
Sad	18%	18%	19%
Anxious	27%	26%	29%
In general, how stressed does using FB make you feel?	1.38 (0.55)	1.40 (0.57)	1.36 (0.53)
In general, I like to use FB when I'm stressed	2.83 (1.03)	2.90 (0.99)	2.74 (1.08)
In general, using FB when stressed makes me feel <i>less</i> stressed	3.32 (0.97)	3.04 (1.03)	3.45 (0.86)
In general, using FB when stressed makes me feel <i>more</i> stressed	2.41 (0.99)	2.44 (0.97)	2.38 (1.04)
Psychosocial Stress			
Tension	3.29 (2.78)	3.02 (2.52)	3.62 (3.07)
Anxiety	3.41 (2.86)	3.61 (2.95)	3.12 (2.76)
Well-being	10.93 (2.72)	11.29 (2.49)	10.48 (2.95)
Positive affect	29.40 (8.24)	28.22 (7.67)	30.80 (8.74)
Negative affect	15.05 (4.98)	14.76 (4.02)	15.40 (5.97)
Physiological stress			
Systolic blood pressure	112.34 (12.38)	112.18 (14.15)	112.55 (10.04)
Diastolic blood pressure	71.77 (7.87)	71.94 (8.18)	71.57 (7.58)
Heart rate	72.10 (10.86)	73.98 (11.19)	69.88 (10.14)
Cortisol	0.17 (0.11)	0.18 (0.12)	0.17 (0.10)

Note. Reported values reflect *n* = 92. FB = Facebook. FBI = Facebook Intensity Scale. Participants responded to number of FB Friends, Years with Facebook account, and Daily use as closed-ended questions. For these items, values represent the number, years, and time in minutes that correspond

to the median responses from ordinal 1-to-5 scales. FBI low/high intensity represent number of participants in each group after a median split was applied to the Facebook Intensity Scale. Percentages for each state (lonely, bored, etc.) represent percentage of participants who agreed or strongly agreed with each statement. All other values represent baseline group means and standard deviations. Cortisol values represent raw salivary cortisol concentration in $\mu\text{g/dL}$. Bolded values indicate a significant difference between conditions at $p \leq .05$.

Table 1b. *Full Sample and Condition Values for Baseline and Facebook Use Measures.*

	Full sample	Control Condition	FB Condition
<i>n</i>	100	30	70
Females (<i>n</i>)	48	14	34
Age	19.48 (1.75)	19.29 (1.20)	19.62 (2.28)
FB activity			
FB friends	≤ 200	≤ 300	≤ 200
Years with FB account	≤ 6	≤ 6	≤ 6
Daily use (minutes)	≤ 30	≤ 30	≤ 30
FBI	3.53 (0.79)	3.75 (0.77)	3.44 (0.80)
Most common activities:	View videos, view photos, follow links	View videos, view photos, use FB Messenger	View videos, view photos, following links
I find myself wanting to use FB most when feeling:			
Lonely	42.6%	36.6%	44%
Bored	95%	93.4%	95.7%
Stressed	30%	30%	30%
Sad	19%	16.7%	20%
Anxious	22%	20%	22.8%
In general, how stressed does using FB make you feel?	1.35 (0.54)	1.43 (0.50)	1.31 (0.55)
In general, I like to use FB when I'm stressed	3.00 (1.08)	3.17 (0.95)	2.93 (1.013)
In general, using FB when stressed makes me feel <i>less</i> stressed	3.23 (0.96)	3.20 (0.88)	3.24 (1.00)
In general, using FB when stressed makes me feel <i>more</i> stressed	2.27 (0.85)	2.23 (0.86)	2.29 (0.85)
Psychosocial Stress			
Tension	2.91 (3.09)	4.27 (3.34)	2.33 (2.80)
Anxiety	3.50 (3.61)	4.49 (3.92)	3.07 (3.41)
Well-being	10.57 (2.58)	9.89 (2.45)	10.87 (2.59)
Mood	10.00 (2.36)	9.41 (2.38)	10.25 (2.33)
Insecurity	3.15 (3.38)	3.62 (3.05)	2.95 (3.53)
Irritation	1.56 (2.44)	2.21 (3.05)	1.28 (2.09)
Nervousness	2.82 (3.23)	3.52 (3.80)	2.52 (2.93)
Timidity	2.63 (3.04)	3.17 (3.43)	2.41 (2.86)
Fear	1.49 (2.24)	1.90 (2.35)	1.33 (2.19)
Physiological stress			
Systolic blood pressure	110.53 (13.60)	110.86 (12.01)	110.39 (14.32)
Diastolic blood pressure	72.66 (10.04)	73.40 (8.64)	72.33 (10.64)
Heart rate	73.54 (13.05)	74.20 (15.96)	73.27 (11.68)
Cortisol	0.17 (0.13)	0.21 (0.14)	0.16 (0.12)
sAA	54.83 (51.94)	64.68 (55.59)	50.59 (49.96)
Threat to Social Self			
State Self-esteem	52.84 (9.52)	51.36 (9.53)	53.47 (9.52)
Shame	1.44 (2.25)	1.95 (2.67)	1.22 (2.03)
Humiliation	1.96 (8.01)	1.22 (1.77)	2.28 (9.51)
Self-consciousness	3.77 (4.18)	4.64 (4.27)	3.41 (4.12)
Embarrassment	2.78 (3.61)	3.36 (3.94)	2.53 (3.47)
Self-esteem	9.66 (2.76)	8.33 (2.94)	10.24 (2.49)

Note. Reported values reflect $n = 100$. FB = Facebook. FBI = Facebook Intensity Scale. Participants responded to number of FB Friends, Years with Facebook account, and Daily use as closed-ended questions. For these items, values represent the number, years, and time in minutes that correspond to the median responses from ordinal 1-to-5 scales. Most common activities were determined based on frequency of participants reporting that they did the activity at least once per week. Percentages for each state (lonely, bored, etc.) represent percentage of participants who agreed or strongly agreed with each statement. All other values represent baseline condition means and standard deviations. Cortisol and sAA values represent raw salivary cortisol concentration in $\mu\text{g/dL}$ and sAA concentration in U/mL. Bolded values indicate a significant difference between conditions at $p \leq .05$.

Table 2b. *Control and Facebook Use Condition Means and Standard Deviations During Stress Response.*

	+8		+20		+45		+60	
	Control	FB	Control	FB	Control	FB	Control	FB
Psychosocial Stress								
Tense	7.87(3.52)	6.58 (3.83)	4.90(4.09)	2.84(2.97)	4.16(3.53)	1.82(2.38)	2.81(3.29)	1.41(1.76)
Anxious	7.38(4.03)	6.43(4.41)	5.39(4.08)	2.95(3.03)	4.46(4.04)	2.32(2.89)	3.29(3.45)	1.68(2.12)
Well-being	6.93(3.59)	8.10(3.78)	8.01(3.45)	9.49(3.16)	7.76(3.46)	9.94(3.45)	7.63(3.51)	9.57(3.72)
Mood	5.31(2.85)	7.32(3.32)	6.42(3.48)	8.59(3.14)	7.46(3.24)	9.44(2.84)	7.14(3.23)	10.78(8.37)
Insecure	6.30(3.98)	5.47(4.74)	5.07(4.12)	3.09(3.36)	3.63(3.55)	1.85(2.32)	2.65(2.89)	1.71(2.16)
Irritated	8.35(3.82)	6.06(4.86)	4.96(4.42)	2.68(3.06)	4.41(4.46)	2.18(3.37)	3.64 (4.02)	1.64(2.29)
Nervous	7.05(4.43)	6.01 (4.60)	4.24(3.91)	2.95(3.36)	3.00(3.30)	1.75(2.39)	2.36(2.76)	1.20(1.58)
Timid	6.67(4.51)	4.19(3.99)	4.19(3.99)	2.84(3.48)	2.91(3.11)	1.91(2.83)	2.44(3.11)	1.81(2.38)
Afraid	4.52(4.29)	3.49(4.00)	2.76(3.35)	2.34(3.04)	2.18(2.88)	1.35(1.97)	1.66(2.61)	0.98(1.27)
Physiological Stress								
SBP	129.41(21.98)	123.27(17.84)	112.06(13.03)	107.36(14.12)	106.93(12.48)	104.41(14.04)	108.97(12.44)	103.45(13.07)
DBP	85.00(12.97)	82.33(10.99)	79.03(18.18)	74.36(9.95)	72.73(8.42)	70.31(8.79)	73.20(8.77)	70.58(10.06)
HR	77.03(16.97)	76.27(15.90)	73.40(15.16)	70.63(11.15)	72.66(13.51)	68.97(13.09)	71.60(13.38)	68.94(13.27)
Cortisol	0.12(0.08)	0.12(0.10)	0.25(0.16)	0.29(0.33)	0.15(0.09)	0.18(0.15)	0.11(0.08)	0.14(0.13)
sAA	4.00(1.41)	3.95(1.34)	4.19(0.89)	3.99(0.97)	—	—	—	—
Threat to Social Self								
SSES	40.70(15.14)	47.71(13.82)	—	—	—	—	48.83(13.06)	53.78(13.29)
Shame	6.25(4.98)	4.48(4.41)	4.50(4.11)	2.66(3.21)	3.33(4.15)	1.93(2.65)	3.02(4.02)	1.61(2.14)
Humiliation	6.98(4.92)	5.63(4.79)	5.05(4.59)	3.18(3.93)	3.49(4.35)	1.63(2.24)	2.91(3.62)	1.69(2.34)
Self-conscious	8.20(4.10)	6.68(4.61)	6.07(4.27)	4.22(3.77)	4.10(3.59)	3.08(3.77)	4.25(3.44)	2.95(3.41)
Embarrassed	7.63(4.65)	6.29(4.73)	4.60(4.33)	2.82(3.22)	3.49(3.79)	1.99(2.84)	2.62(3.06)	1.93(2.73)
Self-esteem	7.54(3.53)	7.38(3.57)	6.91(3.19)	8.67(3.45)	7.57(2.74)	9.31(3.25)	10.69(17.18)	9.93(2.80)

Note. SBP = systolic blood pressure. DBP = diastolic blood pressure. HR = heart rate. SSES = State Self-esteem Scale. Cortisol and sAA values represent raw salivary cortisol concentration in $\mu\text{g/dL}$ and sAA concentration in U/mL. Bolded values indicate a significant difference between conditions at $p \leq .05$.

Table 1c. *Sub-sample Participant Demographics for Facebook Use After the Events.*

	Full sample	Used FB After Event	
		Yes	No
n	552	446	106
age	19.78 (1.92)	19.82 (2.03)	19.55 (1.37)
% female	73	75.1	65.4
% underclassmen	64.9	64	69.2
% first generation	71.5	71.7	69.2
MSPSS	65.35 (14.24)	66.15 (13.55)	62.10 (16.54)
FB use min/day	70.21(106.86)	78.45 (115.03)	36.27 (51.96)
FBI total	3.11 (0.82)	3.25 (0.75)	2.52 (0.84)
Initiate	2.65 (0.91)	2.66 (0.89)	2.59 (0.99)
Maintain	4.43 (0.80)	4.45 (0.67)	3.91 (1.10)
Seek social info	3.25 (0.92)	3.35 (0.85)	2.81 (1.06)

Note. FB = Facebook. % Underclassmen = percentage of freshmen and sophomores. MSPSS = Multidimensional Scale of Perceived Social Support. FB min/day = self-reported minutes of Facebook use per day. FBI = Facebook Intensity Scale. Initiate/Maintain/Seek Social Info = Initiating Social Contact, Maintain Social Ties, and Seeking Social Information subscales of the Facebook Connections Strategies Scale. Columns represent the full sample and the number of participants who reported using Facebook for any reason versus not using it at all in response to the events. Bolded values represent significant differences between those who did and those who did not use the site at $p \leq .05$.

Table 2c. *Sub-sample Participant Demographics for Purpose of Facebook Use in Response to the Events.*

	Full sample	Information Seeking		Social Support Seeking		Emotional Expression	
		Yes	No	Yes	No	Yes	No
n	552	427	19	320	126	258	188
age	19.78 (1.92)	19.83 (2.05)	19.66(1.02)	19.90 (2.09)	19.62(1.82)	20.11 (2.40)	19.43 (1.25)
% female	73.00	75.60	61.10	74.40	76.60	73.30	77.40
% underclassmen	64.90	63.60	73.30	62.10	69.40	59.10	71.00
% first generation	71.50	72.50	52.60	71.20	72.50	72.70	70.40
MSPSS	65.35 (14.24)	66.29 (13.54)	62.72 (13.58)	66.34 (13.29)	65.78 (14.21)	66.57 (14.05)	65.64 (12.82)
FB min/day	70.21(106.86)	79.75 (115.96)	47.11 (86.43)	82.46 (120.81)	68.54 (99.03)	87.64 (123.52)	65.86 (101.34)
FBI total	3.11 (0.82)	3.28 (0.74)	2.71 (0.82)	3.36 (0.72)	2.96 (0.77)	3.37 (0.73)	3.08 (0.75)
Initiate	2.65 (0.91)	2.66 (0.88)	2.62 (1.09)	2.68 (0.88)	2.59 (0.89)	2.68 (0.92)	2.63 (0.83)
Maintain	4.43 (0.80)	4.55 (0.67)	4.41 (0.66)	4.53 (0.69)	4.58 (0.59)	4.55 (0.69)	4.54 (0.63)
Seek social info	3.25 (0.92)	3.36 (0.85)	3.23 (0.98)	3.35 (0.87)	3.35 (0.80)	3.36 (0.89)	3.32 (0.80)

Note. % Underclassmen = percentage of freshmen and sophomores. MSPSS = Multidimensional Scale of Perceived Social Support. FB min/day = self-reported minutes of Facebook use per day. FBI = Facebook Intensity Scale. Initiate/Maintain/Seek Social Info = Initiating Social Contact, Maintain Social Ties, and Seeking Social Information subscales of the Facebook Connections Strategies Scale. Columns represent the full sample and the number of participants who reported using Facebook for the purpose of information seeking, social support seeking, or emotional expression in response to the events. Bolded values represent significant differences between those who did and did not use the site for each purpose at $p \leq .05$.

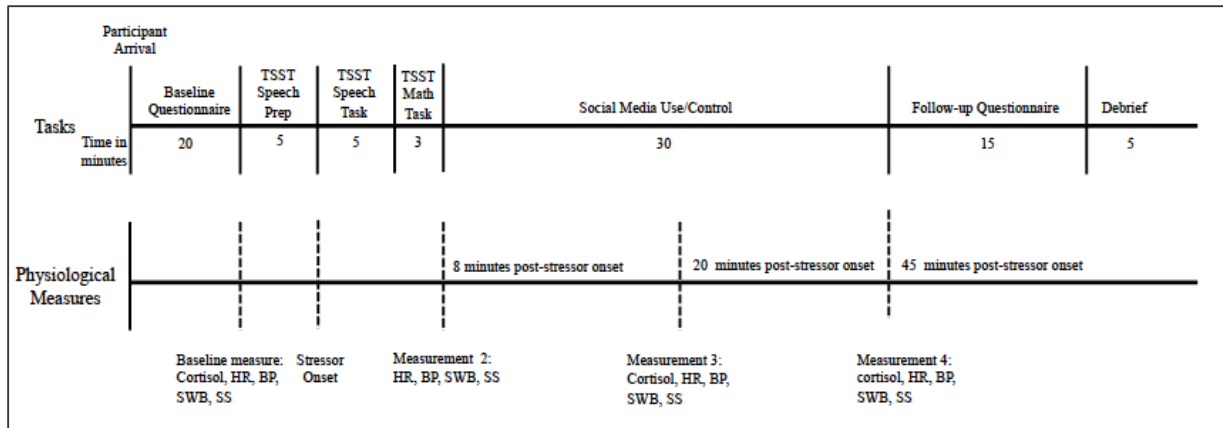
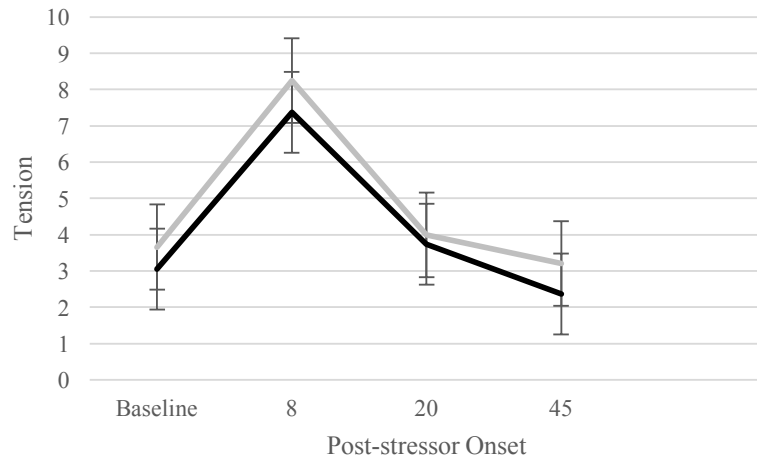


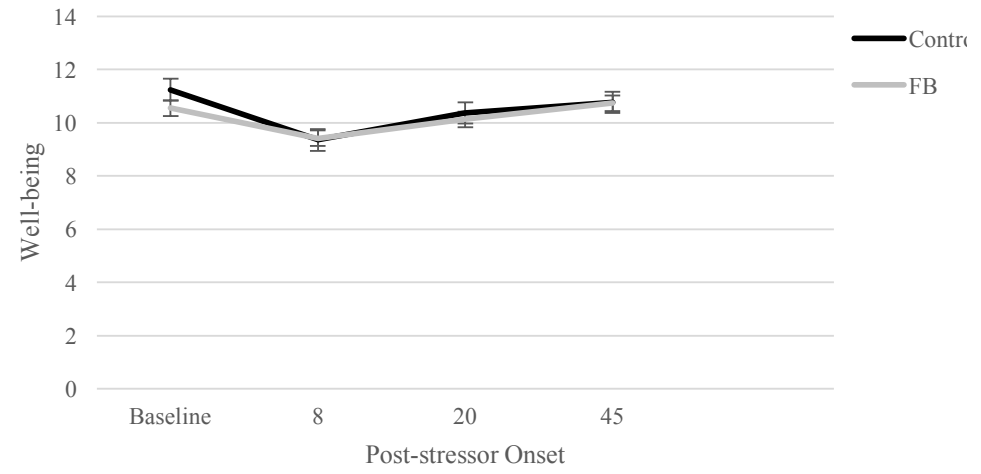
Figure 1a. Timeline for procedural tasks and physiological sample measurements. TSST = Trier Social Stress Test, HR = heart rate, BP = blood pressure, SWB = subjective well-being, SS = subjective stress.

FACEBOOK USE AND STRESS

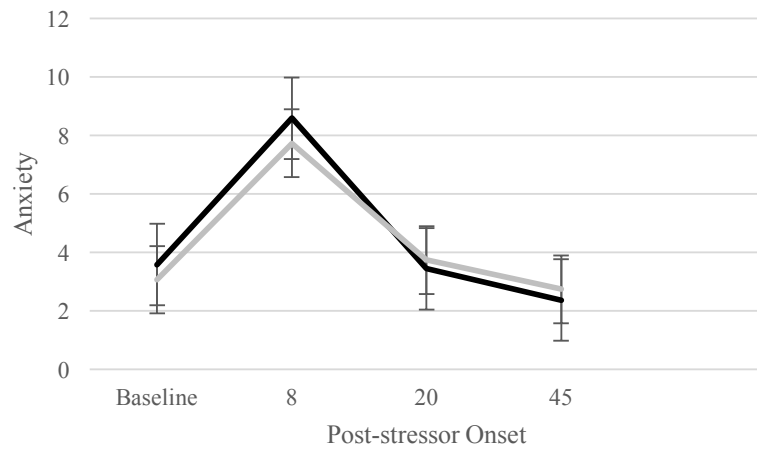
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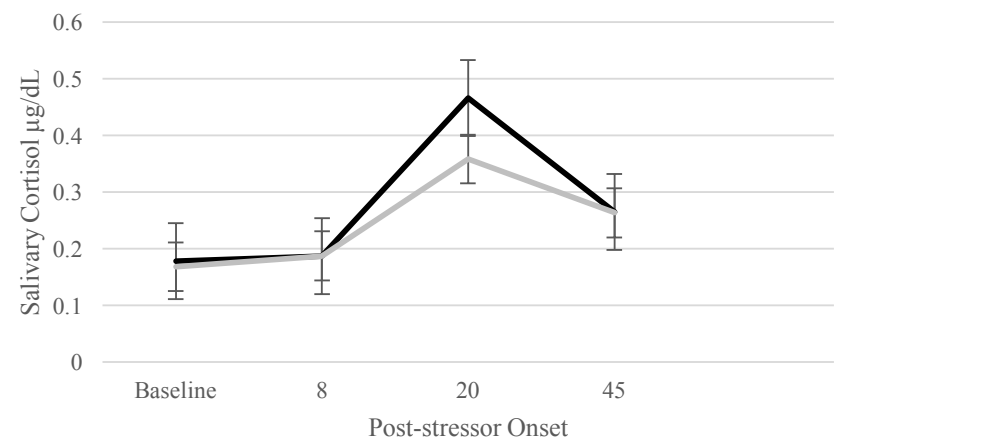
A



C



B



D

Figure 2a. Subjective stress markers and cortisol for Facebook and Control conditions. Bars represent standard errors. Facebook and Control conditions showed no significant differences at any time point ($p < .05$). Raw cortisol values are shown in Plot D; log-transformed scores were used for analyses.

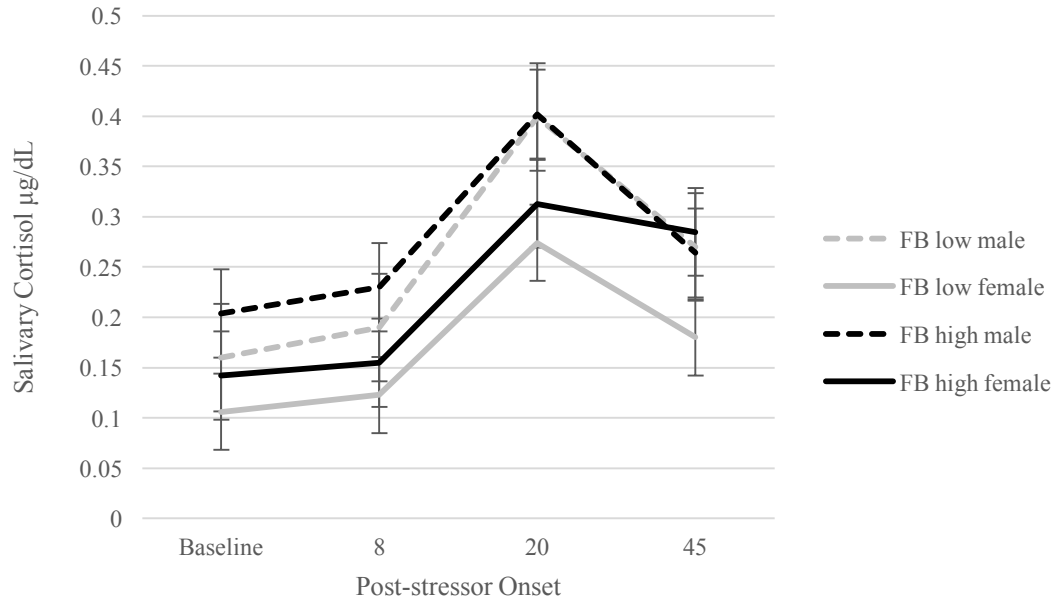


Figure 3a. Salivary cortisol response to stress for the Facebook use condition by gender and high/low Facebook Intensity. Raw cortisol values are reported here; log-transformed values were used for analyses.

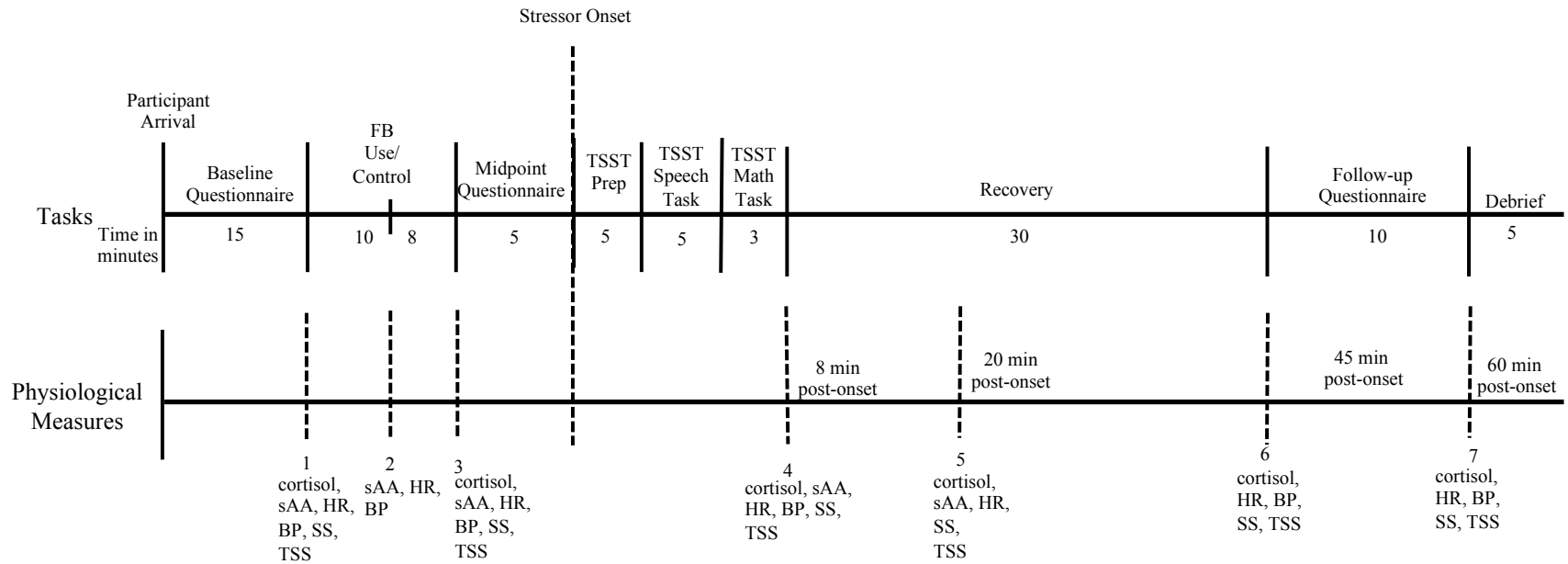
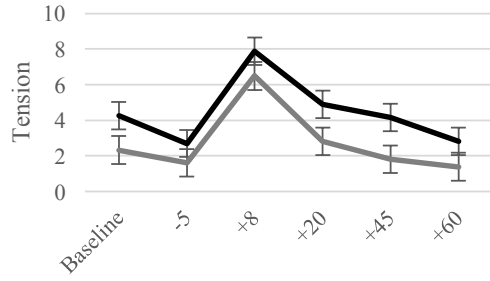


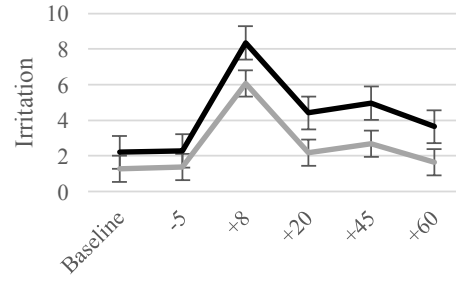
Figure 1b. Timeline for procedural tasks, psychosocial, physiological, and threat to social-self measurements. TSST = Trier Social Stress Test. sAA = salivary alpha-amylase. HR = heart rate. BP = blood pressure. SS = subjective stress. TSS = threat to social self.

FACEBOOK USE AND STRESS

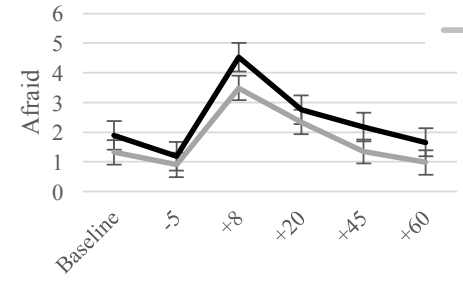
— Control
— FB



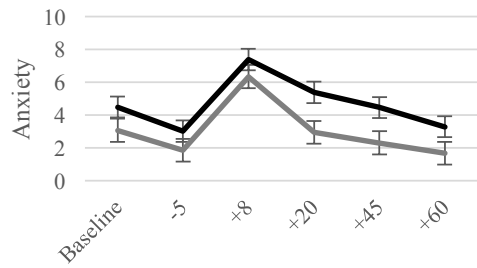
A



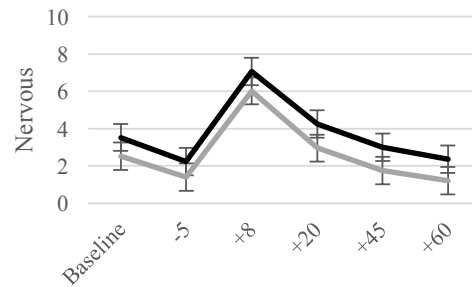
D



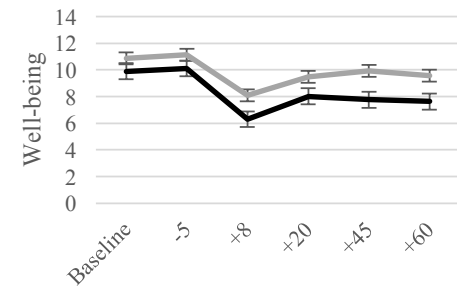
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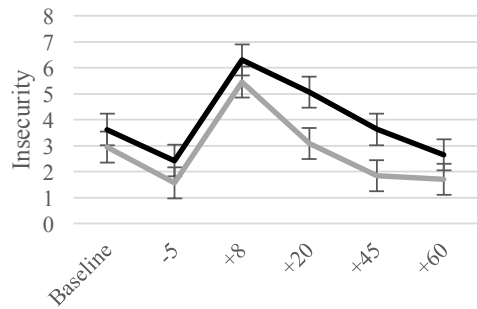
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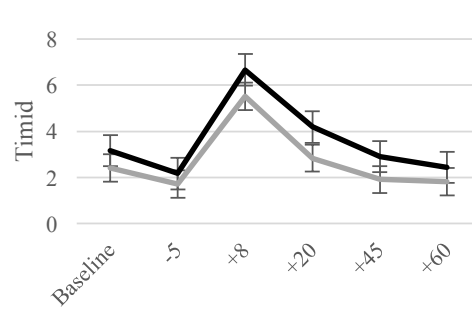
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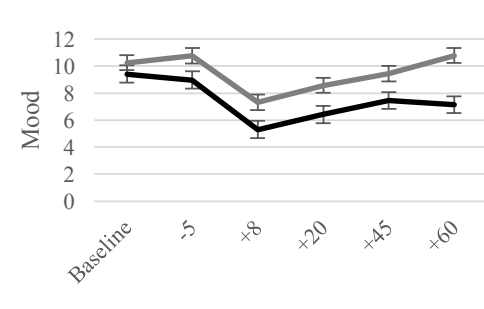
H



C



F

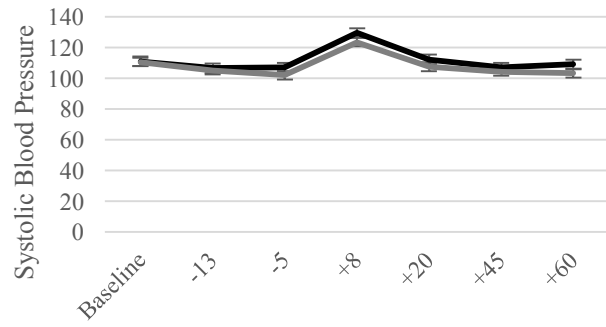


I

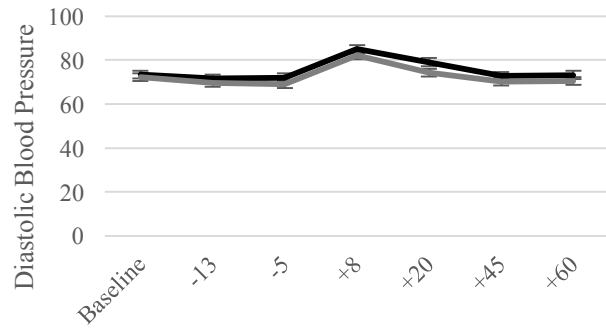
Figure 2b. Psychosocial stress markers for Facebook and Control conditions. X-axes represent minutes post-stressor onset. Bars represent standard errors. Conditions showed significant differences for measures of mood, anxiety, insecurity, irritation, tension, and well-being at $p \leq .05$.

FACEBOOK USE AND STRESS

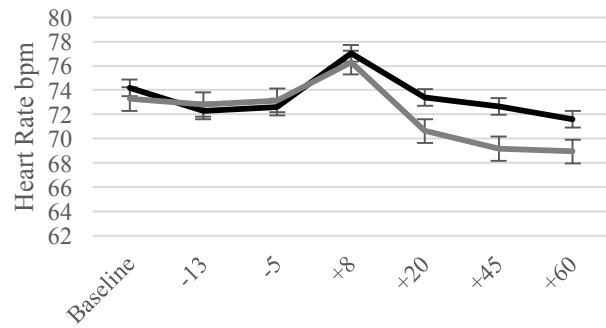
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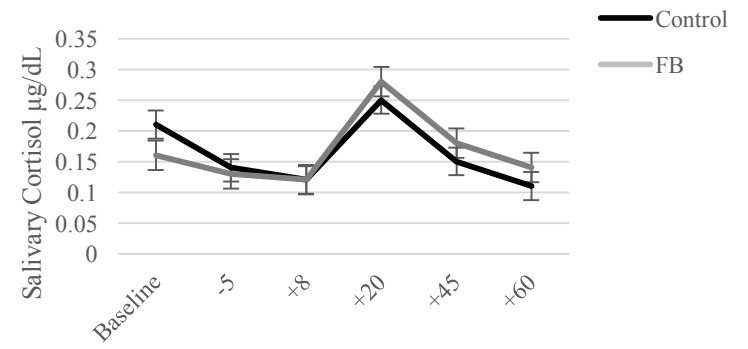
A



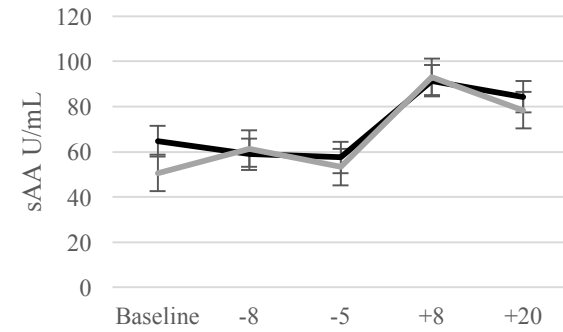
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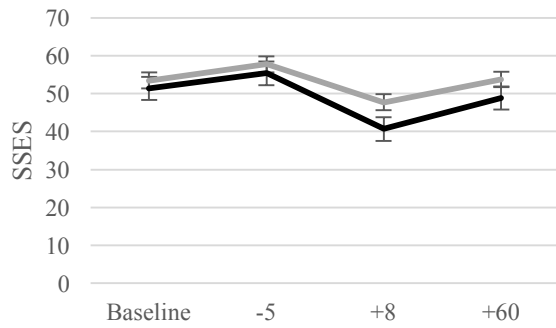


E

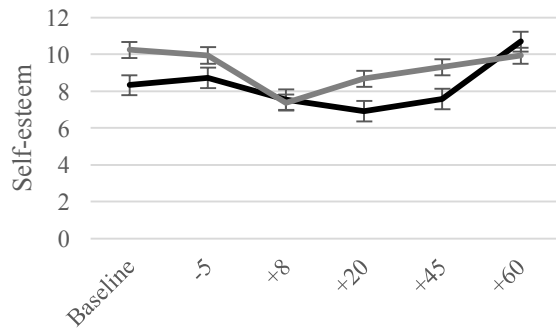
Figure 3b. Physiological stress markers for Facebook and Control conditions. X-axes represent minutes post-stressor onset. Bars represent standard errors. Cortisol and sAA values represent raw salivary cortisol concentration in $\mu\text{g/dL}$ and sAA concentration in U/m; log-transformed values were used for analyses. Conditions showed significant differences for systolic blood pressure at $p \leq .05$.

FACEBOOK USE AND STRESS

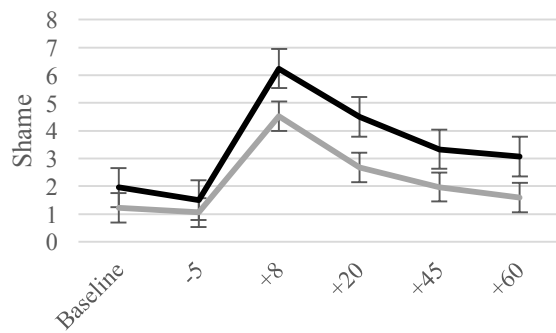
59



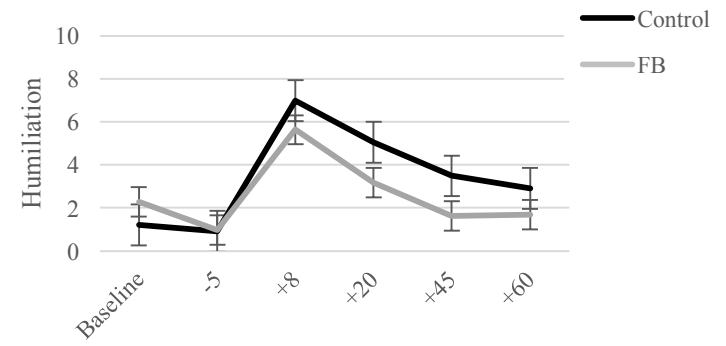
A



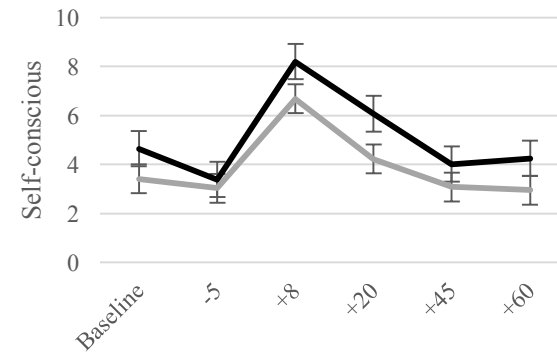
B



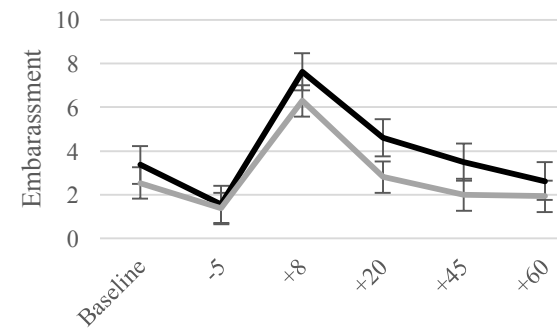
C



D



E



F

Figure 4b. Threat to social-self markers for Facebook and Control conditions. X-axes represent minutes post-stressor onset. Bars represent standard errors. SSES = State Self-esteem Scale. Conditions showed significant differences on measures of SSES, embarrassment, shame, and humiliation at $p \leq .05$.

APPENDIX A—Questionnaire Items

Roman Numerals I, II, and III identify in which study items were used.

Facebook Intensity Scale (I, II, and III)

Approximately how many Facebook friends do you have?

- 0-49
- 50-199
- 200-299
- 300-399
- 400+

How many of your Facebook friends do you consider actual friends?

- 0-5
- 6-19
- 20-39
- 40+

For approximately how many years have you had a Facebook account?

- less than 1 year
- 1-3 years
- 4-5 years
- 6-8 years
- 9+ years

In the past week, approximately how much time PER DAY have you spent actively using Facebook?

- 0-14 minutes
- 15-29 minutes
- 30-44 minutes
- 45-59 minutes
- 60+ minutes

Please rate your agreement with the following statements:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Facebook is part of my everyday life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am proud to tell people that I am on Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facebook has become part of my daily routine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel out of touch when I haven't logged onto Facebook for a while	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that I am part of the Facebook community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would be sorry if Facebook shut down	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Facebook Activity Survey (I, II, and III)

Please indicate how often you do each of the following on Facebook

Facebook Connection Strategies Scale (III)

Please respond to the following scenarios:

Imagine a UC Merced student you've never met in real life or had a face-to-face conversation with. How likely are you to do the following?

	Very Unlikely	Somewhat Unlikely	Neither Likely or Unlikely	Somewhat Likely	Very Likely
Browse their profile on Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add them as a friend on Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contact them using Facebook, or by using Facebook information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meet them face-to-face	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Imagine someone at UC Merced who lives/lived in your residence hall who you would recognize but have never spoken to. How likely are you to do the following?

	Very Unlikely	Somewhat Unlikely	Neither Likely or Unlikely	Somewhat Likely	Very Likely
Browse their profile on Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add them as a friend on Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contact them using Facebook, or by using Facebook information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meet them face-to-face	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Think about one of your close friends. How likely are you to do the following?

	Very Unlikely	Somewhat Unlikely	Neither Likely or Unlikely	Somewhat Likely	Very Likely
Browse their profile on Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add them as a friend on Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contact them using Facebook, or by using Facebook information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meet them face-to-face	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate your agreement with the following statements:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I use Facebook to meet new people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have used Facebook to check out someone I have met socially	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I use Facebook to learn more about other people in my classes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I use Facebook to learn more about other people living near me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Positive and Negative Affect Scale (I)

The following scale consists of a number of words that describe different feelings and emotions.

Read each item and indicate to what extent you feel this way RIGHT NOW

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Disinterested	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Excited	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Strong	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guilty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scared	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hostile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enthusiastic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Proud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ashamed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inspired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nervous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determined	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attentive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jittery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Active	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Afraid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Facebook Use Items

(I, II)

Which method do you MOST OFTEN use to access Facebook?

- Facebook mobile app
- Facebook website from a computer
- Both the Facebook mobile app and the Facebook website

(I, II)

You just used Facebook for (30) 20 minutes. How does this amount of time compare to the amount of time you would normally spend using Facebook in one sitting?

- I normally spend LESS than (30) 20 minutes using Facebook in one sitting
- I normally spend about (30) 20 minutes using Facebook in one sitting
- I normally spend MORE than (30) 20 minutes using Facebook in one sitting

(I, II)

Because you just used Facebook for (30) 20 minutes in one sitting, did you engage in any Facebook activities that you would NOT normally engage in?

- Yes
- No

(I, II)

If so, what did you do?

(I, II)

I find myself wanting to use Facebook most when I am feeling:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Lonely	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bored	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

(I, II)

Please rate your agreement with each of the following statements:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
In general, I like to use Facebook when I am stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In general, using Facebook when I am stressed makes me feel less stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In general, using Facebook when I am stressed makes me feel more stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following set of questions asks about how you feel RIGHT NOW after using Facebook/sitting quietly for the past (30) 20 minutes.

(I, II)

Please indicate which statement you agree with MOST

- Using Facebook/sitting quietly positively changed my mood
- Using Facebook/sitting quietly negatively changed my mood
- Using Facebook/sitting quietly did not change my mood

(I, II)

Please indicate which statement you agree with MOST

- Using Facebook/sitting quietly made me feel less stressed
- Using Facebook/sitting quietly made me feel more stressed
- Using Facebook/sitting quietly did not change my stress level

(I, II)

How much did using Facebook/sitting quietly influence your sense of well-being, either positively or negatively?

- Not at all
- A little
- Moderately
- A lot

(III)

On average, how many TIMES PER DAY do you log into Facebook? (Enter 0 if you log in fewer than once per day.)

(III)

On average, how many MINUTES PER LOGIN do you spend using Facebook?

Visual Analogue Scale Items. (Study I contained only tension, anxiety, and well-being. Study II contained all items)

How tense do you feel right now?	X-----X
Not at all tense	Extremely tense
How insecure do you feel right now?	X-----X
Not at all insecure	Extremely insecure
How anxious do you feel right now?	X-----X
Not at all anxious	Extremely anxious
What is your overall sense of well-being right now?	X-----X
Not at all well	Extremely well
How embarrassed do you feel right now?	X-----X
Not at all embarrassed	Extremely embarrassed
How irritated do you feel right now?	X-----X
Not at all irritated	Extremely irritated
How nervous do you feel right now?	X-----X
Not at all nervous	Extremely nervous
How timid do you feel right now?	X-----X
Not at all timid	Extremely timid
How afraid do you feel right now?	X-----X
Not at all afraid	Extremely afraid
How ashamed do you feel right now?	X-----X
Not at all ashamed	Extremely ashamed
How humiliated do you feel right now?	X-----X
Not at all humiliated	Extremely humiliated

State Self Esteem Scale (II)

These items are designed to measure what you are thinking at this moment. The best answer is what you feel is true of yourself RIGHT NOW.

	Not at all	A little bit	Somewhat	Very much	Extremely
I feel confident about my abilities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am worried about whether I am regarded as a success or failure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel frustrated or rattled about my performance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that I am having trouble understanding things that I read.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel self-conscious.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel as smart as others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel displeased with myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am worried about what other people think of me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel confident that I understand things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel inferior to others at this moment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel concerned about the impression I am making.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that I have less scholastic ability right now than others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel like I'm not doing well.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am worried about looking foolish.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Task Rating (II)

How difficult was the task you just completed (speech and math)?

X-----X

Not at all difficult

Extremely difficult

Did you feel threatened during the task you just completed?

X-----X

Not at all threatened

Extremely threatened

Did you feel challenged by the task you just completed?

X-----X

Not at all challenged

Extremely challenged

**Note that the Visual Analogue Scale has been reduced in size from the original for formatting purposes.

Facebook Use in Response to Campus Violence (III)

Did you use Facebook for ANY purpose during and after the events?

- Yes
- No

Rate your agreement with the following items:

After the events, I used Facebook for finding information (e.g., campus safety, campus closure, details about the suspect and victims, checking on the safety of my friends/family)

- Not at all
- A little
- Somewhat
- Quite a bit
- A lot

Facebook was important for finding information about the events.

- Completely disagree
- Disagree
- Neutral
- Agree
- Completely agree

Using Facebook to find information about the events made me feel mostly:

- Sad
- Angry
- Comforted
- Confused
- Relieved
- Other, please specify _____
- Using Facebook to find information about the events did not affect my feelings.
- I did not use Facebook to find information about the events.

After the events, I used Facebook for seeking social support (e.g., talking with friends/family about the events, etc.)

- Not at all
- A little
- Somewhat
- Quite a bit
- A lot

Facebook was important for seeking social support for the events.

- Completely disagree
- Disagree
- Neutral
- Agree
- Completely agree

Using Facebook to seek social support for the events made me feel mostly:

- Sad
- Angry
- Comforted
- Confused
- Relieved
- Other, please specify _____
- Using Facebook to seek social support in relation to the events did not affect my feelings.
- I did not use Facebook to seek social support in relation to the events.

After the events, I used Facebook for expressing my feelings (e.g., sharing thoughts and feelings about the events)

- Not at all
- A little
- Somewhat
- Quite a bit
- A lot

Facebook was important for expressing my feelings about the events.

- Completely disagree
- Disagree
- Neutral
- Agree
- Completely agree

Using Facebook to express my feelings about the events made me feel mostly:

- Sad
- Angry
- Comforted
- Confused
- Relieved
- Other, please specify _____
- Using Facebook to express my feelings about the events did not affect my feelings.
- I did not use Facebook to express my feelings about the events.

Viewing information about the events on Facebook was upsetting.

- Completely disagree
- Disagree
- Neutral
- Agree
- Completely agree

I avoided using Facebook during and after the events.

- Yes
- No

I used Facebook more than I normally would during and after the events to find information, seek social support, or express my feelings.

- Yes
- No

Overall, Facebook was helpful during and after the events.

- Completely disagree
- Disagree
- Neutral
- Agree
- Completely agree

Overall, Facebook was harmful during and after the events.

- Completely disagree
- Disagree
- Neutral
- Agree
- Completely agree

Demographic Items (I, II, III, unless otherwise noted)

Sex

- Male
- Female
- Other
- Choose not to answer

Age

Year in school at UC Merced

- freshman
- sophomore
- junior
- senior
- senior+

Major

Are you a first-generation college student? (i.e., neither of your parents graduated from a 4-year institution).

- Yes
- No

Race/Ethnicity

- Caucasian/White
- Hispanic/Latino
- African American/Black
- Native American/American Indian
- Asian/Pacific Islander
- Bi-racial _____
- Other _____

(I, II)

Are you currently using hormonal contraceptives?

- Yes
- No

(I, II)

Do you currently smoke cigarettes or other tobacco products?

- Yes
- No

(I, II)

Have you ever smoked cigarettes or other tobacco products?

- Yes
- No

(I, II)

Do you currently use recreational drugs?

- Yes
- No

(I, II)

Have you ever used recreational drugs?

- Yes
- No

(I, II)

Do you currently use any anabolic/androgenic steroids?

- Yes
- No

(I, II)

Have you ever used anabolic/androgenic steroids?

- Yes
- No

(I, II)

On average, how much alcohol do you consume per week? (One drink = 1.5 oz. hard liquor, or 5 oz. wine, or 12 oz. beer)

- none
- 1-2 drinks
- 3-4 drinks
- 5 drinks
- 6+ drinks

(I, II)

Do you currently use prescription medication that contains cortisol, cortisone, or hydrocortisone?

- Yes
- No

Do you currently use anti-depressant medication?

- Yes
- No

Have you ever used anti-depressant medication?

- Yes
- No

Are you currently diagnosed with an anxiety disorder?

- Yes
- No

Have you ever been diagnosed with an anxiety disorder?

- Yes
- No

Do you currently take anti-anxiety medication?

- Yes
- No

Have you ever taken anti-anxiety medication?

- Yes
- No

Are you currently diagnosed with post-traumatic stress disorder (PTSD)?

- Yes
- No

Have you ever been diagnosed with post-traumatic stress disorder (PTSD)?

- Yes
- No