

Mobile Computing Addiction, Depression, and Self-esteem

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Abstract

Over the past several years, mobile computing (MC) technology has undergone rapid advancement and adoption. While MC use now has deep roots in daily life, heavy MC users tend to have worse mental health and weakened cognitive abilities compared to those without MC devices (Ward, Duke, Gneezy, & Bos, 2017). This research study explored associations between the usage time of four MC applications (Instagram, Snapchat, Facebook, Email), depression, self-esteem, and self-reported MC addiction. Seventy-seven Connecticut College students completed the revised Center for Epidemiologic Studies Depression Scale (CESD-R), the Rosenberg Self-esteem Scale (RSE), and the Problematic Mobile Phone Use Scale (PUMP). These participants also reported their screen time spent on each of the four MC apps based on their phone battery's 7-day report, as well as a brief questionnaire about any atypical MC usage during that week. Depression scores and Snapchat usage time were negatively correlated ($r(70) = -.292$, $p = .014$). Potential behavioral modifications that could improve the general well-being of MC users are discussed.

Keywords: mobile computing, usage time, addiction, depression, self-esteem

Mobile Apps' Effects on Depression and Self-perception

The mind is susceptible to damage from today's ubiquitous MC (mobile computing). Over the past several years, MC technology has undergone rapid advancement and adoption. MC now has deep roots in day-to-day life. Disconnecting from this technology could place users at severe disadvantages. Using MC positions users to succeed; social media applications (apps) enable users to satisfy the drive to connect with others, utility services like Uber give users access to technological systems, and LinkedIn and AngelList help users find career opportunities. MC can help us survive and find fulfillment. However, such a sudden, radical adoption of MC is also associated with negative side effects for many users. Heavy MC users tend to have worse mental health and weakened cognitive abilities compared to those without MC devices (Ward, Duke, Gneezy, & Bos, 2017). Our MC use might offer a world of information, communicative power, imagined online communities and more, at the very tips of our fingers, but MC may also cause us a great deal of loss.

With MC still in its infancy, researchers have a lot to learn about its effects on mental health and cognition. The majority of research on this topic addresses the connection between MC use, addiction, and variables such as depression, self-control, and self-perception. A cross-sectional study from 2017, for example, identified that MC use is strongly associated with depression, anxiety, compulsive behavior, functional impairment and even addiction symptoms such as tolerance and withdrawal (Matar Boumosleh, Jaalouk, & Hayashi, 2017). The apparent addiction processes of MC suggest that the urge to interact with one's MC grows over time, and will therefore worsen if not soon confronted. Existing research helps to clarify some of the connections between MC user behavior and symptoms: Alexithymia, the inability to identify and describe emotions in the self, is a strong predictor of abnormally high MC use, suggesting that MC use could be a symptom (Gao, et al., 2017). In addition, strong attachment anxiety is also a predictor of high MC use (Han, Geng, Jou, Gao, & Yang, 2017). Other research has identified strong associations between MC use and a slew of socio-psychological dimensions; loneliness, boredom, egoism, and independence (Titilope, 2014). Relationship, love-affair, and work-related stress are also predictors of high MC use (Kuang-Tsan & Fu-Yuan, 2017). The research has gone so far as to identify an association between MC use and the quality of parenting (Lian, You, Huang, & Yang, 2016). While there is far more research to be done on the topic, many researchers are starting to believe that

eliminating the use of some MC apps and/or reducing overall use can have a positive effect on many parts of a user's life (Carr, 2017).

Quitting MC is not, however, a cure-all when it comes to mental health. Recent studies on academic performance vs. MC use reveal confounding variables; study time, for example, is a better predictor of academic success than is MC use (Olufadi, 2015). Such research shows that not all MC users are equally susceptible to the negative side effects associated with the addiction. It may even show that some MC users are not experiencing the "addiction" at all. More recently, researchers have turned to personality type as the key to understanding the variability in addiction among MC use. In the case of weak self-perception, MC is often used as a tool to garner validation, which may further weaken self-perception in a vicious cycle (De-Sola, Talledo, Rubio, & Rodríguez de Fonseca, 2017). The cyclical nature of MC use weakening self-perception supports the idea that one could work to strengthen self-perception as a way of breaking the addiction.

While existing studies have explored associations between personality type and engagement with MC, the data collected often includes now-outdated interactions, such as the use of SMS, calling, and changing the background wallpaper on the device (Blaszczynski, Butt, & Phillips, 2008). With so much application evolution, the recent ubiquity of social media, and greater overall processing ability (for instance, providers can serve entire movies over a cellular network), the way users engage with this technology remains in continual flux. MC is not just one tool, but rather, potentially millions of tools encapsulated in one mobile device. Because MC use encapsulates great complexity, psychological research must tackle countless subtopics. One subtopic, to which researchers have paid great attention, is gaming. In a study from 2010, researchers found a strong association between playing video games and having low self-esteem (Jackson, Von Eye, Fitzgerald, Zhao, & Witt, 2010). This type of research is particularly useful because it provides data on a critical yet non-existent instruction manual: how to tweak interactions with technology to support mental health.

Researchers investigating these subtopics must also take into account the users' approach to interacting with MC. There are so many MC users, use cases, experiences and other exceptions which inhibit otherwise strong research. A recent study attempted to combat use case as a confounding variable:

researchers investigating WeChat (one of the predominant social media apps in China) collected data about how users sought to control their social environments (Hou, et al., 2017). Specifically, they collected data on the context of, and emotion behind, the engagement. Whether one is dealing with confrontational or pleasurable communications, for example, is critical in understanding the complete picture of MC's effect. Susceptibility to MC's side effects could change at a moment's notice. Not only are the users always changing, but so is the MC and its subtopics.

This "instruction manual" is critical as it becomes increasingly apparent that mental health is suffering. In 2013, a team of Taiwanese researchers found a strong association between MC use, suicidal ideation, and number of suicide attempts (Peng-Wei, et al., 2014). As MC grows more ubiquitous and takes on even greater roles in our lives, it will likely continue to impact mental health and claim victims (some of which will commit suicide as the result of toxic MC addiction). Surely, one would think that finding solutions is one of the top priorities of the corporations that create MC platforms and apps. Yet, we live in a turbulent transitional period in which the technology creators capitalize on addiction to survive in their competitive marketplace. Businesses employ lobbyists to help control widespread perceptions of MC as a purely-positive force for the general population's wellbeing.

To be fair, MC is, in many ways, a force for good. It gives our world a kind of central nervous system, and we can communicate in new and unprecedented patterns. It also brings about revolutions and allows disenfranchised people to claim their rightful voices. MC is without a doubt a force for good in the longterm advancement of humankind, and this research does not mean that it is time to shut down MC development. The aforementioned literature leads us to demand a plan that prioritizes the health of MC users. It is time to design new research to tackle the widespread MC and subtopics of 2017 and beyond. Contrasting social media, entertainment, utility, and other apps can give insight into what is an acceptable or healthy use of MC, and what should be abandoned. In the likely case that users refuse to abandon harmful MC apps, perhaps there is a way to tweak use patterns to benefit mental health and cognition. Many developers and data scientists have attempted to create MC apps for mental healthcare (Luxton, McCann, Bush, Mishkind, Reger, Roberts & Michael, 2011). Unfortunately, these solutions have not been created using the data insights of addiction-promoting tech companies. Meditation, diet, and exercise monitoring apps might be a step in the right direction, but they, by no means, undo our many steps in the

harmful direction. Without the kinds of large-scale psychological insights that the tech creators exploit, it is going to be a challenge to create effective technology-based solutions to preserve mental health. Tackling this issue might be a matter of educating users and protecting them through shifting the legislative priorities of government. This is difficult, however, when many of these MC companies control resources on which governments rely. Perhaps, necessary change will come about naturally when MC reaches max-toxicity. In that event, users would attribute poor mental health to MC and demand change. It would be ironic for such a revolution to take place on MC platforms, but perhaps this is one of its' healthy uses. In any event, this category of research can pave the way for such an awakening and, ultimately, a process of healing.

Method

Research Design

This IRB-approved, correlational, within-subjects study was designed to illuminate associations between app (Instagram, Snapchat, Facebook and Email) usage time, depression, self-esteem, and self-reported MC addiction. There were several research hypotheses:

A) High Snapchat usage will have the strongest significant association (more so than Instagram and Facebook) with high depression and low self-esteem.

B) Email usage will have a significant association with low depression and high self-esteem.

C) High PUMP scores will be associated with high CESD-R and low RSES scores.

To avoid carryover effects, presentation ordering of scales and usage input were partially counterbalanced into two configurations: (A) scales, usage entry, and (B) usage entry, scales.

Participants

The participants were 77 students attending Connecticut College that received credit to fulfill a course requirement. They were required to both have and use the four focus apps (Facebook, Instagram, Snapchat and Email) on their MC device (iOS device required). The participants were found through SONA and were selected without regard to demographic background.

Materials

Participant Consent Form (See Appendix A)

Center for Epidemiologic Studies Depression Scale Revised (See Appendix B)

Severity of depression was measured using the revised Center for Epidemiologic Studies Depression Scale (CESD-R). Originally developed by Laurie Radloff, questions from this scale relate to participants' experience of depression symptoms. Certain questions were reverse-scored. Composite scores range from zero to 60, with lower scores indicating low levels of depression and higher scores indicating severe depression. This scale has a high internal consistency (Cronbach $\alpha = .85-.9$) (Beck, Steer, & Brown, 1996).

Rosenberg Self-esteem Scale (See Appendix C)

Self-esteem was measured with the Rosenberg Self-esteem Scale (RSES), which was developed by Morris Rosenberg. The RSES is composed of ten questions, five of which are positively-worded with the other five negatively-worded (negatively-worded questions were reverse-scored). Response options of RSES questions range from one to four, with lower values indicating agreement and higher values indicating disagreement. This scale has a high internal consistency (Cronbach $\alpha = .85$) (Rosenberg, 1965).

Problematic MC Use Scale (See Appendix D)

Participants' perceptions of whether their MC usage/addiction is problematic were measured using the Problematic Mobile Phone Use (PUMP) Scale. Questions from this scale asked about MC's effects on tolerance, withdrawal, time management, physical and psychological state, responsibility, risk-aversion and relationships. The composite of question scores can range from zero to 100, with lower scores indicating that subjects do not see their use of MC as problematic. This scale has a high internal consistency (Cronbach $\alpha = .94$) (Van Dam, Earleywine, 2011).

App Usage Time Report Form (See Appendix E)

This form was specific to this study, and included four simple, numerical inputs. Users were instructed to navigate to the battery section of their settings application on their MC device. From there, they selected the "past 7 days" overview, and reported the screen time they spent on Instagram, Snapchat, Facebook, and their chosen Email provider.

App Usage Anomaly Check (See Appendix F)

This questionnaire was also specific to this study. In order to eliminate potential outliers, the final questionnaire asks participants whether their MC usage over the past 7 days is atypical or deviates from their normal usage.

Debriefing Form (See Appendix G)

Procedure

SONA was used to enroll participants. Once enrolled, participants attended a 30-minute session, during which they were instructed to navigate to a url, which redirects to a Qualtrics survey (with the various form and survey materials in a simple, digital form). Participants were instructed to "complete the survey, and tell me your name before you leave, so that I can give you course credit." The study took place in Bill Hall over the course of three separate sessions, each of which had a maximum enrollment of

30 participants. The data were anonymized and its availability was restricted to the analysis process. The ethical issues were limited to requesting participants to reflect on their emotional state, self-esteem, and potentially problematic MC use.

Results

| | n | M | SD |
|-----------------------|----------|----------|-----------|
| CESD-R score | 70 | 19.43 | 7.29 |
| RSE score | 70 | 20.67 | 5.71 |
| PUMP score | 70 | 35.13 | 13.7 |
| Snapchat Usage (hrs) | 70 | 5.77 | 6.27 |
| Instagram Usage (hrs) | 70 | 4.86 | 4.45 |
| Facebook Usage (hrs) | 70 | 1.71 | 2.52 |
| Email Usage (hrs) | 70 | 1.52 | 3.97 |
| Total App Usage (hrs) | 70 | 13.87 | 13.59 |

Table 1. Means and standard deviations

The statistical analyses used for this study include multiple Pearson correlations. Analyses were meant to explore the usage of each application as a correlate of scores on the 3 scales. Analyses were also meant to explore associations with participant views of whether their MC usage (self-perceived addiction) is problematic. Seven participant entries with over 40 total hours of app usage were excluded from analysis, however no participants were excluded due to their responses on the App Usage Anomaly form.

The first hypothesis, that there would be a correlation between Snapchat usage time and depression scores, was supported, however it was in the opposite direction of what was predicted. A Pearson's correlation test reveals a moderate negative correlation ($r(70) = -.292, p=.014$). Participants with relatively high depression scores tended to have relatively low Snapchat usage.

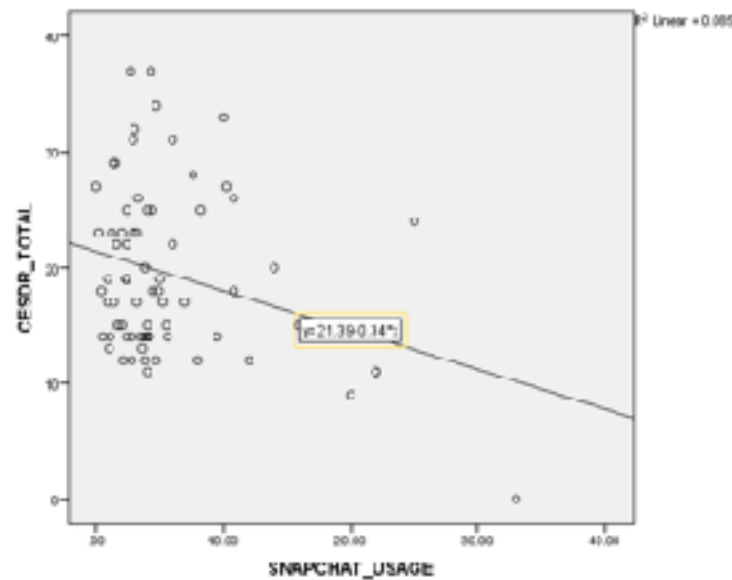


Figure 1. Depression scores (CESD-R) and Snapchat usage time (hrs)

The second hypothesis, that Email usage would be associated with low depression and high self-esteem, was rejected. Both Pearson's correlations were insignificant, for example, email usage time and depression scores ($r(70) = -.049, p=.689$).

The third hypothesis, that high PUMP scores would be associated with high CESD-R and RSES scores, was also rejected. Nevertheless, further analysis of relationships between PUMP and other data revealed a weak to moderate negative correlation with Email usage time that bordered on significance ($r(70) = -.292, p=.053$). Additionally, the combined hours of the four focus apps held a similar correlation to depression scores, however it also bordered on significance. ($r(70) = -.229, p=.057$).

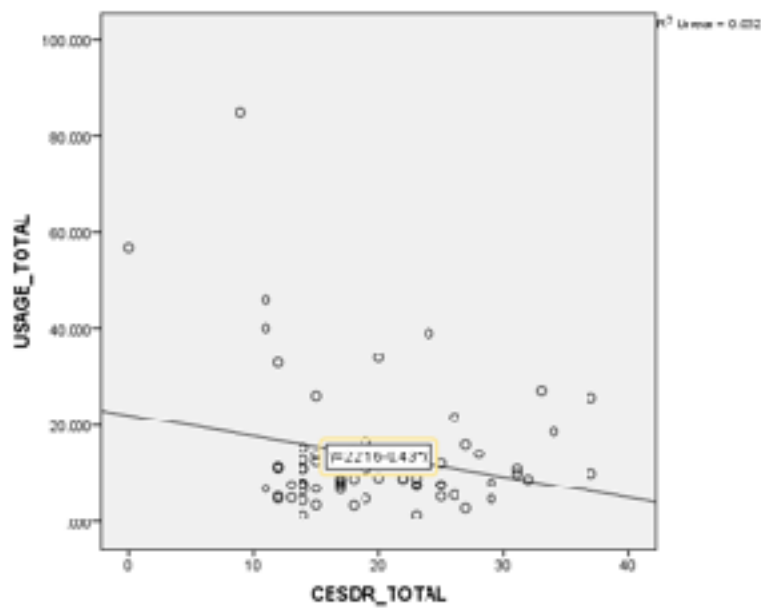


Figure 2. Depression scores (CESD-R) and combined usage time

Finally, there was a weak to moderate association between PUMP scores and email usage time that also bordered on significance ($r(70) = -.232, p = .053$).

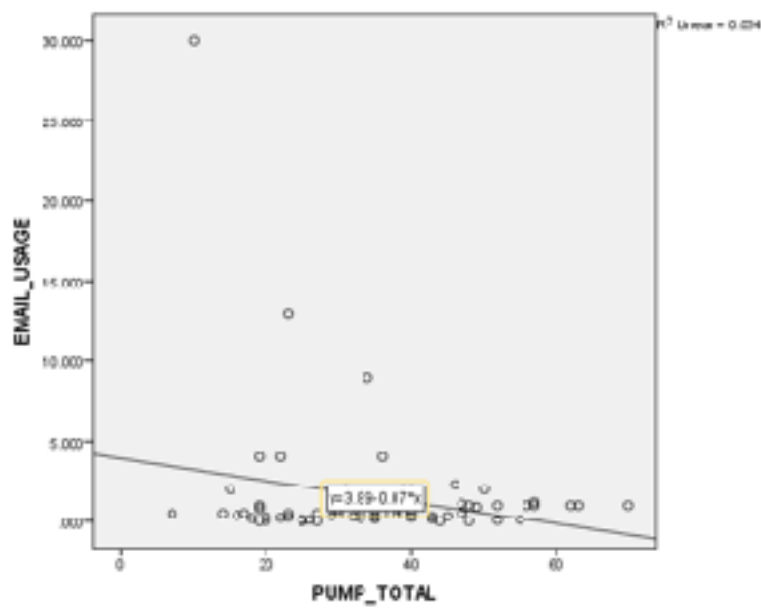


Figure 3. Email usage time and PUMP scores

Discussion

Individuals reporting depression symptoms actually spent less time on average across the four focus apps. While the first hypothesis was developed with the underlying assumption that Snapchat usage would directly affect depression scores in a positive direction, the inverse was seen. The same is true for the association between combined hours and depression. Given that the participants were already users of the MC apps, they were accustomed to a certain “fix” of MC time. These weak to moderate associations suggest that the time users spend on the focus apps could have a direct bearing on their levels of depression. The associations also suggests that feelings of depression could motivate one to turn to MC as a coping mechanism. If the former is true (that reaching higher usage times results in greater overall happiness of the user), it would follow that a reduction or complete halting of MC usage would result, at least in the short-term, in greater symptoms of depression. In the long-term, however, perhaps the association would be diminished, resulting in levels of depression (or a lack thereof) that are unlinked from something so variant and sometimes-trivial as interactions with MC.

The second hypothesis, that Email usage time would be associated with higher self-esteem and lower depression scores, is rejected. The underlying assumption that shaped this hypothesis was that those who spend more time on email than others are doing so for self-advancement purposes. Email is often considered to be a very formal or strictly-professional platform by college students. It would follow that those who engage the most with such a platform are working toward a brighter future for themselves, which is intrinsically rewarding and should produce lower levels of depression and higher self-esteem. No such association was found.

However, an association was found between Email usage time and high PUMP scores. This suggests that heavy Email users were more aware of their mobile computing usage as something that could be problematic. These users did not necessarily spend more time on their devices than others, yet they paid greater attention to the likelihood of MC habits as being something they should improve upon.

There was little variation between self-esteem scores, which made it difficult to find any kind of correlation between self-esteem and the other data. Before the completion of the study, with only 54 participant entries, a Pearson’s correlation test revealed a moderate association between self-esteem and PUMP scores ($r(54) = -.28, p=.037$). Somehow, the extra 16 participants reduced the strength of the

association and jolted the significance outside the bounds of the desired threshold. Nevertheless, this finding suggests that one's image of their own mobile computing habits is linked to self-esteem. Depending on the direction(s) of this association, one could (a) improve self-esteem by reducing mobile computing usage, or (b) become less MC-addicted by fostering better self-perception.

Confounds and future directions

This research was limited by participant availability, which limited statistical power. There was no demographics questionnaire, so it was impossible to understand the extent to which various elements of identity affected the data. When analyzing depression scores, it's important, in the future, to account for gender differences (as women are at greater risk for depression than men). To combat this confounding variable, future versions of this study could separate participants into quasi-experimental groups by gender.

A shortcoming of this study's data collection and analysis is its lack of objective outlier identification. The number input fields for hours spent weren't validated with any rules. If participants had wanted to do so, they could have entered that they'd spent a trillion hours on an app in one week. While no outliers this extreme were observed, there were a few responses that seemed too extreme to allow into the analyses. The cutoff for maximum time spent was arbitrarily set at 40 hours per week. Based off rough calculations, it seems unlikely that a student could fulfill academic requirements, eat, sleep, and still have this much time for MC interaction. In future versions of the study, it will be important to create validation rules for time spent on MC. The ultimate solution to this problem would be programmatically retrieving values from participants' devices (perhaps through an application created for the study). This solution would prevent participants from reporting false data. Moreover, the participant would not be as aware of what data is being collected, which could be helpful in further minimizing carryover effects. While partial counterbalancing (via two survey orderings) was implemented to reduce the effect of screen time reporting on other responses, this could have been implemented in a more systematic way. There was no way to control the number of participants in each group, which meant that either counterbalancing group was different in size. In future research, not only would I like to control for potential carryover effects between screen time reporting and the scales section, I would also like to randomize the presentation of scales and of the questions within them.

Another limitation of the study is that it was limited to only four focus apps. Within this set are three social media applications and a platform which is regarded as a professional communication utility. In choosing the focus applications for an updated version of this study, it would be beneficial to opt for variation in application genre. Similarly, there are major differences in an application's user experience depending on the platform. In this study, participants had to be users of iOS. It would be interesting to explore differences in mental health between Android and iOS users (perhaps even device model).

Selecting new scales would also be a good next step, specifically regarding the intricacies of personality type and interpersonal shortcomings. Longitudinal research on the reduction of mobile computing usage could potentially reveal many changes in a given subject depending on mobile computing habits and the strength of the addiction. Perhaps this is a good route to finding an optimal usage balance which is tailored to each individual's personality type.

References

- Blaszczynski, A., Butt, S., & Phillips, J. (2008). Personality and self reported mobile phone use. *Computers in Human Behavior*, 24(2), 346-360. doi:10.1016/j.chb.2007.01.019
- Carr, N. (2017). How Smartphones Hijack Our Minds. *The Wallstreet Journal*. Retrieved from <https://www.wsj.com/articles/how-smartphones-hijack-our-minds-1507307811>
- De-Sola, j., Talledo, H., Rubio, G., & Rodríguez de Fonseca, J. (2017). Development of a Mobile Phone addiction Craving Scale and its validation in a Spanish adult population. *Frontiers in Psychiatry*, 8(8). doi: 10.3389/fpsy.2017.00090
- Gao, T., Li, J., Zhang, H., Gao, J., Kong, Y., Hu, Y., & Mei, S. (2017) The influence of alexithymia on mobile phone addiction: The role of depression, anxiety and stress. *Journal of Affective Disorders*, 225, 761-766. doi:10.1016/j.jad.2017.08.020
- Han, L., Geng, J., Jou, M., Gao, F., & Yang, H. (2017). Relationship between shyness and mobile phone addiction in Chinese young adults: Mediating roles of self-control and attachment anxiety. *Computers in Human Behavior*, 76, 363-371. doi:10.1016/j.chb.2017.07.036
- Hou, J., Ndasauka, Y., Jiang, Y., Ye, Z., Wang, Y., Yang, L., & Zhang, X. (2017). Excessive use of WeChat, social interaction and locus of control among college students in China. *PLoS ONE*, 12(8), e0183633. doi:10.1371/journal.pone.0183633
- Jackson, L., Von Eye, A., Fitzgerald, H., Zhao, Y., & Witt, E. (2010). Self-concept, self-esteem, gender, race and information technology use. *Computers in Human Behavior*, 26(3), 323-328. doi: 10.1016/j.chb.2009.11.001
- Kuang-Tsan, C. & Fu-Yuan, H. (2017). Study on relationship among university students' life stress, smart mobile phone addiction, and life satisfaction. *Journal of Adult Development* 24(22), 109-118. doi: 10.1007/s10804-016-9250-9
- Lian, L., You, X., Huang, J., & Yang, R. (2016). Who overuses Smartphones? Roles of virtues and parenting style in Smartphone addiction among Chinese college students. *Computers in Human Behavior*, 65, 92-99. doi: <https://doi.org/10.1016/j.chb.2016.08.027>

- Luxton, D., McCann, R., Bush, N., Mishkind, M., Reger, G., Roberts, & Michael C. (2011). MHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice*, 42(6), 505-512. doi:10.1037/a0024485
- Matar Boumosleh, J., Jaalouk, D., & Hayashi, N. (2017). Depression, anxiety, and mobile phone addiction in university students- A cross sectional study. *PLoS ONE*, 12(8). doi: 10.1371/journal.pone.0182239
- Merlo, L., Stone, A., & Bibbey, A. (2013). "Measuring Problematic Mobile Phone Use: Development and Preliminary Psychometric Properties of the PUMP Scale." *Journal of Addiction*, 2013. doi: 10.1155/2013/912807
- Olufadi, Y. (2015). A configurational approach to the investigation of the multiple paths to success of students through mobile phone use behaviors. *Computers & Education*, 86, 84-104. doi:10.1016/j.compedu.2015.03.005
- Peng-Wei, W., Tai-Ling L., Chih-Hung K., Huang-Chi L., Mei-Feng H., Yi-Chun Y., & Cheng-Fang Y. (2014). Association between problematic cellular phone use and suicide: The moderating effect of family function and depression. *Comprehensive Psychiatry* 55(2), 342-348. doi:10.1016/j.comppsy.2013.09.006
- Rosenberg, M. (1965). Society and the adolescent self-image. Princeton, NJ: Princeton University Press.
- Titilope, A. O. (2014). Socio-psychological dimensions of mobile phone addiction and usage patterns amongst teenagers in higher institutions of learning in Kwara State. *International Journal of Information and Communication Technology Education*, 10(2), 1+. doi:10.4018/ijicte.2014040101
- Van Dam, N., Earleywine, M. (2011). Validation of the Center for Epidemiologic Studies Depression Scale—Revised (CESD-R): Pragmatic depression assessment in the general population. *Psychiatry Research*, 186(1). doi: 10.1016/j.psychres.2010.08.018
- Ward, A. F., Duke, K., Gneezy, A., & Bos, M. W. (2017). Brain drain: The mere presence of one's own smartphone reduces available cognitive capacity. *Journal of the Association for Consumer Research*, 2(2), 140-154. doi: 10.1086/691462

Yang, Yuan-Sheng & Yen, Ju-Yu & Ko, Chih-Hung & Cheng, Chung-Ping, & Yen, Cheng-Fang. (2010).

The association between problematic cellular phone use and risky behaviors and low self-esteem among Taiwanese adolescents. *BMC Public Health*. 10, 217+. doi: 10.1186/1471-2458-10-217

*Appendix A***Consent Form to Participate in Research at Connecticut College**

I have been asked to participate in a research study conducted by Harry Solovay (harrysolovayuxresearch@gmail.com) of Connecticut College.

INTRODUCTION: In accordance with the policies of Connecticut College, I have been asked to read this information carefully. If I agree to participate, I will sign in the space provided to indicate that I have read and understood the information furnished on this consent form.

PURPOSE: The purpose of this research is to investigate mobile computing usage.

DURATION AND LOCATION OF STUDY: If I agree to participate in this study, my participation will last for a half hour. A requirement of participation is attendance at Bill Hall, room 308.

PROCEDURES: Participants of this study will report the amount of time they spent on Facebook, Instagram, Snapchat, and Email. Finally, participants will fill out several surveys administered through Qualtrics.

POTENTIAL RISKS AND DISCOMFORTS: I understand there are no known or anticipated risks associated with participation in this study.

BENEFITS: A benefit to me of participating in this study is that I will fulfill a course requirement.

CONFIDENTIALITY: I understand the data collected in this study will be kept confidential unless disclosure is required by law.

RIGHT TO REFUSE OR WITHDRAW: I understand that my participation is voluntary. I may refuse to participate or discontinue my participation at any time; there will be no penalty for doing so and I will still receive my course credit as stated above. Some details of this project may not be made known to me until my session is completed. I realize at the completion of the session that I have the option of withholding the responses I have provided from subsequent analysis. I also understand that the researcher has the right to withdraw me from participation in the study at any time.

OFFER TO ANSWER QUESTIONS: If I have any questions about this study, I may email the researcher (Harry Solovay) at harrysolovayuxresearch@gmail.com. If I have questions about my rights as a participant, I may contact the Connecticut College IRB at alzak@conncoll.edu.

I certify that I am at least 18 years old and I agree to participate in this research project:

Signature: _____

*Appendix B***Center for Epidemiologic Studies Depression Scale Revised (CESD-R)**

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

- 1 = rarely or none of the time (less than 1 day)
- 2 = some or a little of the time (1-2 days)
- 3 = occasionally or a moderate amount of time (3-4 days)
- 4 = most or all of the time (5-7 days)

- 1) I was bothered by things that usually don't bother me.
- 2) I did not feel like eating; my appetite was poor.
- 3) I felt that I could not shake off the blues even with help from my family or friends.
- 4) I felt that I was just as good as other people.
- 5) I had trouble keeping my mind on what I was doing.
- 6) I felt depressed.
- 7) I felt that everything I did was an effort.
- 8) I felt hopeful about the future.
- 9) I thought my life had been a failure.
- 10) I felt fearful.
- 11) My sleep was restless.
- 12) I was happy.
- 13) I talked less than usual.
- 14) I felt lonely.
- 15) People were unfriendly.
- 16) I enjoyed life.
- 17) I had crying spells.
- 18) I felt sad.
- 19) I felt that people dislike me.
- 20) I could not get "going."

*Appendix C***Rosenberg Self-esteem Scale**

Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement.

| | | | |
|----------------|-------|----------|-------------------|
| 1 | 2 | 3 | 4 |
| Strongly agree | Agree | Disagree | Strongly Disagree |

- 1) On the whole, I am satisfied with myself.
- 2) At times I think I am no good at all.
- 3) I feel that I have a number of good qualities.
- 4) I am able to do things as well as most other people.
- 5) I feel I do not have much to be proud of.
- 6) I certainly feel useless at times.
- 7) I feel that I'm a person of worth, at least on an equal plane with others.
- 8) I wish I could have more respect for myself.
- 9) All in all, I am inclined to feel that I am a failure.
- 10) I take a positive attitude toward myself.

*Appendix D***Problematic Mobile Phone Use scale (PUMP)**

Please indicate how much you agree or disagree with each statement as being true.

| | | | | |
|----------------|---|---------|---|-------------------|
| 1 | 2 | 3 | 4 | 5 |
| Strongly agree | | Neutral | | Strongly Disagree |

- 1) When I decrease the amount of time spent using my cell phone I feel less satisfied.
- 2) I need more time using my cell phone to feel satisfied than I used to need.
- 3) When I stop using my cell phone, I get moody and irritable.
- 4) It would be very difficult, emotionally, to give up my cell phone.
- 5) The amount of time I spend using my cell phone keeps me from doing other important work.
- 6) I have thought in the past that it is not normal to spend as much time using a cell phone as I do.
- 7) I think I might be spending too much time using my cell phone.
- 8) People tell me I spend too much time using my cell phone.
- 9) When I am not using my cell phone, I am thinking about using it or planning the next time I can use it.
- 10) I feel anxious if I have not received a call or message in some time.
- 11) I have ignored the people I'm with in order to use my cell phone.
- 12) I have used my cell phone when I knew I should be doing work/schoolwork.
- 13) I have used my cell phone when I knew I should be sleeping.
- 14) When I stop using my cell phone because it is interfering with my life, I usually return to it.
- 15) I have gotten into trouble at work or school because of my cell phone use.
- 16) At times, I find myself using my cell phone instead of spending time with people who are important to me and want to spend time with me.
- 17) I have used my cell phone when I knew it was dangerous to do so.
- 18) I have almost caused an accident because of my cell phone use.
- 19) My cell phone use has caused me problems in a relationship.
- 20) I have continued to use my cell phone even when someone asked me to stop.

*Appendix E***App Usage Time Report Form**

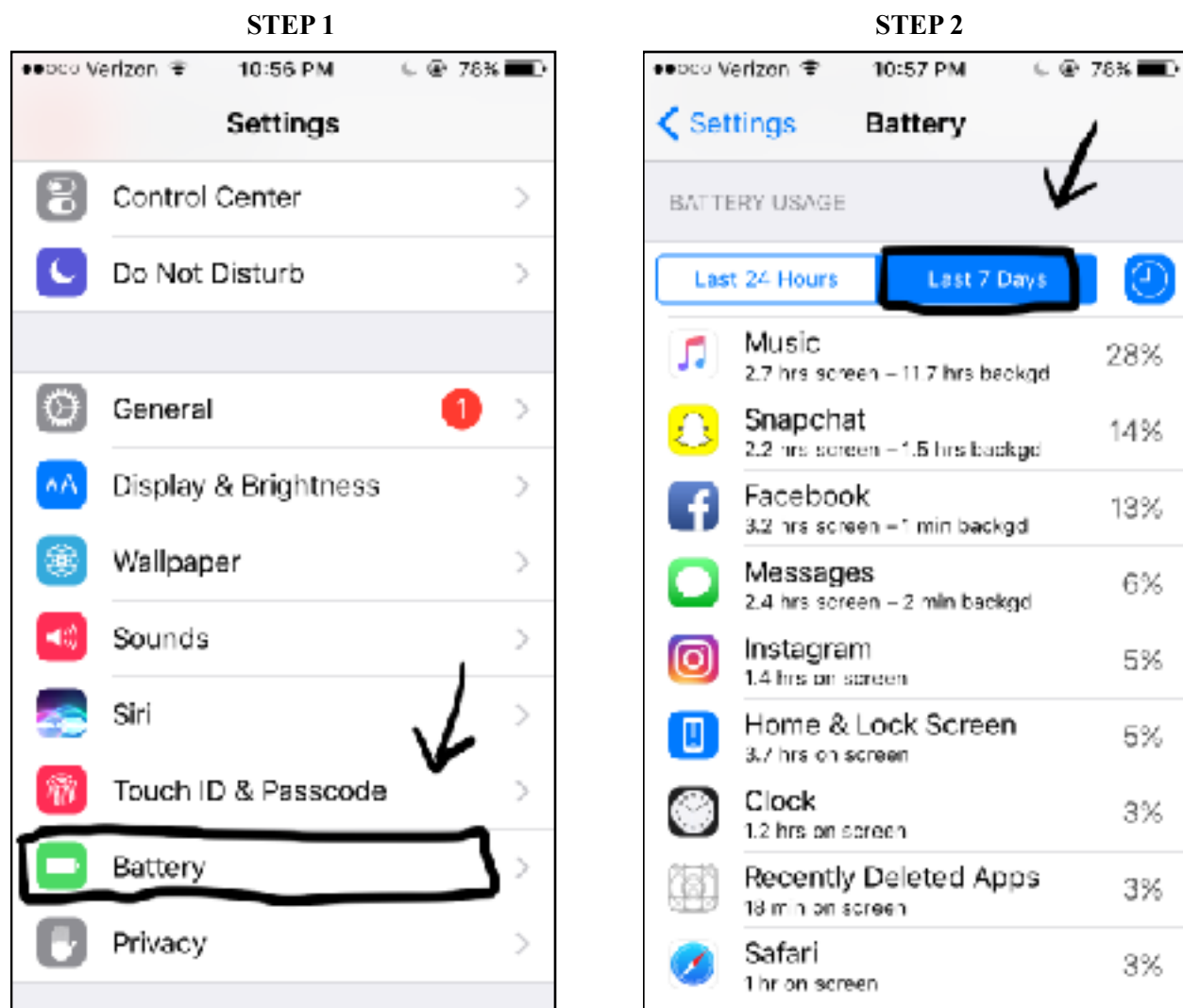
Step 1: Please navigate to the “Battery” screen inside of your settings application.

Step 2: Select the "Last 7 Days" tab.

Step 3: If usage is only displayed as a percentage, tap on any list item until usage is also displayed in hours.

Step 4: Please enter your time spent (in hours) on each of the following applications (Snapchat, Instagram, Facebook, Email)

Guiding visuals:



*Appendix F***App Usage Anomaly Check**

In the past week, was there an event or situation that caused you to interact with your phone differently from how you would on a typical day? (Examples: family crisis, end of a relationship, etc.)

Do you think that your past week of phone usage is similar to that of other weeks?

*Appendix G***Debriefing Form**

You have just participated in a research study conducted by Harry Solovay (harrysolovayuxresearch@gmail.com). Thank you so much for participating in this study. I (Harry Solovay) hope you enjoyed the experience.

You were initially told that the purpose of this study was to investigate mobile computing. Now that you've completed your participation, I can be more specific about the purpose: I hope to identify relationships between usage of the four focus applications (Facebook, Instagram, Snapchat, and Email), depression, and self-esteem.

As you know, your participation in this study is voluntary. If you so wish, you may withdraw after reading this debriefing form, at which point all records of your participation will be destroyed. You will not be penalized if you withdraw (that being said, please don't).

If you have questions about the study, please ask me after this session. If you have questions later, please email harrysolovayuxresearch@gmail.com. If, as a result of your participation in this study, you experienced any adverse reaction, please contact the Connecticut College IRB at alzak@conncoll.edu.

Last but not least, have a great day!