aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Current Directions in Psychological Science
2019, Vol. 28(4) 372–379

DOI: 10.1177/0963721419838244
www.psychologicalscience.org/CDPS
SAGE

More Time on Technology, Less Happiness? Associations Between Digital-Media Use and Psychological Well-Being

Jean M. Twenge
Department of Psychology, San Diego State University

Abstract

Studies using large samples consistently find that more frequent users of digital media are lower in psychological well-being than less frequent users; even data sets used as evidence for weak effects show that twice as many heavy users (vs. light users) are low in well-being. Differences in perspective may stem from the statistics used; I argue that comparing well-being across levels of digital-media use is more useful than the percentage of variance explained, as most studies on digital-media use do not measure other influences on well-being (e.g., genetics, trauma), and these other influences, unlike frequency of digital-media use, are rarely controllable. Nonusers are generally lower in well-being than light users of digital media, however, suggesting that limited use may be beneficial. Longitudinal and experimental studies suggest that at least some of the causation moves from digital-media use to lower well-being. Mechanisms may include the displacement of activities more beneficial to well-being (sleep, face-to-face social interaction), upward social comparison, and cyberbullying.

Keywords

digital media, well-being, happiness, depression, social media, electronic devices

Over the past decade, adolescents and young adults have spent an increasing amount of time using digital media (including social media, electronic games, texting, and Internet sites) and using electronic devices (including smartphones, tablets, and computers). The amount of time teens spent online doubled between 2006 and 2016; by 2016, U.S. 17- and 18-year-olds spent 6 hr a day texting, online, and on social media during their leisure hours (Twenge, Martin, & Spitzberg, 2018), and 95% owned a smartphone (Anderson & Jiang, 2018). The generation born since 1995, known as *iGen*, was the first to reach adolescence after smartphones became common (Twenge, 2017).

Given the large amount of time iGen teens and young adults spend with digital media and screens, it seems important to determine whether digital-media use is associated with lower psychological well-being. (Here, I define well-being broadly, including positive emotions such as happiness and life satisfaction as well as indicators of negative emotion such as depression and suicide attempts.) This question has been subject to considerable debate, with several observers concluding it is still unclear whether digital-media use is meaningfully associated with well-being (e.g., Best, Manktelow, & Taylor, 2014; Odgers, 2018; Turk, 2018). In this article, I explore whether people who spend more time using digital media are more likely to suffer from low psychological well-being (focusing on larger and more population-representative studies with sample sizes above 1,000), address some of the challenges in this research area, and discuss why digital-media use might be associated with well-being.

Associations Between Digital-Media Use and Psychological Well-Being

Across several large studies, adolescents and young adults who spent more time using digital media reported lower psychological well-being, including more stress and

Corresponding Author:
Jean M. Twenge, San Diego State University, Department of Psychology, 5500 Campanile Dr., San Diego, CA 92182
E-mail: jeantwenge@gmail.com

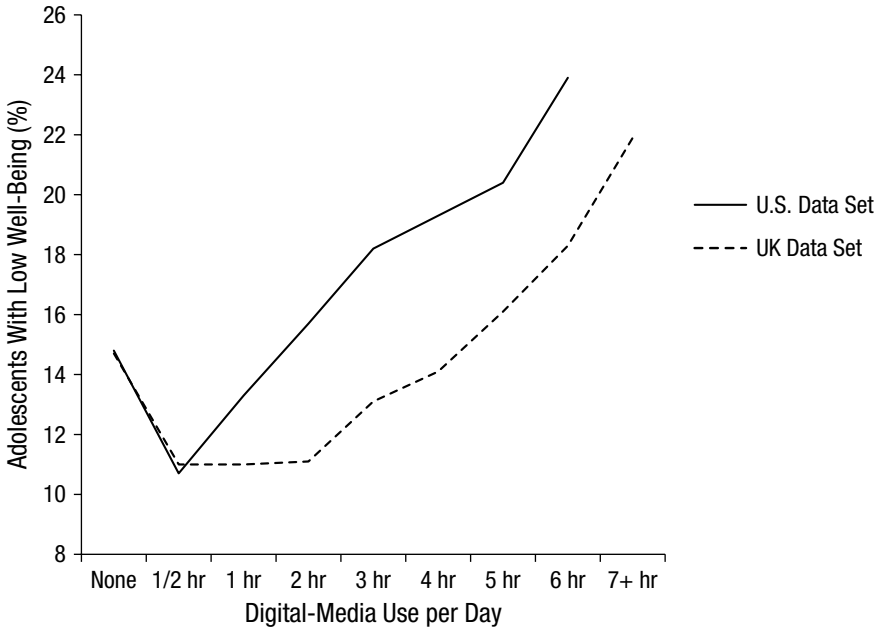

Fig. 1. Percentage of adolescents with low well-being as a function of their frequency of digital-media use. Demographic controls are included. U.S. data are from Twenge, Martin, and Campbell (2018), examining time online and unhappiness. UK data are from Twenge and Campbell (2019), examining smartphone use and low well-being (the UK data were originally presented in Przybylski & Weinstein, 2017).

psychological problems (Rosen et al., 2014), lower overall psychological well-being (Shakya & Christakis, 2017), lower life satisfaction (Booker, Skew, Kelly, & Sacker, 2015), less happiness (Twenge, Martin, & Campbell, 2018; see Fig. 1), more feelings of loneliness and social isolation (Primack et al., 2017), more depressive symptoms (Lin et al., 2016), and more diagnoses of anxiety and depression (Twenge & Campbell, 2018). These associations are often considerable; for example, adolescents who spent 5 hr or more a day (vs. 1 hr a day) on electronic devices were 66% more likely to have at least one risk factor for suicide (Twenge, Joiner, Rogers, & Martin, 2018).

In many of these studies, the associations between digital-media use and low well-being were not completely linear. Nonusers of digital media were slightly more likely to be low in well-being than light users. Then, after that lower amount (between 0.5 and 2 hr) is exceeded, well-being steadily declines, with the heaviest users of digital media (6–7+ hr) the most likely to be low in well-being (see Fig. 1). Thus, the happiest and most well-adjusted individuals are less frequent users, and the most unhappy and least well-adjusted individuals are the most frequent users.

Two additional large studies both found lower levels of well-being among more frequent users of digital media and also found the typical curvilinear pattern in which nonusers were slightly lower in well-being than light users (Ferguson, 2017; Przybylski, 2014). However, it is difficult to compare these studies with the previously described research, as neither directly compared light users with heavy users or reported means or percentages for well-being within groups. Nevertheless, the results of both studies are consistent with the general conclusion that more frequent digital-media use is linked with lower well-being.

Three other large studies reported no meaningful association between digital-media use and well-being. First, Przybylski and Weinstein (2017) examined a sample of 120,115 15-year-olds residing in the United Kingdom, assessing the number of hours per day they spent using computers, televisions, smartphones, and electronic games and measuring well-being with a 14-item scale. More frequent users of digital media were lower in well-being than less frequent users, but the authors concluded that the association between digital media and well-being (based on the percentage of variance explained) was so weak that medical professionals should no longer offer advice to parents about screen time. As Przybylski and Weinstein write, "the possible deleterious relation between media use and well-being may not be as practically significant as some researchers have argued" (p. 213). This study has been repeatedly cited in both academic articles and the popular press as evidence that digital-media use is not meaningfully associated with psychological well-being (e.g., Gonzalez, 2018; Odgers, 2018; Turk, 2018).

In contrast to these conclusions, however, a reanalysis of this data found that UK teens who spent more

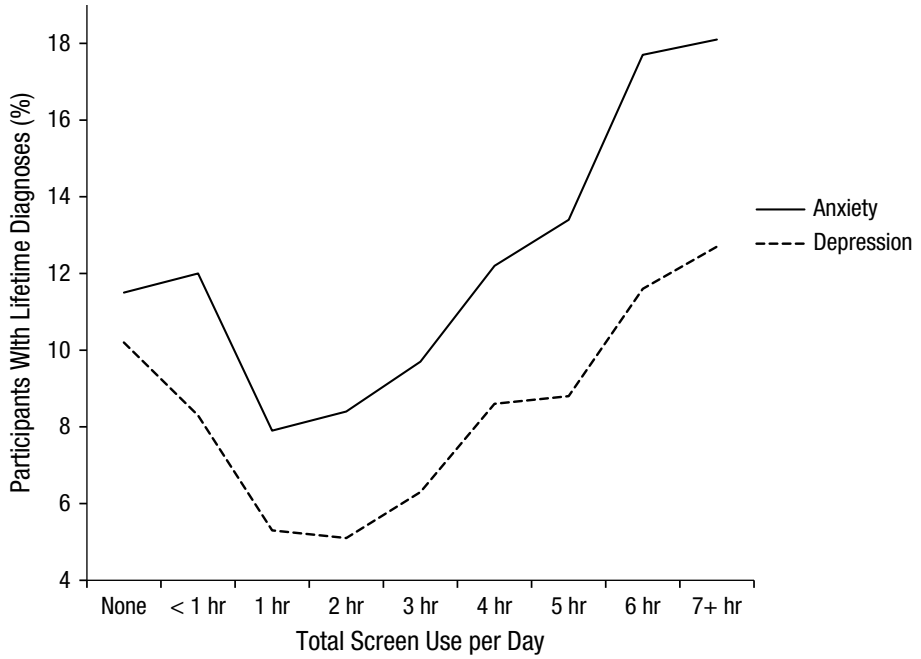

Fig. 2. Percentage of 14- to 17-year-olds with lifetime diagnoses of anxiety and depression as a function of their hours per day of screen use. Demographic controls are included. Data are from the National Survey of Children's Health (Twenge & Campbell, 2018).

than 7 hr a day on their smartphones were twice as likely to be low in well-being as those who spent an hour (Przybylski & Weinstein, 2017; Twenge & Campbell, 2019; see Fig. 1). It is difficult to dismiss a doubling of individuals low in well-being as trivial or practically insignificant. In addition, the pattern and magnitude of the differences is very similar to that in the U.S. data on time spent online and unhappiness (see Fig. 1), which also reveals a doubling of low well-being from light to heavy use.

Second, Przybylski and Weinstein (2019) used data from the 2011–2012 National Survey of Children's Health (NSCH, administered by the U.S. Census Bureau) to examine associations between screen time and well-being among preschool children, determining that screen time had no measurable link to well-being, a conclusion that was widely cited (e.g., Krisch, 2018; Molina, 2017). However, this administration of the NSCH included only four items measuring well-being asked only of caregivers with preschool-age children. In contrast, the 2016 administration of the NSCH asked a wide array of questions on well-being of the caregivers of 2- to 17-year-old children and adolescents. This more comprehensive survey showed pervasive and robust associations between hours of screen time and lower well-being, including less curiosity, lower self-control, more distractibility, more difficulty making friends, less emotional stability, and more inability to finish tasks, with heavy users of screens often twice as likely to be low in well-being as light users. In addition, heavy users were twice as likely to have received a diagnosis of anxiety or depression from a mental-health-care professional (see Fig. 2; Twenge & Campbell, 2018). Thus, when a more comprehensive array of well-being items were examined in the NSCH, the more frequent use of screens was reliably associated with lower well-being among children and adolescents.

Third, Orben and Przybylski (2019) examined linear correlations in three large data sets (Youth Risk Behavior Surveillance, YRBS; Monitoring the Future; and the Millennium Cohort Study, MCS), concluding that screen time explained only 0.4% of the variance in well-being. These first two data sets were previously shown to demonstrate significant and meaningful associations between digital-media use and well-being (Twenge, Joiner, et al., 2018; Twenge, Martin, & Campbell, 2018). Orben and Przybylski described the MCS as the "highest-quality" data set they examined and concluded that it showed little practical association between digital-media use and well-being. However, using the same MCS data, Kelly, Zilanawala, Booker, and Sacker (2019) found that heavy (vs. light) users of social media were more than twice as likely to have clinically relevant symptoms of depression (see Fig. 3). How can both be true? Orben and Przybylski argue that the variation in conclusions occurs because researchers make different decisions about control variables, scales, and years. However, these choices may be significantly less impactful than deciding which statistic to report (percentage of variance explained based on linear

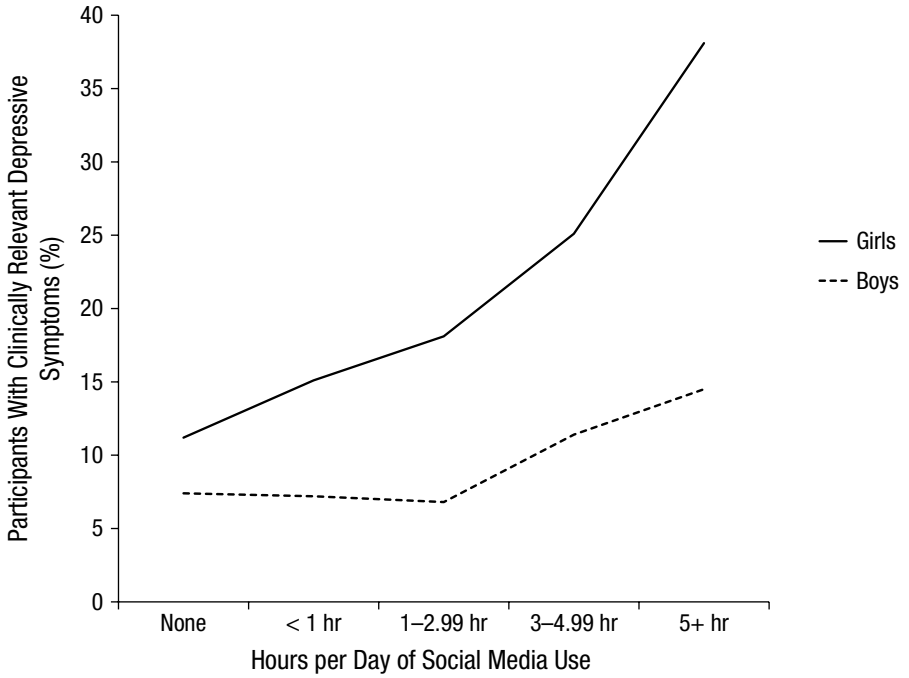

Fig. 3. Percentage of participants with clinically relevant depressive symptoms as a function of their hours per day of social media use, separately for girls and boys. Data are from the Millennium Cohort Study (Kelly, Zilanawala, Booker, & Sacker, 2019).

correlations vs. outcomes within levels of digital-media use), with percentage of variance explained obscuring meaningful differences. The YRBS data set provides another example. Using Orben and Przybylski's analytical specifications, we find that electronic device use explains 0.5% of the variance in suicide attempts, yet twice as many adolescents using devices more than 5 hr a day (vs. 1 hr a day) have attempted suicide (13.2% vs. 6.6%). Both of these examples suggest that linear analyses are suppressing the effect and that the percentage of variance explained does not capture practical importance.

A recent meta-analysis, primarily of smaller studies, also found a link between social media use and lower well-being. The author described the link as weak (Huang, 2017); however, as in some of the studies above, the author reported only linear correlations, and the percentage of individuals low in well-being within each usage group was not examined.

Finally, a few studies have found links between digital-media use and higher psychological well-being. For example, Dienlin, Masur, and Trepte (2017) found that adults who voluntarily increased their social media use had higher life satisfaction 6 months later. Valkenburg, Peter, and Schouten (2006) are often cited as demonstrating that social media use is linked to enhanced well-being. However, this study instead found a null effect for social media use and well-being; higher well-being occurred only if users received positive feedback from others on the site. If they received negative feedback, they had lower well-being. Thus, with the exception of a few studies, larger samples of adolescents consistently demonstrate that there are significant and meaningful associations between high levels of digital-media use and low levels of well-being.

Challenges in Research on Digital-Media Use and Well-Being

This area of research has several challenges. First, studies have consistently found that people who spend more time on social media sites also spend more time with others in face-to-face communication (Dienlin et al., 2017; Twenge, Spitzberg, & Campbell, 2019). Because face-to-face communication is linked to higher well-being, the association between social media use and well-being may appear to be positive or null when it is actually negative. This issue appears to be the most pronounced for texting, social media, and video chatting and less for time online or gaming, which are not highly correlated with time spent on face-to-face social interaction (Twenge et al., 2019). Thus, researchers should aim to measure and control for levels of face-to-face social interaction when assessing links between well-being and digital media, particularly social media. Another issue concerns the rapid change in digital

media technology and its adoption. Some studies were conducted before smartphones became common and thus before levels of digital-media use were significantly elevated. Given that light digital-media use is not associated with low well-being, less recent studies may be more likely to find null or positive effects.

In addition, measuring amounts of time use is inherently difficult. Some larger surveys asked about social media use not in hours but in broad categories ranging from "never" to "almost every day." Given that the vast majority of adolescents now use social media every day, this type of measurement lacks variance, a likely explanation for why effects using such measures are smaller than those relying on digital-media use reported in hours (Twenge, Martin, & Campbell, 2018). Measurement in hours, although showing more variation, has inherent inaccuracies, as these estimates are usually provided retrospectively and in broad groupings (e.g., "1–2 hr"). Reports completed by caregivers may be inaccurate if they are unaware of the amount of time their children are spending with digital media. Future research should explore time use with app trackers such as Screen Time on the iPhone, which can record the amount of time spent on each app (Hunt, Marx, Lipson, & Young, 2018). However, although potentially accurate and objective, these trackers would need to be validated (e.g., to ensure that they measured active time on the app). They would also need to be employed on all devices used by the participants.

Finally, there is the perennial question of how large associations need to be to matter. Some researchers (Ferguson, 2017; Orben & Przybylski, 2019; Przybylski, 2014; Przybylski & Weinstein, 2017) argue that digital media explains such a small percentage of the variance in well-being (often between 0.4% and 5%) that the links are trivial. In an interview (Brodwin, 2018), Przybylski described the size of the effects in his 2017 article as "literally the lowest quality of evidence that you could give that people wouldn't laugh you out of the room" (para. 13). However, as discussed above, this same data set shows a doubling of low well-being from light to heavy use, which hardly seems trivial or laughable.

Thus, perceptions of the size of associations may depend on the type of statistic presented, which may in turn depend on the research question. Percentage of variance explained answers the question, "What percentage of the variation among individuals in well-being is linked to digital-media use and not other factors?" However, this is generally not the question researchers are actually asking, given that studies in this area do not include assessments of other likely causes of well-being (e.g., genetic predisposition, past trauma). It may also not be the question that clinicians and laypeople most want answered, given that many causes of well-being (e.g., genetics) are not easily changeable. Instead, the question clinicians and laypeople may instead want answered is, "What is the difference in well-being associated with different levels of digital-media use?" Comparing the percentage of individuals low in well-being across levels of use better answers this question than calculating the percentage of variance explained. Thus, percentage of variance may not be particularly helpful for identifying lifestyle factors significantly associated with well-being. For example, Funder and Ozer (2019) note that percentage of variance explained "allows writers to disparage certain findings that they find incompatible with their own theoretical predilections." They conclude that percentage of variance explained is "not merely uninformative; for purposes of evaluating effect size, the practice is actively misleading." This is not a new insight: Rosnow and Rosenthal (1989) made this point three decades ago using several examples of interventions (such as low-dose aspirin and heart attacks) that explained a small percentage of variance yet led to a halving of negative outcomes. Rosnow and Rosenthal (1989) concluded that percentage of variance was an outdated and ineffective metric for understanding practical importance, and this seems to apply for studies of digital-media use and well-being as well.

Why Digital-Media Use Is Associated With Lower Well-Being

The studies reviewed thus far are correlational. Given that, (a) more frequent digital-media use may cause lower well-being, (b) lower well-being may cause more frequent digital-media use, or (c) confounding variables may cause both. The previously described studies controlled for variables such as gender, race, age, and socioeconomic status, although other potential confounds should be identified and examined. I delve into the first two possibilities in more depth below.

Lower well-being causes more digital-media use

Perhaps unhappy and depressed people spend more time with digital media. If that explained all of the association between digital-media use and well-being, however, longitudinal studies that followed the same people would find that well-being predicted later digital-media use, but digital-media use did not predict later well-being. Instead, longitudinal studies have generally found that digital-media use does predict later well-being (e.g., Allen & Vella, 2015; Schmiedeberg & Schroder, 2017; Shakya & Christakis, 2017), although some studies find

a reciprocal relationship (Kim, 2017). In addition, the increases in adolescent depression after smartphones became common after 2011 (Twenge, Joiner, et al., 2018) cannot be explained by low well-being causing digital-media use (if so, one would be forced to posit that an unexplained rise in teen depression caused greater ownership and use of smartphones). Thus, although reverse causation may explain some of the association between digital-media use and low well-being, it seems clear it does not explain all of it.

More digital-media use causes low well-being

The gold standard for proving causation is an experiment with random assignment to conditions. In one experiment, Facebook users were randomly assigned to either continue their normal use or abstain for a week; those who abstained reported more happiness and less depression at the end of the week (Tromholt, 2016). Another experiment asked college students to limit their social media use to 10 min a day per platform and no more than 30 min a day total compared with a control group that continued their normal use. Those who limited their use were less lonely and less depressed after 1 week and throughout the next 2 weeks (Hunt et al., 2018).

If heavy digital-media use is a cause of low well-being, how and why might that occur? First, digital media interferes with both sleep duration and sleep quality (Chang, Aeschbach, Duffy, & Czeisler, 2015; Twenge, Krizan, & Hisler, 2017), partially because the blue light emitted by electronic devices interferes with the production of the sleep hormone melatonin in the evening (Wood, Rea, Plitnick, & Figueiro, 2013). Portable devices, such as tablets and phones, may be especially likely to have this effect, as they are often carried into the bedroom or bed and held closer to the face than other blue-light-emitting devices such as televisions (Twenge, Hisler, & Krizan, 2018). Shortened and lower-quality sleep is a major risk factor for low well-being, including anxiety and depression (Franzen & Buysse, 2008), suggesting that sleep issues may mediate the link between digital-media use and lower well-being.

More frequent digital-media use may also displace time spent on activities more beneficial for happiness and mental health, including face-to-face social interaction, exercise, reading, and time spent outdoors (Larson et al., 2018; Twenge et al., 2019). In addition, several experiments have found that the presence of smartphones in social situations reduces the enjoyment of these activities (Kushlev, Hunter, Proulx, Pressman, & Dunn, 2019). Like sleep displacement, these possible explanations are indirect effects of screen time rather than a direct cause; in both cases, it is not digital-media use itself that causes low well-being but the lack of more beneficial uses of time. Even if this does not occur at the individual level, it may occur at the group level as adolescents shift how they spend their leisure time.

It is also possible that digital-media use directly causes lower well-being. For example, social media sites may encourage upward social comparison with other people, leading to depression (Steers, Wickham, & Acitelli, 2014). Cyberbullying, another direct effect of digital media, is also a significant risk factor for depression (Kim, 2017). In this area, unlike in the other mechanisms, the feedback people receive online is important (Valkenberg et al., 2006).

In conclusion, large studies consistently find that more frequent digital-media use is associated with lower well-being among adolescents. Although some of this relationship may be due to lower well-being causing digital-media use, longitudinal and experimental studies suggest that at least some of the link is due to digital-media use leading to lower well-being. Possible mechanisms include sleep disruption, displacement or disruption of face-to-face social interaction or physical activity, social comparison, and cyberbullying. Although more experimental studies are needed, research thus far suggests that restricting leisure-time digital-media use to lower levels may have benefits for psychological well-being.

Recommended Reading

Kushlev, K., Hunter, J. F., Proulx, J., Pressman, S. D., & Dunn, E. (2019). (See References). A clever random-assignment experiment in which participants with access to their smartphones in a waiting room were less likely to converse with other people and less likely to smile at them than participants without access to their smartphones.

Lin, L. Y., Sidani, J. E., Shensa, A., Radovic, A., Miller, E., Colditz, J. B., . . . Primack, B. A. (2016). (See References). A large cohort study of young adults (ages 19–32 years) that showed that heavy users of social media were significantly more likely to be depressed than light users, with a linear dose-response trend with greater social media use.

Twenge, J. M., Martin, G. N., & Campbell, W. K. (2018). (See References). Documents a sudden drop in happiness, life satisfaction, and self-esteem among U.S. adolescents after smartphones became common in the early 2010s and reports that screen and nonscreen activities are linked to less happiness and more happiness, respectively.

Action Editor

Randall W. Engle served as action editor for this article.

ORCID iD

Jean M. Twenge https://orcid.org/0000-0002-6542-8281

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

References

Allen, M. S., & Vella, S. A. (2015). Screen-based sedentary behaviour and psychosocial well-being in childhood: Cross-sectional and longitudinal associations. *Mental Health and Physical Activity*, *9*, 41–47.

Anderson, M., & Jiang, J. (2018). Teens, social media & technology 2018. *Pew Research Center*. Retrieved from http://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/

Best, P., Manktelow, R., & Taylor, B. (2014). Online communication, social media and adolescent wellbeing: A systematic narrative review. *Children and Youth Services Review*, *41*, 27–36.

Booker, C. L., Skew, A. J., Kelly, Y. J., & Sacker, A. (2015). Media use, sports participation, and well-being in adolescence: Cross-sectional findings from the UK Household Longitudinal Study. *American Journal of Public Health*, *105*, 173–179.

Brodwin, E. (2018, March 19). There's no solid evidence that people get addicted to social media — and using it could actually be beneficial. *Business Insider*. Retrieved from https://www.businessinsider.com/social-media-iphone-facebook-instagram-addiction-2018-3

Chang, A. M., Aeschbach, D., Duffy, J. F., & Czeisler, C. A. (2015). Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proceedings of the National Academy of Sciences, USA*, *112*, 1232–1237.

Dienlin, T., Masur, P. K., & Trepte, S. (2017). Reinforcement or displacement? The reciprocity of FTF, IM, and SNS communication and their effects on loneliness and life satisfaction. *Journal of Computer-Mediated Communication*, *22*, 71–87.

Ferguson, C. J. (2017). Everything in moderation: Moderate use of screens unassociated with child behavior problems. *Psychiatric Quarterly*, *88*, 797–805.

Franzen, P. L., & Buysse, D. J. (2008). Sleep disturbances and depression: Risk relationships for subsequent depression and therapeutic implications. *Dialogues in Clinical Neuroscience*, *10*, 473–481.

Funder, D. C., & Ozer, D. J. (2019). Evaluating effect size in psychological research: Sense and nonsense. *Advances in Methods and Practices in Psychological Science*, *2*, 156–168. doi:10.1177/2515245919847202

Gonzalez, R. (2018, February 1). It's time for a serious talk about the science of tech "addiction." *Wired*. Retrieved from https://www.wired.com/story/its-time-for-a-serious-talk-about-the-science-of-tech-addiction/

Huang, C. (2017). Time spent on social networking sites and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking*, *20*, 346–354.

Hunt, M. G., Marx, R., Lipson, C., & Young, J. (2018). No more FOMO: Limiting social media decreases loneliness and depression. *Journal of Social & Clinical Psychology*, *37*, 751–768.

Kelly, Y., Zilanawala, A., Booker, C., & Sacker, A. (2019). Social media use and adolescent mental health: Findings from the UK Millennium Cohort Study. *EClinicalMedicine*, *6*, 59–68. doi:10.1016/j.eclinm.2018.12.005

Kim, H. H. (2017). The impact of online social networking on adolescent psychological well-being (WB): A population-level analysis of Korean school-aged children. *International Journal of Adolescence and Youth*, *22*, 364–376.

Krisch, J. (2018, January 24). New data points to benefits of moderate screen time. *Fatherly*. Retrieved from https://www.fatherly.com/health-science/moderate-screen-time-good-kids-science

Kushlev, K., Hunter, J. F., Proulx, J., Pressman, S. D., & Dunn, E. (2019). Smartphones reduce smiles between strangers. *Computers in Human Behavior*, *91*, 12–16.

Larson, L. R., Szczytko, R., Bowers, E. P., Stephens, L. E., Stevenson, K. T., & Floyd, M. F. (2018). Outdoor time, screen time, and connection to nature: Troubling trends among rural youth? *Environment & Behavior*. Advance online publication. doi:10.1177/0013916518806686

Lin, L. Y., Sidani, J. E., Shensa, A., Radovic, A., Miller, E., Colditz, J. B., . . . Primack, B. A. (2016). Association between social media use and depression among U.S. young adults. *Depression and Anxiety*, *33*, 323–331.

Molina, B. (2017, January 8). Maybe you're being too strict with your kid's screen time, study suggests. *USA Today*. Retrieved from https://www.usatoday.com/story/tech/news/2017/12/18/maybe-youre-being-too-strict-your-kids-screen-time-study-suggests/960894001

Odgers, C. (2018). Smartphones are bad for some teens, not all. *Nature*, *554*, 432–434.

Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behavior*, *3*, 173–182.

Primack, B. A., Shensa, A., Sidani, J. E., Whaite, E. O., Lin, L. Y., Rosen, D., . . . Miller, E. (2017). Social media use and perceived social isolation among young adults in the U.S. *American Journal of Preventative Medicine*, *53*, 1–8.

Przybylski, A. K. (2014). Electronic gaming and psychosocial adjustment. *Pediatrics*, *134*, e716–e722.

Przybylski, A. K., & Weinstein, N. (2017). A large-scale test of the Goldilocks hypothesis: Quantifying the relations between digital-screen use and the mental well-being of adolescents. *Psychological Science*, *28*, 204–215.

Przybylski, A. K., & Weinstein, N. (2019). Digital screen time limits and young children's psychological well-being: Evidence from a population-based study. *Child Development*, *90*, e56–e65

Rosen, L. D., Lim, A. F., Felt, J., Carrier, L. M., Cheever, N. A., Lara-Ruiz, J. M., . . . Rokkum, J. (2014). Media and technology use predicts ill-being among children, preteens and teenagers independent of the negative health impacts of exercise and eating habits. *Computers in Human Behavior*, *35*, 364–375.

Rosnow, R. L., & Rosenthal, R. (1989). Statistical procedures and the justification of knowledge in psychological science. *American Psychologist*, *44*, 1276–1284.

Schmiedeberg, C., & Schroder, J. (2017). Leisure activities and life satisfaction: An analysis with German panel data. *Applied Research in Quality of Life*, *12*, 137–151.

Shakya, H. B., & Christakis, N. A. (2017). Association of Facebook use with compromised well-being: A longitudinal study. *American Journal of Epidemiology*, *185*, 203–211.

Steers, M. N., Wickham, R. E., & Acitelli, L. K. (2014). Seeing everyone else's highlight reels: How Facebook usage is linked to depressive symptoms. *Journal of Social & Clinical Psychology*, *33*, 701–731.

Tromholt, M. (2016). The Facebook experiment: Quitting Facebook leads to higher levels of well-being. *Cyberpsychology, Behavior, and Social Networking*, *19*, 661–666.

Turk, V. (2018, January 11). Apple investors say iPhones cause teen depression. Science doesn't. *Wired UK*. Retrieved from https://www.wired.co.uk/article/apple-investors-iphone-kids-depression-suicide-evidence

Twenge, J. M. (2017). *iGen: Why today's super-connected kids are growing up less rebellious, more tolerant, less happy—and completely unprepared for adulthood*. New York, NY: Atria Books.

Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventative Medicine Reports*, *12*, 271–283.

Twenge, J. M., & Campbell, W. K. (2019). Media use is linked to lower psychological well-being: Evidence from three datasets. *Psychiatric Quarterly*. Advance online publication. doi:10.1007/s11126-019-09630-7

Twenge, J. M., Hisler, G. C., & Krizan, Z. (2018). Associations between screen time and sleep duration are primarily driven by portable electronic devices: Evidence from a population-based study of U.S. children ages 0–17. *Sleep Medicine*. Advance online publication. 10.1016/j.sleep.2018.11.009

Twenge, J. M., Joiner, T. E., Rogers, M. L., & Martin, G. N. (2018). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among U.S. adolescents after 2010 and links to increased new media screen time. *Clinical Psychological Science*, *6*, 3–17.

Twenge, J. M., Krizan, Z., & Hisler, G. (2017). Decreases in self-reported sleep duration among U.S. adolescents 2009–2015 and links to new media screen time. *Sleep Medicine*, *39*, 47–53.

Twenge, J. M., Martin, G. N., & Campbell, W. K. (2018). Decreases in psychological well-being among American adolescents after 2012 and links to screen time during the rise of smartphone technology. *Emotion*, *18*, 765–780.

Twenge, J. M., Martin, G. N., & Spitzberg, B. H. (2018). Trends in U.S. adolescents' media use, 1976–2016: The rise of digital media, the decline of TV, and the (near) demise of print. *Psychology of Popular Media Culture*. Advance online publication. doi:10.1037/ppm0000203

Twenge, J. M., Spitzberg, B. H., & Campbell, W. K. (2019). Less in-person social interaction with peers among U.S. adolescents in the 21st century and links to loneliness. *Journal of Social and Personal Relationships*. Advance online publication. doi:10.1177/0265407519836170

Valkenburg, P. M., Peter, J., & Schouten, A. P. (2006). Friend networking sites and their relationship to adolescents' well-being and social self-esteem. *Cyberpsychology & Behavior*, *9*, 584–590.

Wood, B., Rea, M. S., Plitnick, B., & Figueiro, M. G. (2013). Light level and duration of exposure determine the impact of self-luminous tablets on melatonin suppression. *Applied Ergonomics*, *44*, 237–240.