Emotion

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Decreases in Psychological Well-Being Among American Adolescents After 2012 and Links to Screen Time During the Rise of Smartphone Technology

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In nationally representative yearly surveys of United States 8th, 10th, and 12th graders 1991–2016 (N = 1.1 million), psychological well-being (measured by self-esteem, life satisfaction, and happiness) suddenly decreased after 2012. Adolescents who spent more time on electronic communication and screens (e.g., social media, the Internet, texting, gaming) and less time on nonscreen activities (e.g., in-person social interaction, sports/exercise, homework, attending religious services) had lower psychological well-being. Adolescents spending a small amount of time on electronic communication were the happiest. Psychological well-being was lower in years when adolescents spent more time on screens and higher in years when they spent more time on nonscreen activities, with changes in activities generally preceding declines in well-being. Cyclical economic indicators such as unemployment were not significantly correlated with well-being, suggesting that the Great Recession was not the cause of the decrease in psychological well-being, which may instead be at least partially due to the rapid adoption of smartphones and the subsequent shift in adolescents' time use.

Keywords: psychological well-being, self-esteem, birth cohort, social media, Internet

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Cultures change through mechanisms including economic, technological, and political trends, and this cultural change often impacts individuals (Markus & Kitayama, 2010; Oishi, Graham, Kesebir, & Galinha, 2013). This process of cultural evolution involves the transfer of information and can be shaped by ecological pressures affecting people's lives (Varnum & Grossmann, 2017). Such cultural shifts may have a particularly strong impact on young people, whose worldviews are still forming (Stewart & Healy, 1989). Overall, a growing body of research supports the idea that cultural change leads to birth cohort and/or time period differences in characteristics such as empathy (Konrath, O'Brien, & Hsing, 2011), sexual behavior Twenge, Sherman, & Wells, 2017, job characteristics (Wegman, Hoffman, Carter, Twenge, & Guenole, 2017), and individualism (Grossmann & Varnum, 2015). Cultural changes may also affect psychological well-being (Oishi et al., 2013; Twenge, Sherman, & Lyubomirsky, 2016).

In this paper, we seek to document recent trends in the psychological well-being of adolescents and explore the cultural changes that may have produced them. We draw from Monitoring the Future (MtF), a large, nationally representative survey of American 8th, 10th, and 12th graders conducted every year since 1991. With samples of same-age participants over many years, the time-lag method of this project allows the disentangling of age effects from those of cultural change (Schaie, 1965). Although any differences could be caused by either birth cohort (which only affects young people) or time period (which affects those of all ages), both birth cohort and time period effects capture cultural change (Campbell, Campbell, Siedor, & Twenge, 2015).

We have two primary goals. First, we aim to document trends in adolescents' psychological well-being. We conceptualize psychological well-being as it is measured in this dataset, which includes self-esteem, self-satisfaction, domain satisfaction, life satisfaction, and happiness. Second, we explore possible mechanisms behind these trends. We focus on two primary possible mechanisms: economic conditions and screen time spent on electronic communication such as social media, texting, and Internet use. The most severe economic recession since the Great Depression took place from 2007 to 2009; previous research has established the importance of economic trends on shifts in the characteristics of individuals (Cooper, 2011; Frasquilho et al., 2016). In addition, the 2007 introduction of smartphones allowed mobile and nearly constant access to the Internet, with the majority of Americans owning a smartphone by the end of 2012 (Smith, 2017). Several studies have linked new media screen time, including social media use, to lower psychological well-being (Huang, 2017; Kross et al., 2013; Shakya & Christakis, 2017), including among adolescents (Przybylski & Weinstein, 2017), although the latter paper found a curvilinear pattern with low levels of use, rather than nonuse, associated with the highest well-being.

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Previous Research on Birth Cohort/Time Period Changes in Psychological Well-Being

Most research documented a consistent increase in psychological well-being, especially among younger populations, between the 1960s and the 2000s. Self-esteem increased among children, college students, and adults (Gentile, Twenge, & Campbell, 2010; Twenge, Campbell, & Carter, 2017), though among high school students the increase did not appear in the total self-esteem scale (Bachman, O'Malley, Freedman-Doan, Trzesniewski, & Donnellan, 2011) but was limited to the factor Tafarodi and Milne (2002) identified as self-liking (Twenge & Campbell, 2008). American adolescents' happiness, domain satisfaction, and life satisfaction also increased between the 1990s and 2011 (Twenge et al., 2016). Overall, adolescents of the 2000s were significantly higher in psychological well-being than those in the 1970s, 1980s, or 1990s.

However, research examining adolescents' psychological well-being after 2011 is scant. Some have reported that caseloads at college (Kingkade, 2016) and high school (Anderssen, 2013; Noguchi, 2014) counseling centers increased after 2011. Given that seeking counseling is often an indicator of low psychological well-being, this creates the possibility that trends in adolescents' well-being after 2011 may differ from those before that year. However, it is not clear if these increases are due to more students being willing to seek treatment or if they represent declines in more wide-ranging indicators of psychological well-being among the general population of adolescents. In addition, these sources note that the cause of the increase in caseloads is not known. Below, we consider two possible causes for trends in psychological well-being in recent years: economic factors and the rise of new media technology.

The Influence of Economic Factors

Economic factors are often examined as a larger cultural influence on individual personality and other characteristics (Bianchi, 2016; Grossmann & Varnum, 2015; Leckelt et al., 2016). A large body of research has documented that unemployment has a negative effect on psychological well-being (e.g., Frasquilho et al., 2016). Children and adolescents' psychological well-being is often indirectly affected as unemployment can strain relationships with parents (McLoyd, Jayaratne, Ceballo, & Borquez, 1994). As a general indicator of the health of the economy, stock market performance may also covary with well-being, as might median household income and gross domestic product (GDP). Other economic factors may also have an impact. In particular, income inequality is linked to lower happiness when matched by year (Oishi, Kesebir, & Diener, 2011), and the number of high school students entering college may capture shifts in the job market.

The Influence of Electronic Communication

The smartphone (a mobile phone with Internet access, often with a touch screen), was introduced with the first iPhone in 2007 and was adopted faster than nearly any other technological innovation (DeGusta, 2012). Half of Americans owned a smartphone by 2012 and 77% by 2016 (Smith, 2017). Among United States teens specifically, smartphone ownership jumped from 37% in 2012% to 73% in 2015 (Lenhart, 2015). Perhaps as a result, adolescents' social interactions have changed considerably in the last 10 years, with teens spending more time on electronic communication and less time on in-person (face-to-face) interaction (Boyd, 2015; Twenge & Uhls, 2017).

These trends in how adolescents spend their social time may have an impact on psychological well-being. Many studies have established a strong link between in-person social interaction and higher psychological well-being (Blakemore, 2012; Lieberman, 2014; Shakya & Christakis, 2017; for a previous review, see Baumeister & Leary, 1995). However, research examining links between social media use (one of adolescents' primary electronic communication activities on smartphones) and psychological well-being are conflicting. Several studies, including those using experimental and longitudinal designs, have found that social media use leads to lower psychological well-being (Kross et al., 2013; Shakya & Christakis, 2017; Tromholt, 2016; for a meta-analysis, see Huang, 2017). One study found correlations specifically between greater time spent on smartphones and lower well-being among teens (Przybylski & Weinstein, 2017), although this effect was curvilinear. On the contrary, other studies have found that social media use can increase psychological well-being (Davis, 2012; Valkenburg, Peter, & Schouten, 2006), and still others find no relationship (Jelenchick, Eickhoff, & Moreno, 2013). Overall, reviews of the research literature on electronic communication and psychological well-being have concluded that the results of these studies are mixed (Best, Manktelow, & Taylor, 2014). In addition, few studies have simultaneously examined the effects of in-person social interaction and electronic communication on the psychological well-being of adolescents, and those that did so were conducted before smartphones gained market saturation (e.g., Pea et al., 2012).

Present Research

We had two primary goals. In Study 1, we sought to determine trends in adolescents' psychological well-being, drawing from a large ($N = 1.1$ million), nationally representative survey of United States adolescents measuring several aspects of psychological well-being including happiness, life satisfaction, domain satisfaction, self-esteem, and self-satisfaction. For the sake of brevity, we use "psychological well-being" as an umbrella term for these constructs, recognizing that other conceptualizations also include additional factors such as meaning (e.g., Ryff & Keyes, 1995). We take a data-driven approach, using the variables that are available in these large surveys. In Study 2, we explored possible mechanisms behind the trends in psychological well-being, including changes in adolescents' time use and national economic factors.

Study 1

The purpose of Study 1 was to determine birth cohort/time period differences in psychological well-being, with a focus on changes since 2007 when both the economy and available technology underwent large disruptions. We included data since 1991 as the 8th and 10th grade surveys began in that year; several previous studies examined well-being among 12th graders between 1976 and 1990 (e.g., Bachman et al., 2011; Twenge et al., 2016).

Method

Participants. MtF (Johnston, Bachman, O'Malley, Schulenberg, & Miech, 2017) surveyed a nationally representative sample of 12th graders each year 1976–2016, and 8th and 10th graders 1991–2016. All procedures of the survey are annually reviewed and approved by the University of Michigan Institutional Review Board. For the items and years used here, maximum N for 8th graders = 437,293; N for 10th graders = 398,673, and N for 12th graders = 311,552; total N = 1.1 million.

Measures.

Self-esteem. Eighth, 10th, and 12th graders were asked six items from the Rosenberg Self-Esteem scale (Rosenberg, 1965): "I take a positive attitude toward myself," "On the whole, I'm satisfied with myself," "Sometimes I think that I am no good at all" (reverse scored), "I feel I am a person of worth, on an equal plane with others," "I am able to do things as well as most other people," and "I do not have much to be proud of" (reverse scored; $\alpha = .83$). Tafarodi and Milne (2002) identified the first three items as measuring self-liking and the next three items as measuring self-competence.

Domain satisfaction. The 12th grade survey asked about satisfaction in 14 areas of life:

> The next questions ask how satisfied or dissatisfied you are with several aspects of your life. . . . How satisfied are you with . . . ": "Your job? (if you have no job, leave blank)," "the neighborhood where you live?" "Your personal safety in your neighborhood, on your job, and in your school—safety from being attacked and injured in some way?" "The safety of things you own from being stolen or destroyed in your neighborhood, on your job, and in your school?" "Your educational experiences?" "Your friends and other people you spend time with?" "The way you get along with your parents?" "Yourself?" "Your standard of living—the things you have like housing, car, furniture, recreation, and the like?" "The amount of time you have for doing things you want to do?" "The way you spend your leisure time—recreation, relaxation, and so on?" "Your life as a whole these days?" "The way our national government is operating?" "The amount of fun you are having?"

Response choices ranged from 1 to 7, with 1 (*completely dissatisfied*), 4 (*neutral*), and 7 (*completely satisfied*). Because many students did not answer the item about a job, we excluded this item and formed a 13-item scale ($\alpha = .83$).

Self-satisfaction. We examined the item about satisfaction with "yourself" separately as a measure of self-satisfaction.

Life satisfaction. A single item asked of a different subset of students was, "How satisfied are you with your life as a whole these days?" with choices of 1 (*completely dissatisfied*), 2 (*quite dissatisfied*), 3 (*somewhat dissatisfied*), 4 (*neither, or mixed feelings*), 5 (*somewhat satisfied*), 6 (*quite satisfied*), and 7 (*completely satisfied*).

Happiness. Eighth, 10th, and 12th graders were asked, "Taking all things together, how would you say things are these days—would you say you're very happy, pretty happy, or not too happy these days?" with response choices coded 1, 2, or 3.

Statistical analyses. Because these measures of psychological well-being were in most cases asked of different subsamples (called a form), we were not able to perform a factor analysis or reliability analysis of all of the constructs. However, we did examine correlations among these constructs where possible, and all correlations were positive, greater than $r = .30$, and statistically significant (see Table 1 in the online supplemental materials).

Data collected over time can be analyzed in various ways, including grouping by generation blocks (e.g., Boomers, GenX, Millennials, iGen), by decades, or by individual year. We separated the older data into 5-year intervals (e.g., 2000–2004) to provide a compromise between specificity and breadth, dividing at the decade and half-decade marks to enable references to specific time periods (e.g., "the early 2000s," for 2000–2004). For the years 2012 and later, after smartphones were used by the majority of Americans, we display the year-by-year data. The figures also display the year-by-year data for most measures. Due to the large sample sizes, we focus primarily on effect sizes rather than statistical significance. The p values are two-tailed.

Data availability. The MtF data sets used here are publicly available online at the MtF website.

Results and Discussion

After staying steady or rising between 1991 and 2011, adolescents' psychological well-being dropped noticeably between 2012 and 2016 (Table 1). Self-esteem declined after 2012 (Figure 1), as did measures of self-satisfaction, life satisfaction, and domain satisfaction (Figure 2). After rising since the early 1990s, adolescents' happiness fell (Figure 3).

Effect sizes for the decline between 2012 and 2016 range from $d = -.07$ to $d = -.24$, with an average of $d = -.14$. Although this is traditionally considered a small effect size, it must be understood in the context of the very brief 4-year period over which it occurred. The change here corresponds to $d = -.04$ per year, an unusual amount of change for a short period of time. On average, birth cohort shifts are about $d = .015$ to $d = .02$ per year in national samples (Twenge & Foster, 2010). Thus, this yearly rate of change is more than twice as large as many previously identified birth cohort differences.

Across the 14 domains of life satisfaction, the largest declines between 2012 and 2016 appeared in satisfaction with life as a whole, friends, amount of fun, self, and personal safety; satisfaction with the government, parents, and the safety of property increased during this time (see Table 2 and supplemental Figure 1). The domains most strongly correlated with happiness were also those that declined the most, $r(14) = -.71$, $p = .005$.

Replicating previous research (Twenge & Campbell, 2008), between the early 1990s and the mid-2000s, 12th graders increased in the self-esteem factor of self-liking but decreased in self-competence (Tafarodi & Milne, 2002). After 2012, however, 12th graders declined in both self-liking and self-competence (see Figure 2 in the online supplemental materials).

Study 2

Next, we sought to explore possible mechanisms behind the sudden decrease in adolescents' psychological well-being. Previous research identified significant cohort differences in how adolescents spend their time, including less time spent with friends in person and more time spent on electronic communication such as social media and the Internet, a possible consequence of the increasing use of smartphones (Twenge & Uhls, 2017). Economic factors have also been implicated in changes in individuals' psy-

Table 1
U.S. Adolescents' Psychological Well-Being, 1991–2016

Scale	Grade	*N*	1991–1994	1995–1999	2000–2004	2005–2009	2010–2011	2012	2013	2014	2015	2016	*d* (1991–1994 to 2010–2011)	*d* (2012 to 2016)
Self-esteem	8	173,171	3.96 (.89)	4.00 (.89)	4.00 (.91)	4.00 (.91)	3.98 (.92)	3.97 (.92)	3.87 (.97)	3.81 (.99)	3.84 (.99)	3.83 (.99)	.02	−.15
Self-esteem	10	176,441	3.97 (.88)	3.99 (.89)	3.98 (.88)	4.00 (.87)	3.98 (.89)	3.96 (.89)	3.86 (.94)	3.81 (.97)	3.81 (.95)	3.79 (.95)	.01	−.18
Self-esteem	12	61,709	4.04 (.79)	4.08 (.80)	4.06 (.80)	4.05 (.79)	4.03 (.82)	4.03 (.81)	3.97 (.83)	3.88 (.89)	3.86 (.89)	3.83 (.90)	−.01	−.24
Self-satisfaction	12	63,221	5.43 (1.52)	5.44 (1.54)	5.43 (1.57)	5.46 (1.54)	5.51 (1.56)	5.46 (1.58)	5.47 (1.57)	5.27 (1.67)	5.25 (1.74)	5.17 (1.77)	.05	−.17
Domain satisfaction	12	59,347	4.96 (.93)	5.00 (.93)	5.08 (.95)	5.11 (.94)	5.14 (.95)	5.19 (.93)	5.16 (.92)	5.08 (.97)	5.06 (1.04)	5.12 (1.01)	.19	−.07
Life satisfaction	12	60,642	4.79 (1.57)	4.91 (1.57)	4.98 (1.55)	5.04 (1.53)	5.02 (1.60)	5.01 (1.58)	5.01 (1.60)	4.93 (1.58)	4.95 (1.59)	4.89 (1.60)	.15	−.08
Happiness	8	437,293	1.99 (.57)	2.02 (.58)	2.04 (.58)	2.05 (.59)	2.06 (.59)	2.07 (.58)	2.04 (.59)	2.02 (.59)	2.02 (.59)	2.03 (.59)	.12	−.07
Happiness	10	398,673	1.99 (.58)	2.02 (.58)	2.03 (.58)	2.05 (.58)	2.06 (.59)	2.06 (.58)	2.04 (.59)	2.01 (.59)	2.00 (.59)	1.98 (.59)	.12	−.14
Happiness	12	311,552	2.00 (.59)	2.03 (.59)	2.08 (.59)	2.10 (.59)	2.09 (.60)	2.11 (.60)	2.09 (.59)	2.08 (.60)	2.06 (.60)	2.04 (.60)	.15	−.12

Note. All *ds* $\geq .03$ are significant at $p < .05$. Self-esteem is a six-item measure; domain satisfaction is a 13-item measure.

chological characteristics over time (Bianchi, 2016; Grossmann & Varnum, 2015; Leckelt et al., 2016; Oishi et al., 2011). Others have speculated that academic pressure such as too much homework may be behind reports of rising psychological issues among adolescents (Dwyer, 2014).

Given the impossibility of random-assignment experiments in work on cultural change, we developed a two-part test in which possible mechanisms can be ruled in or out. This test is not designed to rule out complex relationships (e.g., interactive or suppressor effects) but instead to assess straightforward linear relationships. For a variable to be a possible cause of the decrease in psychological well-being, it must (a) be correlated with psychological well-being among a population of individuals, and (b) change over time in a corresponding pattern (e.g., variables positively correlated with psychological well-being would need to decrease when well-being was declining, and variables negatively correlated with psychological well-being would need to increase when well-being was declining). Thus, we undertook a two-step process.

First, we examined correlations between adolescents' psychological well-being and the time they spent on a wide variety of activities, including electronic communication and screen time (e.g., Internet, social media, texting, gaming, TV), in-person/face-to-face social interaction, and other nonscreen activities (e.g., homework, sports/exercise, attending religious services). These analyses, corresponding to the first part of the two-part test, sought to determine which activities were linked to higher (vs. lower) psychological well-being among adolescents at the individual level. As MtF employs a time-lag rather than a longitudinal design (with different participants every year), we were only able to examine concurrent, and not lagged, relationships among activities and psychological well-being at the individual level. Previous research found that the link between electronic communication and lower well-being had a curvilinear component (Przybylski & Weinstein, 2017); thus, we also examined the exposure-response curve between electronic communication and well-being.

Second, we matched mean, composite psychological well-being by year with average time spent on screen and nonscreen activities and with broader cultural indicators such as smartphone adoption, unemployment, stock market performance, income inequality, median income, GDP, and college enrollment to provide a view of correlations when matched by year at the group level. Matching characteristics by year follows the method of previous research examining possible causes behind cultural change (Grossmann & Varnum, 2015; Twenge, Campbell, & Carter, 2014; Varnum & Grossmann, 2016). We also examined these correlations lagged by year, to provide a view of whether the activity or indicator changed before psychological well-being, or instead if psychological well-being changed before the activity or indicator (e.g., if the increase in the frequency of Internet use preceded or followed the decline in psychological well-being). These are known as Granger causality analyses (Granger, 1969). These analyses constitute the second part of the two-part test for ruling in or out possible mechanisms behind the recent decrease in adolescents' psychological well-being, demonstrating which activities and indicators changed at the same time. These analyses focus on 2006 and later, when the MtF survey began asking about time spent online.

Figure 1. Total self-esteem, 8th, 10th, and 12th graders, 1991–2016. Error bars represent ±1 *SE*. The *y*-axis is truncated to illustrate the changes. The potential range of self-esteem was 1–5, with an *SD* of approximately .97. More detail given in Table 1.

Method

Participants. Participants were the 8th, 10th, and 12th grade students who completed the MtF surveys (as detailed in Study 1), focusing on recent years when items about online activities were asked.

Measures.

Psychological well-being. Measures included self-esteem, life satisfaction (with life as a whole), and happiness, as these were the items asked of the same participants as the items on activities.

New media screen activities. For clarity, we include the label we will use for each activity in italics. Across all grade levels, *Internet hours per week* was assessed with the following item beginning in 2006: "Not counting work for school or a job, about how many hours a week do you spend on the Internet e-mailing, instant messaging, gaming, shopping, searching, downloading music, etc.?" To estimate the number of hours spent per week, response choices were recoded to none = 0, less than 1 = .5, 1–2 hr = 1.5, 3–5 hr = 4, 6–9 hr = 7.5, 10–19 hr = 14.5, 20–29 hr = 24.5, and 30 or more = 35. In 2010, "30 or more" became 30–39 hr and a new choice, 40 hr or more, was added; we estimated these as 30–39 hr = 34.5 and 40 or more = 45.

In 2008, an item on *gaming hours per week* was added: "About how many hours a week do you spend . . . playing electronic games on a computer, TV, phone, or other device?" In 2010, "texting on a cell phone" (*texting hours per week*) was added. In 2013, "visiting social networking sites like Facebook" (referred to as *social media hours per week*) and "video chatting (Skype, etc.)," (*video chat hours per week*) were added. All of these items had the same response choices in hours as Internet use.

Another section begins, "The next questions ask about the kinds of things you might do. How often do you do each of the following?" which includes "visit social networking websites (like Facebook)." This item was added in 2009 and was asked until 2011 as "like MySpace or Facebook." Response choices were 1 (*never*), 2 (*a few times a year*), 3 (*once or twice a month*), 4 (*at least once a week*), and 5 (*almost everyday*; we refer to this item as *social media 1–5 scale* to distinguish it from the item asking about social media use in terms of hours per week). Beginning in 2005, another question asked 8th and 10th graders, "How often do you use each of the following to get information about news and current events? The Internet" (*reading news online*) with the same response choices.

TV watching. Eighth and 10th graders were asked two questions on TV viewing. First: "How much TV do you estimate you watch on an average weekday?" Response choices were recoded to none = 0, half-hour or less = .25, about 1 hr = 1, about 2 hr = 2, about 3 hr = 3, about 4 hr = 4, and 5 hr or more = 6. Second: "How much TV do you estimate you watch on an average WEEKEND (both Saturday and Sunday combined)?" Response choices were recoded to none = 0, an hour or less = .5, 1–2 hr = 1.5, 3–4

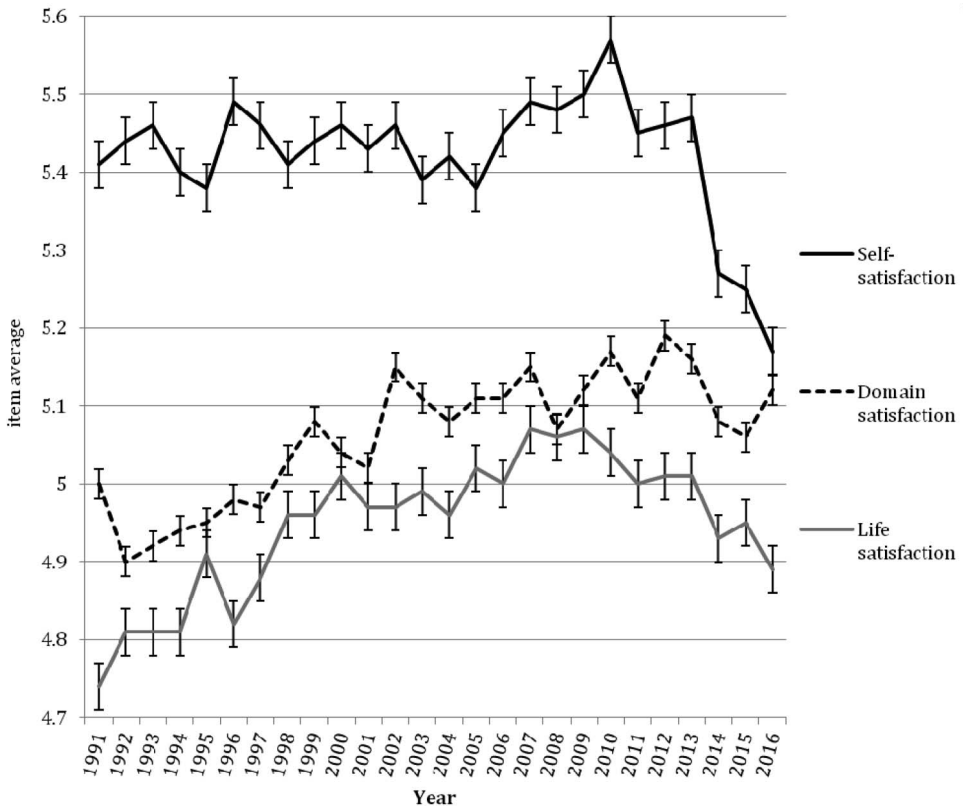

Figure 2. Self-satisfaction, domain satisfaction, and life satisfaction, 12th graders, 1991–2016. Error bars represent ±1 *SE*. The *y*-axis is truncated to highlight the changes. The potential range of each satisfaction measure was 1–7, with *SD*s of approximately 1.56, .95, and 1.57, respectively. More detail given in Table 1.

hr = 3.5, 5–6 hr = 5.5, 7–8 hr = 7.5, and 9 or more hours = 10. We multiplied the weekday estimate by 5, added the weekend estimate, and divided the total by 7 to obtain a daily estimate (*TV watching hours per day*). Twelfth graders were asked only the item about weekday TV watching.

In-person social interaction. Four items were asked in the same section beginning "How often do you do each of the following?": "get together with friends, informally;" "go to parties or other social affairs;" "ride around in a car (or motorcycle) just for fun;" "go to a shopping mall." Response choices were 1 (*never*), 2 (*a few times a year*), 3 (*once or twice a month*), 4 (*at least once a week*), and 5 (*almost everyday*). Another item asked about going out: "During a typical week, on how many evenings do you go out for fun and recreation? (Don't count things you do with your parents or other adult relatives)" with response choices recoded as "less than one" = .25, "one" = 1, two = 2, "three" = 3, "four or five" = 4.5, "six or seven" = 6.5. Less than one was recoded as .25 instead of .50 because "none" was not a response choice on this item. Another asked about dating: "On the average, how often (if ever) do you go out with a date?" with choices recoded to "never" = 0, "once a month or less" = .12, "2 or 3 times a month" = .58, "once a week" = 1, "2 or 3 times a week" = 2.5, and "over 3 times a week" = 4. The calculations for the first two recodes were as follows: once a month or less = .50 times a month, divided by 4.3 (the average number of weeks in a month) = .12; 2 or 3 times a month = 2.5, divided by 4.3 = .58. The six items were *Z* scored, added together, and divided by 6 (α = .68; *in-person social interaction*).

Homework. "About how many hours do you spend in an average week on all your homework including both in school and out of school?" with response choices recoded to 0 hr = 0, 1–4 hr = 2.5, 5–9 hr = 7, 10–14 hr = 12, 15–19 hr = 17, 20–24 hr = 22, and 25 or more hours = 30 (*homework hours per week*).

Sports or exercise. "How often do you do each of the following? Actively participate in sports, athletics, or exercising." Response choices were 1 (*never*), 2 (*a few times a year*), 3 (*once or twice a month*), 4 (*at least once a week*), and 5 (*almost everyday*; *sports/exercise*).

Religious services. "How often do you attend religious services?" Response choices were 1 (*never*), 2 (*rarely*), 3 (*once or twice a month*), and 4 (*once a week or more*; (*religious services*).

Paid job. "During an average week how much money do you get from a job or other work?" Those who answered anything except "none" were coded as having a paid job (*have a paid job*).

Print media. Eighth and 10th graders were asked: "How often do you do each of the following? Read magazines. Read newspapers." Response choices were 1 (*never*), 2 (*a few times a year*), 3 (*once or twice a month*), 4 (*at least once a week*), and 5 (*almost everyday*). Responses were added and divided by 2 (α = .59; *print media*).

Economic factors. We gathered yearly statistics on the (a) unemployment rate (*unemployment*), (b) the change in the Dow

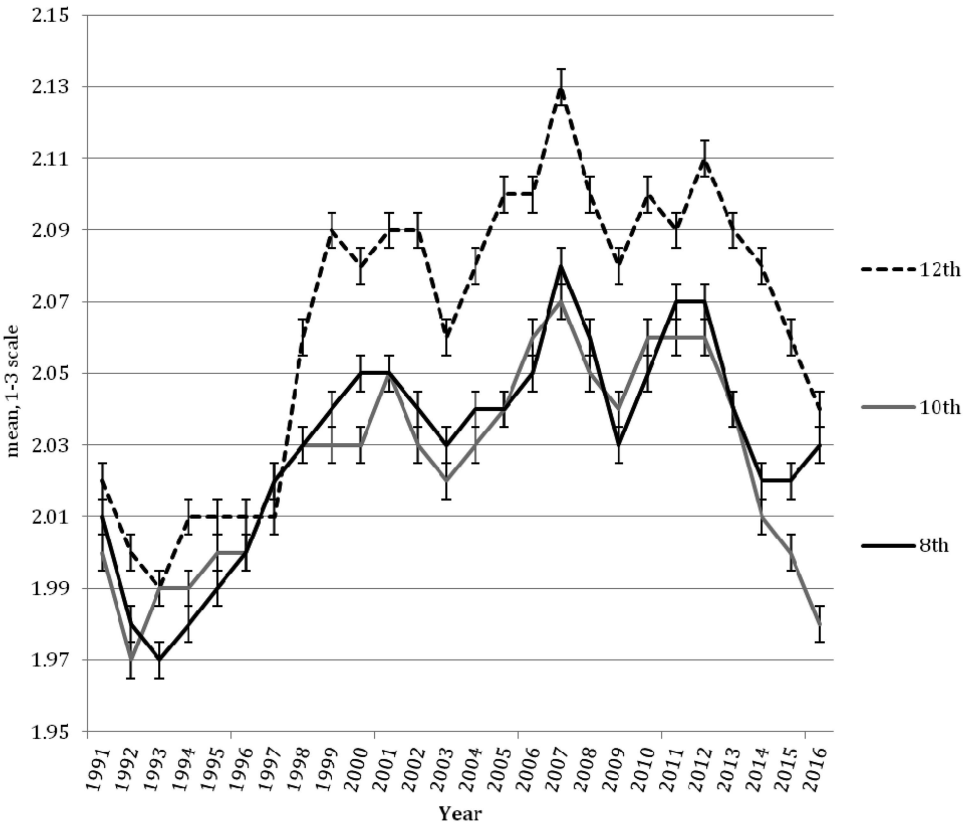

Figure 3. Happiness, 8th, 10th, and 12th graders, 1991–2016. Error bars represent ±1 *SE*. The *y*-axis is truncated to highlight the changes. The potential range of the happiness measure was 1–3, with an *SD* of approximately .59. More detail is given in Table 1.

Jones Industrial Average (DJIA) stock market indicator (*DJIA change*), (c) the GINI index of income inequality (*income inequality*), (d) median household income in 2015 dollars (*median household income*), (e) gross domestic product (*GDP*), and (f) the percentage of high school graduates who enroll in college (*college enrollment*) from publicly available sources such as the Bureau of Labor Statistics and the Federal Reserve Bank.

Smartphone adoption. We gathered yearly statistics on the percentage of the United States population who owns a smartphone (*smartphone adoption*) from surveys conducted by the Pew Research Center (Smith, 2017). These statistics were available beginning in 2011. Smartphones were introduced in 2007, so we set 2006 at zero and assumed linear growth between 2007 and 2010.

Statistical analyses. We limited the analyses examining the correlations between psychological well-being and activities to the years 2013–2016, when the survey asked the more rigorous question about time spent on social media (in terms of hours per week rather than the very general *never* to *almost every day* scale, which in later years has lacked variance as the vast majority of adolescents now use social media every day).

We focused primarily on the 8th and 10th grade samples because the items on electronic communication in hours and the six in-person social interaction items were asked of the same participants, while they were not for 12th graders. In addition, fewer 12th graders were asked the items on hours spent on electronic communication (n = 7,361) than 8th to 10th graders (n = 34,413), resulting in several exposure cells with low n (e.g., for 12th graders reporting video chatting 30–39 hr a week, n = 51). Thus, the 12th grade data should be interpreted with caution. However, we report the results for 12th graders for the sake of completeness.

We first report bivariate correlations between the activities and the measures of psychological well-being. Next, we report partial correlations controlled for demographic factors, including race/ethnicity (with dummy codes for Black and Hispanic; the survey measures race/ethnicity as only White, Black, and Hispanic), sex, socioeconomic status (SES; mother's education), and grade level. We also plotted the exposure-response curve between electronic communication and happiness, both using means (in tables) and using the percentage who identified as "not very happy" (in figures).

We examined possible additive and interaction effects for screen time with in-person social interaction, as adolescents who spend more time with their friends in person may also be more likely to interact with their friends online. To illustrate these results, we created a figure showing mean happiness for those low and high in in-person social interaction and low and high in hours spent on social media. For in-person social interaction, this was those ±1 *SD* of the mean. Social media and texting hours had a right-skewed distribution, so we compared those who spent no time or less than

an hour (low) with those who spent 20 hr a week or more (high). These roughly corresponded to the bottom and top 20% of the distribution. As only 8th and 10th graders were asked the six in-person social interaction items on the same form as the electronic communication hours items, these analyses focused on these age groups. We also report the exposure-response curve for happiness controlled for sex, race, SES, grade, and in-person social interaction, again for 8th and 10th graders only.

To examine the co-occurrence of psychological well-being with electronic communication, nonscreen activities, and economic factors, we matched the means of these variables among 8th and 10th graders by year. Matching by year is an established method for exploring cultural change at the group level (Grossmann & Varnum, 2015; Twenge et al., 2014; Varnum & Grossmann, 2016). Because means vary less than individuals, these ecological correlations are often high; to compensate, the *df* is the number of years rather than the number of individuals. For these analyses, we created an index of the two measures of psychological well-being asked of the 8th and 10th graders (self-esteem and happiness). We limited this analysis to 8th and 10th graders because the correlational analyses for activities and well-being relied primarily on that population, and because 12th graders were not asked about total hours spent watching TV, reading news online, or print media use. These analyses examined the years 2006–2016, as the item on Internet use was first asked in 2006. We were limited to the screen activities with data beginning 2006 or earlier: Internet use, smartphone adoption, reading news online, and TV watching. We examined these correlations concurrently as well as for the activity one year before a well-being measurement, and the activity one year after a well-being measurement (known as Granger causality analyses: Granger, 1969). The *p* values are two-tailed.

Results and Discussion

Adolescents who spent more time on electronic communication and screens (e.g., social media, texting, electronic games, Internet) were less happy, less satisfied with their lives, and had lower self-esteem, especially among 8th and 10th graders. TV watching, an older screen activity, was also linked to lower psychological well-being. In contrast, adolescents who spent more time on nonscreen activities such as in-person social interaction, sports/exercise, print media, and homework had higher psychological well-being (Table 2). Among 8th and 10th graders, every nonscreen activity was correlated with greater happiness, and every screen activity was correlated with less happiness (Figure 4).

The negative correlations between screen activities and well-being were generally weaker among 12th graders, suggesting that time spent on electronic communication is not as strongly linked to well-being among older adolescents as it is among younger adolescents. However, the positive correlations between nonscreen activities and well-being were similar across all age groups. Correlations with well-being were weaker or even positive for the measure of social media on a 1–5 scale ranging from *never* to *nearly every day*, possibly because such a high percentage of adolescents used social media nearly every day by 2013–2016 (75% of 8th and 10th graders and 80% of 12th graders).

Happiness and electronic communication: exposure-response curves. Next, we examined the exposure-response relationship between new media screen activities and happiness. Similar to previous research (Przybylski & Weinstein, 2017), happiness levels were higher among adolescents using new media a few hours a week compared with those not using it all, with mean happiness then progressively declining with more hours of use (Table 3). Just as with the bivariate correlations, these effects were

Table 2
Correlations Between Psychological Well-Being and Time Spent on Screen and Non-Screen Activities, 8th, 10th, and 12th Graders, 2013–2016

Activities	Happiness (8th and 10th)	Happiness (12th)	Life satisfaction (12th)	Self-esteem (8th and 10th)	Self-esteem (12th)
Screen activities and electronic communication					
Social media hours/week	$-.09^{***}$ ($-.07^{***}$)	$-.05^{***}$ ($-.03^{*}$)			
Internet hours/week	$-.11^{***}$ ($-.11^{***}$)	$-.08^{***}$ ($-.08^{***}$)			
Gaming hours/week	$-.09^{***}$ ($-.08^{***}$)	$-.08^{***}$ ($-.07^{***}$)			
Texting hours/week	$-.07^{***}$ ($-.05^{***}$)	$-.03^{*}$ ($-.01$)			
Video chat hours/week	$-.05^{***}$ ($-.05^{***}$)	$-.03^{**}$ ($-.02$)			
Social media (1–5 scale)	$-.01^{**}$ (.01)	$.03^{**}$ ($.04^{***}$)	$.03^{**}$ ($.03^{*}$)	$-.04^{***}$ ($-.01$)	$.03^{*}$ ($.04^{**}$)
Reading news online	.00 ($-.01$)			.01 (.00)	
TV watching hours/day	$-.02^{***}$ ($-.01^{**}$)	$-.01$ (.01)		$-.01^{*}$ ($-.01$)	
Nonscreen activities					
In-person social interaction (composite of 6 activities)	$.12^{***}$ ($.12^{***}$)	$.14^{***}$ ($.14^{***}$)	$.10^{***}$ ($.10^{***}$)	$.10^{***}$ ($.11^{***}$)	$.14^{***}$ ($.13^{***}$)
Homework hours/week	$.02^{***}$ ($.02^{***}$)	.01 (.00)	$.03^{*}$ ($.03^{*}$)	$.03^{***}$ ($.04^{***}$)	.00 (.00)
Sports/exercise	$.16^{***}$ ($.14^{***}$)	$.17^{***}$ ($.16^{***}$)	$.13^{***}$ ($.12^{***}$)	$.23^{***}$ ($.21^{***}$)	$.21^{***}$ ($.20^{***}$)
Religious services	$.08^{***}$ ($.09^{***}$)	$.10^{***}$ ($.11^{***}$)	$.11^{***}$ ($.12^{***}$)	$.15^{***}$ ($.14^{***}$)	$.12^{***}$ ($.12^{***}$)
Have a paid job	$.02^{***}$ (.00)	$.03^{*}$ (.01)	$.03^{*}$ (.02)	$.02^{***}$ (.01)	$.03^{*}$ ($.03^{*}$)
Print media	$.07^{***}$ ($.06^{***}$)			$.08^{***}$ ($.07^{***}$)	

Note. Correlations in parentheses are controlled for sex, race, socioeconomic status (mother's education), and grade (for 8th and 10th graders). TV watching for 8th and 10th graders is a total for both weekdays and weekends; for 12th graders it is weekdays only.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

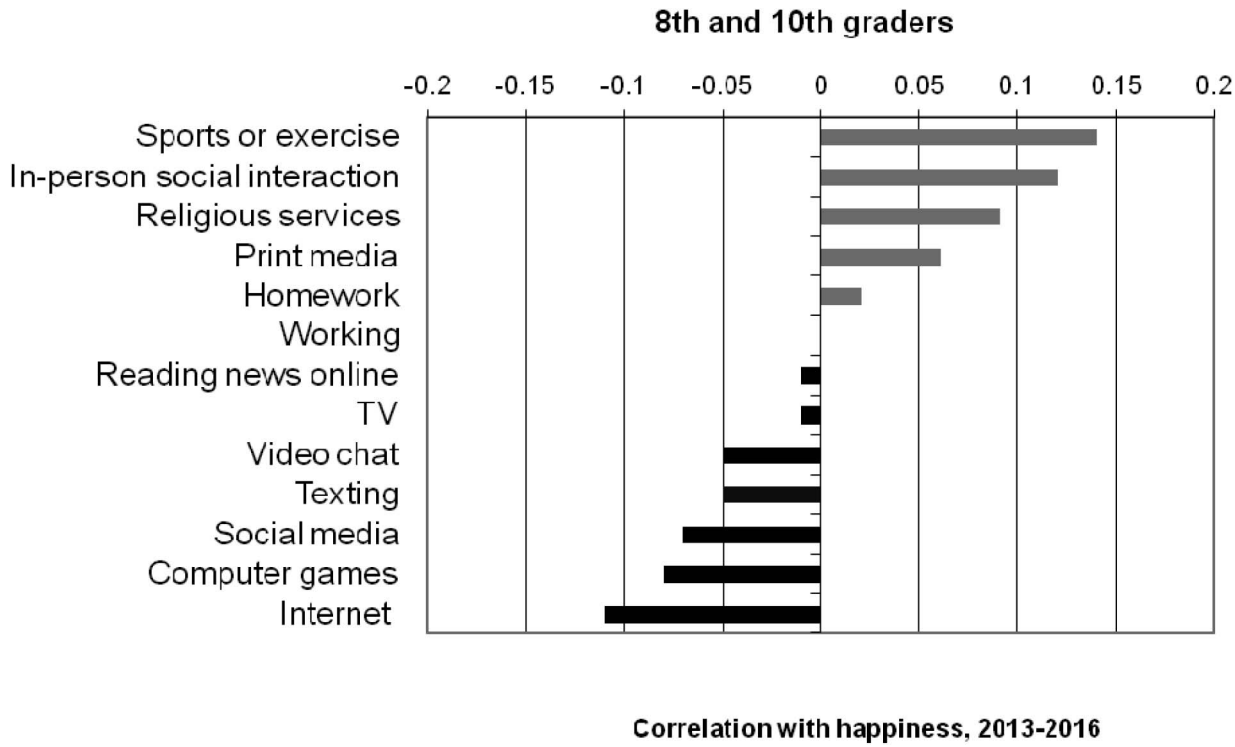

Figure 4. Partial correlations between happiness and screen activities (black bars) and nonscreen activities (gray bars), including demographic controls, 8th ,and 10th graders, 2013–2016.

generally smaller among 12th graders than among 8th and 10th graders.

We also plotted the percentage of teens describing themselves as "not too happy" by levels of new media use. Compared with those using new media only a few hours a week, 8th and 10th graders who engaged with news media 40 hr a week or more (about 6 hr a day) were twice as likely or nearly twice as likely to describe themselves as unhappy (Figure 5A). This extreme level of use was not uncommon, constituting 11% of 8th and 10th graders for online time, 11% for social media use, 10% for gaming, and 13% for texting, though only 3% for video chat. Differences in happiness were considerable even below levels of extreme use. Compared with those using social media 1–2 hr a week, 8th and 10th graders who used social media 10 to 19 hr a week (about 2 hr a day) were 41% more likely to be unhappy (18.10% vs. 12.88%). Eighth and 10th graders who texted 20 to 29 hr a week (about 3.5 hr a day) were 45% more likely to be unhappy than those who texted only 1–2 hr a week (17.90% vs. 12.31%).

The exposure-response curve for 12th graders was more shallow than the curve for 8th and 10th graders, with a higher level of unhappiness among nonusers and an inflection point at a higher number of hours (see Figure 5B). For example, the happiest 12th graders were those who spent 3–5 hr a week on social media (12.08% were unhappy, compared with 15.95% of those who spent no time on social media and 20.35% of those spending 40+ hr a week). Thus those using social media a very high amount of time were 68% more likely to be unhappy, and those not using it at all 32% more likely to be unhappy, than those using it a small amount of time. The curve for 12th graders was more similar to that for 8th and 10th graders for Internet time, with those online 20–29 hr a week 66% more likely to be unhappy than those online only 1–2 hr a week, and those online 40 or more hours a week twice as likely (105%) to be unhappy. Those who did not use the Internet at all were 62% more likely to be unhappy than those who used it 1–2 hr a week.

The role of in-person social interaction. Likely due to individual differences in sociability, adolescents who spent more time interacting with friends in person also spent more time interacting with them online. Of the electronic communication activities, texting was the most highly correlated with in-person social interaction $r(33{,}099) = .29$, $p < .001$, followed by social media on the 1–5 scale, $r(73{,}813) = .28$, $p < 001$, social media hours, $r(33{,}114) = .24$, $p < .001$, reading news online, $r(110{,}363) = .18$, $p < .001$, and video chatting, $r(33{,}043) = .17$, $p < .001$. (Total online time was not correlated with in-person social interaction $r(33{,}222) = .00$, $p = .74$, and gaming was only weakly correlated, $r(33{,}173) = .02$, $p < .001$). Thus, we examined possible additive, suppressive, and interactive effects of electronic communication and in-person social interaction on happiness. In regression equations including in-person social interaction and each electronic communication activity, in-person social interaction was consistently correlated with greater happiness and self-esteem, and electronic communication was consistently correlated with lower happiness and self-esteem. The results were similar when the cross-product (the interaction term) was included in the regression equation (Table 4). The exposure-response curve for unhappiness for 8th and 10th graders was also similar when the demographic variables and the index of in-person social interaction were in-

Table 3
Mean Happiness and Hours Per Week Spent on Screen Activities, 8th and 10th Graders and 12th Graders, 2013–2016

Mean type	None	<1 hr	1–2 hr	3–5 hr	6–9 hr	10–19 hr	20–29 hr	30–39 hr	40+ hr	*d* (0 vs. 40+)	*d* (1–2 vs. 40+)
8th and 10th, nonadjusted											
Social media hours/week	2.04 (.61)	2.08 (.58)	2.08 (.58)	2.03 (.58)	2.02 (.58)	1.98 (.58)	1.97 (.58)	1.91 (.58)	1.91 (.61)	−.21	−.29
Internet hours/week	2.05 (.62)	2.11 (.58)	2.09 (.57)	2.05 (.57)	2.02 (.58)	2.01 (.58)	1.99 (.60)	1.91 (.58)	1.87 (.62)	−.29	−.37
Gaming hours/wk	2.01 (.64)	2.07 (.60)	2.07 (.57)	2.05 (.57)	2.03 (.57)	2.02 (.58)	2.00 (.59)	1.93 (.57)	1.89 (.62)	−.19	−.31
Texting hours/week	1.98 (.63)	2.07 (.58)	2.09 (.57)	2.04 (.57)	2.02 (.58)	2.01 (.59)	1.98 (.56)	1.97 (.61)	1.93 (.61)	−.08	−.27
Video chat hours/week	2.04 (.60)	2.05 (.57)	2.00 (.57)	1.99 (.57)	1.94 (.59)	1.98 (.58)	1.97 (.64)	1.89 (.60)	1.92 (.66)	−.20	−.14
8th and 10th, adjusted for covariates											
Social media hours/week	2.10 (.61)	2.11 (.56)	2.10 (.55)	2.06 (.58)	2.04 (.59)	1.98 (.56)	1.98 (.56)	1.92 (.58)	1.91 (.60)	−.31	−.31
Internet hours/week	2.08 (.59)	2.14 (.56)	2.12 (.57)	2.07 (.55)	2.03 (.56)	2.02 (.57)	2.00 (.58)	1.93 (.57)	1.90 (.57)	−.31	−.39
Gaming hours/week	2.06 (.59)	2.10 (.57)	2.08 (.60)	2.06 (.58)	2.05 (.58)	2.03 (.56)	2.02 (.57)	1.96 (.58)	1.91 (.58)	−.25	−.29
Texting hours/week	2.05 (.59)	2.13 (.59)	2.11 (.59)	2.06 (.59)	2.04 (.56)	2.01 (.57)	1.97 (.57)	1.98 (.57)	1.94 (.59)	−.19	−.29
Video chat hours/week	2.08 (.62)	2.07 (.59)	2.01 (.60)	2.00 (.59)	1.94 (.58)	1.98 (.58)	1.98 (.58)	1.93 (.57)	1.89 (.57)	−.31	−.20
12th graders, nonadjusted											
Social media hours/week	2.09 (.64)	2.06 (.58)	2.10 (.61)	2.10 (.58)	2.06 (.56)	2.08 (.62)	2.07 (.60)	2.02 (.56)	1.99 (.63)	−.16	−.11
Internet hours/week	2.09 (.64)	2.12 (.57)	2.16 (.58)	2.10 (.57)	2.06 (.57)	2.07 (.62)	2.02 (.60)	2.04 (.62)	1.97 (.62)	−.19	−.32
Gaming hours/week	2.11 (.62)	2.09 (.59)	2.12 (.59)	2.07 (.58)	2.07 (.59)	2.06 (.60)	2.00 (.59)	2.02 (.63)	1.95 (.61)	−.26	−.28
Texting hours/week	2.10 (.67)	2.02 (.58)	2.11 (.60)	2.08 (.58)	2.07 (.57)	2.10 (.60)	2.08 (.61)	2.05 (.59)	2.03 (.61)	−.11	−.13
Video chat hours/week	2.08 (.60)	2.09 (.59)	2.05 (.57)	2.04 (.56)	2.04 (.63)	2.07 (.58)	2.02 (.65)	2.04 (.63)	1.97 (.63)	−.18	−.14

Note. Covariates are sex, race (dummy coded), mother's education, grade, and the index of six in-person social interaction activities. Means adjusted for this list of covariates cannot be reported for 12th graders as the six items of the in-person social interaction index were not asked on the same form as these items on electronic communication.

cluded as covariates (see Table 3 and supplemental Figure 3). Thus, when in-person social interaction was controlled, electronic communication was still linked to lower happiness, in some cases at an even higher rate.

The least happy adolescents were those low in in-person social interaction and high in electronic communication, and the happiest were those high in in-person social interaction and low in electronic communication. For example, social media use was negatively related to happiness among both those low in in-person social interaction, $F(1, 2993) = 88.59$, $p < .001$, $d = .43$, and among those high in in-person social interaction, $F(1, 2542) = 42.20$, $p < .001$, $d = .28$ (Figure 6). Similar results appeared for texting: those who spent more time on texting were less happy, including both those low in in-person social interaction, $F(1, 3020) = 69.52$, $p < .001$, $d = .38$ and for those high in in-person social interaction, $F(1, 2588) = 20.56$, $p < .001$, $d = .23$ (see Figure 4 in the online supplemental materials).

Well-being, activities, and economic indicators by year. Next, we matched mean psychological well-being by year with mean levels of adolescents' activities as well as broader cultural indicators. This provides a view of the trends at the group or cultural level. These analyses showed that psychological well-being was lowest in years when adolescents spent more time online, on social media, and reading news online, and when more Americans owned smartphones. Psychological well-being was highest in years when adolescents spent more time with their friends in person, reading print media, and on exercise/sports (Table 5). Homework time was not related to psychological well-being when matched by year. TV watching declined over time; thus, TV watching was positively correlated with psychological well-being when matched by year.

We then lagged these indicators by one year in either direction, known as Granger causality analyses. These analyses suggested that the changes in activities, particularly those in new media screen activities, preceded the decrease in psychological well-being rather than vice versa (see Table 5). The same was also true of most nonscreen activities, with decreases in these activities predicting psychological well-being one year later.

Last, we matched economic indicators by year with mean psychological well-being. The GINI index of income inequality was a significant predictor of lower psychological well-being, both concurrently and as a predictor from one year before. GDP was also a significant negative predictor in all three comparisons. Median family income and college enrollment were not significantly correlated with yearly well-being. However, cyclical economic factors such as unemployment and yearly change in the DJIA were not significantly correlated with psychological well-being when matched by year, either concurrently or when lagged. Thus, the Great Recession is unlikely to be a direct cause (at least in current or 1-year lagged effects) of the decline in psychological well-being, as unemployment peaked in 2010 and psychological well-being began to decline only after 2012. In contrast, smartphone adoption and Internet time increased at the same time as low psychological well-being (Figure 7).

General Discussion

American adolescents' psychological well-being dropped between 2012 and 2016, including lower average levels of self-

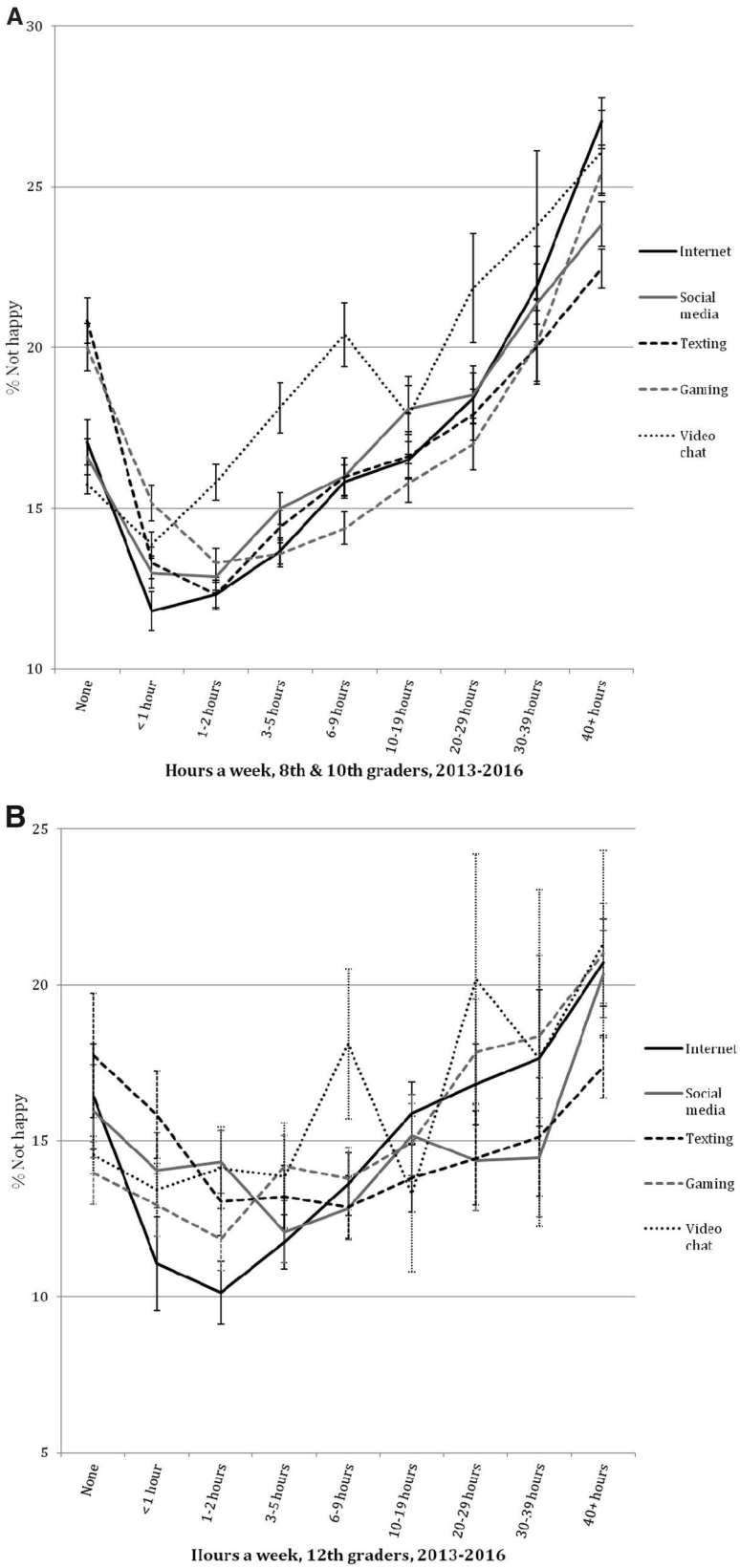

Figure 5 (opposite)

Table 4
Standardized Betas in Multiple Regressions Including Each Screen Activity, In-Person Social Interaction, and Their Product (Interaction Term) to Predict Happiness or Self-Esteem, 8th and 10th Graders and 12th Graders, 2013–2016

Outcome	Screen activity	In-person social interaction	Interaction term
Happiness			
Social media hours/week	−.13*** (−.13***)	.15*** (.15***)	.01
Internet hours/week	−.11*** (−.11***)	.12*** (.12***)	.02*
Gaming hours/week	−.09*** (−.09***)	.12*** (.12***)	.00
Texting hours/week	−.12*** (−.12***)	.15*** (.15***)	.00
Video chat hours/week	−.07*** (−.07***)	.13*** (.13***)	.01
Social media (1–5 scale)	−.05*** (−.06***)	.13*** (.13***)	−.02**
Social media (1–5 scale) 12th graders	.00 (.01)	.13*** (.13***)	.01
Reading news online	−.03*** (−.03***)	.12*** (.12***)	.00
Self-esteem			
Social media (1–5 scale)	−.07*** (−.08***)	.13*** (.13***)	−.01
Social media (1–5 scale) 12th graders	−.01 (−.01)	.14*** (.14***)	.00
Reading news online	−.02** (−.02**)	.11*** (.11***)	−.01

Note. Betas are for 8th and 10th graders unless otherwise specified. Betas outside parentheses are from regressions including the screen activity and the index of six in-person social interaction activities; betas in parentheses are from regressions including each screen activity, in-person social interaction, and the interaction term.
* $p < .05$. ** $p < .01$. *** $p < .001$.

esteem, self-satisfaction, domain satisfaction, life satisfaction, and happiness. One possible cause is the increase in the time adolescents spent on electronic communication, an activity linked to lower psychological well-being among individuals. In Granger causality lagged analyses by year, increases in electronic communication preceded the decline in psychological well-being to a larger extent than trailing it. In some cases the declines in well-being leveled off between 2014 and 2016, around the time that the growth in ownership of smartphones began to slow (Smith, 2017). Electronic communication was the only adolescent activity negatively correlated with psychological well-being that increased at the same time psychological well-being declined. Other activities, such as in-person social interaction, print media, sports/exercise, and attending religious services, were linked to better psychological well-being and declined over time. Thus, these activities satisfy two criteria consistent with a direct causal role in the decline in well-being.

These conclusions come with several caveats. First, other variables not assessed here could play a role; second, some assessed variables may play a more complex or indirect role; and third, these are correlational data that cannot definitively uncover causal evidence. With current research methods, it is very challenging to confidently pinpoint causal forces in cultural change (Varnum & Grossmann, 2017). Given the data and theory we have, the most likely culprit for a cultural force leading to lower well-being among adolescents since 2012 is the increase in electronic communication. That is particularly true as two longitudinal studies established that social media precedes declines in psychological well-being but declines in psychological well-being do not lead to social media use (Kross et al., 2013; Shakya & Christakis, 2017), and a random-assignment experiment showed that adults who gave up Facebook for a week ended that time higher in psychological well-being than those who did not (Tromholt, 2016). Thus, other evidence suggests that the causal arrow points from electronic communication to lower psychological well-being rather than the other way around.

The decline in in-person social interaction among adolescents in recent years (Twenge & Uhls, 2017) may also play a role. The relationship between electronic communication and in-person social interaction varied depending on the level of analysis. Electronic communication and in-person social interaction do not seem to displace each other among individuals, where they are positively correlated. Adolescents who prioritize social relationships over other activities spend more time on both electronic communication and in-person social interaction. However, at the group level over time, in-person social interaction decreased at the same time that electronic communication increased (Twenge & Uhls, 2017). The combination of lower in-person social interaction (positively correlated with well-being) and higher electronic communication (negatively correlated with well-being) may be two possible and related causes of the decline in psychological well-being. The sudden shift in well-being around 2012–13 suggests that the trends in adolescent time use reached a tipping point around that year, perhaps due to the market saturation of smartphones in that period (Lenhart, 2015; Smith, 2017).

Other mechanisms created by screen time may also lower well-being. Adolescents who spend more time on screens also sleep less (Barlett, Gentile, Barlett, Eisenmann, & Walsh, 2012; Hysing et al.,

Figure 5 (opposite). (A) Exposure-response curve for unhappiness and electronic communication, 8th and 10th graders, 2013–2016. (B) Exposure-response curve for unhappiness and electronic communication, 12th graders, 2013–2016. The *y*-axis is truncated to illustrate the changes. The potential range of percent not happy is 0–100%.

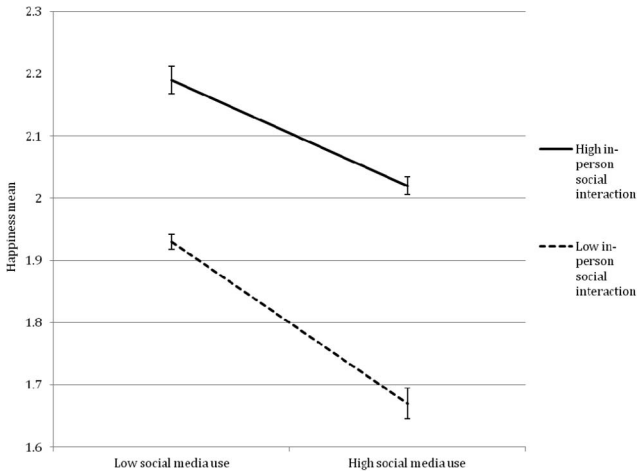

Figure 6. Happiness among 8th and 10th graders low and high (±1 *SD*) in in-person social interaction and low and high (~±1 *SD*) in hours spent on social media, 2013–2016. Error bars represent ±1 *SE*. The *y*-axis is truncated to illustrate the changes. The range of the happiness measure was 1–3, with an *SD* of approximately .59.

2015; Twenge, Krizan, & Hisler, 2017), and inadequate sleep is linked to lower psychological well-being (Kalmbach, Pillai, Roth, & Drake, 2014). Thus, screen time may impact well-being indirectly through sleep time and sleep quality. In addition, screen activities such as social media and texting may be addictive (Alter, 2017), which may mean users are spending time on an activity even if it does not increase well-being.

Replicating previous research examining adolescents in the United Kingdom (Przybylski & Weinstein, 2017), we found that the happiest adolescents were those who spent a small amount of time on electronic communication activities, not those who spent no time. However, the exposure-response curve, especially among 8th and 10th graders, showed steadily lower well-being with more hours of use after a small amount, with adolescents who spent more than 40 hr a week (6 or more hours a day) about twice as likely to be unhappy than those spending only a few hours a week. (A similar pattern has been found with adolescent marijuana use, where abstainers report more psychological problems than moderate users, but heavy users report the most distress; Shedler & Block, 1990). These results suggest that reducing screen time, not eliminating it entirely, may be a useful path for interventions focusing on increasing adolescent well-being.

Cyclical economic factors such as unemployment were not closely linked to psychological well-being, suggesting that the Great Recession can be ruled out as a simple cause, at least in concurrent effects and effects delayed by one year. It is possible that the effects of the recession took more than one year to appear. However, given that the Great Recession began in 2007 (with unemployment peaking in 2010) and the decline in well-being was the most steep around 2013, the effects would have to be delayed by 3 to 6 years, which seems unlikely (see Figure 7). However, income inequality was related to poor psychological well-being, suggesting it may play a role in the decline, consistent with previous research (Oishi et al., 2011).

Some have speculated that poor psychological well-being among recent adolescents is caused primarily by academic pres-

Table 5
Bivariate Correlations Between Yearly Mean Composite Psychological Well-Being (Happiness and Self-Esteem) and Activities and Economic Indicators, Concurrent and Lagged, 8th and 10th Graders, 2006–2016

Activities and indicators	Activity/indicator → Well-being 1 year later	Concurrent	Well-being → Activity/indicator 1 year later
Screen activities and electronic communication			
Internet hours	−.93**	−.95***	−.84**
Reading news online	−.83**	−.81**	−.64*
Smartphone adoption	−.91**	−.87**	−.72*
TV watching hours	.88**	.87**	.83**
Nonscreen activities			
In-person social interaction (composite of six activities)	.93***	.90**	.78***
Homework hours	−.55	−.09	−.06
Sports/exercise	.43	.81*	.82*
Religious services	.54	.67*	.67*
Have a paid job	.71*	.67*	.50
Print media	.87**	.88**	.76**
Economic indicators			
Unemployment	.16	.28	.42
DJIA change	.02	−.20	−.15
Income inequality	−.76**	−.74***	−.55
GDP	−.94**	−.90**	−.79**
Median household income	.15	−.22	−.38
College enrollment	−.02	−.46	−.43

Note. *df* is number of years. DJIA = Dow Jones Industrial Average; GDP = gross domestic product.
* $p < .05$. ** $p < .01$. *** $p < .001$.

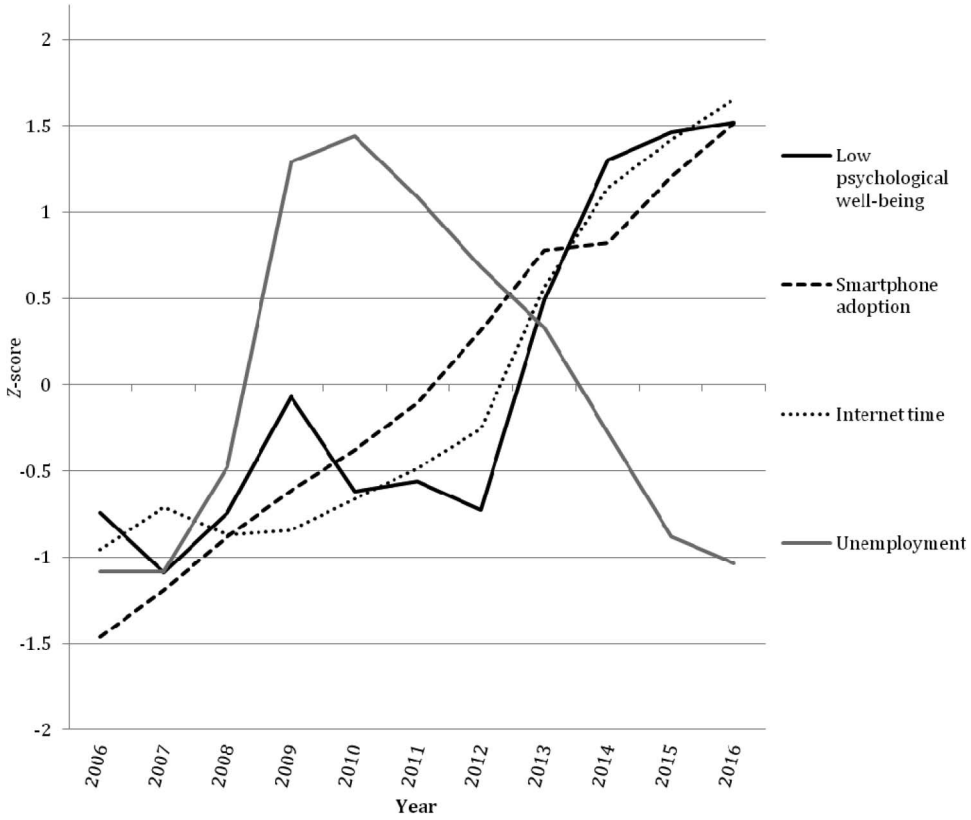

Figure 7. Low psychological well-being among 8th and 10th graders, smartphone adoption in the United States population, Internet time among 8th and 10th graders, and the national unemployment rate, 2006–2016. No error bars are given as data are at the group level. *Z* scores are based on yearly aggregates and thus should not be used to compute individual-level effect sizes.

sure such as too much homework (Dwyer, 2014). However, 8th and 10th graders who spent more time on homework were actually happier and had higher self-esteem. That makes it unlikely that increased homework loads could be responsible for the sudden decrease in adolescents' psychological well-being after 2012. In addition, homework time declined for 8th graders between 2012 and 2016 and was steady among 10th and 12th graders, as was time spent on extracurricular activities (Twenge & Park, 2017).

The abrupt changes in adolescents' time use and well-being suggest a possible generational shift appearing among those born after about 1995. If so, the admittedly arbitrary generational grouping of Millennials (previously thought to be those born 1980–1999) may instead be better demarcated at 1980–1994. If so, a new generation—dubbed iGen—now dominates samples of adolescents and traditional-age college students (Twenge, 2017). Future research should also examine whether well-being has also declined among adults, which might point to a time-period shift rather than a cohort effect. Although adolescents may potentially be more affected by the large shift toward electronic communication, adults may also be impacted by these trends. Similarly, future research should explore whether the decline in well-being appears in other countries and cultures. Arguably, any culture that also experienced a sudden rise in screen time via rapid adoption of the smartphone might see these effects.

In conclusion, adolescents' psychological well-being suddenly decreased after 2012, possibly due to their spending more time on electronic communication and less time on nonscreen activities such as in-person social interaction. The rapid adoption of smartphone technology in the early 2010s may have had a marked negative impact on adolescents' psychological well-being.

References

Alter, A. (2017). *Irresistible: The rise of addictive technology and the business of keeping us hooked*. New York, NY: Penguin Press.

Anderssen, E. (2013, January 21). Why are today's teenagers feeling so anxious? *The Globe and Mail*. Retrieved from https://www.theglobeandmail.com/life/health-and-fitness/health/conditions/why-are-todays-teenagers-feeling-so-anxious/ article7604612/

Bachman, J. G., O'Malley, P. M., Freedman-Doan, P., Trzesniewski, K. H., & Donnellan, M. B. (2011). Adolescent self-esteem: Differences by race/ethnicity, gender, and age. *Self and Identity, 10,* 445–473. http://dx.doi.org/10.1080/15298861003794538

Barlett, N. D., Gentile, D. A., Barlett, C. P., Eisenmann, J. C., & Walsh, D. A. (2012). Sleep as a mediator of screen time effects on US children's health outcomes. *Journal of Children and Media, 6,* 37–50. http://dx.doi.org/10.1080/17482798.2011.633404

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psycho-*

logical Bulletin, 117, 497–529. http://dx.doi.org/10.1037/0033-2909.117.3.497

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. http://dx.doi.org/10.1016/j.childyouth.2014.03.001

Bianchi, E. C. (2016). American individualism rises and falls with the economy: Cross-temporal evidence that individualism declines when the economy falters. *Journal of Personality and Social Psychology, 111,* 567–584. http://dx.doi.org/10.1037/pspp0000114

Blakemore, S. J. (2012). Development of the social brain in adolescence. *Journal of the Royal Society of Medicine, 105,* 111–116. http://dx.doi.org/10.1258/jrsm.2011.110221

Boyd, D. (2015). *It's complicated: The social lives of networked teens*. New Haven, CT: Yale University Press.

Campbell, W. K., Campbell, S., Siedor, L. E., & Twenge, J. M. (2015). Generational differences are real and useful. *Industrial and Organizational Psychology: Perspectives on Science and Practice, 8,* 324–331. http://dx.doi.org/10.1017/iop.2015.43

Cooper, B. (2011). Economic recession and mental health: An overview. *Neuropsychiatrie: Klinik, Diagnostik, Therapie und Rehabilitation: Organ der Gesellschaft Osterreichischer Nervenarzte und Psychiater, 25,* 113–117.

Davis, K. (2012). Friendship 2.0: Adolescents' experiences of belonging and self-disclosure online. *Journal of Adolescence, 35,* 1527–1536. http://dx.doi.org/10.1016/j.adolescence.2012.02.013

DeGusta, M. (2012). Are smart phones spreading faster than any technology in human history? *MIT Technology Review,* May, 9, 2012.

Dwyer, L. (2014, October 3). When anxiety hits at school. *The Atlantic*. Retrieved from https://www.theatlantic.com/health/archive/2014/10/when-anxiety-hits-at-school/380622/

Frasquilho, D., Matos, M. G., Salonna, F., Guerreiro, D., Storti, C. C., Gaspar, T., & Caldas-de-Almeida, J. M. (2016). Mental health outcomes in times of economic recession: A systematic literature review. *BMC Public Health, 16,* 115. http://dx.doi.org/10.1186/s12889-016-2720-y

Gentile, B., Twenge, J. M., & Campbell, W. K. (2010). Birth cohort differences in self-esteem, 1988–2008: A cross-temporal meta-analysis. *Review of General Psychology, 14,* 261–268. http://dx.doi.org/10.1037/a0019919

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica, 37,* 424–438. http://dx.doi.org/10.2307/1912791

Grossmann, I., & Varnum, M. E. (2015). Social structure, infectious diseases, disasters, secularism, and cultural change in America. *Psychological Science, 26,* 311–324. http://dx.doi.org/10.1177/0956797614563765

Huang, C. (2017). Time spent on social network sites and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior and Social Networking, 20,* 346–354. http://dx.doi.org/10.1089/cyber.2016.0758

Hysing, M., Pallesen, S., Stormark, K. M., Jakobsen, R., Lundervold, A. J., & Sivertsen, B. (2015). Sleep and use of electronic devices in adolescence: Results from a large population-based study. *British Medical Journal Open, 5,* e006748–e006748. http://dx.doi.org/10.1136/bmjopen-2014-006748

Jelenchick, L. A., Eickhoff, J. C., & Moreno, M. A. (2013). "Facebook depression?" social networking site use and depression in older adolescents. *Journal of Adolescent Health, 52,* 128–130. http://dx.doi.org/10.1016/j.jadohealth.2012.05.008

Johnston, L. D., Bachman, J. G., O'Malley, P. M., Schulenberg, J. E., & Miech, R. A. (2017). *Monitoring the Future: A continuing study of American youth (12th grade surveys; 8th- and 10th-grade surveys), 2016. ICPSR36799-v1* (pp. 10–26). Ann Arbor, MI: Inter-university Consortium for Political and Social Research.

Kalmbach, D. A., Pillai, V., Roth, T., & Drake, C. L. (2014). The interplay between daily affect and sleep: A 2-week study of young women. *Journal of Sleep Research, 23,* 636–645. http://dx.doi.org/10.1111/jsr.12190

Kingkade, T. (2016, January 13). The number of college students seeking mental health treatment is growing rapidly. *Huffington Post*. Retrieved from https://www.huffingtonpost.com/entry/college-students-mental-health-treatment_us_5696a1dde4b0ce496422e8f1

Konrath, S. H., O'Brien, E. H., & Hsing, C. (2011). Changes in dispositional empathy in American college students over time: A meta-analysis. *Personality and Social Psychology Review, 15,* 180–198. http://dx.doi.org/10.1177/1088868310377395

Kross, E., Verduyn, P., Demiralp, E., Park, J., Lee, D. S., Lin, N., . . . Ybarra, O. (2013). Facebook use predicts declines in subjective well-being in young adults. *PLoS ONE, 8,* e69841. http://dx.doi.org/10.1371/journal.pone.0069841

Leckelt, M., Back, M. D., Foster, J. D., Hutteman, R., Jaeger, G., McCain, J., . . . Campbell, W. K. (2016). Entering adulthood in a recession tempers later narcissism—But only in men. *Journal of Research in Personality, 60,* 8–11. http://dx.doi.org/10.1016/j.jrp.2015.10.006

Lenhart, A. (2015). *Teens, social media, and technology overview 2015*. Washington, DC: Pew Research Center.

Lieberman, M. D. (2014). *Social: Why our brains are wired to connect*. New York, NY: Broadway Books.

Markus, H. R., & Kitayama, S. (2010). Cultures and selves: A cycle of mutual constitution. *Perspectives on Psychological Science, 5,* 420–430.

McLoyd, V. C., Jayaratne, T. E., Ceballo, R., & Borquez, J. (1994). Unemployment and work interruption among African American single mothers: Effects on parenting and adolescent socioemotional functioning. *Child Development, 65,* 562–589. http://dx.doi.org/10.2307/1131402

Noguchi, S. (2014, February 5). Teen health: Depression, anxiety and social phobias rising in kids, educators say. *San Jose Mercury News*. Retrieved from http://www.mercurynews.com/2014/02/05/teen-health-depression-anxiety-and-social-phobias-rising-in-kids-educators-say/

Oishi, S., Graham, J., Kesebir, S., & Galinha, I. C. (2013). Concepts of happiness across time and cultures. *Personality and Social Psychology Bulletin, 39,* 559–577. http://dx.doi.org/10.1177/0146167213480042

Oishi, S., Kesebir, S., & Diener, E. (2011). Income inequality and happiness. *Psychological Science, 22,* 1095–1100. http://dx.doi.org/10.1177/0956797611417262

Pea, R., Nass, C., Meheula, L., Rance, M., Kumar, A., Bamford, H., . . . Zhou, M. (2012). Media use, face-to-face communication, media multitasking, and social well-being among 8- to 12-year-old girls. *Developmental Psychology, 48,* 327–336. http://dx.doi.org/10.1037/a0027030

Przybylski, A. K., & Weinstein, N. (2017). A large-scale test of the Goldilocks hypothesis. *Psychological Science, 28,* 204–215. http://dx.doi.org/10.1177/0956797616678438

Rosenberg, M. (1965). *Society and the adolescent self-image*. Middletown, CT: Wesleyan University Press.

Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology, 69,* 719–727. http://dx.doi.org/10.1037/0022-3514.69.4.719

Schaie, K. W. (1965). A general model for the study of developmental problems. *Psychological Bulletin, 64,* 92–107. http://dx.doi.org/10.1037/h0022371

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.

Shedler, J., & Block, J. (1990). Adolescent drug use and psychological health. A longitudinal inquiry. *American Psychologist, 45,* 612–630. http://dx.doi.org/10.1037/0003-066X.45.5.612

Smith, A. (2017, January 12). Record shares of Americans now own smartphones, have home broadband. Retrieved from Pew Research Center website: http://www.pewresearch.org/fact-tank/2017/01/12/evolution-of-technology/

Stewart, A. J., & Healy, J. M. (1989). Linking individual development and social changes. *American Psychologist, 44,* 30–42. http://dx.doi.org/10.1037/0003-066X.44.1.30

Tafarodi, R. W., & Milne, A. B. (2002). Decomposing global self-esteem. *Journal of Personality, 70,* 443–484. http://dx.doi.org/10.1111/1467-6494.05017

Tromholt, M. (2016). The Facebook experiment: Quitting Facebook leads to higher levels of well-being. *Cyberpsychology, Behavior and Social Networking, 19,* 661–666. http://dx.doi.org/10.1089/cyber.2016.0259

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. (2008). Increases in positive self-views among high school students: Birth-cohort changes in anticipated performance, self-satisfaction, self-liking, and self-competence. *Psychological Science, 19,* 1082–1086. http://dx.doi.org/10.1111/j.1467-9280.2008.02204.x

Twenge, J. M., Campbell, W. K., & Carter, N. T. (2014). Declines in trust in others and confidence in institutions among American adults and late adolescents, 1972–2012. *Psychological Science, 25,* 1914–1923. http://dx.doi.org/10.1177/0956797614545133

Twenge, J. M., Carter, N. T., & Campbell, W. K. (2017). Age, time period, and birth cohort differences in self-esteem: Reexamining a cohort-sequential longitudinal study. *Journal of Personality and Social Psychology, 112,* e9–e17. http://dx.doi.org/10.1037/pspp0000122

Twenge, J. M., & Foster, J. D. (2010). Birth cohort increases in narcissistic personality traits among American college students, 1982–2009. *Social Psychological and Personality Science, 1,* 99–106. http://dx.doi.org/10.1177/1948550609355719

Twenge, J. M., Krizan, Z., & Hisler, G. (2017). Decreases in self-reported sleep duration among U.S. adolescents 2009–2015 and association with links to new media screen time. *Sleep Medicine, 39,* 47–53. http://dx.doi.org/10.1016/j.sleep.2017.08.013

Twenge, J. M., & Park, H. (2017). The decline in adult activities among U.S. adolescents, 1976–2016. *Child Development*. Advance online publication. http://dx.doi.org/10.1111/cdev.12930

Twenge, J. M., Sherman, R. A., & Lyubomirsky, S. (2016). More happiness for young people and less for mature adults: Time period differences in subjective well-being in the United States, 1972–2014. *Social Psychological and Personality Science, 7,* 131–141. http://dx.doi.org/10.1177/1948550615602933

Twenge, J. M., Sherman, R. A., & Wells, B. E. (2017). Sexual inactivity during young adulthood is more common among U.S. Millennials and iGen: Age, period, and cohort effects on having no sexual partners after age 18. *Archives of Sexual Behavior, 46,* 433–440. http://dx.doi.org/10.1007/s10508-016-0798-z

Twenge, J. M., & Uhls, Y. T. (2017). *Less in-person social interaction among U.S. adolescents in the 21st century and links to loneliness*. Manuscript submitted for publication.

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. http://dx.doi.org/10.1089/cpb.2006.9.584

Varnum, M. E. W., & Grossmann, I. (2016). Pathogen prevalence is associated with cultural changes in gender equality. *Nature Human Behaviour, 1,* 0003. http://dx.doi.org/10.1038/s41562-016-0003

Varnum, M. E. W., & Grossmann, I. (2017). Cultural change: The how and the why. *Perspectives on Psychological Science, 12,* 956–972. http://dx.doi.org/10.1177/1745691617699971

Wegman, L. A., Hoffman, B. J., Carter, N. T., Twenge, J. M., & Guenole, N. (2017). Placing job characteristics in context: Cross-temporal meta-analysis of changes in job characteristics since 1975. *Journal of Management*. Advance online publication. http://dx.doi.org/10.1177/0149206316654545

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