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Values-Alignment Messaging Boosts Adolescents' Motivation to Control Social Media Use

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Two preregistered experiments with 2,733 U.S. high school students (age range = 13–19 years) compared the impact of different messages on adolescents' motivation to control social media use (SMU). A traditional message emphasized the benefits of avoiding SMU, whereas a values-alignment message framed controlling SMU as being consistent with autonomy and social justice. Compared to no message or a traditional message, in both studies, a values-alignment message led to greater motivation to control SMU immediately afterward, and in Study 2, awareness of "addictive" social media designs 3 months later. As hypothesized, values-alignment messaging was more motivating for girls than boys. Results offer preliminary support for leveraging adolescents' drives for autonomy and social justice to motivate self-regulation of SMU.

How can adults motivate behavior change in adolescents? To prepare adolescents for adulthood, parents and educators often encourage young people to set and pursue goals that contribute to long-term success, from improving dietary habits and academic performance to reducing bullying and the use of tobacco, drugs, and alcohol. In the United States, universally administered school-based programs are a primary avenue for promoting positive behavior change (Steinberg, 2014, 2015). Unfortunately, many educational efforts designed to motivate behavior change show lower effectiveness during adolescence (Yeager, Dahl, & Dweck, 2018). In this period, sensitivity to immediate rewards—particularly those that grant status and respect among peers—can thwart educational efforts that highlight long-term consequences to promote behavior change (Steinberg, 2015; Yeager et al., 2018). One possible solution is to redirect the motivational power of reward sensitivity toward positive ends by aligning desired behavior with social rewards that already animate adolescents (Dahl, Allen, Wilbrecht, & Suleiman, 2018; Telzer, 2016). Rather than treat adolescents' sensitivity to rewards as a barrier to educational programs, we can instead repurpose it as an asset to spark behavior change (Bryan et al., 2016).

The current investigation tests and extends this emerging theory of behavior change on an outcome that is highly relevant to adolescent development: social media use (SMU). Specifically, we sought to understand how adults can instill reasons that adolescents might internalize and use to self-regulate their SMU. We studied high school students (roughly at the stage of middle adolescence) because they are prolific users of social media

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(Rideout & Robb, 2018), and are of an age when reward sensitivity may be peaking (Crone & Dahl, 2012) and when many traditional behavior change programs show reduced effectiveness (Yeager et al., 2018). Across two preregistered field experiments, we compared the effect of two different theoretical approaches to behavior change, operationalized via proof-of-concept experimental messages, on adolescents' motivation to control SMU, including their interest in learning new self-control strategies. A more traditional message simulated an approach taken by many other educational programs and highlighted the long-term benefits of avoiding SMU, while a novel, values-alignment message sought to align behavior change with immediate social rewards. We also examined gender differences in the impacts of these messages.

SMU as a New Target of Behavior Change Research

In less than 20 years, adolescents' lives have become saturated with social media. Representative surveys show that an overwhelming majority of U.S. adolescents (80%) aged 13 to 17 use social media (Rideout & Robb, 2018), which include Instagram, Snapchat, Facebook, Twitter, and YouTube, among others. Many adolescents say they spend several hours every day on social media (Rideout, 2015), and roughly half (47%) check social media "a few times an hour" or "almost constantly" (Rideout & Robb, 2018). Social media allow young people to socialize with friends, learn about current events, express themselves creatively, meet new people with shared interests, and get social support (Pew Research Center, 2018b)—all of which can contribute to personal and social development.

Notwithstanding its benefits, adults remain uneasy about the influence of SMU on adolescent development (American Psychological Association, 2017; James, Weinstein, & Mendoza, 2019). They worry that adolescents spend too much time on social media and are too attached to their phones (Common Sense Media, 2016a; Pew Research Center, 2018a; Rosen, Cheever, & Carrier, 2008), and that it distracts them from schoolwork and in-person interactions (Pew Research Center, 2018a; Rosen et al., 2008) and impairs sleep (James et al., 2019). Adults also have concerns about the implications of digital technologies and SMU for adolescents' privacy and exposure to cyberbullying (Anderson, 2019).

An understandable response to these worries is to impose limits on the amount of time adolescents spend on social media (American Psychological Association, 2017; Anderson, 2019; Weinstein & Przybylski, 2019). Empirical evidence can support limiting SMU: Students who multitask with social media earn lower grades (Marker, Gnambs, & Appel, 2018), those who use social media at night get worse sleep (Woods & Scott, 2016), and time away from digital technology can improve adolescents' processing of social information (Uhls et al., 2014). Imposing restrictions, however, is not the same as encouraging adolescents to develop internalized reasons for controlling SMU.

Modern school-based digital citizenship programs, which now reach 60,000 U.S. schools, attempt to do this: as of 2019, at least one program has lessons encouraging adolescents to find "media balance" by self-regulating SMU (James et al., 2019). The idea of taking control over SMU indeed appeals to many adolescents. National surveys show that 68% of adolescents believe SMU has a negative impact on people their age (Rideout & Robb, 2018), 41% worry they spend too much time on social media (Pew Research Center, 2018a), and over half (57%) have tried to cut back (Pew Research Center, 2018a)—in part to get away from "digital drama" (Rideout & Robb, 2018). To be sure, many adolescents have favorable views of SMU. But these surveys suggest that a lot of adolescents may also be ready to change their behavior. Few studies, however, have examined effective ways of delivering such messages to adolescents.

A More Traditional Approach to Motivating Self-Regulation of SMU

One way to motivate self-regulation is by appealing to the long-term personal benefits of limiting SMU. This approach is standard to many school-based health programs. Programs designed to encourage health behavior change often attempt to do so by increasing knowledge of long-term consequences, teaching self-regulation skills, and instilling societal expectations of positive behaviors (Steinberg, 2015; Yeager et al., 2018). Earlier versions of some digital citizenship programs (ones available at the time of our experiments, which did not yet involve lessons on "media balance;" Common Sense Media, 2016b) and other educational resources designed to encourage responsible SMU in youth (e.g., Citizens Crime Commission of New York City, 2015) seemed to rely on similar ideas. They included classroom lessons that prompted adolescents to reflect on possible consequences of online activity (e.g., how information posted online today may affect future opportunities) and then learn strategies to change behavior. The logic of

these approaches is supported by decision-making theories showing the predictive power that perceptions of long-term consequences can have on behavior change (Ajzen, 1991) and by research on self-control showing that focusing on distant consequences is one way to overcome immediate temptation (Kober, Kross, Mischel, Hart, & Oschner, 2010).

But there are reasons to question whether this tactic would optimally motivate adolescents to control their SMU. Despite being knowledgeable about long-term consequences, adolescents often do not behave in ways that take into account what might happen in the future (Steinberg, 2008). Adolescents act more impulsively than children and adults do in part because they are more sensitive to environmental rewards (Telzer, 2016). Positive social feedback—which elicits positive emotions and conveys to the individual that they are respected and held in esteem—is an especially powerful reward during adolescence (Yeager et al., 2018). Adolescents readily realign their goals toward the good feelings that result from behaving in ways their peers value, even if upon reflection they might endorse opposite goals (Crone & Dahl, 2012; Yeager et al., 2018). Seeking to change SMU encapsulates this conundrum: Social media taps into key adolescent motivators, including interpersonal feedback (Nesi, Choukas-Bradley, & Prinstein, 2018), making it highly immediately rewarding (Sherman, Payton, Hernandez, Greenfield, & Dapretto, 2016) and thus reinforcing (Lindström, Bellander, Chang, Tobler, & Amodio, 2019). Although adolescents may recognize the long-term benefits of controlling SMU, appealing to such perceptions may do little in the moment to offset the rewards of social media.

A Values-Alignment Approach to Motivating Self-Regulation of SMU

In contrast to highlighting the long-term benefits of avoiding SMU, we tested another approach that sought to make behavior change more immediately rewarding. We did so by framing the motivation to control SMU as being aligned with social values that many adolescents care about: autonomy and social justice (Bryan, Yeager, & Hinojosa, 2019; Bryan et al., 2016). Autonomy—thinking and acting on one's own, without coercion—is important to adolescents because it demonstrates that they are competent people, worthy of respect (Yeager et al., 2018). Social justice refers to having a sensitivity toward and desire to correct societal unfairness (Bryan et al., 2016; Yeager et al., 2014). Working toward social justice provides opportunities to join social movements and contribute knowledge and skills that promote prosocial, beyond-the-self goals (Fuligni, 2019).

Several results in the developmental science literature suggest that *values-alignment* approaches might be more effective for motivating adolescents to control their SMU. Studies of adolescents' neural functioning show that acting independently from adult control and in ways that are of benefit to others elicits activation in regions associated with reward processing (Telzer, 2016). Adolescents with greater activation in reward processing regions during prosocial decisions are not only less likely to engage in risk-taking behaviors (Telzer, Fuligni, Lieberman, & Galván, 2013), but are less likely to find risk-taking rewarding (Telzer, 2016). These data suggest that the "warm glow" adolescents feel during autonomous, prosocial behavior could offset the immediate rewards they might otherwise gain from risky behaviors (Telzer, 2016). In a similar way, framing self-regulation of SMU as a way to pursue autonomy and social justice could provide a viable in-the-moment substitute to the social rewards that come from habitual use. From a social psychological perspective, values-alignment approaches can be considered a "wise" intervention because they target key psychological processes underlying the desired behavior (Walton, 2014).

To align self-regulation of SMU with autonomy and social justice motives, we adapted a message used by Bryan et al. (2016), which originally was designed to change adolescents' preferences for junk food, to focus instead on social media. The values-alignment message was presented as an exposé of how social media companies utilize so-called "addictive designs" (e.g., *likes*) for the purpose of keeping users online as long as possible, to maximize advertising revenue. The message also stressed social justice implications of companies gaining financially from using designs engineered to be hard to resist. Raising awareness of industry practices, we speculated, could prompt adolescents to view self-regulating SMU as a way to join a counter social movement and assert independence from companies seeking to control and profit from their behavior. Thus, a behavior that might serve longer-term goals (i.e., self-regulating SMU) could potentially also feel immediately rewarding by symbolically fulfilling important values that are shared by their peers (Bryan et al., 2016).

In some ways, this message captures what many adolescents already think about the technology industry. One nationally representative survey found that 72% of teens believe technology companies "manipulate people into spending more time on

devices" (Rideout & Robb, 2018). In that survey, one 16-year-old girl said, "The companies that own these social media should stop scamming teenagers into spending a majority of their time on their sites" (p. 29). Until now, the power of such beliefs to shape motivation has not been tested empirically.

Our overall theory of change, supported in part by prior research by Bryan et al. (2016) on junk food preferences and by evaluations of the *truth*® anti-tobacco campaign on adolescent smoking (Evans et al., 2004; Hersey et al., 2005), is depicted in stylized form in Figure 1. We hypothesized that our message would: (a) strengthen the belief that social media companies use addictive design features to entice its users, which would lead to (b) greater perceived alignment between self-regulating SMU and autonomy and social justice, which would (c) enhance overall motivation to control SMU, which would culminate in (d) longer-term behavior change.

Examining Heterogeneity of Messaging Effects: Gender Differences

Another goal of the current investigation was to examine the role of gender in the effectiveness of values-alignment messaging. We focused on gender given the growing body of research indicating that SMU may have greater significance in the lives of adolescent girls than boys. For example, girls are more likely than boys to report that social media is "very" or "extremely" important for friendships, and they place greater emphasis on getting a lot of *likes* and are more worried about being excluded from social media posts (Rideout & Robb, 2018). Girls are also more likely to report that they spend too much time on social media (Pew Research Center, 2018a) and that they take more breaks from SMU due to "digital drama" (Rideout & Robb, 2018). Furthermore, girls report greater psychological dependence on social media (Boer, Stevens, Stevens, Finkenauer, & van den Eijnden, 2020) and make more comparisons to their peers' lives while using it (Nesi & Prinstein, 2015). To the extent that adolescent girls are more emotionally invested in (and possibly more negatively affected by) SMU than boys, we believed it was possible that girls would be more motivated to control their SMU after viewing a message that raised awareness about design features that might intensify dependence.

The Current Investigation

Across two preregistered field experiments, we hypothesized that compared to receiving no message or a traditional message highlighting the long-term personal benefits of avoiding SMU, a values-alignment message would boost adolescents' immediate motivation to control their SMU and promote longer-term changes in social media awareness and behavior. We also tested psychological processes leading to immediate and longer-term outcomes, as outlined in our theory of change (Figure 1). Finally, we examined gender as a possible moderator of messaging effects. In Study 1, we conducted exploratory, nondirectional tests of moderation, and then in Study 2, we tested the confirmatory hypothesis that, compared to boys, a values-alignment message would more strongly impact girls' motivation to control SMU.

Study 1: Initial Evaluation of Messaging Effects

In Study 1, high school students were randomly assigned to read a values-alignment message, a traditional message, or no message at all. A

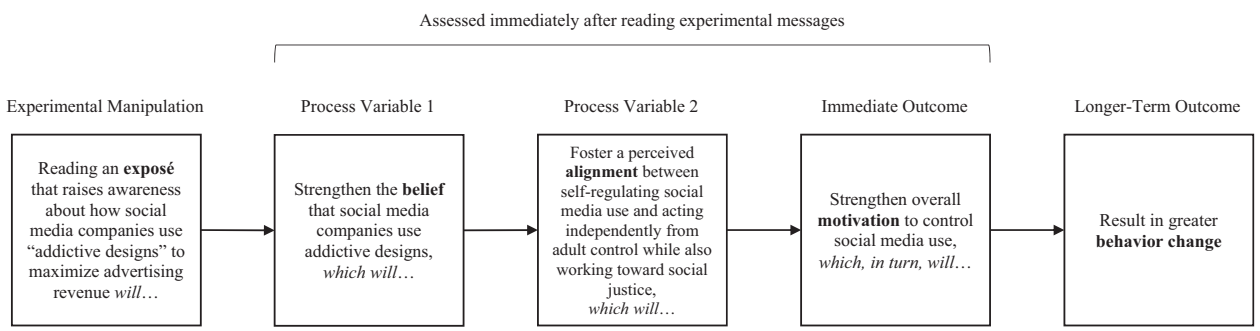

Figure 1. Stylized theory of change for the values-alignment message. The model proposes that reading an exposé that details how social media companies use "addictive designs" will: (1) strengthen the belief that social media companies use addictive design features, which will (2) foster greater perceived alignment between self-regulating social media use and autonomy and social justice, which will (3) strengthen overall motivation to control social media use, which will culminate in (4) longer-term behavior change.

values-alignment message sought to frame a motivation to control SMU as being aligned with desires for autonomy and social justice, whereas a traditional message sought to motivate behavior change by highlighting long-term personal benefits of avoiding SMU. We hypothesized that students who saw a values-alignment message would be more motivated to control SMU immediately afterward and exhibit greater awareness of their SMU and engage in more behavior change over subsequent weeks. Exploratory tests explored gender differences in the messages' effects on motivation to control SMU.

Method

Participants

The analytic sample included 858 first- and third-year students from three public high schools (two suburban, one rural) in the Northeastern United States. The sample reflects the maximum number of students who were eligible and available to participate on the days approved by the schools. Post hoc power analysis using G*Power v3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) shows that $N = 858$ and $\alpha = .05$ provides 74.8% power to detect a one-way, omnibus effect of Cohen's $d = .20$ (a conventionally small effect size). The sample was split equally across first-year (50.93%) and third-year (49.07%) students. According to students' self-reports, they were $M = 15.47$ years old ($SD = 1.13$ years, range = 14–18); 44.76% were girls and 44.41% were boys; 74.36% were White, 4.66% Black, 1.75% Asian, 1.17% Hispanic, and 7.46% mixed or other races and ethnicities (including American Indian, Middle Eastern, and Pacific Islander). Demographic information was self-reported during a baseline survey 3 months prior to random assignment and is thus only available for a maximum of 767 students (89.4%) who completed both the baseline and experimental surveys. See Table S1 for school-level demographic information (National Center for Education Statistics, 2020).

Procedure

This study was approved by the University of Pittsburgh Human Research Protection Office. Schools sent an informational letter about the study and an opt-out permission form to parents. Students provided assent before completing study materials. Classroom teachers introduced the study to students, who then completed all activities independently on school computers during school hours. Activities were presented via Qualtrics Survey Software. Students did not have contact with the research team. The experiment was fully blinded.

Data were collected during the 2017–2018 academic year. Approximately 3 months before the experimental session, students completed a baseline survey in which they provided basic demographic information and answered questions about their social media beliefs, attitudes, and behaviors, in addition to topics unrelated to social media (e.g., academic motivation, mindfulness). During the experimental session, students were randomly assigned at the individual level to either a values-alignment message, traditional message, or no-treatment control. Students did their assigned activities and then completed a battery of self-report and behavioral willingness measures. Finally, students at two of the three schools completed a brief follow-up survey assessing the short-term enduring impact of the messages (the third school did not participate in the follow-up session, as acknowledged in the preregistration plan). A total of 331 (out of 428) students accessed the follow-up survey. Due to the timing of state-standardized testing, one school administered the follow-up survey 2 weeks after the experimental session, and the other administered it approximately 6 weeks after. Students were given a class period (~40 min) to complete the baseline and experimental surveys, and approximately 15 min to complete the follow-up survey.

Experimental Messages for Studies 1 and 2

The two messages (values-alignment, traditional) involved brief reading and writing activities delivered online via Qualtrics. The core content for each was delivered with text that was supplemented with images, graphs and captions, and sources. Both messages involved three writing exercises: one at the halfway point, where students were invited to write about what information they found most interesting so far, and two at the end where students were invited to answer questions related to their assigned message's content. The full experimental messages are freely available to researchers upon request subject to terms of a Material Transfer Agreement; the Supporting Information provides sample excerpts from each message.

Values-alignment message. Our message adhered to the structure and incorporated some of the values-alignment message text used in Bryan et al. (2016), but the content was redesigned to focus on social media (rather than junk food). As in

Bryan et al. (2016), our message used a two-pronged approach to frame controlling SMU as a means of pursuing autonomy and working toward social justice.

First, the message was presented as an exposé of industry practices. It was written to have an exciting and subversive feel by giving information that social media companies supposedly would not want their users to know (Yeager et al., 2018). It drew upon various sources (e.g., popular press articles, books, blogs, videos) to describe how social media companies use "addictive designs" to entice adolescents and others into spending more time on their platforms in order to maximize advertising revenue. The message included descriptions of how: (1) the pull-to-refresh and *like* features can hook users by exploiting intermittent variable rewards, much like slot machines do; (2) Snapstreaks can hook users by exploiting desires for social reciprocity; and (3) bottomless newsfeeds can hook users by removing stopping cues (e.g., Alter, 2017; Bosker, 2016; Harris, 2016; Lewis, 2017; Morgans, 2017). The goal in highlighting such designs was to depict controlling SMU as a way to reassert autonomy from companies trying to control and profit from them (see also, Bryan et al., 2019).

Second, the message emphasized societal consequences and harmful effects of these designs on adolescents' changing views of themselves and their social worlds. It described results of national surveys and data collected during the baseline survey (presented anonymously) showing adolescents' self-reports of feeling "addicted to their phones" (Common Sense Media, 2016a), worrying about missing out, and feeling pressure to be constantly on social media, and results from epidemiological data showing a possible connection between the rise in SMU and documented generational increases in mental health problems (Twenge, Joiner, Rogers, & Martin, 2018). It included short profiles of industry executives and engineers who would not allow their children to use the technology they helped create (Alter, 2017) or who have since spoken out against these addictive designs (e.g., Lewis, 2017). The message also presented results from the baseline survey highlighting how these designs may be impacting participants themselves and their friends (i.e., in terms of how much time was being "stolen" by social media companies to make more advertising revenue). Finally, it suggested that more and more adolescents were beginning to take back control over their SMU as an act of rebellion. The goal in providing this information was to depict controlling SMU as a way to join a growing cultural movement and to be a catalyst for positive social change (by demanding more humane technology designs).

To facilitate internalization of this information, the message ended with two techniques that are common to wise interventions (Walton, 2014): descriptive norms and saying-is-believing. To create a supportive descriptive norm, following prior research by Bryan et al. (2016), the message suggested that a lot of other high school students feel shocked and angry about what social media companies are doing, and that they plan to fight back by learning new strategies to take back control over their SMU. The message then showed three stories attributed to high school social media users (the stories were either adapted from Bryan et al. (2016) or were developed based on interviews and focus groups with individuals who piloted early versions of the message). The stories sought to depict the perception of anger directed at social media companies, and to suggest that this anger could be harnessed into positive, prosocial action (Bryan et al., 2016). In the saying-is-believing exercise, again following Bryan et al. (2016), students were asked to write brief essays explaining why they thought other people were angry about what social media companies were doing and what new actions they could take to fight back and regain control of their SMU.

Traditional message (active control). The active control message was designed to simulate an approach that is more common to universal behavior change programs delivered in schools (Bryan et al., 2019; Yeager et al., 2018)—that is, by highlighting the potential long-term benefits of avoiding SMU, teaching self-regulation strategies, and affirming societal values of positive behavior. It paralleled the values-alignment message in structure but differed in content.

The traditional message was inspired in part by existing digital citizenship curricula available at the time (Common Sense Media, 2016b) and by the healthy eating control condition as described in Bryan et al. (2016). However, the traditional message used original content developed by the study authors. It drew upon various sources (e.g., popular press articles, news and other websites, books, scientific studies) to describe how reducing or eliminating SMU might benefit health (by increasing sleep quality), social functioning (by increasing communication skills), performance in school (by reducing distractibility), and privacy (by reducing likelihood of personal information being spread online). Consistent with the Bryan et al. (2016) healthy eating control condition, after reading about these various long-term benefits, students read tips ostensibly

endorsed by adults about different self-control strategies they could use to eliminate or reduce their SMU. Strategies included deactivating social media accounts, deleting smartphone social media applications, giving social media login information to parents (to self-impose time limits), and installing smartphone applications (or Internet browser extensions) to monitor and limit how much time is spent on social media. To instill a descriptive norm, the message presented stories attributed to adults (e.g., parent) in support of the benefits that may accumulate from staying off social media (Bryan et al., 2016). For the saying-is-believing exercise, students were then asked to write brief essays explaining why they think it is beneficial to eliminate or reduce social media from their life and what new actions they could take to follow the advice of the program and the adults who endorsed it (Bryan et al., 2016).

The traditional message served as a strong control because it conveyed information about the potential long-term personal benefits of avoiding SMU and provided explicit recommendations for strategies that students might use to control their SMU.

No-treatment control (passive control). Students assigned to the passive control condition completed the baseline survey (for a second time in Study 1 or for the first time in Study 2) in lieu of receiving a values-alignment or traditional message.

Measures for Studies 1 and 2

The measures described here were mentioned explicitly in the preregistration plans for Studies 1 and 2. They were all created originally for our experiments. Unless otherwise stated, the following measures were identical across Studies 1 and 2. Other measures were collected during the experiments but were not part of the preregistration plan and so are not described. Scale scores for each construct were calculated by averaging items, such that higher scores indicated greater agreement with the construct. Item order was randomized within each measure, but all measures were presented in a fixed order (that mirrored our theory of change) across students. All continuous self-report items were rated from 1 = *not at all true* to 5 = *completely true*. Descriptive statistics are provided in Table S2. The Supporting Information also includes a full list of items.

Baseline (prerandom assignment) measures. In Study 1, students responded to items assessing *beliefs about social media companies' use of addictive design features*, *intentions to reduce SMU*, and *interest in learning new self-control strategies to cut back on SMU*. These were the only three variables assessed at baseline that matched the primary outcomes described in the preregistration plan. We note that the items used to assess these constructs were not all the same as those used to assess the same constructs during the experimental session.

Immediate outcomes

Motivation to control SMU. Four items assessed students' *intentions to reduce SMU* (e.g., "I'm really going to try to limit my time on social media"). Three items assessed students' *interest to learn new strategies for controlling their SMU* (e.g., "I want to learn new strategies to take control over my SMU"). To assess behavioral willingness, students responded "yes" or "no" to two different choices involving SMU. First, they indicated their *willingness to use a smartphone application* ("app") that keeps track of how much time they spend on social media. They read that these apps could help them better control their SMU. Students who answered "no" were directed to the next question. Those who answered "yes" were given suggestions about possible apps to try. Second, students indicated their *willingness to join the "Time Well Spent" movement* and demand better technology from social media companies (in Study 1 only, this question was framed to students as "signing a petition"). Those who answered "no" were directed to the end of the survey. Students who answered "yes" were given a brief description of the Center for Humane Technology (and their "Time Well Spent" initiative), including a URL to its website, where they could receive periodic informational emails, learn tips for how to manage smartphone usage, and read about the organization's efforts to promote ethical and empowering technology design.

Process variables. Eight items assessed students' *beliefs about social media companies' use of addictive design features* to hook users (e.g., "Social media companies use science and engineering to make their apps more addictive"). Using prior research as a guide (Bryan et al., 2016), six items assessed the degree to which students viewed *reducing SMU as being aligned with autonomy and social justice*. Three items assessed autonomy (e.g., "Cutting back on social media is a way to stand up to people who are trying to control us"), and three items assessed social justice (e.g., "When I cut back on social media, I'm demanding better technology for other kids and teens"). Autonomy and social justice measures were significantly correlated (Study 1: $r = .66$, $p < .001$; Study 2: $r = .67$, $p < .001$). As in Bryan et al. (2016), we combined these items into a single composite.

Follow-up outcomes. Six items assessed the degree to which students *made changes in their SMU*. Three items assessed reductions in SMU (e.g., "I've tried to cut back on social media"), and three items assessed the use of new strategies to control the use of social media (e.g., "I've tried new strategies to take control over my SMU"). Four items assessed the degree to which students were *mindful of urges to use social media* (e.g., "I've been more aware of how often I feel the urge to check social media"). Finally, six items assessed the degree to which students were *aware of how certain social media design features tried to keep them online longer* (e.g., "I've noticed how social media apps are like slot machines").

Analysis Plan for Studies 1 and 2

We preregistered the study design, hypotheses, and analysis plan prior to data collection: Study 1: https://aspredicted.org/gc2s3.pdf; Study 2: https://osf.io/qhgd5. Deidentified data and syntax are available on the Open Science Framework (https://osf.io/thbx4/). Full details of the analytic plan are provided in the Supporting Information. Briefly, we fit one-way analysis of variance (ANOVA) and logistic regression to test preregistered confirmatory hypotheses on immediate and follow-up outcomes. We used indirect effect analysis with 5,000 bootstrapped samples and bias-corrected 95% CI to test the preregistered theory of change. Finally, we used factorial ANOVA and logistic regression to examine gender moderation effects on immediate and follow-up outcomes. Sensitivity analyses, reported in the Supporting Information, show that all preregistered confirmatory tests were robust to: (a) missing data (Tables S14–S16), and (b) corrections for multiple comparisons (with the exception of some condition-by-gender interaction effects in Study 2, Tables S17–19). The Supporting Information also provides details about the study samples (Figures S1 and S2), data exclusions, the experimental messages and wording changes across Studies 1 and 2, minor deviations from the preregistration plan, and results of tests on ancillary preregistered outcomes (Table S9).

Results

Preliminary Analysis

Random assignment was effective (see Table S3). Data were available for 93.4% to 94.8% of the immediate outcomes and 73.6% to 74.8% of the follow-up outcomes; rates of missing data did not differ significantly by condition or condition-by-gender (Table S5). Students assigned to a values-alignment message (M = 28.99, SD = 19.32) or traditional message (M = 30.34, SD = 19.68) wrote similar numbers of words on average across the three writing prompts ($t(534) = 0.80$, $p = .423$; also see Table S20).

Main Effects on Immediate Outcomes

Motivation to control SMU. As shown in Table 1, students assigned to a values-alignment message had stronger intentions to reduce SMU ($F(2, 805) = 7.26$, $p = .001$) and greater interest in learning new self-control strategies ($F(2, 804) = 6.09$, $p = .002$) than did students in either a traditional message (ps < .005, ds = .30 and .27) or no-treatment control (ps < .005, ds = .26 and .25). Students who saw a values-alignment message were also more willing to join the "Time Well Spent" movement (aka "sign a petition," Wald $\chi^2(2) = 9.25$, $p = .010$) compared to students in a traditional message ($p = .003$) but not a no-treatment control ($p = .079$). There was no effect of condition (Wald $\chi^2(2) = 3.30$, $p = .192$) on willingness to use a time-monitoring app. See Table S7 for pairwise comparisons and effect size estimates.

Process variables. As predicted, students assigned to a values-alignment message held a stronger belief that social media companies use addictive design features ($F(2, 810) = 11.10$, $p < .001$) compared to students in both a traditional message ($p < .001$, $d = .41$) and no-treatment control ($p = .014$, $d = .21$); the no-treatment control also held a stronger belief compared to the traditional message ($p = .024$, $d = .20$). Also consistent with hypotheses, students who saw a values-alignment message perceived greater alignment between reducing SMU and pursuing autonomy and social justice ($F(2, 808) = 7.33$, $p = .001$) compared to students in a traditional message ($p < .001$, $d = .33$) and (at significance threshold) a no-treatment control ($p = .050$, $d = .17$). The traditional message and no-treatment control did not differ significantly ($p = .058$, $d = .16$). See Table 1. (Analyzing autonomy and social justice separately revealed similar effects; Table S9.)

Main Effects on Follow-Up Outcomes

Two-to-six weeks after the experimental session, conditions did not differ significantly on behavior change ($F(2, 314) = 2.43$, $p = .090$), mindfulness of SMU ($F(2, 317) = 0.23$, $p = .797$), or awareness of addictive social media design features ($F(2,$

Table 1
Effect of Condition on Immediate Outcomes

Variables	Study 1				Study 2			
	n	*M*	*SD*	Test of between-condition difference	*n*	*M*	*SD*	Test of between-condition difference
Motivation to control social media use								
Intentions to reduce social media use								
No-treatment control	275	2.58_b	0.99	$F(2,805) = 7.26$, $p = .001$	567	2.70_b	1.12	$F(2, 1,676) = 16.18$, $p < .001$
Traditional message	266	2.53_b	0.99		555	2.69_b	1.15	
Values-alignment message	267	2.84_a	1.05		557	3.03_a	1.18	
Interest in learning strategies for taking control over social media use								
No-treatment control	275	2.76_b	0.98	$F(2,804) = 6.09$, $p = .002$	566	2.80_b	1.09	$F(2, 1,677) = 17.80$, $p < .001$
Traditional message	266	2.74_b	1.01		556	2.87_b	1.11	
Values-alignment message	266	3.02_a	1.04		558	3.18_a	1.15	
Willingness to use a smartphone time-monitoring application*								
No-treatment control	276	$37.3\%_a$		Wald $\chi^2(2) = 3.30$, $p = .192$	568	$33.8\%_{a,b}$		Wald $\chi^2(2) = 9.20$, $p = .010$
Traditional message	265	$34.7\%_a$			555	$29.7\%_b$		
Values-alignment message	265	$42.3\%_a$			558	$38.4\%_a$		
Willingness to join "Time Well Spent" movement*								
No-treatment control	276	$23.2\%_{a,b}$		Wald $\chi^2(2) = 9.25$, $p = .010$	566	$17.5\%_{a,b}$		Wald $\chi^2(2) = 8.04$, $p = .018$
Traditional message	264	$18.6\%_b$			553	$13.6\%_b$		
Values-alignment message	261	$29.9\%_a$			557	$19.9\%_a$		
Process variables								
Belief that social media companies use addictive design features								
No-treatment control	274	3.36_b	0.69	$F(2,810) = 11.10$, $p < .001$	580	3.22_b	0.64	$F(2, 1,720) = 165.43$, $p < .001$
Traditional message	270	3.23_c	0.67		568	3.05_c	0.72	
Values-alignment message	269	3.50_a	0.71		575	3.77_a	0.74	
Appeals to autonomy and social justice								
No-treatment control	277	$2.44_{a,b}$	0.87	$F(2,808) = 7.33$, $p = .001$	573	2.26_b	0.85	$F(2, 1,699) = 50.68$, $p < .001$
Traditional message	266	2.30_b	0.83		562	2.25_b	0.87	
Values-alignment message	268	2.59_a	0.87		567	2.73_a	1.02	

Note. Unadjusted means (*M*) and standard deviations (*SD*) are displayed. Different subscript letters indicate *M* are different at $p < .05$.
*The between-condition difference and pairwise comparisons are based on logistic regression with full-information maximum likelihood to account for missing data, but descriptive statistics (*n*, *M*, *SD*) are based on observed data.

312) = 1.98, $p = .140$; (see Table 2 and Table S8 for pairwise comparisons).

Theory of Change

Indirect effect analysis revealed support for a preliminary theory of change. Compared to a no-treatment control and traditional message, students in a values-alignment condition held a stronger belief that social media companies use addictive designs, which, in turn, significantly predicted many of the remaining outcomes specified in Figure 1 (see Table S10). We did not test the full theory of change in Study 1 because we realized after the fact that our preregistration plan did not unambiguously describe the entire sequence of hypothesized psychological changes. Thus, in Study 1, we only fit models based on the most straightforward interpretation of the preregistration plan. We corrected these ambiguities in the preregistration plan for Study 2, which enabled a single test of our full theory of change.

Gender Differences

Exploratory analyses revealed that two of the six condition-by-gender interaction effects on immediate outcomes were significant. The first, on the belief that social media companies use addictive designs ($F(2, 727) = 3.22$, $p = .040$), indicated a slight enhancement effect for both girls and boys assigned to a values-alignment message. The second interaction effect, on intentions to reduce SMU ($F(2, 720) = 3.60$, $p = .028$), indicated an enhancement effect for girls, but not boys, assigned to a values alignment message. No significant interaction effects were observed for follow-up outcomes (see Table S12).

Table 2
Effect of Condition on Follow-Up Outcomes

	Study 1				Study 2			
Variables	*n*	*M*	*SD*	Test of between-condition difference	*n*	*M*	*SD*	Test of between-condition difference
Mindfulness of social media use								
No-treatment control	111	2.77_a	0.98	$F(2,317) = 0.23$, $p = .797$	401	3.00_a	1.06	$F(2, 1,269) = 0.74$, $p = .480$
Traditional message	106	2.71_a	1.09		430	3.09_a	1.20	
Values-alignment message	103	2.67_a	1.02		441	3.09_a	1.14	
Behavior change								
No-treatment control	111	2.28_a	1.05	$F(2,314) = 2.43$, $p = .090$	398	2.59_a	1.12	$F(2, 1,266) = 0.63$, $p = .533$
Traditional message	105	2.02_a	0.94		431	2.52_a	1.13	
Values-alignment message	101	2.29_a	0.99		440	2.51_a	1.16	
Awareness of addictive social media design features								
No-treatment control	111	$2.65_{a,b}$	1.06	$F(2,312) = 1.98$, $p = .140$	397	2.76_b	1.13	$F(2, 1,257) = 5.63$, $p = .004$
Traditional message	104	2.50_b	1.14		428	2.75_b	1.16	
Values-alignment message	100	2.81_a	1.14		435	2.99_a	1.20	

Note. Unadjusted means (*M*) and standard deviations (*SD*) are displayed. Different subscript letters indicate *M* are different at $p < .05$.

Discussion

Study 1 provided initial support for the hypothesis that aligning behavior change with intrinsically rewarding adolescent values of autonomy and social justice would boost motivation (Bryan et al., 2016). Compared to students who read a traditional message highlighting long-term personal benefits of avoiding SMU, those who read a brief values-alignment message that framed controlling SMU as a social justice-oriented, autonomous behavior were more motivated to self-regulate their SMU immediately afterward. Though there were no main effects of a values-alignment message on follow-up outcomes, theory of change analysis revealed that strengthening the belief that social media companies use addictive designs did predict greater awareness of addictive social media design features in the weeks following viewing the message. This finding accords with results of national surveys showing that a majority of adolescents believe technology companies try to manipulate them into using their platforms (Rideout & Robb, 2018), but until now had not been examined as a possible motivator of behavior change. Finally, Study 1 provided suggestive evidence that a values-alignment message was more effective for motivating girls to control their SMU compared to boys.

Study 2: Replication of Messaging Effects

Study 2 was a direct replication in another sample of high school students, conducted 1 year after Study 1, in a different part of the country, and with a longer follow-up period. We also addressed the limitations of the original preregistration plan by more clearly specifying models for binary outcomes and the complete theory of change (Figure 1). Based on exploratory findings from Study 1, we also added a preregistered confirmatory hypothesis that a values-alignment message would be more effective at motivating girls to control their SMU compared to boys.

Method

Participants

The analytic sample included 1,875 first- through fourth-year students from one public, suburban high school in the Southeastern United States. The sample size again reflects the maximum number of students who were eligible and available to participate on the testing days provided by the schools. Power analysis using G*Power v3.1 showed that a sample of 1,875 and $\alpha = .05$ provides 97.9% power to detect a one-way, omnibus effect and a condition-by-gender interaction effect of Cohen's $d = .20$. According to official school records, students were $M = 15.92$ years old ($SD = 1.22$ years, range = 13–19); 39.89% of the sample were first-year students, 24.32% second-year, 19.84% third-year, and 15.95% fourth-year; 50.72% were girls and 49.28% were boys; 48.16% were White, 34.35% Hispanic, 7.41% Asian, 7.15% Black, and 2.83% mixed or other races and ethnicities (including American Indian and Pacific Islander); 24.0% were eligible for free or

reduced-price lunch; 9.07% were English language learners; and 15.41% had an individualized education plan. Information about race/ethnicity was missing for two (0.1%) students. See Table S1 for aggregate, school-level demographic information.

Procedure

Data for Study 2 were collected and de-identified by the Character Lab Research Network (CLRN) before being shared with our team. The CLRN is a consortium of schools working collaboratively with scientists to advance character development research (https://characterlab.org/research-network/). Study 2 was approved by the University of Pittsburgh Human Research Protection Office and the CLRN. Study 2 was conducted during the 2018-2019 academic year, approximately 1 year after Study 1. Students were given a class period (~45 min) to complete experimental and follow-up surveys during regular school hours. We made every effort to conduct a precise replication, and thus purposefully kept the experimental materials and procedures as similar to Study 1 as was possible. The following are notable exceptions: (1) there was no baseline (prerandom assignment) survey; and (2) the follow-up survey was administered approximately 3 months after the experimental session. A total of 1,296 (69.1%) students accessed the follow-up survey.

Results and Discussion

Preliminary Analysis

Random assignment was effective (Table S4). Data were available for 89.4% to 91.9% of the immediate outcomes and 67.2% to 67.8% of the follow-up outcomes. Rates of missing data for the immediate (but not follow-up) outcomes showed differential attrition by condition and condition-by-gender, with girls in the traditional message and values-alignment message having more missing data than girls in the no-treatment control (there were a few condition differences across boys, too, but these were less consistently observed; see Table S6). As in Study 1, students assigned to a values-alignment message (M = 41.52, SD = 30.05) or traditional message (M = 41.78, SD = 28.90) wrote similar numbers of words on average across the three writing prompts (t(1,196) = 0.16, p = .877; see also Table S21).

Main Effects on Immediate Outcomes

Motivation to control SMU. Replicating results of Study 1, students assigned to a values-alignment message had stronger intentions to reduce SMU (F(2, 1,676) = 16.18, p < .001) and greater interest in learning new self-control strategies (F(2, 1,677) = 17.80, p < .001) than did students in either a traditional message (ps < .001, ds = .29 and .27) or no-treatment control (ps < .001, ds = .29 and 0.33). Students who saw a values-alignment message were also more willing to join the "Time Well Spent" movement (Wald $\chi^2(2) = 8.04$, p = .018) and use a time-monitoring app (Wald $\chi^2(2) = 9.20$, p = .010) compared to students in a traditional message (ps = .005 and .002, respectively) but not a no-treatment control (ps = .295 and .112, respectively). The traditional message and no-treatment control did not differ significantly on any outcome (see Table 1).

To gauge the effect of a values-alignment message on overall motivation to control SMU, following our preregistration plan, we averaged z-scores of the four motivation measures (rs = .23–.72, ps < .001) to form a composite. Students assigned to a values-alignment message had stronger overall motivation to control SMU (F(2, 1,688) = 16.35, p < .001) compared to both the traditional message (t(1,688) = 5.31, p < .001, 95% CI [.198, .430], d = .31) and no-treatment control (t(1,688) = 4.50, p < .001, 95% CI [.149, .380], d = .26). The traditional message and no-treatment control did not differ (t(1,688) = −0.83, p = .404, 95% CI [−.067, .165], d = .05).

Process measures. Students assigned to a values-alignment message again held a stronger belief that social media companies use addictive designs (F(2, 1,720) = 165.43, p < .001) and perceived greater alignment between reducing SMU and autonomy and social justice (F(2, 1,699) = 50.68, p < .001) compared to students in either a traditional message (ps < .001, ds = .99 and .51) or no-treatment control (ps < .001, ds = .80 and .50; see Table 1).

Main Effects on Follow-Up Outcomes

At 3-month follow-up, students assigned to a values-alignment message reported greater awareness of addictive social media design features in their daily life (F(2, 1,257) = 5.63, p = .004) compared to a traditional message and the no-treatment control (ps < .01, ds = .20 and .20, respectively). See Table 2. Condition was not a significant predictor of behavior change (F(2, 1,266) = 0.63, p = .533) or mindfulness of SMU (F(2, 1,269) = 0.74, p = .480).

Theory of Change

Indirect effect analysis supported our overall theory of change (Figure 1), both when comparing a

values-alignment message to a traditional message (indirect effect = −.041, 95% CI [−.059, −.027]), and when comparing a values-alignment message to a no-treatment control (indirect effect = −.032, 95% CI [−.046, −.021]; see Figure S5 and Table S11).

Gender Differences

Three of the six condition-by-gender interaction effects on immediate outcomes were significant (or on the threshold of significance): (a) belief that social media companies use addictive designs ($F(2, 1{,}717) = 6.32$, $p = .002$); (b) alignment of autonomy and social justice with reducing SMU ($F(2, 1{,}696) = 4.26$, $p = .014$); and (c) willingness to use a time-monitoring app (Wald $\chi^2(2) = 5.97$, $p = .050$; Figure 2). Consistent with hypotheses, girls in a values-alignment message reported the highest levels on each outcome. No significant interactions were observed for follow-up outcomes (see Table S13).

Non-Preregistered Exploratory Analysis

To promote greater transparency of the research findings, we briefly report results of analyses using two variables that were not preregistered, but whose relevance to the current study may appear straightforward. See Supporting Information for full results. The first variable was a process measure for the information conveyed in the traditional message (e.g., "Staying off social media helps me protect my privacy"), measured at immediate posttest. The traditional message and values-alignment message did not differ significantly on this variable (Study 1: $p = .179$; Study 2: $p = .324$), but both tended to outperform the no-treatment control (ps = .134 to < .001). Thus, students assigned to the traditional message internalized the core information at higher rates than would be expected had they not received any message (Table S9).

The second variable was self-reported time spent on social media, informed by prior research (Woods & Scott, 2016), measured during the follow-up session. In Study 1, neither the main effect of condition nor condition-by-gender interaction effect were significant ($F(2, 325) = 1.16$, $p = .315$; $F(2, 292) = 0.27$, $p = .760$, respectively). Likewise, in Study 2, the main effect of condition was not significant ($F(2, 1{,}254) = 0.35$, $p = .705$; see Tables S9, S12, and S13).

However, in Study 2, and consistent with the preregistered findings, the data revealed a significant condition-by-gender interaction effect ($F(2, 1{,}251) = 7.12$, $p = .001$). Boys assigned to a values-alignment message reported spending more time on social media 3 months later compared to boys assigned to the no-treatment control ($p = .007$), but not compared to the traditional message ($p = .349$).

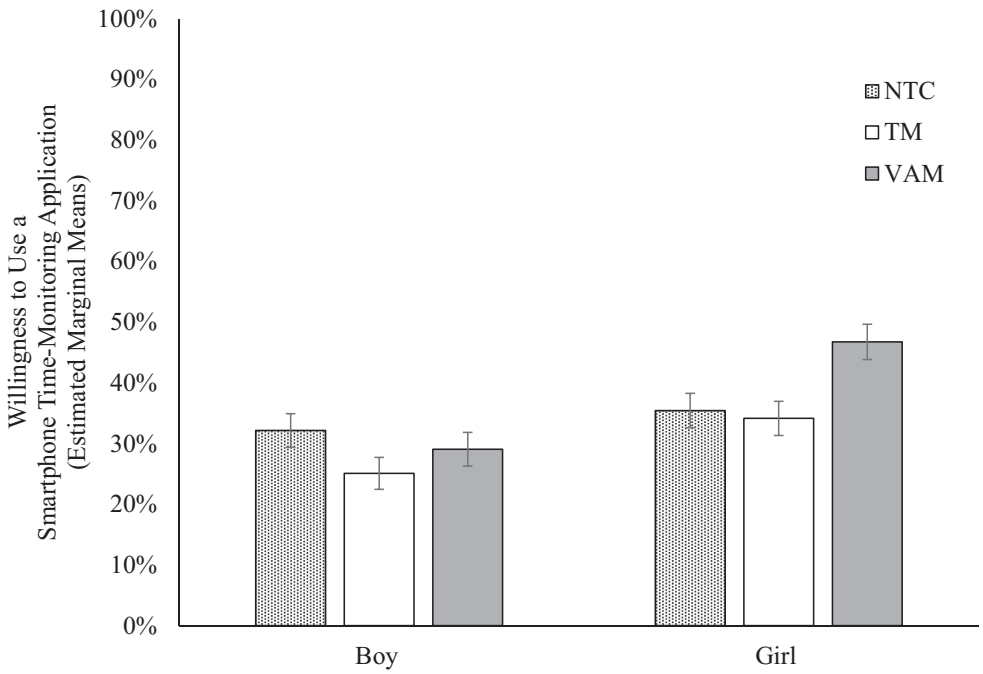

Figure 2. Condition-by-gender interaction effect on willingness to use a smartphone time-monitoring application to control social media use (Study 2). NTC = no-treatment control; TM = traditional message; VAM = values-alignment message. Error bars are ±1 *SE*.

Contrariwise, girls assigned to a values-alignment message reported spending less time on social media compared to the no-treatment control (p = .009), but not compared to the traditional message (p = .091; see Table S13 and Figure S6).

General Discussion

The current investigation tested a theory of adolescent behavior change that argues that adolescents' sensitivity to immediate social rewards—often considered a barrier to traditional educational programs—can be repurposed to encourage greater self-regulation (Bryan et al., 2016; Telzer, 2016; Yeager et al., 2018). We tested this hypothesis in the context of a novel, developmentally relevant outcome: adolescents' motivation to self-regulate their SMU. Across two preregistered field experiments with 2,733 adolescents, we found some evidence in support of this theory. Adolescents who read a brief message that aligned the desired behavioral outcome with their drives for autonomy and social justice had stronger motivation to control SMU compared to those who saw no message or who read a message that conveyed information about the benefits of avoiding SMU. This boost in motivation predicted self-reported change in social media behaviors, including attempts to cut back and try new self-control strategies, up to 3 months later. In Study 2, values-alignment messaging also led to greater awareness of "addictive designs" 3 months later. In both studies, preregistered moderation analyses indicated that a values-alignment message was more effective at motivating girls than boys.

Implications for Science and Practice

Results of this investigation add new empirical support to the theory that adolescents' sensitivity to immediate rewards can be leveraged to create internalized motivation for behavior change. A common approach for encouraging adolescents to set and pursue positive long-term goals is to highlight future consequences of the actions they take now (Steinberg, 2015). While this approach is supported by decision-making theories, in practice, such appeals often show reduced effectiveness during adolescence (Yeager et al., 2018). Our traditional message was no more effective than receiving no message on motivation.

Why was a values-alignment message more compelling to teens? We theorize that it increased the immediate symbolic value of controlling SMU by appealing to autonomy and social justice, two values whose fulfillment is intrinsically rewarding to adolescents (Bryan et al., 2016). By raising awareness about social media designs that entice people into spending more time online and about the toll it might take on society, the message encouraged adolescents to view self-regulating SMU as an opportunity to make an independent, socially conscious choice. Because adolescence is a developmental period in which individuals reprioritize their goals toward immediate social rewards (Crone & Dahl, 2012), framing self-regulation as a means of fulfilling such intrinsically rewarding goals could help to offset the hedonic pleasure provided by SMU (Sherman et al., 2016). Pursuing goals for intrinsic rather than extrinsic reasons is known to support behavioral persistence in adolescents (Galla, Amemiya, & Wang, 2018; Woolley & Fishbach, 2016).

Results extend prior efforts to harness adolescents' autonomy and social justice motives (Bryan et al., 2016; Hersey et al., 2005), not only by focusing on another outcome relevant to adolescent development but also by considering heterogeneity of effects. We hypothesized and found that a values-alignment message had a stronger effect for girls than for boys. Results of non-preregistered, exploratory tests (in Study 2) also showed that a values-alignment message led to less self-reported SMU 3 months later for girls, whereas it led to more self-reported time on social media for boys.

It is possible that the values-alignment message's content—which described prominent "peer feedback" features such as *likes* and Snapstreaks—more effectively captured girls' SMU experiences, thereby increasing their receptivity to it. As discussed earlier, adolescent girls are more likely than boys to report emotional investment in the interpersonal connection and feedback provided by social media, and that they spend too much time on social media and have taken breaks to escape "digital drama" (Pew Research Center, 2018a; Rideout & Robb, 2018). They also report greater preoccupation with and social comparison on social media (Boer, Stevens, et al., 2020; Nesi & Prinstein, 2015). Emphasizing how design features might subtly intensify compulsive use and social evaluation could be more pertinent for girls. Our findings do not necessarily mean that this approach cannot also motivate boys (see Bryan et al., 2019), but future research is necessary to unpack these gender differences to optimize values-alignment messages for various demographic subgroups.

What are the practical implications of this investigation? Many school-based educational programs that focus on long-term consequences show reduced effectiveness for motivating self-regulation during adolescence (Yeager et al., 2018)—presumably because appealing to distant outcomes is an uphill battle against adolescents' drives for immediate rewards (Steinberg, 2015). But this does not mean that any effort by adults to help adolescents internalize positive long-term goals is destined to fall short. Our findings highlight the possibility that instead of trying to fight against adolescents' sensitivity to rewards, it might be better to make the act of behavior change more immediately rewarding: In this case, by reframing desired behavior as an opportunity for adolescents to make independent choices that contribute positively to the world. This suggests that desires for autonomy and social justice be given consideration in the creation of adult-delivered messages targeting adolescents' technology choices.

Limitations and Future Directions

Our experiments have numerous limitations. Practically, this investigation should not be construed as a critique of any specific digital citizenship program since the content of our traditional message was derived from many sources (and also because one key digital citizenship program available during our experiments was redesigned in 2019; Common Sense Media, 2019a). This investigation should also not be taken as a recommendation that the specific values-alignment message examined here be used as part of a broad-based digital citizenship curriculum. The message we designed is a proof-of-concept preliminary demonstration, and its contribution is primarily for advancing behavior change theory. Revisions, updates, and further research are required before it could contribute directly to ongoing intervention efforts for fostering more responsible and intentional SMU. Given the speed at which social media sites can evolve—alongside an evolving body of research on their individual and societal effects—it is certain that any message targeting SMU will also need to evolve, too. For example, when describing the harmful effects of industry practices on society, the message briefly referenced a study that used nationally representative data and documented possible connections between the observed epidemiological rise in adolescent depressive symptomatology and expanded use of digital technology, including SMU (Twenge et al., 2018). There have since been empirical rebuttals to that study (e.g., Heffer, Good, Daly, MacDonell, & Willoughby, 2019) and to the argument that SMU is consequentially associated with adolescents' mental health (Orben & Przybylski, 2019). We should note that the values-alignment message was not intended to reduce adolescents' depressive symptoms (and we did not include any such measures in our study), nor does the message's argument need to hinge on a connection to depressive symptoms. But in light of knowledge gained in recent years, we believe it would be prudent in the future to remove the suggestion that the rise in depressive symptoms may be connected to increased SMU until further research has been conducted.

Furthermore, the term "addictive" to characterize technology use is increasingly being debated, even when used colloquially. Our values-alignment message followed other academics who have used it to describe design features intended to capture and sustain users' attention (Alter, 2017) and national campaigns that have used it to raise awareness about these design practices (Morgan, 2018). A recently revised school-based digital citizenship curriculum now also includes the same term that our message used, "addictive design," to educate students about features of an "app that are intended to hook the user into frequent use" (Common Sense Media, 2019b). However, others argue that such terminology risks creating a moral panic (Orben, 2020). To avoid these concerns, if the term "addictive designs" continues to be used, it will be important to explicitly define what, exactly, it means, and perhaps also to provide examples of "humane designs" (e.g., options to disconnect for a period of time), as one digital citizenship curriculum now does (Common Sense Media, 2019b).

The exposé-style framing of the values-alignment message, adapted from other campaigns aimed at changing adolescents' health behaviors (Allen, Vallone, Vargyas, Healton, & Foundation, 2010; Bryan et al., 2016), is likely not the only way to harness adolescents' desires for autonomy and social justice. Rather than framing controlling SMU as a fight against injustice, another approach is to have high school students give advice to younger students. For example, high school students could write essays advising younger students about how "addictive designs" enhance the interests of technology companies (by increasing advertising revenue), and about self-control strategies they use that can counteract this effect by making SMU more aligned with personal goals. Giving advice to younger students is a saying-is-believing exercise that has been

shown to motivate behavior change in high school students (Eskreis-Winkler, Milkman, Gromet, & Duckworth, 2019), presumably because it boosts confidence (Eskreis-Winkler, Fishbach, & Duckworth, 2018), but it is also a way to be of service to others.

Scientific limitations also suggest directions for future research. First, our dependent measures focused on a motivation to self-regulate—and in many cases, reduce—SMU. We are quick to point out that our measures of self-regulation included more than just cutting back SMU (e.g., using time-monitoring apps, joining a social movement, becoming more aware of social media design features in everyday life). Notably, cutting back SMU (at least temporarily) does appear to be a relevant goal for many adolescents (Pew Research Center, 2018a), and setting time limits is an option for students in a revised digital citizenship curriculum on finding "media balance" (Common Sense Media, 2019c). But reducing overall SMU is not the only or even the "optimal" outcome to study. Future research could examine whether values-alignment messaging increases SMU that is subjectively perceived to be more prosocial or personally meaningful and less regrettable or distracting (Sagioglou & Greitemeyer, 2014). Raising awareness of industry practices may also increase adolescents' interest in learning about the broader implications of SMU (e.g., for privacy) and in using that interest as an "opportunity to find more balance in their digital lives" (Common Sense Media, 2019b).

Another limitation is that results are based exclusively on a single set of self-reported outcomes that were created or adapted for this investigation. Future research could use sensor data to capture objective SMU or other behavioral outcomes (e.g., changing privacy settings). Relatedly, there were few direct effects of condition on longer-term outcomes and not all the condition-by-gender interaction effects survived corrections for multiple comparisons. Future research is required to replicate and extend these findings using alternative long-term outcomes.

The external validity of this investigation cannot be assumed for adolescents who do not share demographic characteristics of those included in our samples. Though the sample sizes provided power to detect small main and interactive effects, we relied on convenience samples to test our hypotheses. Participants were sampled from mostly White, suburban schools where about a quarter of students received financial assistance. Future research is required to understand whether our results generalize to other sociocultural contexts. For example, it remains unknown whether values-alignment messaging would be more effective in countries with higher rates of problematic SMU (Boer, van den Eijnden, et al., 2020). Future research could also examine the impact of values-alignment messages for younger adolescents (ages 11–13) on their motivation to take proactive steps toward using social media intentionally. Adolescents' sensitivity to rewards increases with the onset of puberty (Crone & Dahl, 2012), and so possibly, early adolescents could be responsive to messaging that leverages these emerging desires (Yeager et al., 2018). But because fewer middle school youth use social media compared to high school youth (Rideout, 2015), the impacts of such messages may be moderated by whether these younger adolescents and their peers have started interacting through social media.

Although the results provided evidence for our theory of change, we cannot rule out the possibility that other differences between the values-alignment and traditional messages may have influenced results. For example, there were small differences in word counts across some individual writing prompts (Tables S20 and S21) which may indicate variation in cognitive processing of the messages. Also, as reported in the Supporting Information, students reported feeling that the values-alignment message was more important than the traditional message. Nonetheless, students assigned to the traditional message internalized its core idea (that avoiding social media offers long-term personal benefits) better than those in a no-treatment control, and further, such beliefs were positively associated with motivation to control SMU. This suggests that, overall, the traditional message successfully activated the key theoretical process, but future work could refine the messages' designs to provide a purer test of theory.

Conclusion

Adolescent development is now entwined with social media. Beyond imposing restrictions on adolescents' use of social media, a growing societal need will be to understand how adults can empower adolescents to take stock of their SMU so that they can make more informed and intentional choices. The reach of digital citizenship programs in over 50% of U.S. schools is a big step in this direction (Common Sense Media, 2019d). The current research suggests that leveraging adolescents' drives to act independently from adult control and to serve a larger societal purpose, two highly

rewarding adolescent values, may be one approach for instilling a motivation for self-regulating social media use.

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Supporting Information

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Appendix S1. Supplemental Online Material.