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**Social Media Desire and Impulsiveness: Intensified by Self-Immersion, Reduced by
Mindfulness**

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Abstract

Two laboratory experiments with undergraduates examined how social media desire emerges, intensifies, and can be altered. At the start of the experiment, participants submitted a Facebook status update and were led to believe that this would be posted and that responses to it would be monitored and logged over the course of the experiment. Desire to check Facebook increased following a subsequent 15-minute waiting period where participants heard sounds notifying them of friends responding to their status update, but they were not allowed to check the notifications. Moreover, reward simulations—mental elaborations about the positive aspects of checking social media—during the waiting period strengthened this desire. Both experiments also contrasted a group of participants who engaged in either a brief mindfulness, self-immersion, or, in Study 1, unfocused attention exercise during the 15-minute waiting period. Following the exercise, participants then adopted this new perspective while viewing and rating a Facebook advertisement (Study 1), or while performing a self-control task that allowed them to switch between practicing math skills or watching entertaining videos (Study 2). Participants in the mindfulness condition reported significantly less Facebook desire compared with participants in control conditions. Moreover, mindfulness led participants to report less positive attitudes about the Facebook advertisement (Study 1) and spend more time spent practicing math, as opposed to watching entertaining videos (Study 2). Reductions in reward simulations mediated these effects. These findings advance theoretical understanding of how social media desire unfolds and suggest ways for helping young adults manage these desires.

Keywords: social media; desire; self-control; mindfulness

Social Media Desire and Impulsiveness: Intensified by Self-Immersion, Reduced by Mindfulness

Social media is a defining self-control problem of the 21st century. The constant accessibility of social media through smartphones, coupled with highly reinforcing design features (e.g., intermittent variable rewards) (Alter, 2017; Harris, May 19, 2016), has given rise to a new class of powerful desires. Apart from eating and sleep, experience sampling studies show that people desire technology more than anything else (Hofmann, Vohs, & Baumeister, 2012). Desires to check technology, including social media, are incredibly difficult to resist: Self-control failure rates for technology approach 50%, more than almost any other desire (Hofmann et al., 2012). It therefore comes as little surprise then that 63% of Millennials aged 18 to 37 claim they are “attached” to their smartphone (American Psychological Association, 2017). Moreover, social media intrudes on students’ engagement with academic work, potentially undermining long-term performance. Undergraduates average less than six minutes on homework before switching off-task due to technological distractions (Rosen, Carrier, & Cheever, 2013), and those who use the Internet for nonacademic purposes in class (e.g., to check social media) earn lower grades (Ravizza, Uitvlugt, & Fenn, 2016).

Despite the enormous influence of social media on young adults’ lives, little research has been undertaken to understand how social media desire emerges, intensifies, and can be altered. The current study examined one psychological mechanism theoretically linked to social media desire—reward simulations—and the potential effect of experimentally manipulating reward simulations on desire and self-control. In two experiments, we tested the hypothesis that exposure to social media stimuli can trigger an increase in desire and that reward simulations intensify this desire. We also tested the hypothesis that a brief mindfulness exercise, compared to

control exercises, can interrupt reward simulations, ultimately reducing desire and supporting self-control.

Desire, Reward Simulations, and Social Media

Desire is defined as an affectively-laden cognitive event in which an object, person, or activity that is associated with pleasure or relief from discomfort is brought into focal attention (Kavanagh, Andrade, & May, 2005). It is subjectively experienced as a feeling of wanting something or wanting to do something (Hofmann & Van Dillen, 2012). Desires originate relatively spontaneously when external or internal cues signaling reward trigger an impulse to act (Berridge & Robinson, 2016; Heatherton & Wagner, 2011; Hofmann, Friese, & Strack, 2009; Hofmann & Van Dillen, 2012; Kavanagh et al., 2005; Kotabe & Hofmann, 2015). For example, the sound of an incoming Facebook notification—an experience often associated with reward (Sherman, Payton, Hernandez, Greenfield, & Dapretto, 2016)—may automatically activate an impulse to check our smartphone. These impulses can then discharge as mindless, automatic behavior (Hofmann & Van Dillen, 2012), but not always.

Our focus here is on what happens when an impulse to check social media is not immediately acted upon, for example, when a student is sitting in class, if their smartphone is outside of reach, or if they are trying to reduce their use of social media. Multiple theories suggest that beyond the initial impulse, appetitive cues can also trigger additional thoughts about the object of desire (Hofmann & Van Dillen, 2012; Kavanagh et al., 2005; Papies & Barsalou, 2015). These so-called *reward simulations* (or cognitive elaborations) involve mentally simulating the actual experience of fulfilling the desire and relishing in the ensuing pleasure (Kavanagh et al., 2005; Papies & Barsalou, 2015). Consider food as an example. When asked to describe appetizing food, people more often spontaneously refer to its taste and texture (e.g.,

“sweet;” “crunchy”), situations for eating it (e.g., “movie,” “party”), and its hedonic qualities (e.g., “tasty,” “delicious”) (Papies, 2013). Similarly, getting a smartphone notification may prompt additional mental simulations of checking Facebook and imagining the joy (or relief from discomfort) it may bring.

Reward simulations are important for motivating behavior because they feel subjectively real (Papies & Barsalou, 2015), and thus convincingly convey the pleasure to be gained by fulfilling the desire (May, Kavanagh, & Andrade, 2014). Consequently, the more a person (wittingly or unwittingly) immerses themselves in the fantasy, the more enchanted they become, and the stronger the desire and motivation to seek it out becomes (Hofmann & Van Dillen, 2012). Studies show, for example, that individuals who score high on individual difference measures of “desire thinking”—the tendency to engage in vivid reward simulations about desires—report more problems with gambling, binge eating, drinking alcohol, and nicotine dependence (Caselli, Ferla, Mezzaluna, Rovetto, & Spada, 2012; Caselli, Nikcevic, Fiore, Mezzaluna, & Spada, 2012; Fernie et al., 2014; Martino et al., 2017).

Reward simulations may also play a role in social media desire and behavior. There is indirect evidence to suggest that they do. The aforementioned individual difference measure of desire thinking has been shown to predict problematic Internet use above and beyond hours of weekly use, anxiety, and depression (Spada, Caselli, Slaifer, Nikčević, & Sassaroli, 2014). Teenagers’ and emerging adults’ own descriptions of smartphones also appear to convey the central role of spontaneous reward simulations in heightening pleasure and fueling motivation (Walsh, White, & Young, 2008). For example, when asked about her smartphone use, one female (age 19) said, “...when you get something [messages] you’re like something’s there, someone wants to talk to me, and you just feel anxious or excited or whatever and you want to

actually pick it up or answer it;” another female (age 17) said, “...if I have one message received I’m like, yeah, sweet, check it. If there’s like 2 or 3 messages I’m like, YES, who’s it from kind of thing, like I get excited because I’ve got a lot of messages” (Walsh et al., 2008, p. 86). These studies suggest that while social media desires may be categorically distinct from desires for food, sleep, and shopping, they appear to involve similar cognitive processes. This makes sense as reward simulations are theorized to be a part of a more general cognitive mechanism underlying learning and behavior (Papies & Barsalou, 2015).

We assume that reward simulations for social media can be adaptive in aligning attention, cognition, and behavior toward a desired object, but they can also have undesirable consequences when they lead people to act against their long-term goals (e.g., forgo studying). The potential for these undesirable consequences suggests that it is important to understand factors that might reduce the onset and intensity of reward simulations and minimize their effect on behavior. Prior research, grounded in the Elaborated Intrusion Theory of Desire (Kavanagh et al., 2005), suggests that techniques to direct attention away from desire-related images, thoughts, and urges can reduce desire (Hamilton, Fawson, May, Andrade, & Kavanagh, 2013; May, Andrade, Batey, Berry, & Kavanagh, 2010; May, Andrade, Willoughby, & Brown, 2012). For example, participants assigned to either a body scan exercise, in which they focused on specific parts of the body, or a guided imagery exercise, in which they imagined taking a walk in the forest, did not show increases in food craving following a waiting period where they were not allowed to eat (Hamilton et al., 2013).

Though it appears possible to interrupt reward simulations through distraction, the ubiquity and multitude of cues to check social media suggests distraction techniques may not be enough. Some research estimates that individuals interact with their smartphone more than 2,500

times per day (Winnick, June 16, 2006), which may render distraction useless to all but the most conscientious users. Moreover, distracting oneself from cues that trigger desire, and even from the unfolding of desire itself, reduces opportunities for individuals to learn about the phenomenology of desire. For example, while engaging in distraction, individuals may be oblivious to the connection between reward simulations and feeling an urge to check social media; likewise, they may not observe how positive feelings during a prior encounter carry forward to subsequent encounters in the form of positive fantasies or expectations. By removing such opportunities to learn about how desire is subjectively experienced, distraction may not ultimately support individuals' own ingenuity about ways to manage their desires. Rather than directing attention away from desire, the current study explores whether it is possible to direct attention toward reward simulations without having them hijack one's mind. We argue that using mindfulness to observe reward simulations as temporary mental phenomena can dismantle their appeal and minimize their effect on desire and behavior (Papies, Pronk, Keesman, & Barsalou, 2015).

Mindfulness, Decentering, and Reward Simulations

Mindfulness is a term with historical roots in Buddhism (Analayo, 2003), but which nevertheless lacks a single, universally accepted definition. Classically, it can be defined as a mental faculty that enables us to become consciously aware of what is occurring in the present moment (Van Dam et al., 2018). Mindfulness is characterized by a presence of mind, one that is alert, receptive, and absent of distraction (Analayo, 2003; Bodhi, 2011; Brown & Ryan, 2003). In the psychological literature, mindfulness is often defined by two interrelated dimensions: the self-regulation of attention to present moment experiences, coupled with a nonjudgmental, receptive, nonreactive orientation toward those experiences (Bishop et al., 2004). During a

mindful mode of information processing, perceptual inputs are apprehended in conscious awareness without attempts to control, suppress, or alter them; mindfulness functions simply to reveal what is happening so that the nature of the experience can be investigated and understood (Galla, Kaiser-Greenland, & Black, 2016). This can be contrasted with a conceptually-driven, self-immersed mode of processing, in which perceptual inputs are unconsciously filtered through habitual evaluations, self-referential concerns, and automatic emotional reactions (Brown, Ryan, & Creswell, 2007).

During mindfulness training individuals are taught to direct and sustain awareness to the moment-to-moment flow of subjective experience. Through sustained mindful observation of experience, individuals learn to recognize that thoughts, feelings, urges, and other mental phenomena are impermanent; they arise and pass away on their own (Grabovac, Lau, & Willett, 2011). As a result, individuals cultivate the capacity to distance themselves from their mental experience, viewing thoughts as simply “thoughts” (Lutz, Jha, Dunne, & Saron, 2015; Papies, Barsalou, & Custers, 2012). This capacity has been variously referred to as “metacognitive insight” (Chambers, Gullone, & Allen, 2009), “decentering” (Bernstein et al., 2015), “cognitive defusion” (Hayes, Luoma, Bond, Masuda, & Lillis, 2006), “mindful attention” (Papies et al., 2012), “reperceiving” (Shapiro, Carlson, Astin, & Freedman, 2006), “self distancing” (Kross & Ayduk, 2017), and “dereification” (Lutz et al., 2015) (here, we use the term decentering). The capacity for decentering is thought to help individuals deautomate from habitual reactions triggered by different experiences (Bernstein et al., 2015; Kang, Gruber, & Gray, 2013).

Insofar as reward simulation reflects self-immersion (or fusion, reification, etc.) in a fantasy that feels subjectively real, then becoming aware of the simulation as a mere representation—comprised of transient thoughts, images, and urges that arise and pass away—

might pierce the veil of realism, diminishing its appeal. Upon losing its representational value, the reward simulation should dissipate, ultimately reducing the desire to obtain the object (Lutz et al., 2015). In the current context, mindfulness may permit a sense of psychological space to dispassionately observe reward simulations about social media without getting overly immersed in them. In so doing, individuals may be granted a degree of freedom over their desires, opening the door to more effective action that supports long-term academic goals (e.g., staying engaged in work despite opportunities for leisure).

A growing body of research suggests that it may be possible to induce a state of mindful decentering through brief training protocols (Baquedano et al., 2017; Bowen & Marlatt, 2009; Caselli, Gemelli, Spada, & Wells, 2016; Lacaille et al., 2014; Lebois et al., 2015; Papies et al., 2012; Papies et al., 2015; Tincher, Lebois, & Barsalou, 2015). These studies have also shown that adopting a decentered, non-self-immersed stance toward experience can reduce automatic reactions to appetitive food stimuli (Baquedano et al., 2017; Papies et al., 2012; Papies et al., 2015), and reduce unhealthy eating and substance use (Bowen & Marlatt, 2009; Forman, Hoffman, Juarascio, Butryn, & Herbert, 2013; Forman et al., 2007; Lacaille et al., 2014). However, few studies to date have specifically examined whether reducing reward simulations is a mechanism linking training in mindfulness to reductions in desire and changes in self-control. Likewise, to our knowledge, no studies have focused on social media desire and academic self-control as outcomes.

The Current Study

In two experiments, we tested our theoretical claims that social media stimuli would trigger an increase in desire, and that as reward simulations increase so too would social media desire. Our focus was on Facebook, the most widely-used social media platform among 18-to-24

year olds (Pew Research Center, March 1, 2018). As key dependent variables, we measured self-reported reward simulations and Facebook desire. Both experiments also contrasted a group of participants who engaged in either a brief mindfulness or self-immersion (or, in Study 1, an unfocused attention) exercise on these outcomes (see also, Baquedano et al., 2017; Papies et al., 2012; Papies et al., 2015). Our hypothesis was that adopting a mindful perspective toward Facebook stimuli (i.e., notification sounds) would reduce the desire to check Facebook and that reductions in reward simulations would mediate these effects.

We also examined whether the mindfulness exercise could have additional effects on attitudes toward Facebook (Study 1) and self-control on an academic skill-building activity (Study 2). By targeting individuals' perceptions of Facebook reward simulations, we expected to change their reactions to ads that may otherwise entice them into using Facebook. In other words, mindfulness may change individuals' perceptions of social media ads from positive fantasies to fleeting moments of unfulfilling gratification. And to the degree that reward simulations are associated with individuals' self-control efforts (Hofmann & Van Dillen, 2012), we also expected that reducing reward simulations would increase engagement on an academic skill-building activity that entailed simultaneously forgoing opportunities for leisure.

Overall, this investigation is the first to unpack the theoretical associations between social media desire, reward simulation, mindfulness, and self-control in college students. Theoretically, this study tests whether desire for social media is intensified by reward simulations and whether inducing a mindful state can reduce reward simulations and in turn, desire and impulsive behavior. Practically, our aim is to improve understanding of metacognitive perceptions that can alter social media desire.

Study 1

In Study 1, undergraduates participated in a laboratory study framed as an experiment to understand how social media content “goes viral.” At the start of the experiment, participants were asked to sign into their Facebook account through a web browser-based interface that installed a program that they believed would provide the experimenters with direct access to their Facebook page (see Methods). Participants then wrote a status update and were told this would be posted to their Facebook page and that the program would continuously log activity on that page. Over a subsequent 15-minute waiting period, participants heard intermittent sounds notifying them that friends responded to their post, but they were not allowed to check the notifications. During this waiting period, participants were randomly assigned to one of three experimental conditions: (1) a mindfulness induction in which they observed urges to check Facebook as temporary mental events, (2) a self-immersed induction in which they contemplated the pleasures of Facebook, or, (3) an unfocused attention induction in which they allowed their minds to wander freely. All participants rated their desire to check Facebook before and after the waiting period. Finally, participants deployed the newly-learned approach while viewing and rating a Facebook advertisement.

In total, we tested five confirmatory hypotheses, two involving the sample in aggregate, and three involving the experimental contrasts. Regarding the full sample, we tested the hypothesis that (1) desire to check Facebook would increase following the 15-minute waiting period where participants heard notification sounds indicating friends had *liked* or commented on their status, but were not allowed to see the notifications, and that (2) the intensity of reward simulations would predict a further increase in this desire. For the experimental contrasts, we tested the hypothesis that (3) participants assigned to the mindfulness condition would report less Facebook desire and less reward simulations compared to participants in the other two

conditions, that (4) the effect of mindfulness on Facebook desire would be mediated by its effects on reduced reward simulations, and that (5) participants in the mindfulness condition would report less positive attitudes toward a Facebook advertisement.

Method

Participants. The sample included $N = 123$ (M age = 20.06 years, $SD = 1.32$; 71% female; 60% White) undergraduates drawn from two universities. We had no overall stopping rule for data collection; we sought to collect as much data as possible within the span of one academic semester. Power analysis using G*Power version 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007) revealed that a total sample of 54 would provide an estimated 95% power to detect a medium-sized ($f = 0.25$), within-between subjects interaction effect using repeated measures ANOVA with three groups, three measurement occasions, and assuming a correlation of $r = .50$ among repeated measures. Both studies reported here were approved by the University of Pittsburgh's (and for Study 1, the University of Pennsylvania's) Institutional Review Board, and participants provided consent. Data were collected between February and April 2016.

Procedure. All studies, measures, and experimental manipulations conducted for this project are reported, although we focus our analysis only on variables related to our core theoretical concerns (see Measures section for more details).¹ The entire experiment lasted approximately 45-to-60 minutes, was self-paced, and delivered online through Qualtrics (www.qualtrics.com).

Recruitment. Participant recruitment varied by university. At one of the universities, we distributed fliers around campus and offered \$10 compensation to undergraduates enrolling in

¹ Materials, measures, and data for Study 1 and Study 2 are available online (Open Science Framework URL will be provided following peer review).

the study. At the other university, we recruited undergraduates through the psychology subject pool and provided course credit for participation. To be eligible to participate in the study, all participants needed to have an active Facebook account.

Introduction and baseline questions. Expectation effects and demand characteristics were minimized by informing all participants that they were participating in a study designed to understand what makes Facebook posts “go viral.” The words *mindfulness* and *meditation* were never used during the experiment (until the debriefing). The experiment was fully blinded. Participants were not aware this was an experiment testing the effect of different interventions, nor were they told the study hypotheses. Likewise, researchers were blinded to condition; participants were assigned to condition based on a randomizer embedded within the Qualtrics survey. Upon arriving to the testing room, participants were greeted by the experimenter and directed to an individual computer station. Participants were also given a pair of headphones to wear for the duration of the study.

Participants logged onto their Facebook account (www.facebook.com) in the presence of an experimenter. The experimenter then wrote down each participant’s Facebook User ID (a unique numerical code that identifies each Facebook user). The User ID was required for the experimenter to invite participants to serve as beta-testers on a private Facebook program (it was also used to verify that participants had a Facebook account). Participants were told that as part of the experiment, they would install a Facebook program called *PsychExpt_PU* that would post status updates and monitor subsequent activity on their personal Facebook page. After the experimenter obtained the User ID, the participant logged out of Facebook and returned to the Qualtrics survey. Participants then provided basic demographic information and completed Likert-response items about their Facebook use, enjoyment using Facebook, dependence on and

attachment to Facebook, and the 15-item Mindful Attention Awareness Scale (Brown & Ryan, 2003), a widely used measure of dispositional mindfulness.

Facebook program and status update. While participants completed baseline questions, the experimenter used a separate laboratory computer and worked behind-the-scenes on the Facebook Developer page to invite participants to install and serve as beta-testers on the *PsychExpt_PU* program (using the User ID obtained earlier). After participants completed the baseline questions, they raised their hand to signal to the experimenter they were ready to move onto the next phase of the study (the survey would not advance to the next page without a password). The experimenter entered the password, and then on the next page, clicked an embedded URL directing them to the beta-tester invite page on Facebook. Participants once again logged onto their personal Facebook account, whereupon they received a request to install the program, *PsychExpt_PU*. With assistance from the experimenter, participants granted permission for the program to access their personal Facebook information (i.e., public profile, email address, news feed, status updates, and photos) and to post to their Facebook page.²

After installing the program, participants returned to Qualtrics, and waited for a few seconds as the Facebook program supposedly synced to the survey (which was shown visually by a loading bar that advanced from 0% to 100%). On the next page, participants were invited to write a Facebook status update that they thought would get a lot of *likes* and comments from their Facebook friends; a post they thought would “go viral.” There were no restrictions on the content of the status update, but it could not be more than 140 characters. After writing the status, they were informed that, “By clicking “next”, you are allowing the app to post this status.

² Participants had to accept the invitation to continue with the experiment (two participants in Study 2 withdrew from the study at this point and were therefore excluded from analysis).

The app will then track the notifications you receive about your status.” After clicking *next*, participants saw another loading bar to indicate the program successfully posted their status update to Facebook. Participants were then informed they could check any *likes* and comments at the end of the study. They noted how many *likes* or comments they thought they would get in the next 15 minutes, and then completed three items assessing Facebook desire, four items assessing discomfort related to the desire, and the 10-item Positive and Negative Affect Schedule, short-form (Mackinnon et al., 1999).

Unbeknownst to participants, the *PsychExpt_PU* program was not in fact used to interact with their Facebook pages: It did not post status updates, it was not linked to any portion of the Qualtrics survey, and the researchers never had access to participants’ Facebook account or personal information at any time. The program (though real) was used solely as a means of reinforcing the cover story, and for convincing participants that their status update was being posted to Facebook for their friends to see and respond to (via *likes* and comments).

Experimental inductions.³ Participants were then invited to do a different, 15-minute activity while they waited for their friends to *like* and comment on their status update. Participants were informed that during the next activity they may hear sounds notifying them that their Facebook friends had *liked* or commented on the status update. We used the actual Facebook notification sound to increase believability, and participants listened to a sample tone before moving on.

At this point, participants were randomly assigned to one of three conditions: (1) a *mindfulness* induction in which they observed urges to check Facebook as temporary mental events, (2) a *self-immersed* induction in which they contemplated the pleasures of Facebook, or,

³ All scripts for the experimental inductions are provided in the **Online Supplemental Material**.

(3) an *unfocused attention* induction in which they allowed their minds to wander freely. The two active conditions (mindfulness, self-immersed) were introduced to participants as “*a new way of thinking about Facebook*.” Specifically, participants in these two conditions saw the following preamble text and heard it read aloud through an audio recording:

While we wait for your Facebook notifications to build, we invite you to do an exercise for fifteen minutes. During this exercise, you will learn a new way of thinking about and approaching Facebook. We developed this approach by conducting research studies with college students like you on their social media use. Over the course of the next 15 minutes, you will try out this new approach with some guidance. Then you will apply it to a few situations. At the end of the study, we will ask you questions about your experience using this approach and your thoughts about Facebook more generally.

Keep in mind, that throughout the next 15 minutes, you may hear notification sounds from your Facebook as your friends either “like” or “comment” on your recent status update. Instead of checking these immediately, however, we will use the notification sounds to help you practice this new approach. You will be able to check your notifications at the end of this study.

Participants in the unfocused attention condition saw/heard the following preamble text:

While you wait for your Facebook notifications to build, we invite you to do an exercise for fifteen minutes. Keep in mind, that throughout the next 15 minutes, you may hear notification sounds as your friends either “like” or “comment” on your recent status update. Instead of checking these notifications immediately, however, you will be able to check your notifications at the end of this study.

All participants then listened to the main induction audio recording, depending on their experimental condition, all of which were recorded by the second author. Throughout the approximately 15-minute audio recording, participants received intermittent sounds purportedly notifying them that a friend responded to their status update, but they were not allowed to check them. The frequency of notification sounds was standardized across the conditions (26 “dings” in total), and they were roughly evenly distributed throughout the three audio recordings (slight variations in timing of the sounds was done to accommodate differences in the scripts). Like the

PsychExpt_PU program, the notification sounds provided false feedback; they were intended to make participants think their status was receiving *likes* and comments, but their status update was never posted to Facebook.

Mindfulness induction. The mindfulness induction was adapted from existing exercises designed to help individuals work more skillfully with desire and craving (Bowen, n.d.; Bowen & Marlatt, 2009; Papies et al., 2012; Papies et al., 2015), as well as from more general mindfulness activities (Arch & Craske, 2006; Feldman, Greeson, & Senville, 2010). However, ours was adapted to focus specifically on thoughts, emotions, and urges concerning Facebook. The audio began by introducing the activity as an opportunity to relate differently to the experience of craving and urges to use Facebook. Following a brief period of body and breath awareness, participants were then encouraged for the remainder of the exercise to pay attention to whether their mind had wandered into thoughts about Facebook, and if so, to observe these thoughts more closely. Recall that during the audio recording, participants also heard intermittent sounds notifying them that friends had *liked* or commented on their status. Participants were encouraged to use these moments (if and when they happened) as opportunities to observe their inner reactions to these sounds, and to treat any thoughts and feelings about Facebook as temporary mental events that arise and fall away on their own (Papies et al., 2012; Papies et al., 2015), like waves on an ocean. Emphasis throughout was placed on both *awareness* of thoughts and feelings about Facebook and *acceptance* of these experiences as normal, but temporary reactions.

Self-immersed induction. The self-immersed induction was modeled closely after exercises designed to encourage individuals to fully “immerse” themselves in their subjective experience (Lebois et al., 2015; Papies et al., 2012; Papies et al., 2015; Tincher et al., 2015), and

was more generally informed by early research on delay of gratification (Mischel & Baker, 1975). The audio began by introducing the activity as an opportunity to relate differently to Facebook by reconnecting with its positive aspects, as opposed to mindlessly interacting with it. Participants were first encouraged to visualize themselves in front of their computer and imagine receiving a Facebook notification. They were invited to fully and vividly experience any positive emotions and thoughts that came with getting notifications and with checking them. For example, participants were encouraged to reflect on the fact that getting a notification was an indication that one of their friends had taken time out of their day to reach out and stay connected to them; to validate them; to make them feel good. To reinforce the immersion message, participants were encouraged to treat notifications in a similar way to that of an upcoming vacation—to use anticipation and mental imagery as a means for getting excited about Facebook notifications. Participants were also encouraged to use the intermittent notification sounds (if and when they happened) as opportunities to ponder the types of positive comments their friends were posting to their recent status update. Emphasis throughout was placed on both reconnecting to the pleasures of Facebook (as opposed to “mindlessly” interacting with it) and experiencing these pleasures (positive emotion, social connection) as vividly as possible.⁴

Unfocused attention training induction. The unfocused attention induction was adapted from Arch and Craske (2006), and encouraged participants to “...*simply think about whatever comes to mind. Let your mind wander freely without trying to focus on anything in particular.*”

⁴ The mindfulness and self-immersed inductions were balanced relatively closely for word count (1,259 and 1,188 words, respectively) and each mentioned the word “Facebook” 15 times. The exact length of each audio-recorded induction was 902 seconds (unfocused attention), 900 seconds (self-immersed), and 909 seconds (mindfulness).

Just let your mind roam as it normally would.” Variations of these instructions were provided intermittently throughout the 15-minute recording.

Post-experimental induction assessment. Immediately after the 15-minute training/waiting period, participants completed two items assessing state reward simulations, two items assessing state decentering, and three items assessing intrusive thoughts—the first two measures being used to test our proposed psychological mechanisms of action. Participants also rated one item designed to assess the degree to which Facebook desire would change across time (“If you were unable to check Facebook for another hour, would your urges get stronger, stay the same, or get weaker?”). Finally, they completed the same measures of Facebook desire, discomfort, and positive and negative affect that were completed at baseline.

Facebook advertisement. In the final phase of the experiment, participants were asked to watch and rate a short (71-second) promotional video for Facebook. Participants in the mindfulness and self-immersed conditions were also encouraged to adopt the approach they had just learned and practiced as they watched the video. Before watching the video, these participants listened to a brief audio recording summarizing the main points of their training. Then, during the video, text was presented above the video reminding them of what to do (mindfulness: “*As you watch the video, try to recognize that any thoughts, emotions, and urges triggered by the video are simply temporary mental events that arise and fall away on their own.*”; self-immersed: “*As you watch the video, try to fully experience any positive thoughts, emotions, and desires triggered by the video.*”). Participants in the unfocused attention control condition simply watched the video with no further instructions.

After watching the video, participants responded to an open-ended question, “Who do you think is the target audience of this ad? Please limit answer to a few words.” Then, they

reported the degree to which the video made them like Facebook, and the degree to which the video made them want to check Facebook. They rated their current Facebook desire one last time using the same items as before. Finally, participants answered a single item assessing state decentering and reward simulations.

Debriefing. Participants completed a willingness-to-accept-craving task adapted from prior research (Read & Loewenstein, 1999; Sayette, Loewenstein, Griffin, & Black, 2008), but due to potentially problematic deviations from the original task (we explicitly stated in the survey that responses would not have real-world monetary consequences), it is not described further. Then, participants responded to an open-ended suspicion probe about the study's purpose (intended to identify whether anyone suspected the Facebook *PsychExpt_PU* program or the notification sounds were fake), and binary forced-choice questions about whether they were confident the program posted their status, whether they had prior mindfulness meditation experience, and whether anyone (a friend, classmate) had told them the study's true purpose.

Finally, participants were fully debriefed, during which time they also deleted the program from their account (the experimenter assisted as necessary). Likewise, the experimenter removed participants as beta-testers from the Facebook Developers page. Participants were then paid or given course credit.

Measures. Unless otherwise specified, items for each measure described below were averaged to create composite scores, with higher scores indicating greater endorsement of the construct. We refer to the baseline assessment prior to random assignment as T1, the assessment immediately after the experimental inductions as T2, and the assessment immediately after the Facebook advertisement as T3. Alphas are reported based on the final analytic sample (see Preliminary Analyses section for more information).

Facebook desire. At T1, T2, and T3, participants rated three items assessing current desire for Facebook (e.g., “I’m craving Facebook”) from 0 = *not at all* to 10 = *very much*. The observed alphas, split by condition, were $> .93$ (T1), $> .92$ (T2), and $> .91$ (T3).

State reward simulations and decentering. At T2, participants rated two items assessing state reward simulation (e.g., “I vividly imagined positive thoughts and feelings about checking Facebook”) and two items assessing state decentering (e.g., “I did not get wrapped up in my urges to check Facebook”) from 0 = *not at all* to 10 = *very much*. Observed alphas, split by condition, were $> .61$, with the exception of state decentering in the mindfulness condition, with an observed alpha of $.27$. (Recall that participants also completed single-item measures assessing these constructs at T3. For current purposes, we focus only on T2 assessments.)

Facebook advertisement attitudes. At T3, participants responded to single-item scales assessing the degree to which the ad made them like Facebook and made them want to check Facebook, both from 0 = *not at all* to 10 = *very much*.

Positive and negative affect. Participants completed the 10-item Positive and Negative Affect Schedule, short-form (Mackinnon et al., 1999). Participants rated five items (alert, determined, enthusiastic, excited, inspired) assessing current positive affect, and five items (afraid, distressed, nervous, scared, upset) assessing current negative affect, from 1 = *not at all* to 5 = *extremely*. The observed alphas, split by condition, were $> .70$ (T1) and $> .75$ (T2).

Results

Preliminary analyses. A total of 11 participants were excluded from analysis for the following reasons: $n = 4$ reported written doubts in the open-ended suspicion probe about whether the Facebook *PsychExpt_PU* program or notification sounds were real; $n = 2$ reported talking with someone beforehand about the true purpose of the study; $n = 2$ did not finish the

experiment; and $n = 3$ did not receive guided audio instructions due to a computer error. This left $n = 112$ participants for whom all analyses are based. The proportion of participants excluded from analysis did not differ significantly across condition, $\chi^2(2) = 0.80, p = .670$.⁵

A majority of participants (74 out of 112) responded “no” to the forced-choice, post-experiment question, “Are you confident this app posted your status update to Facebook?.” Though participants’ responses on this item were unexpected, it is balanced by the fact that only 4 participants explicitly reported written doubts about the veridicality of the *PsychExpt_PU* program in the open-ended suspicion probe. Importantly, the confidence rating did not differ significantly across experimental condition, $\chi^2(2) = 0.27, p = .872$, nor did it moderate any associations reported below. It is worth noting here that the forced-choice confidence question only provided a strong test of confidence among participants who responded “yes.” “No” responses included participants with no confidence, those with some confidence, and those who had doubts due solely to the question itself. We made some alterations to the procedure in Study 2 to try to address this issue, and we also return to the confidence ratings in the General Discussion. Beyond that, we do not consider it further.

Hypothesis 1: Does exposure to social media stimuli increase desire? We used a paired samples *t*-test to test the first hypothesis that exposure to social media stimuli (i.e., notification sounds) would increase desire. This hypothesis was confirmed. Results revealed that Facebook desire (collapsed across conditions) increased from T1 ($M = 3.22, SD = 2.62$) to T2 (M

⁵ Consistent with prior research (Arch et al., 2016; Papies et al., 2012; Papies et al., 2015; Schumacher, Kemps, & Tiggesmann, 2017), participants were never explicitly told to “down-regulate” desire. To rule against the hypothesis that the results were driven by participants who may have reported in the open-ended suspicion probe that the study was about consciously regulating desires, we conducted exploratory follow-up analyses without these participants (see also, Collins, Best, Stritzke, & Page, 2016). Results of this reanalysis are similar to those presented in the main text. See **Online Supplemental Material** for more details.

$= 4.28, SD = 2.74$), $t(111) = -5.45, p < .001$. This indicates that the 15-minute waiting/training period—during which participants heard notification sounds indicating friends had *liked* or commented on their status update—increased desire for Facebook. Positive and negative mood did not change significantly, $ps = .713$ and $.231$, respectively, suggesting that the waiting period selectively targeted desire.

Hypothesis 2: Do reward simulations boost social media desire? We next used bivariate correlations and multiple regression to test the second hypothesis that reward simulations during the waiting period would predict an increase in desire. This hypothesis was also confirmed. T2 state reward simulations (collapsed across conditions) were positively correlated with T2 Facebook desire, $r(110) = .72, p < .001$. T2 Facebook desire was also associated with T2 positive and negative affect, $r(110) = .36$ and $.43, p < .001$, respectively. A simultaneous multiple regression with T1 Facebook desire as a covariate showed that T2 state reward simulations, $b = 0.43, p < .001, 95\% CI [0.29, 0.57]$, significantly predicted change in Facebook desire from T1 to T2, but T2 positive affect, $b = -0.04, p = .851$, and negative affect, $b = 0.46, p = .058$, did not.

Random assignment. We now describe results of the experimental contrasts on Facebook desire, reward simulations, and attitudes toward a Facebook advertisement. Recall that during the 15-waiting period, participants were randomly assigned to one of three conditions: mindfulness ($n = 37$), self-immersed ($n = 36$), or unfocused attention ($n = 39$).

Random assignment was effective; conditions did not differ significantly ($p < .05$) on demographic characteristics or any major study variable (e.g., Facebook desire) at T1. However, the conditions differed significantly on self-reported number of total Facebook friends ($M_{\text{unfocused attention}} = 788, M_{\text{immersed}} = 1,123, M_{\text{mindfulness}} = 999$), $F(2, 109) = 3.71, p = .028$, and on how often

they update their status or post content on Facebook ($M_{\text{unfocused attention}} = 2.77$, $M_{\text{immersed}} = 3.67$, $M_{\text{mindfulness}} = 3.51$), $F(2, 109) = 4.04$, $p = .020$. Because participants completed these measures before the experimental inductions were administered, we suspect these differences were due to random chance. But, the pattern of means suggests differences between the unfocused attention condition and the self-immersed and mindfulness conditions. To rule out any potential effect of these few baseline differences, we controlled for these variables in the analyses reported below. The two items, $r(110) = .33$, $p < .001$, were z -score standardized and then averaged to create a single covariate.

Hypothesis 3: Does mindfulness reduce social media desire and reward simulations?

Facebook desire. We fit a 3-by-3 repeated measures ANCOVA with condition (unfocused attention, self-immersed, mindfulness) as the between-subjects factor and time (T1, T2, T3) as the within-subjects factor to test the hypothesis that participants in the mindfulness condition would report less Facebook desire than participants in either the self-immersed or unfocused attention conditions. This analysis revealed a marginal condition-by-time interaction effect, $F(4, 216) = 2.20$, $p = .070$, $\eta_p^2 = .039$. As shown in **Table 1**, follow-up pairwise comparisons indicated that participants in the mindfulness condition reported less Facebook desire than participants in both the self-immersed, $p = .009$, and unfocused attention, $p = .040$, conditions immediately after the experimental inductions (T2). Likewise, participants in the mindfulness condition reported less desire after watching the Facebook advertisement (T3) compared to self-immersed, $p = .001$, and unfocused attention, $p = .018$, conditions. Facebook desire did not differ across the self-immersed and unfocused attention conditions at T2, $p = .580$, or T3, $p = .291$. The results are graphically depicted in **Figure 1**.

Though the desire *means* differed across condition at T2 and T3, inspection of Figure 1 shows that the desire *slopes* from T2 to T3 appeared relatively similar. Indeed, the conditions did not differ in the rate of change in desire from T2 to T3, $F(2, 108) = 0.25, p = .778, \eta_p^2 = .005$. Given that all conditions reported similar change in Facebook desire from T2 to T3, we ran another model testing the main effect of condition on overall Facebook desire. We fit a univariate ANCOVA with condition as a between-subjects predictor of Facebook desire, averaged across T2 and T3. In addition to the covariate (standardized average of Facebook friends and frequency of Facebook posts), we also included T1 Facebook desire as another covariate. This analysis revealed a main effect of condition, $F(2, 107) = 6.21, p = .003, \eta_p^2 = .104$. Follow-up pairwise comparisons showed that participants in the mindfulness condition ($M = 3.09, 95\% \text{ CI } [2.55, 3.62]$) reported lower overall levels of Facebook desire compared to participants in the self-immersed ($M = 4.38, 95\% \text{ CI } [3.83, 4.93]$), $p = .001$, and unfocused attention ($M = 4.07, 95\% \text{ CI } [3.53, 4.60]$), $p = .013$, conditions. The self-immersed and unfocused attention conditions did not differ, $p = .427$.

State reward simulations and decentering. We fit a multivariate ANCOVA with T2 state reward simulations and decentering as the multivariate dependent variable to test the hypothesis participants in the mindfulness condition would report less intense reward simulations and greater decentering than participants in either the self-immersed or unfocused attention conditions. The multivariate effect of condition was significant, $F(4, 216) = 4.57, p = .001, \eta_p^2 = .078$. Separate between-subjects tests further showed a main effect of condition on state reward simulations, $F(2, 108) = 7.58, p = .001, \eta_p^2 = .123$, but not state decentering, $F(2, 108) = 1.84, p = .164, \eta_p^2 = .033$. As shown in **Table 1**, follow-up pairwise comparisons showed that participants in the self-immersed condition reported more reward simulations than participants in

the mindfulness, $p < .001$, and unfocused attention, $p = .005$, conditions. The mindfulness and unfocused attention conditions did not differ, $p = .442$, although there was a directional effect with mindfulness being slightly lower. There were no differences in state decentering across conditions, $ps > .06$.

Beyond the low reliability of T2 state decentering in the mindfulness condition (.27), it is worth noting here that state decentering was also uncorrelated with both T2 state reward simulations, $r(110) = -.01$, $p = .924$, and Facebook desire, $r(110) = -.10$, $p = .276$.

Hypothesis 4: Do reductions in reward simulations mediate the effect of mindfulness on social media desire? To test the hypothesis that state reward simulations (T2) mediated the effect of condition on Facebook desire, we conducted a bootstrapped indirect effect analysis with 5,000 samples using the PROCESS macro version 2.16.3 for SPSS (Preacher, 2013). Two separate dummy codes were created for the self-immersed and unfocused attention conditions with the mindfulness condition serving as the reference group. The dependent measure was overall Facebook desire, averaged across the T2 and T3 assessments. Baseline (T1) Facebook desire, in addition to the covariate described previously (standardized average of Facebook friends and frequency of Facebook posts), were included as control variables.

Compared to the mindfulness condition, participants in the self-immersed condition reported more state reward simulations, that in turn predicted changes in Facebook desire, $b_{\text{indirect effect}} = 0.65$, 95% CI [0.23, 1.27]. In contrast, participants in the unfocused attention condition did not report more reward simulations compared to the mindfulness condition; consequently, no evidence for mediation was observed, $b_{\text{indirect effect}} = 0.07$, 95% CI [-0.24, 0.47]. See **Figure 2** for a graphical depiction of the results.

Ruling out an alternative explanation: Controlling for the association between positive affect and desire. Exploratory repeated measures ANCOVA showed a marginally significant condition-by-time interaction effect for changes in positive affect from T1 to T2, $F(2, 108) = 2.75, p = .068, \eta_p^2 = .048$. As shown in **Table 1**, participants in the mindfulness condition showed a slight decrease in positive affect, whereas participants in the self-immersed condition showed a slight increase. Positive affect in the unfocused attention condition remained relatively stable. The condition-by-time interaction effect for negative affect was not significant, $F(2, 108) = 0.26, p = .772, \eta_p^2 = .005$.

To test the possibility that changes in positive affect explained the mediating effect of reward simulations on Facebook desire, we ran another indirect effect model, but with changes in positive affect (T2 minus T1 scores) as an additional covariate. Controlling for changes in positive affect, results showed that the indirect effect of state reward simulations on Facebook desire was still significant in the comparison between the mindfulness and self-immersed conditions, $b_{\text{indirect effect}} = 0.50, 95\% \text{ CI } [0.15, 1.03]$.

Hypothesis 5: Does mindfulness change attitudes toward a Facebook advertisement?

We fit a multivariate ANCOVA with condition as the between-subjects factor and T3 Facebook “liking” and “wanting” as the multivariate dependent variable to test the hypothesis participants in the mindfulness condition would report less positive attitudes toward a Facebook advertisement than participants in either the self-immersed or unfocused attention conditions. This analysis revealed a significant multivariate effect of condition, $F(4, 216) = 3.15, p = .015, \eta_p^2 = .055$. Separate between-subjects tests further showed a significant main effect of condition on wanting, $F(2, 108) = 5.87, p = .004, \eta_p^2 = .098$, and a marginal effect of liking, $F(2, 108) = 2.61, p = .078, \eta_p^2 = .046$. As shown in **Table 1**, follow-up pairwise comparisons showed that

participants in the mindfulness condition reported that the advertisement made them want to check Facebook less than participants in the self-immersed, $p = .001$, and unfocused attention, $p = .045$, conditions. By contrast, participants' liking of Facebook following the advertisement was similar across mindfulness and unfocused attention conditions, $p = .639$, and both reported less liking of Facebook compared to the self-immersed condition, $p = .030$ and $.098$, respectively.

Discussion

Study 1 revealed five major findings. First, the results demonstrated that mere exposure to social media stimuli can increase desire. Participants reported increases in Facebook desire following a 15-minute period in which they purportedly received comments and *likes* on a status update, but could not check them. Second, the data showed that mentally elaborating upon the rewarding implications of social media stimuli (notification “dings”) further intensified desire. That is, participants who reported more reward simulations during the 15-minute waiting period also reported greater increases in their desire to check Facebook, holding constant positive and negative affect.

Third, this study provided the first evidence that mindfulness can change social media desire. Compared to participants assigned to a self-immersed or unfocused attention induction, those assigned to a brief mindfulness induction reported less intense desire to check Facebook. These results thus provide initial evidence for another route by which individuals might manage the frequent intrusions inherent to smartphone-enabled social media applications. Beyond distraction, individuals may also bring mindful awareness to the transitory experience of thoughts, emotions, and desires triggered by the presence of social media and smartphones to alter the unfolding of desire.

Fourth, the results offered initial support for the hypothesis that reductions in reward simulations explained the effect of mindfulness on Facebook desire. Compared to participants who received the self-immersed induction, those who received the mindfulness induction reported less state reward simulations that, in turn, predicted less social media desire.

Fifth, and finally, results showed that mindfulness changed individuals' reactions to a Facebook advertisement. Watching a Facebook advertisement while adopting a mindful perspective led participants to report less positive attitudes toward Facebook. Interestingly, adopting a mindful perspective did not change their overall opinion (liking) of Facebook, only the degree to which they said the advertisement made them "want" to check Facebook. This suggests that interrupting the mental fantasy provoked by the ad made Facebook appear less tempting but not less enjoyable (Berridge & Robinson, 2016).

Study 2

Study 1 provided initial support for the main hypotheses, namely, that exposure to social media stimuli would increase the desire to check it and that reward simulations about those stimuli would further increase this desire. Study 1 also provided support for the hypothesis that a brief mindfulness induction would interrupt reward simulations, and consequently, reduce social media desire. In Study 2, we conducted a direct replication and extension of Study 1. In addition to testing our core hypotheses, we also included a behavioral measure of academic self-control in which undergraduates were given the choice of whether to allocate their time to solving math problems or to watching entertaining videos (citation blinded for review). We included this measure as a way to test another core theoretical assumption that the ways in which students respond to social media desires influence whether they are able to work diligently toward long-term academic learning goals. We argue that students who mentally indulge in reward

simulations related to social media will be more likely to give in to desires for immediate pleasure (and thus disengage from academic work). Conversely, students who mindfully observe thoughts, emotions, and urges to check social media should be less likely to disengage from their academic work.

Finally, in Study 2, we conducted an exploratory test of another potential mechanism linking mindfulness to enhanced self-control. Prior research in clinical and social psychology has found that mindfulness can moderate, or “decouple,” the link between desire and behavior (Ostafin, Bauer, & Myxter, 2012; Ostafin & Marlatt, 2008). For example, several studies investigating the effect of mindfulness training for substance use cessation found that self-report measures of craving predicted substance use only among individuals who engaged in less mindfulness practice (Elwafi, Witkiewitz, Mallik, Thornhill, & Brewer, 2012; Enkema & Bowen, 2017; Garrison et al., in press). Likewise, Papies et al. (2015; Study 1) found that adopting a mindful perspective for 12 minutes (compared to a self-immersed perspective) reduced the association between sexual motivation and judgments of attractiveness and desirability of opposite-sex others. These studies offer evidence for the intriguing hypothesis that mindfulness enables individuals to become aware of, yet transcend momentary motivational states (e.g., craving) to act in ways that are more consistent with enduringly valued goals. In Study 2, we tested this exploratory hypothesis by examining whether mindfulness moderates the association between Facebook desire and academic self-control. Based on prior research, we predicted that Facebook desire would impair performance on the self-control task among individuals randomly assigned to a self-immersed induction but not a mindfulness induction.

Method

Participants. The sample included $N = 131$ (M age = 19.30 years, $SD = 1.75$; 43% female; 67% White) undergraduates from one university who participated for course credit. Like Study 1, we had no overall stopping rule for data collection; we sought to collect as much data as possible within the span of one academic semester. Power analysis using G*Power version 3.1.9.2 (Faul et al., 2007) revealed that a total sample of 128 would provide an estimated 80% power to detect a medium-sized ($d = 0.50$), between-subjects effect. Data were collected between February and April 2017.

Procedure

Changes to the procedure. The procedure and materials were identical to Study 1, with the following exceptions. First, we reduced the number of baseline (pre-random assignment) survey items to minimize participant burden. But, because our primary dependent variable was self-control on an academic task in which students allocated time between solving math problems and watching online videos, we added baseline assessments of self-reported attitudes toward math and YouTube (“[practicing math/watching YouTube videos] is enjoyable in the moment,” “[practicing math/watching YouTube videos] is relevant to my long-term goals;” 1 = *strongly disagree* to 6 = *strongly agree*). Second, based on participants’ responses in Study 1 about the number of notifications they expected to receive during the 15-minute waiting period ($M = 7.75$, $SD = 7.35$), we reduced the number of Facebook notification “dings” from 26 to 9. Third, to maximize statistical power we included only the self-immersed and mindfulness inductions for our key experimental contrasts (see also, Baquedano et al., 2017; Papies et al., 2012; Papies et al., 2015; Tincher et al., 2015). Fourth, we replaced the Facebook advertisement activity with a behavioral measure of self-control (T3; see “Academic Diligence Task” in the Measures section for a full description). Fifth, we modified the immediate post-induction (T2)

state decentering items to try to improve reliability (recall that the alpha was unacceptably low for participants in the mindfulness condition in Study 1, $\alpha = .27$), (see “state reward simulations and decentering” in Measures section for a full description). Sixth, and finally, the end of the experiment included a modified funnel debriefing in which participants provided written responses to a series of open-ended suspicion probes. As in Study 1, these questions were designed to identify participants who may have doubted whether the Facebook program or notification sounds were real.

Measures. The self-report measures used to assess Facebook desire and positive and negative affect were identical to those used in Study 1. The observed alphas (based on the final analytic sample), split by condition, for Facebook desire were $> .92$ (T1), $> .93$ (T2), and $> .93$ (T3); the observed alphas, split by condition, for positive and negative affect were $> .76$ (T1) and $> .83$ (T2).

Academic Diligence Task. Participants completed an online behavioral measure of self-control called, the Academic Diligence Task (ADT; Galla et al., 2014). This 8-minute version of the task involved a split-screen interface with the choice of completing two-step algebra problems (e.g., $-7x + 9 = -12$, solve for x) or watching entertaining videos downloaded from YouTube. Participants were introduced to the task as a way to “*improve problem-solving ability, which can be helpful in many areas of life.*” They also read that whenever they felt like it, they were free to click on the opposite side of the screen to watch any of nine different videos. Participants were able to toggle back and forth between the math and videos as many times as they wanted during the 8-minute task, but they could only do one activity at a time.

Before starting the ADT, participants read that thoughts, urges, and desire may arise during the math problems, and that if and when that happens, they could use them as

opportunities to “adopt the new approach” they learned during the 15-minute waiting period. Participants listened to a brief (~100 second) audio recording summarizing the main points of their specific training. Then, during the ADT, text was presented above the math problems reminding them of what to do (mindfulness: “*Try to see urges to watch the videos as temporary mental events that pass on their own;*” self-immersed: “*Try to fully experience any urges to watch the videos.*”).

Unbeknownst to participants, the ADT software recorded their engagement with the task that was then used to derive several indices of self-control (Fraundorf, 2017). We calculated the total number of math problems solved correctly (productivity), the total percentage of time participants spent solving the math problems (time on task), and the number of times participants switched between the math and videos (switches). Inspection of the data revealed that time on task was severely non-normally distributed (skewness = -2.14; kurtosis = 4.29). To remedy this, we created a binary time on task variable based on the median value (98.75%), such that participants at or below the median were given a score of 0 and participants above the median were given a score of 1.⁶

Subjective experience during Academic Diligence Task. After completing the Academic Diligence Task, participants responded to single-item scales assessing how bored they felt by the math problems and how tempted they felt to watch the videos, both from 0 = *not at all* to 10 = *very much*. They also completed single-item scales assessing motivational conflict, but due to

⁶ Alternatively, we rank-ordered the time on task variable and then used parametric statistics (independent samples *t*-test) to compare conditions. We also conducted a non-parametric Mann-Whitney *U* test on the untransformed data to compare conditions. In all cases the same pattern of results emerged, so we report results using the median-split time on task variable.

experimenter error, the measures of motivational conflict were only completed by a subset of participants ($n = 115$). Consequently, we focus only on the boredom and temptation ratings.

State reward simulations and decentering. At T2, participants rated the same two items assessing state reward simulation as in Study 1 (alphas, split by condition, $> .60$). They also completed two new items assessing state decentering (“I treated thoughts, urges, and desires to check Facebook as temporary mental events,” “I observed urges and desires to check Facebook as experiences that arise and pass away on their own”) from 0 = *not at all* to 10 = *very much*. Observed alphas, split by condition, were $> .72$. (Similar to Study 1, participants also completed single-item measures assessing these constructs after completing the Academic Diligence Task [T3]. For current purposes, we focus only on T2 assessments.)

Results

Preliminary analyses. Similar to Study 1, $n = 3$ participants were excluded due to written doubts on the open-ended suspicion-probe regarding the veridicality of the Facebook program and notification sounds. This left $n = 128$ participants for whom all analyses are based. One additional participant did not complete the ADT (or the post-ADT survey questions) due to a computer error, so ADT data were available for $n = 127$ participants. The proportion of participants excluded from analysis did not differ significantly across condition, $\chi^2(1) = 0.30$, $p = .586$.

Hypothesis 1: Does exposure to social media stimuli increase desire? Consistent with Study 1, Facebook desire (collapsed across conditions) increased from T1 ($M = 2.64$, $SD = 2.43$) to T2 ($M = 4.06$, $SD = 2.78$), $t(127) = -7.04$, $p < .001$, confirming our first hypothesis that exposure to social media stimuli (i.e., notification sounds) triggers desire. By contrast, positive and negative affect did not change significantly, $ps = .701$ and $.530$, respectively.

Hypothesis 2: Do reward simulations intensify social media desire? The data also supported our second hypothesis in that T2 state reward simulations (collapsed across conditions) were positively correlated with T2 Facebook desire, $r(126) = .71, p < .001$. T2 Facebook desire was also associated with T2 positive and negative affect, $r(126) = .33$ and $.43, p < .001$, respectively. A simultaneous multiple regression with T1 Facebook desire as a covariate showed that T2 state reward simulations, $b = 0.61, p < .001, 95\% \text{ CI } [0.48, 0.75]$, and T2 negative affect, $b = 0.90, p < .001, 95\% \text{ CI } [0.46, 1.35]$, but not T2 positive affect, $b = .19, p = .352$, significantly predicted change in Facebook desire from T1 to T2.

Random assignment. Random assignment was effective; individuals in the mindfulness ($n = 65$) and self-immersed ($n = 63$) conditions did not differ significantly ($p < .05$) on demographic characteristics or any major study variable (e.g., Facebook desire) at baseline. However, the conditions differed significantly on baseline enjoyment when using Facebook ($M_{\text{immersed}} = 3.76, M_{\text{mindfulness}} = 3.49; t(126) = 2.15, p = .034$). To account for any potential effect of this baseline difference, we controlled for this variable in analyses reported below.

Hypothesis 3: Does mindfulness reduce social media desire and reward simulations?

Facebook desire. Similar to Study 1, we fit a 2-by-3 repeated measures ANCOVA with condition (immersed, mindfulness) as the between-subjects factor and time (T1, T2, T3) as the within-subjects factor to test the hypothesis that participants in the mindfulness condition would report less Facebook desire than participants in the self-immersed condition. This analysis revealed a marginally significant condition-by-time interaction effect, $F(2, 248) = 2.94, p = .055, \eta_p^2 = .023$. As shown in **Table 2**, follow-up pairwise comparisons revealed that participants in the mindfulness condition reported less Facebook desire than participants in the immersed

condition at T2 and T3, $p = .064$ and $.042$, respectively, holding constant T1 Facebook enjoyment. Results are graphically depicted in **Figure 3**.

Consistent with Study 1, the desire *slopes* from T2 to T3 did not differ across condition, $F(1, 124) = 0.06, p = .815, \eta_p^2 < .001$. Given that both conditions reported similar change in Facebook desire from T2 to T3, we ran another model testing the main effect of condition on overall Facebook desire. We fit a univariate ANCOVA with condition as a between-subjects predictor of Facebook desire, averaged across T2 and T3. In addition to the covariate (T1 Facebook enjoyment), we also included T1 Facebook desire as another covariate. This analysis revealed a main effect of condition, $F(1, 124) = 6.52, p = .012, \eta_p^2 = .05$. Planned comparisons showed that participants in the mindfulness condition ($M = 2.67, 95\% \text{ CI } [2.22, 3.13]$) reported lower overall levels of Facebook desire compared to participants in the immersed condition ($M = 3.51, 95\% \text{ CI } [3.05, 3.98]$).

State reward simulations and decentering. We fit a multivariate ANCOVA with T2 state reward simulations and decentering as the multivariate dependent variable to test the hypothesis that individuals in the mindfulness condition would report less intense reward simulation and higher decentering. The multivariate effect of condition was significant, $F(2, 124) = 10.29, p < .001, \eta_p^2 = .142$. Separate between-subjects tests further showed a main effect of condition on state reward simulations, $F(1, 125) = 10.85, p = .001, \eta_p^2 = .080$, but not state decentering, $F(1, 125) = 0.51, p = .477, \eta_p^2 = .004$. As shown in **Table 2**, participants in the self-immersed condition reported more reward simulations than participants in the mindfulness condition, but they did not differ on their state decentering.

It is worth noting here that even though state decentering was more reliable than in Study 1, the measure again did not function along theoretical lines. Contrary to expectations and prior

research, higher T2 state decentering was associated with stronger Facebook desire, $r(126) = .39$, $p < .001$, and stronger reward simulations, $r(126) = .49$, $p < .001$.

Hypothesis 4: Do reductions in reward simulations mediate the effect of mindfulness on social media desire? Consistent with Study 1, T2 state reward simulations mediated the relationship between condition and Facebook desire (averaged across time 2 and time 3), such that participants in the self-immersed condition reported more reward simulations, that in turn, predicted greater Facebook desire, $b_{\text{indirect effect}} = 0.64$, 95% CI [0.29, 1.15]. See **Figure 4** for a graphical depiction of the results.

Ruling out negative affect as a possible confound. Exploratory repeated measures ANCOVA showed a significant condition-by-time interaction effect for changes in negative affect from T1 to T2, $F(1, 125) = 4.51$, $p = .036$, $\eta_p^2 = .035$. As shown in **Table 2**, participants in the mindfulness condition showed a slight decrease in negative affect, whereas participants in the immersed condition showed a slight increase. The condition-by-time interaction effect for positive affect was not significant, $F(1, 125) = 1.87$, $p = .174$, $\eta_p^2 = .015$.

To test the possibility that changes in negative affect explained the mediating effect of reward simulations on Facebook desire, we ran additional indirect effect models, but with changes in negative affect (T2 minus T1 scores) as an additional covariate. Controlling for changes in negative affect (and T1 Facebook enjoyment), results showed that the indirect effect on Facebook desire were still significant, $b_{\text{indirect effect}} = 0.64$, 95% CI [0.30, 1.16].

Hypothesis 5: Does mindfulness change self-control? To test the hypothesis that mindfulness would alter academic self-control, we fit a logistic regression with condition (self-immersed = 0, mindfulness = 1) as a predictor of time on task (median split). T1 Facebook enjoyment was also included as a covariate, and robust standard errors were used to correct for

deviations from normality. Participants in the mindfulness condition spent more time on the math skill-building task than participants in the immersed condition, $OR = 4.08$, $p < .001$, 95% CI [1.92, 8.67]. Compared to participants in the immersed condition, those in the mindfulness condition had 300% greater odds of spending more than the median amount of time solving the math problems, holding constant the covariate.

Likewise, negative binomial regression with robust standard errors showed that participants in the mindfulness condition ($M_{unadjusted} = 0.46$) made fewer switches between the math and videos compared to those in the self-immersed condition ($M_{unadjusted} = 1.61$) holding constant the covariate, incident rate ratio = 0.31, $p = .001$, 95% CI [0.16, 0.61]. Finally, multiple regression analysis showed that participants in the mindfulness condition ($M_{unadjusted} = 38.22$) solved more correct math problems than participants in the self-immersed condition ($M_{unadjusted} = 35.34$), but this difference did not reach statistical significance, $b = 2.18$, $SE = 2.30$, $p = .346$, 95% CI [-2.38, 6.74].

An indirect effect analysis with 5,000 bootstrapped samples showed that reward simulations also mediated the effect of mindfulness on ADT productivity,⁷ such that participants in the immersed condition reported more reward simulations, that in turn, predicted solving fewer math problems, $b_{indirect\ effect} = -1.62$, 95% CI [-4.02, -0.30]. See **Figure 4**.

Recall that participants also rated how boring it was to solve math problems and how tempted they felt by the videos immediately after completing the ADT. To test whether mindfulness influenced participants' subjective experience during the ADT, we fit a multivariate ANCOVA with condition as the between-subjects factor, T1 Facebook enjoyment as the

⁷ We chose ADT productivity (number of math problems solved correctly) as the dependent variable in the mediation and exploratory moderation analyses since it was the only normally-distributed variable derived from the ADT.

covariate, and T3 ratings of boredom and temptation as the multivariate dependent variable. This analysis revealed a significant multivariate effect of condition, $F(2, 123) = 4.96, p = .008, \eta_p^2 = .075$. Separate between-subjects tests further showed a significant main effect of condition on temptation, $F(1, 124) = 8.89, p = .003, \eta_p^2 = .067$, but not on boredom, $F(1, 124) = 0.39, p = .535, \eta_p^2 = .003$. As shown in **Table 2**, participants in the mindfulness condition reported less temptation to watch videos during the ADT than participants in the immersed, but they did not differ in their ratings of boredom.

Exploratory hypothesis: Does mindfulness decouple the relationship between Facebook desire and academic self-control? To test the hypothesis that mindfulness would decouple the association between Facebook desire and self-control, we conducted a moderated regression analysis using the PROCESS macro version 2.16.3 for SPSS (Preacher, 2013). In this model, T2 Facebook desire was the independent variable, condition (0 = immersed, 1 = mindfulness) was the moderator, and ADT productivity was the dependent variable. We also included T1 Facebook desire and T1 Facebook enjoyment as covariates. This analysis revealed a significant T2 Facebook desire-by-condition interaction, $b = 2.36, p = .004, 95\% \text{ CI } [0.75, 3.96]$. A simple slope analysis, shown in **Figure 5**, demonstrates that T2 Facebook desire was a statistically significant predictor of ADT productivity among participants in the self-immersed condition, $b = -1.98, p = .003, 95\% \text{ CI } [-3.27, -0.70]$, but not among participants in the mindfulness condition, $b = 0.38, p = .568, 95\% \text{ CI } [-0.92, 1.68]$.

Discussion

Study 2 replicated the results of Study 1. The data again showed that exposure to personally-relevant social media stimuli (i.e., Facebook notification sounds) increased desire, and that reward simulations about those stimuli further intensified this desire. Likewise, the data

showed that mindfully attending to social media stimuli resulted in both lower Facebook desire and lower reward simulations compared to immersing oneself in them. Finally, the data showed that reward simulations mediated the relationship between mindfulness and Facebook desire, such that individuals assigned to the mindfulness induction reported less intense reward simulations about Facebook that in turn predicted less intense desire to check Facebook.

Study 2 also extended prior results by including a behavioral measure of self-control. Here, the data showed that participants assigned to a brief mindfulness induction spent more time working on a tedious but “good for you” academic assignment compared to those assigned to a self-immersion induction. This suggests that beyond reducing the subjective experience of desire, mindfulness may also support successful self-control toward activities that advance long-term academic goals. Interestingly, participants in the mindfulness condition did not report higher levels of boredom despite spending more time on the math task. They did, however, report less temptation to watch entertaining videos, suggesting that mindfully attending to one’s reactions to rewarding stimuli (social media notifications, entertaining videos) can reduce the desirability of those stimuli. And consistent with our theoretical assumptions, mediation analysis showed that mindfulness predicted self-control (solving more math problems) through a reduction in reward simulations.

Exploratory analyses also showed that mindfulness moderated the association between Facebook desire and academic self-control. Facebook desire, measured immediately following the 15-minute waiting period, predicted solving fewer math problems among participants in the self-immersed condition but not in the mindfulness condition. In other words, mindfulness decoupled the link between desire and behavior (Elwafi et al., 2012; Enkema & Bowen, 2017; Papies et al., 2015). This suggests another mechanism through which mindfulness may support

self-control, not through the direct reduction of craving, but through the transcendence of craving. Given that temptations are a common part of everyday life (Hofmann et al., 2012), it may not be reasonable to expect individuals to be able to manage each one. Rather, it may be that by becoming aware of the momentary temptation in a non-reactive, psychologically-distanced manner (i.e., *non*-self-immersed manner), individuals are able to enact their long-term goals despite the presence of temptation.

General Discussion

Two experiments sought to identify and unpack psychological mechanisms for how social media desire emerges and intensifies in young adults. We hypothesized that reward simulations—mental elaborations on the personally-relevant and reinforcing qualities of social media (e.g., social status, positive feelings)—strengthen desire to check social media, and that mindfulness can interrupt reward simulations, in turn deescalating desire and improving self-control.

In Study 1, the data showed that desire to check Facebook increased during a short waiting period where individuals received notifications from friends about a status update, but could not check those notifications. Moreover, reward simulations during this waiting period further increased Facebook desire. Consistent with our other hypothesis, individuals randomly assigned to receive a guided mindfulness exercise—in which they treated thoughts, emotions, and urges about Facebook as temporary mental events—reported less desire to check Facebook, compared to individuals randomly assigned to receive a guided self-immersed exercise—in which they contemplated the social benefits and rewards about Facebook—or an unfocused attention exercise—in which they allowed their thoughts to wander freely. Moreover, individuals who practiced mindfulness while watching an advertisement for Facebook said it made them

want to check Facebook less than individuals in the other two conditions. Finally, reductions in reward simulation mediated the effect of mindfulness on desire. Individuals in the mindfulness condition reported less vivid mental fantasies about checking Facebook compared to individuals in the self-immersed condition, and that in turn predicted lower desire.

In Study 2, we directly replicated the finding that exposure to Facebook notifications increases desire and that reward simulations enhance that desire. We further replicated the finding that individuals trained in mindfulness reported less reward simulation and Facebook desire compared to individuals trained in self-immersion. Study 2 built upon the results of Study 1 by showing that mindfulness also supported self-control on a tedious academic skill-building activity. Compared to individuals in the self-immersed condition, those in the mindfulness condition spent more time solving algebra problems, made fewer switches between solving problems and watching entertaining videos, and solved more problems correctly (although this last difference was not statistically significant). Consistent with our theoretical assumptions, reductions in reward simulation explained the effect of mindfulness on self-control. Finally, exploratory analyses showed that mindfulness moderated the association between Facebook desire and self-control. Desire to check Facebook had a negative association with solving algebra problems in the self-immersed condition, but was unrelated to solving math problems in the mindfulness condition.

Implications for Theory and Measurement

Results of these experiments contribute to theories of desire. This is, to our knowledge, the first study to show that mere exposure to social media stimuli (i.e., notifications) can increase desire. These results build upon prior research showing that having a smartphone taken away for 20 minutes increases anxiety (Cheever, Rosen, Carrier, & Chavez, 2014), but suggests that

beyond triggering avoidance orientations, social media stimuli can also trigger strong approach orientations in the form of desire. Given the ubiquity of smartphone-enabled social media stimuli in individuals' everyday lives, our results also help explain why individuals experience so many desires to check technology throughout the day (Hofmann et al., 2012). This study also enhances our understanding of the mechanisms underlying the maintenance and intensification of social media desire. Though prior research has shown that reward simulations can increase desire in other domains, including alcohol and cigarettes (May, Andrade, et al., 2014), our study suggests that social media desire operates under the same cognitive process. In both experiments, individuals who self-reported more intense and vivid fantasies of checking Facebook during a waiting period when they were receiving notifications (but could not check them) also reported stronger desire to check Facebook after the waiting period. One interesting direction for future research would be to unpack the content of the reward simulations triggered by social media stimuli and how they may change across time. Our experiments assumed that positive fantasies were driving the association between social media stimuli and desire, but it could also be the case that individuals engage in negative mental elaborations (e.g., worries about missing something) following deprivation. In other words, social media desire may be fueled both by anticipated rewards (e.g., social status) and by relief from discomfort (e.g., feeling isolated) (Kavanagh et al., 2005).

Our study also contributes to theories of mindfulness. A growing body of research shows that mindfulness can reduce desire and improve self-control in a number of domains, including cigarette smoking (Bowen & Marlatt, 2009), substance use (Bowen et al., 2009), and food consumption (Lacaille et al., 2014). Our experiments add to this list and show that mindfulness can reduce desire for social media and support self-control for academic activities. In both

experiments, individuals in the mindfulness condition reported lower Facebook desire, compared to those in a self-immersed condition (and in Study 1, an unfocused attention condition).

Moreover, in Study 1, individuals in the mindfulness condition reported less positive attitudes toward a Facebook advertisement, and in Study 2, spent more time on a math skill-building activity. Our results also extend much of the prior research by introducing reward simulations as a possible mechanism. In both experiments, individuals in a mindfulness condition reported less reward simulation than individuals in a self-immersed condition that in turn reduced desire, and in Study 2, boosted self-control. These results are aligned with classical models of mindfulness, which posit that when mindfulness is actively engaged in the mind, secondary elaborations triggered by perceptual inputs are minimized (Analayo, 2003, 2009; Grabovac et al., 2011).

Our results also ruled out changes in positive and negative affect as a possible alternative explanation to reward simulations. Given that our experimental inductions had differential effects on participants' state affect, and that affect and desire were correlated, it is possible that changes in affect following the inductions could have accounted for the relationship between reward simulation and desire. In both studies, however, reward simulations predicted desire (and in Study 2, self-control) above and beyond the effect of changes in positive and negative affect. These results further support the proposition that reward simulations are an important cognitive process underlying desire (Hofmann & Van Dillen, 2012; Kavanagh et al., 2005), and could serve as a target of interventions designed to reduce craving and boost self-control.

Finally, our study may have implications for measuring and manipulating social media desire. When collapsed across condition our data showed that a short, 15-minute period during which individuals listened to, but could not check social media notifications, increased their desire but did not change positive or negative affect. This relatively brief procedure may be

useful for future research interested in examining different aspects of social media desire, including its neural correlates and how desire unfolds across time (or with each successive notification). Future research could also explore whether changes in social media desire during the procedure capture meaningful individual differences that predict behavior outside the lab. Of course, improvements to the procedure (e.g., titrating the number of notifications to maximize desire) may also be required, but it does offer a potentially cost-effective and standardized way of eliciting social media desire.

Some Remaining Questions

Not all of our initial hypotheses were supported by the experimental findings. For instance, in Study 1, though the mindfulness condition had lower overall Facebook desire and less positive attitudes toward a Facebook advertisement than the unfocused attention condition, there was no difference in state reward simulations across these two conditions. There are at least two possible reasons for this. First, since Facebook desire was not very high overall ($M = 3.22$, 4.28 , and 3.41 across T1, T2, and T3, respectively, on a 0 to 10 scale), it is possible that the intensity of reward simulations may have also been blunted (i.e., these suffered from floor effects). Second, the unfocused attention induction specifically encouraged participants to allow their minds to wander and may have thus offered them a partial distraction from Facebook or a type of relaxation (see also, Collins et al., 2016).

Relatedly, in both studies the conditions did not differ on immediate post-induction assessments of state decentering. Again, there are several possible explanations. Recall that our measures of state decentering exhibited unacceptably low reliability ($\alpha = .27$) for participants in the mindfulness condition in Study 1. Moreover, state decentering did not demonstrate clear evidence of construct validity: In Study 1 it was uncorrelated with both state reward simulations

and Facebook desire, and in Study 2, it was positively correlated with both. These results contradict theories of decentering and other empirical research that has shown negative associations between decentering and desire suggesting that our measure may not have adequately assessed the decentering construct (Baquedano et al., 2017; Lacaille et al., 2014). We note that multiple other mindful decentering induction/training studies did not include measures of state decentering (Bowen & Marlatt, 2009; Forman et al., 2007; Lebois et al., 2015; Papies et al., 2012; Papies et al., 2015; Tincher et al., 2015), so it is not entirely clear whether the measures we created for the current study were inappropriate. Likewise, even more intensive mindfulness training programs do not always produce improvements in self-reported mindfulness despite improvements in other self-control-related outcomes (e.g., Garrison et al., in press). Future research will be required to advance the measurement of decentering, especially in the context of mindfulness training to support self-control.

Beyond measurement issues, it is also possible that the lack of group differences on state decentering may have had something to do with the experimental induction instructions. The self-immersed training was carefully designed to give participants the “flavor” of mindfulness, without including the theoretically-active message—that is, observing thoughts, emotions, and urges as temporary mental events. The self-immersed instructions purposefully conveyed to participants the value of savoring experience, which interestingly, has been shown to induce mindful states (Arch et al., 2016). It is therefore possible that in addition to inducing greater immersion in reward simulations triggered by notification sounds, the self-immersed instructions also induced a level of moment-to-moment attentiveness toward experience that might not have otherwise existed.

Limitations and Future Directions

This study has several limitations that suggest directions for future research. Our study was primarily focused on understanding individuals' experience of social media desire and so we relied on straightforward self-report assessments thereof. Though desire is considered a conscious experience (Hofmann & Van Dillen, 2012; Kavanagh et al., 2005) and therefore readily measured by self-report surveys (Hofmann et al., 2009; May, Andrade, et al., 2014; Sayette et al., 2000), desire is also characterized by automatically triggered behavioral impulses. Future studies might incorporate measures of these reactive impulses to assess whether reward simulations strengthen automatic response tendencies in addition to consciously-experienced desire. Likewise, combining implicit measures with self-report measures would help parse the effect of mindfulness on the entire desire generation process (Papies et al., 2012).

Another limitation is the potential for demand characteristics in these studies. For example, the explicit questioning about reward simulation, desire, and affect throughout the procedure may have influenced how participants responded to the experimental inductions. Though it may not be possible to fully rule out demand characteristics, there are several important factors that mitigate their influence on the results. First, participants were invited to participate in a study about what makes social media content “go viral,” not social media desire or learning ways to control their desires. Second, the terms “mindfulness” and “meditation” were never used in the experiment. Third, the participants were not aware that the experiment was testing the effect of different interventions, and the experimenters were blinded to participants' condition. Fourth, the inclusion of a behavioral measure of self-control in Study 2 helped guard against systematic biased reporting; likewise, the observation of a moderation effect whereby Facebook desire predicted self-control in the self-immersed condition but not the mindfulness condition is hard to explain as solely the result of demand characteristics. Fifth, results of a post

hoc reanalysis that excluded participants who reported the study was about consciously regulating desires (in the open-ended suspicion probe) were nearly identical to those using the full sample. (It is worth noting that more individuals in the mindfulness condition were excluded based on this criterion than individuals in the other conditions, suggesting that the follow-up analysis was conservative against the mindfulness condition.)

There are two additional design limitations. First, in Study 1, a majority (66%) of participants answered “no” to the debriefing question “Are you confident this app posted your status update to Facebook?” (response options: yes or no). Though this was surprising, it was balanced by the fact that only a small fraction of participants ($n = 4$) explicitly endorsed this view in the open-ended suspicion probe. Of course, participants may have underreported their suspicion in the open-ended probe to avoid a perceived penalty (Orne, 2009), but we find little reason to suspect underreporting would have differed systematically across experimental conditions. Evidence for this is that the confidence rating (yes/no) did not differ significantly by condition, nor did it moderate the effect of condition on any observed results. Participants’ low confidence may have been due to the high number of notification sounds they received in Study 1 (26 dings), but which were substantially reduced in Study 2 (9 dings). Moreover, the use of a dichotomous, rather than a continuous confidence rating scale (Bostyn, Sevenhant, & Roets, in press), may have artificially inflated participants’ skepticism. The dichotomous rating scale only provided a strong test of confidence among participants who responded “yes.” “No” responses would have included participants with no confidence and those with some (but not total) confidence. It is also possible that simply asking participants the question at the end of the experiment aroused suspicion that would not have otherwise existed. The low confidence ratings

do not pose any obvious threat to the internal validity of participants' ratings on the Facebook advertisement, since this had nothing to do with their own status updates.

The second design limitation is that to maximize statistical power, in Study 2, we compared mindfulness only to a self-immersed condition (see also, Baquedano et al., 2017; Kross, Ayduk, & Mischel, 2005; Kross, Duckworth, Ayduk, Tsukayama, & Mischel, 2011; Lebois et al., 2015; Papies et al., 2012; Papies et al., 2015; Tincher et al., 2015). As such, it is not possible to determine whether mindfulness boosted self-control, self-immersed impaired self-control, or both. Results from Study 1 suggest that those in the mindfulness condition reported lower desire and less positive attitudes toward a Facebook advertisement compared to an unfocused attention condition, providing evidence that mindfulness in fact reduced desire. Moreover, it is important to remember that the inductions were used primarily to test theoretical pathways about the ways in which different cognitive orientations toward experience may alter desire, and not about testing the efficacy of mindfulness training on self-control (i.e., the study was not framed or designed to “improve” students' performance). Research on mindfulness often describes two main orientations toward experience—a conceptually-driven, self-immersed perspective and a mindful perspective (Brewer et al., 2011; Brown & Ryan, 2003; Brown et al., 2007; Creswell, 2017)—so these were also the focus of the current experiments. That said, to the extent that mindfulness interrupts reward simulations that exacerbate desire and impair self-control, future intervention research can test this possibility against inert and active control trainings (e.g., cognitive reappraisal).

Conclusion

The current research represents an initial step forward in understanding how social media desire emerges, intensifies, and can be altered. The results suggest that exposure to social media

notifications increases desire, and that engaging in elaborative fantasies about the positive implications of those notifications further strengthens this desire. Results also suggest that mindful observation of the natural ebb and flow of desire-related thoughts, emotions, and urges interrupts elaborative fantasies, thereby reducing desire. This research paves the way for the creation of new interventions to help students manage unwanted social media desire in their everyday lives.

References

- Alter, A. L. (2017). *Irresistible: The rise of addictive technology and the business of keeping us hooked*. New York, NY: Penguin Press.
- American Psychological Association. (2017). *Stress in America: Coping with change, part 2: Technology and social media*. Retrieved from <http://www.apa.org/news/press/releases/stress/2017/technology-social-media.PDF>
- Analayo. (2003). *Satipatthana: The direct path to realization*. Birmingham: Windhorse.
- Analayo. (2009). *From craving to liberation: Excursions into the thought-world of the Pali discourses*. New York: The Buddhist Association.
- Arch, J. J., Brown, K. W., Goodman, R. J., Della Porta, M. D., Kiken, L. G., & Tillman, S. (2016). Enjoying food without caloric cost: The impact of brief mindfulness on laboratory eating outcomes. *Behaviour Research and Therapy*, 79, 23-34.
doi:<http://dx.doi.org/10.1016/j.brat.2016.02.002>
- Arch, J. J., & Craske, M. G. (2006). Mechanisms of mindfulness: Emotion regulation following a focused breathing induction. *Behaviour Research and Therapy*, 44(12), 1849-1858.
- Baquedano, C., Vergara, R., Lopez, V., Fabar, C., Cosmelli, D., & Lutz, A. (2017). Compared to self-immersion, mindful attention reduces salivation and automatic food bias. *Scientific Reports*, 7(1), 13839. doi:10.1038/s41598-017-13662-z
- Bernstein, A., Hadash, Y., Lichtash, Y., Tanay, G., Shepherd, K., & Fresco, D. M. (2015). Decentering and Related Constructs: A Critical Review and Metacognitive Processes Model. *Perspectives on Psychological Science*, 10(5), 599-617.
doi:10.1177/1745691615594577

- Berridge, K. C., & Robinson, T. E. (2016). Liking, wanting, and the incentive-sensitization theory of addiction. *American Psychologist*, 71(8), 670-679.
doi:<http://dx.doi.org/10.1037/amp0000059>
- Bishop, S. R., Lau, M., Shapiro, S. L., Carlson, L. E., Anderson, N. D., Carmody, J., . . . Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, 11(3), 230-241.
- Bodhi, B. (2011). What does mindfulness really mean? A canonical perspective. *Contemporary Buddhism*, 12, 19-39.
- Bostyn, D. H., Sevenhant, S., & Roets, A. (in press). Of mice, men, and trolleys: Hypothetical judgment versus real-life behavior in trolley-style moral dilemmas. *Psychological Science*. doi:10.1177/0956797617752640
- Bowen, S. (Producer). (n.d.). Urge surfing. Retrieved from
<http://depts.washington.edu/abrc/mbrp/recordings/Urges%20Surfing.mp3>
- Bowen, S., Chawla, N., Collins, S. E., Witkiewitz, K., Hsu, S., Grow, J., . . . Marlatt, A. (2009). Mindfulness-based relapse prevention for substance use disorders: A pilot efficacy trial. *Substance Abuse*, 30(4), 295-305.
- Bowen, S., & Marlatt, A. (2009). Surfing the urge: Brief mindfulness-based intervention for college student smokers. *Psychology of Addictive Behaviors*, 23(4), 666-671.
- Brewer, J. A., Worhunsky, P. D., Gray, J. R., Tang, Y.-Y., Weber, J., & Kober, H. (2011). Meditation experience is associated with differences in default mode network activity and connectivity. *Proceedings of the National Academy of Sciences*.
doi:10.1073/pnas.1112029108

- Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, 84, 822-848.
- Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, 18, 211 - 237.
- Caselli, G., Ferla, M., Mezzaluna, C., Rovetto, F., & Spada, M. M. (2012). Desire Thinking across the Continuum of Drinking Behaviour. *European Addiction Research*, 18(2), 64-69.
- Caselli, G., Gemelli, A., Spada, M. M., & Wells, A. (2016). Experimental modification of perspective on thoughts and metacognitive beliefs in alcohol use disorder. *Psychiatry Research*, 244, 57-61. doi:<https://doi.org/10.1016/j.psychres.2016.07.029>
- Caselli, G., Nikcevic, A., Fiore, F., Mezzaluna, C., & Spada, M. M. (2012). Desire thinking across the continuum of nicotine dependence. *Addiction Research & Theory*, 20(5), 382-388. doi:10.3109/16066359.2011.644842
- Chambers, R., Gullone, E., & Allen, N. B. (2009). Mindful emotion regulation: An integrative review. *Clinical Psychology Review*, 29, 560-572.
- Cheever, N. A., Rosen, L. D., Carrier, L. M., & Chavez, A. (2014). Out of sight is not out of mind: The impact of restricting wireless mobile device use on anxiety levels among low, moderate and high users. *Computers in Human Behavior*, 37, 290-297.
doi:<https://doi.org/10.1016/j.chb.2014.05.002>
- Collins, K. R. L., Best, I., Stritzke, W. G. K., & Page, A. C. (2016). Mindfulness and zest for life buffer the negative effects of experimentally-induced perceived burdensomeness and thwarted belongingness: Implications for theories of suicide. *Journal of Abnormal Psychology*, 125(5), 704-714. doi:10.1037/abn0000167

Creswell, J. D. (2017). Mindfulness interventions. *Annual Review of Psychology*, 68, 491-516.

doi:doi:10.1146/annurev-psych-042716-051139

Elwafi, H. M., Witkiewitz, K., Mallik, S., Thornhill, T. A., & Brewer, J. A. (2012). Mindfulness training for smoking cessation: Moderation of the relationship between craving and cigarette use. *Drug and Alcohol Dependence*, 130, 222-229.

Enkema, M. C., & Bowen, S. (2017). Mindfulness practice moderates the relationship between craving and substance use in a clinical sample. *Drug Alcohol Depend*, 179, 1-17.

doi:10.1016/j.drugalcdep.2017.05.036

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175-191.

Feldman, G., Greeson, J., & Senville, J. (2010). Differential effects of mindful breathing, progressive muscle relaxation, and loving-kindness meditation on decentering and negative reactions to repetitive thoughts. *Behaviour Research and Therapy*, 48(10), 1002-1011. doi:<http://dx.doi.org/10.1016/j.brat.2010.06.006>

Fernie, B. A., Caselli, G., Giustina, L., Donato, G., Marcotriggiani, A., & Spada, M. M. (2014). Desire thinking as a predictor of gambling. *Addictive Behaviors*, 39(4), 793-796.

doi:<https://doi.org/10.1016/j.addbeh.2014.01.010>

Forman, E. M., Hoffman, K. L., Juarascio, A. S., Butryn, M. L., & Herbert, J. D. (2013).

Comparison of acceptance-based and standard cognitive-based coping strategies for craving sweets in overweight and obese women. *Eating Behaviors*, 14, 64-68.

doi:10.1016/j.eatbeh.2012.10.016

- Forman, E. M., Hoffman, K. L., McGrath, K. B., Herbert, J. D., Brandsma, L. L., & Lowe, M. R. (2007). A comparison of acceptance- and control-based strategies for coping with food cravings: An analog study. *Behaviour Research and Therapy*, 45, 2372-2386.
doi:10.1016/j.brat.2007.04.004
- Fraundorf, S. H. (2017). Data processing for Academic Diligence Task [computer software]. Retrieved from <https://github.com/sfraundorf/ADT>
- Galla, B. M., Kaiser-Greenland, S., & Black, D. S. (2016). Mindfulness training to promote self-regulation in youth: Effects of the Inner Kids program. In A. K. Schonert-Reichl & W. R. Roeser (Eds.), *Handbook of Mindfulness in Education: Integrating Theory and Research into Practice* (pp. 295-311). New York, NY: Springer.
- Galla, B. M., Plummer, B. D., White, R. E., Meketon, D., D'Mello, S. K., & Duckworth, A. L. (2014). The Academic Diligence Task (ADT): Assessing individual differences in effort on tedious but important schoolwork. *Contemporary Educational Psychology*, 39, 314-325. doi:10.1016/j.cedpsych.2014.08.001
- Garrison, K. A., Pal, P., O'Malley, S. S., Pittman, B. P., Gueorguieva, R., Rojiani, R., . . . Brewer, J. A. (in press). Craving to Quit: A randomized controlled trial of smartphone app-based mindfulness training for smoking cessation. *Nicotine & Tobacco Research*.
doi:10.1093/ntr/nty126
- Grabovac, A. D., Lau, M. A., & Willett, B. R. (2011). Mechanisms of mindfulness: A Buddhist psychological model. *Mindfulness*. doi:10.1007/s12671-011-0054-5
- Hamilton, J., Fawson, S., May, J., Andrade, J., & Kavanagh, D. J. (2013). Brief guided imagery and body scanning interventions reduce food cravings. *Appetite*, 71, 158-162.
doi:<http://dx.doi.org/10.1016/j.appet.2013.08.005>

- Harris, T. (May 19, 2016). How technology hijacks people's minds—from a magician and Google's design ethicist. Retrieved from <http://www.tristanharris.com/2016/05/how-technology-hijacks-peoples-minds%E2%80%8A-%E2%80%8Afrom-a-magician-and-googles-design-ethicist/>
- Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., & Lillis, J. (2006). Acceptance and Commitment Therapy: Model, processes and outcomes. *Behaviour Research and Therapy*, 44(1), 1-25. doi:<https://doi.org/10.1016/j.brat.2005.06.006>
- Heatherton, T. F., & Wagner, D. D. (2011). Cognitive neuroscience of self-regulation failure. *Trends in Cognitive Science*, 15(3), 132-139.
- Hofmann, W., Friese, M., & Strack, F. (2009). Impulse and self-control from a dual-systems perspective. *Perspectives on Psychological Science*, 4, 462-479.
- Hofmann, W., & Van Dillen, L. (2012). Desire: The new hotspot in self-control research. *Current Directions in Psychological Science*, 21, 317-322.
- Hofmann, W., Vohs, K. D., & Baumeister, R. F. (2012). What people desire, feel conflicted about, and try to resist in everyday life. *Psychological Science*, 23, 582-588.
- Kang, Y., Gruber, J., & Gray, J. R. (2013). Mindfulness and de-automatization. *Emotion Review*, 5(2), 192-201. doi:10.1177/1754073912451629
- Kavanagh, D. J., Andrade, J., & May, J. (2005). Imaginary relish and exquisite torture: The elaborated intrusion theory of desire. *Psychological Review*, 112(2), 446-467. doi:10.1037/0033-295X.112.2.446
- Kotabe, H., & Hofmann, W. (2015). On integrating the components of self-control. *Perspectives on Psychological Science*, 10, 618-638.

- Kross, E., & Ayduk, O. (2017). Chapter Two - Self-Distancing: Theory, Research, and Current Directions. In J. M. Olson (Ed.), *Advances in Experimental Social Psychology* (Vol. 55, pp. 81-136): Academic Press.
- Kross, E., Ayduk, O., & Mischel, W. (2005). When asking "why" does not hurt: Distinguishing rumination from reflective processing of negative emotions. *Psychological Science*, 16(9), 709-715.
- Kross, E., Duckworth, A., Ayduk, O., Tsukayama, E., & Mischel, W. (2011). The effect of self-distancing on adaptive versus maladaptive self-reflection in children. *Emotion*, 11(5), 1032-1039. doi:10.1037/a0021787
- Lacaille, J., Ly, J., Zacchia, N., Bourkas, S., Glaser, E., & Knauper, B. (2014). The effects of three mindfulness skills on chocolate cravings. *Appetite*, 76, 101-112. doi:10.1016/j.appet.2014.01.072
- Lebois, L. A. M., Papies, E. K., Gopinath, K., Cabanban, R., Quigley, K. S., Krishnamurthy, V., . . . Barsalou, L. W. (2015). A shift in perspective: Decentering through mindful attention to imagined stressful events. *Neuropsychologia*, 75, 505-524. doi:<http://dx.doi.org/10.1016/j.neuropsychologia.2015.05.030>
- Lutz, A., Jha, A. P., Dunne, J. D., & Saron, C. D. (2015). Investigating the phenomenological matrix of mindfulness-related practices from a neurocognitive perspective. *American Psychologist*, 70(7), 632-658. doi:10.1037/a0039585
- Mackinnon, A., Jorm, A. F., Christensen, H., Korten, A. E., Jacomb, P. A., & Rodgers, B. (1999). A short form of the Positive and Negative Affect Schedule: evaluation of factorial validity and invariance across demographic variables in a community sample. *Personality and Individual Differences*, 27(3), 405-416. doi:10.1016/S0191-8869(98)00251-7

- Martino, F., Caselli, G., Felicetti, F., Rampioni, M., Romanelli, P., Troiani, L., . . . Spada, M. M. (2017). Desire thinking as a predictor of craving and binge drinking: A longitudinal study. *Addictive Behaviors*, *64*, 118-122.
doi:<http://dx.doi.org/10.1016/j.addbeh.2016.08.046>
- May, J., Andrade, J., Batey, H., Berry, L. M., & Kavanagh, D. J. (2010). Less food for thought. Impact of attentional instructions on intrusive thoughts about snack foods. *Appetite*, *55*, 279-287. doi:10.1016/j.appet.2010.06.014
- May, J., Andrade, J., Kavanagh, D. J., Feeney, G. F. X., Gullo, M. J., Statham, D. J., . . . Connor, J. P. (2014). The Craving Experience Questionnaire: A brief, theory-based measure of consummatory desire and craving. *Addiction*, *109*(5), 728-735. doi:10.1111/add.12472
- May, J., Andrade, J., Willoughby, K., & Brown, C. (2012). An Attentional Control Task Reduces Intrusive Thoughts About Smoking. *Nicotine & Tobacco Research*, *14*(4), 472-478.
doi:10.1093/ntr/ntr238
- May, J., Kavanagh, D. J., & Andrade, J. (2014). The elaborated intrusion theory of desire: A 10-year retrospective and implications for addiction treatments. *Addictive Behaviors*(0).
doi:<http://dx.doi.org/10.1016/j.addbeh.2014.09.016>
- Mischel, W., & Baker, N. (1975). Cognitive appraisals and transformations in delay behavior. *Journal of Personality and Social Psychology*, *31*(2), 254-261.
- Orne, M. T. (2009). Demand characteristics and the concept of quasicontrols. In R. Rosenthal & R. L. Rosnow (Eds.), *Artifacts in behavioral research: Robert Rosenthal and Ralph L. Rosnow's classic books* (pp. 110-137). New York, NY: Oxford University Press.

- Ostafin, B. D., Bauer, D. J., & Myxter, P. (2012). Mindfulness decouples the relation between automatic alcohol motivation and heavy drinking. *Journal of Social and Clinical Psychology, 31*, 729-745.
- Ostafin, B. D., & Marlatt, G. A. (2008). Surfing the urge: Experiential acceptance moderates the relation between automatic alcohol motivation and hazardous drinking. *Journal of Social and Clinical Psychology, 27*, 426-440.
- Papies, E. (2013). Tempting food words activate eating simulations. *Frontiers in Psychology, 4*(838). doi:10.3389/fpsyg.2013.00838
- Papies, E. K., & Barsalou, L. W. (2015). Grounding desire and motivated behavior: A theoretical framework and review of empirical evidence. In W. Hofmann & L. F. Nordgren (Eds.), *The Psychology of Desire* (pp. 36-60). New York: Guilford.
- Papies, E. K., Barsalou, L. W., & Custers, R. (2012). Mindful attention prevents mindless impulses. *Social Psychological and Personality Science, 3*, 291-299.
doi:10.1177/1948550611419031
- Papies, E. K., Pronk, T. M., Keesman, M., & Barsalou, L. W. (2015). The benefits of simply observing: Mindful attention modulates the link between motivation and behavior. *Journal of Personality and Social Psychology, 108*, 148-170. doi:10.1037/a0038032
- Pew Research Center. (March 1, 2018). *Social media use in 2018*. Retrieved from http://assets.pewresearch.org/wp-content/uploads/sites/14/2018/03/01105133/PI_2018.03.01_Social-Media_FINAL.pdf
- Preacher, K. J. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford Press.

- Ravizza, S. M., Uitvlugt, M. G., & Fenn, K. M. (2016). Logged In and Zoned Out. *Psychological Science*. doi:10.1177/0956797616677314
- Read, D., & Loewenstein, G. (1999). Enduring pain for money: Decisions based on the perception and memory of pain. *Journal of Behavioral Decision Making*, 12(1), 1-17.
- Rosen, L. D., Carrier, L. M., & Cheever, N. A. (2013). Facebook and texting made me do it: Media-induced task-switching while studying. *Computers in Human Behavior*, 29, 948-958. doi:10.1016/j.chb.2012.12.001
- Sayette, M. A., Loewenstein, G., Griffin, K. M., & Black, J. J. (2008). Exploring the cold-to-hot empathy gap in smokers. *Psychological Science*, 19(9), 926-932.
- Sayette, M. A., Shiffman, S., Tiffany, S. T., Niaura, R. S., Martin, C. S., & Shadel, W. G. (2000). The measurement of drug craving. *Addiction*, 95, S189-S210.
- Schumacher, S., Kemps, E., & Tiggemann, M. (2017). Acceptance- and imagery-based strategies can reduce chocolate cravings: A test of the elaborated-intrusion theory of desire. *Appetite*, 113, 63-70. doi:<http://dx.doi.org/10.1016/j.appet.2017.02.012>
- Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology*, 62(3), 373-386.
- Sherman, L. E., Payton, A. A., Hernandez, L. M., Greenfield, P. M., & Dapretto, M. (2016). The Power of the Like in Adolescence: Effects of Peer Influence on Neural and Behavioral Responses to Social Media. *Psychological Science*, 27(7), 1027-1035. doi:10.1177/0956797616645673
- Spada, M. M., Caselli, G., Slaifer, M., Nikčević, A. V., & Sassaroli, S. (2014). Desire Thinking as a Predictor of Problematic Internet Use. *Social Science Computer Review*, 32(4), 474-483. doi:10.1177/0894439313511318

- Tincher, M. M., Lebois, L. A., & Barsalou, L. W. (2015). Mindful attention reduces linguistic intergroup bias. *Mindfulness*.
- Van Dam, N. T., van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., . . . Meyer, D. E. (2018). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science, 13*, 36-61. doi:10.1177/1745691617709589
- Walsh, S. P., White, K. M., & Young, R. M. (2008). Over-connected? A qualitative exploration of the relationship between Australian youth and their mobile phones. *Journal of Adolescence, 31*(1), 77-92. doi:<https://doi.org/10.1016/j.adolescence.2007.04.004>
- Winnick, M. (June 16, 2006). Mobile touches: a study on humans and their tech. Retrieved from <https://blog.dscout.com/mobile-touches>

Table 1
Experimental Condition Estimated Means and 95% Confidence Intervals in Study 1

	Time 1 (baseline)			Time 2 (after experimental inductions)			Time 3 (after Facebook advertisement)		
	Mindfulness	Self-Immersed	Unfocused Attention	Mindfulness	Self-Immersed	Unfocused Attention	Mindfulness	Self-Immersed	Unfocused Attention
	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]
Primary Dependent Variables									
Facebook Desire	2.83 [2.02, 3.63]	3.54 [2.71, 4.37]	3.30 [2.49, 4.11]	3.30 [2.44, 4.16]	4.95 [4.06, 5.84]	4.59 [3.73, 5.46]	2.34 [1.58, 3.10]	4.25 [3.47, 5.03]	3.65 [2.89, 4.41]
Advertisement Like	--	--	--	--	--	--	5.74 [4.95, 6.54]	7.00 [6.18, 7.82]	6.01 [5.21, 6.81]
Advertisement Want	--	--	--	--	--	--	2.81 [2.04, 3.59]	4.70 [3.90, 5.49]	3.94 [3.17, 4.72]
Process Variables									
State Reward Simulation	--	--	--	3.38 [2.53, 4.24]	5.68 [4.80, 6.56]	3.86 [3.00, 4.72]	--	--	--
State Decentering	--	--	--	4.69 [3.91, 5.47]	5.07 [4.27, 5.87]	3.98 [3.21, 4.76]	--	--	--
Affect Variables									
Positive Affect	2.12 [1.85, 2.39]	2.12 [1.84, 2.40]	2.26 [1.99, 2.53]	1.94 [1.69, 2.19]	2.30 [2.04, 2.55]	2.20 [1.95, 2.44]	--	--	--
Negative Affect	1.55 [1.35, 1.76]	1.74 [1.53, 1.95]	1.81 [1.60, 2.01]	1.47 [1.24, 1.69]	1.74 [1.50, 1.97]	1.73 [1.50, 1.95]	--	--	--

Notes: Means (*M*) and 95% Confidence Interval (CI) are adjusted for covariates (number of Facebook friends, frequency of posting to Facebook) that showed significant ($p < .05$) baseline differences across condition.

Table 2

Experimental Condition Estimated Means and 95% Confidence Intervals (CI) in Study 2

	Time 1		Time 2		Time 3	
	(baseline)		(after experimental inductions)		(during/after Academic Diligence Task)	
	Mindfulness	Self-Immersed	Mindfulness	Self-Immersed	Mindfulness	Self-Immersed
	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]	<i>M</i> [95% CI]
Primary Dependent Variable						
Facebook Desire	2.61 [2.01, 3.21]	2.69 [2.07, 3.30]	3.62 [2.94, 4.30]	4.55 [3.85, 5.25]	1.69 [1.12, 2.25]	2.54 [1.96, 3.12]
Academic Diligence Task Variables						
Time on Task [†]	--	--	--	--	95.17%	85.16%
Productivity	--	--	--	--	37.88 [34.72, 41.03]	35.70 [32.46, 38.93]
Number of Switches [†]	--	--	--	--	0.46	1.61
Boredom	--	--	--	--	6.79 [6.12, 7.46]	6.48 [5.80, 7.17]
Temptation	--	--	--	--	2.82 [2.15, 3.49]	4.27 [3.59, 4.96]
Process Variables						
State Reward Simulation	--	--	3.70 [3.11, 4.28]	5.09 [4.50, 5.68]	--	--
State Decentering	--	--	5.78 [5.20, 6.35]	5.48 [4.90, 6.06]	--	--
Affect Variables						
Positive Affect	2.11 [1.93, 2.30]	2.05 [1.87, 2.24]	2.07 [1.87, 2.26]	2.14 [1.94, 2.34]	--	--
Negative Affect	1.53 [1.36, 1.70]	1.55 [1.38, 1.73]	1.42 [1.25, 1.60]	1.61 [1.43, 1.79]	--	--

Notes: Means (*M*) and 95% Confidence Interval (CI) are adjusted for covariates (Facebook enjoyment) that showed significant ($p < .05$) baseline differences across condition. [†] Unadjusted observed means are presented.

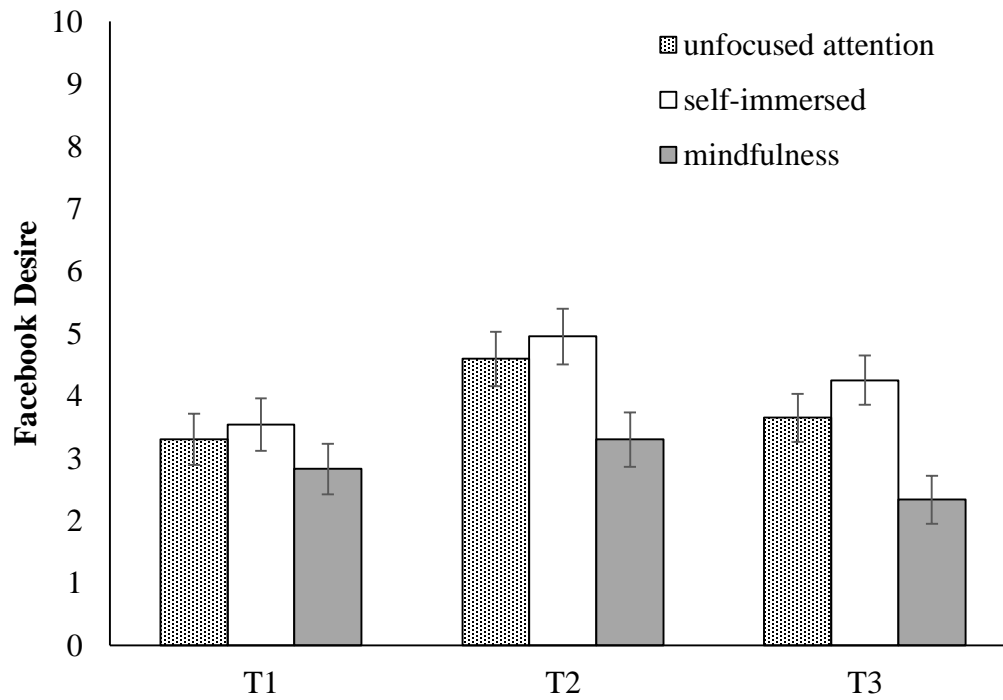


Figure 1. Study 1. Change in Facebook desire across the three assessments by condition. Error bars represent +/- 1 standard error.

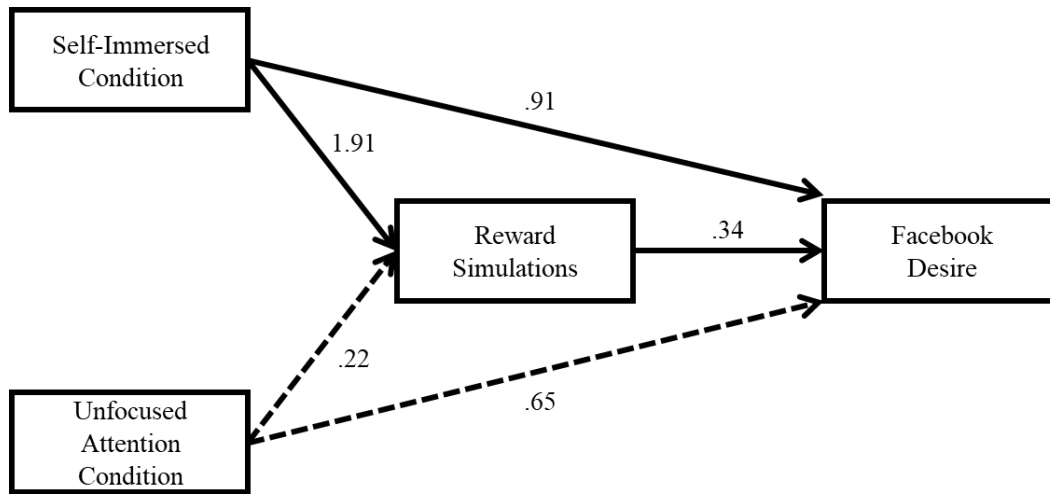


Figure 2. Study 1. The effect of condition on Facebook desire averaged across T2 and T3 is partially mediated by reward simulation. The coefficients shown are unstandardized. Condition effects are relative to mindfulness (dummy coded as 0). Solid lines are significant at $p < .05$; dashed lines are not statistically significant. Models adjusted for covariates (number of Facebook friends, frequency of posting to Facebook) that showed significant ($p < .05$) baseline differences across condition, and T1 Facebook desire.

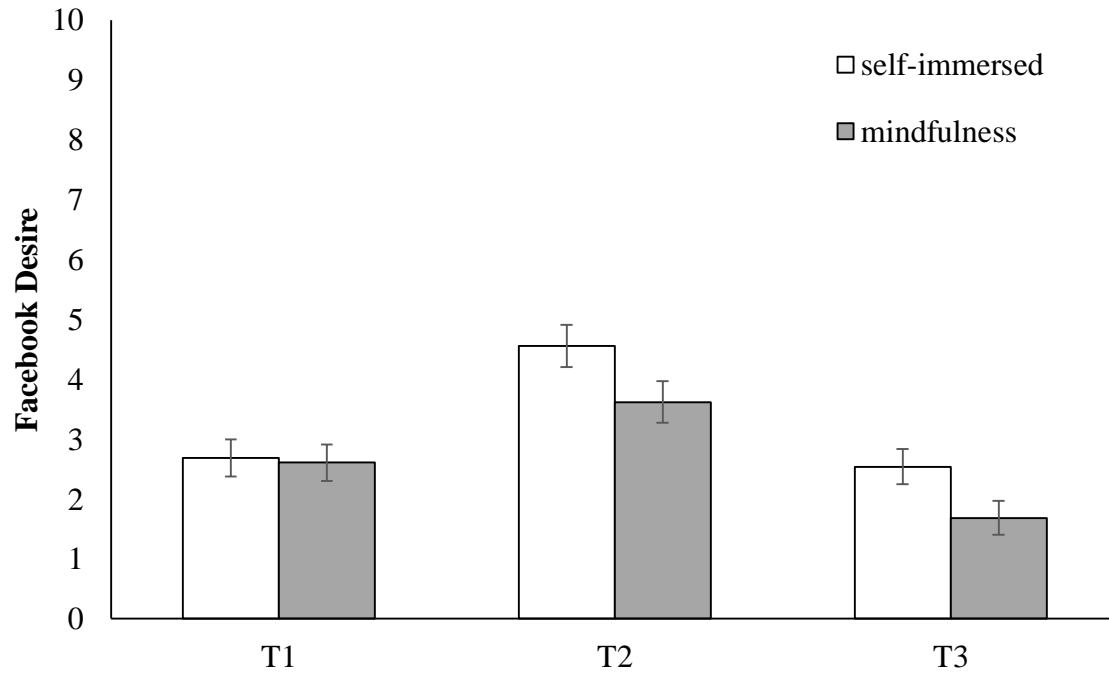


Figure 3. Study 2. Change in Facebook desire across the three assessments by condition. Error bars represent +/- 1 standard error.

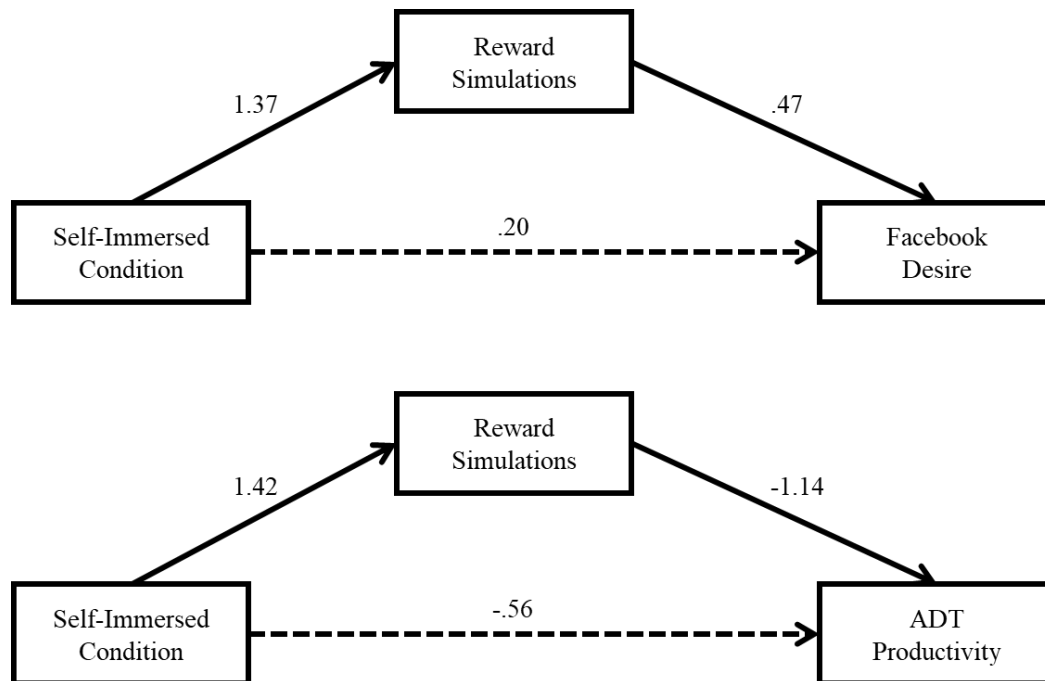


Figure 4. Study 2. The effect of condition on Facebook desire averaged across T2 and T3 (upper panel) and number of algebra problems solved (lower panel) is partially mediated by reward simulation. The coefficients shown are unstandardized. Condition effects are relative to mindfulness (dummy coded as 0). Solid lines are significant at $p < .05$; dashed lines are not statistically significant. Models are adjusted for covariates (Facebook enjoyment) that showed significant ($p < .05$) baseline differences across condition, and (for upper panel only) T1 Facebook desire. ADT = Academic Diligence Task.

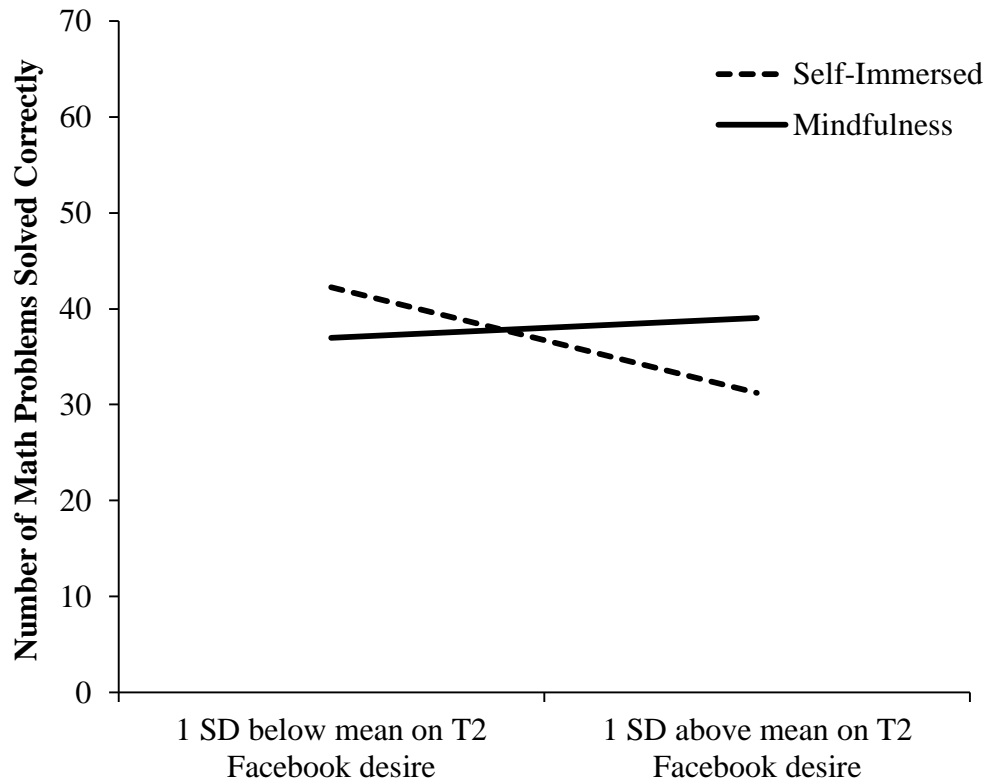


Figure 5. Study 2. Condition moderates the association between T2 Facebook desire and number of algebra problems solved correctly on the Academic Diligence Task. Models are adjusted for covariates (Facebook enjoyment) that showed significant ($p < .05$) baseline differences across condition and T1 Facebook desire.

Social Media Desire and Impulsiveness: Intensified by Self-Immersion, Reduced by Mindfulness

Supplemental Material

The supplemental material includes:

1. Results of a post hoc reanalysis of data from Study 1 and 2. (All results reported as part of this reanalysis are considered exploratory.)
2. Results of a reanalysis of Study 2 using math problems attempted as another self-control outcome.
3. Scripts for audio recordings in Study 1.
4. Scripts for audio recordings in Study 2.

1. Results of a post hoc reanalysis of data from Study 1 and 2.

Coding of open-ended responses to suspicion probe. Two coders (second and third authors of the paper) were provided datasets containing participants' responses to the open-ended suspicion probe questions (condition assignment was not included in the datasets). Before coding responses, the two coders and the first author created a basic scoring system for identifying participants who may have indicated the study was about consciously regulating desires or urges (as indicated by the use of words, including "control," "cope," "resist," "self-control," "manage," "drop," "regulate"). The coding scheme was deliberately kept simple since this analysis was not even considered until after the data for both studies had been collected, and was thus entirely exploratory. In Study 1, coders agreed on 88.4% ($n = 107$ of 121) of responses, and in Study 2, coders agreed on 88.8% ($n = 111$ of 125) of responses. For any disagreements, the two coders and the first author met and resolved the final codes by having the two coders discuss reasons why they thought the response belonged to certain a category or not.

A similar procedure was used to identify participants who may have indicated the study was about consciously increasing desires or urges to social media. In Study 1, coders agreed on 98.3% ($n = 119$ of 121) of such responses, and in Study 2, coders agreed on 98.4% ($n = 123$ of 125) of responses.

In Study 1, 17 participants (of 123 total) were identified as having indicated the study was about consciously regulating desires or urges, and 1 was identified as having indicated the study was about increasing desires or urges. In Study 2, 18 participants (of 131 total) were identified as having indicated the study was about consciously regulating desires or urges, and 5 were identified as having indicated the study was about increasing desires or urges.

In Studies 1 and 2, individuals assigned to the mindfulness induction were more likely to report the study was about consciously regulating desires ($\chi^2(2) = 6.91, p = .032$; $\chi^2(1) = 8.27, p = .004$, respectively). In Study 1, individuals did not differ on reports that the study was about increasing desires ($\chi^2(2) = 2.04, p = .360$), but in Study 2, participants in the self-immersed induction were more likely to report the study was about increasing desires ($\chi^2(1) = 5.64, p = .018$).

Exclusion rates by condition. When excluding the participants who indicated the study was about consciously regulating or increasing desires (along with the other exclusion criteria

mentioned in the main text), the overall exclusion rates did not differ significantly across condition (Study 1: $\chi^2(2) = 5.04, p = .081$; Study 2: $\chi^2(1) = 2.63, p = .105$).

Post hoc reanalysis sample size. The post hoc reanalysis for Study 1 includes $N = 95$ participants ($n = 37$ unfocused attention; $n = 31$ self-immersed; $n = 27$ mindfulness). The post hoc reanalysis for Study 2 includes $N = 105$ participants ($n = 55$ self-immersed; $n = 50$ mindfulness).

Reanalysis of Study 1. The same T1 (baseline) variables (number of Facebook friends, frequency of updating Facebook status) mentioned in the main text, plus T1 Facebook enjoyment, showed statistically significant differences ($p < .05$) across condition. In ANOVA and regression analyses reported below, a single covariate comprised of the average of these three z -standardized variables was included.

Hypothesis 1: Does exposure to social media stimuli increase desire? This hypothesis was confirmed. Results revealed that Facebook desire (collapsed across conditions) increased from T1 ($M = 3.21, SD = 2.61$) to T2 ($M = 4.37, SD = 2.78$), $t(94) = -5.73, p < .001$. Positive and negative mood did not change significantly, $ps = .819$ and $.866$, respectively, suggesting that the waiting period selectively targeted desire.

Hypothesis 2: Do reward simulations boost social media desire? This hypothesis was also confirmed. T2 state reward simulations (collapsed across conditions) were positively correlated with T2 Facebook desire, $r(93) = .72, p < .001$. Desire was also associated with T2 positive and negative affect, $r(93) = .38$ and $.42, p < .001$, respectively. A simultaneous multiple regression with T1 Facebook desire as a covariate showed that state reward simulations, $b = 0.40, p < .001, 95\% \text{ CI } [0.25, 0.56]$, significantly predicted change in Facebook desire from T1 to T2, but positive affect, $b = -0.04, p = .859$, and negative affect, $b = 0.41, p = .125$, did not.

Hypothesis 3: Does mindfulness reduce social media desire and reward simulations?

Facebook desire. We fit a 3-by-3 repeated measures ANCOVA with condition (unfocused attention, self-immersed, mindfulness) as the between-subjects factor and time (T1, T2, T3) as the within-subjects factor to test the hypothesis that participants in the mindfulness condition would report less Facebook desire than participants in either the self-immersed or unfocused attention conditions. This analysis did not show a significant condition-by-time interaction effect, $F(4, 182) = 1.42, p = .231, \eta_p^2 = .030$. Follow-up pairwise comparisons indicated that participants in the mindfulness condition reported less Facebook desire than participants in both the self-immersed, $p = .052$, and unfocused attention, $p = .107$, conditions immediately after the experimental inductions (T2). Likewise, participants in the mindfulness condition reported less desire after watching the Facebook advertisement (T3) compared to self-immersed, $p = .007$, and unfocused attention, $p = .085$, conditions. Facebook desire did not differ across the self-immersed and unfocused attention conditions at T2, $p = .768$, or T3, $p = .326$.

As in the main text, we also fit a univariate ANCOVA with condition as a between-subjects predictor of Facebook desire, averaged across T2 and T3. In addition to the covariate described previously (standardized average of Facebook friends, frequency of Facebook posts, and Facebook enjoyment), we also included T1 Facebook desire as another covariate. This

analysis revealed a main effect of condition, $F(2, 90) = 3.45, p = .036, \eta_p^2 = .071$. Follow-up pairwise comparisons showed that participants in the mindfulness condition ($M = 3.33, 95\% \text{ CI } [2.71, 3.96]$) reported lower overall levels of Facebook desire compared to participants in the self-immersed ($M = 4.43, 95\% \text{ CI } [3.85, 5.00]$), $p = .011$, and unfocused attention ($M = 4.08, 95\% \text{ CI } [3.53, 4.62]$), $p = .089$, conditions. The self-immersed and unfocused attention conditions did not differ, $p = .392$.

State reward simulations and decentering. We fit a multivariate ANCOVA with T2 state reward simulations and decentering as the multivariate dependent variable to test the hypothesis participants in the mindfulness condition would report less intense reward simulations and greater decentering than participants in either the self-immersed or unfocused attention conditions. The multivariate effect of condition was significant, $F(4, 182) = 3.64, p = .007, \eta_p^2 = .074$. Separate between-subjects tests further showed a main effect of condition on state reward simulations, $F(2, 91) = 5.01, p = .009, \eta_p^2 = .099$, but not state decentering, $F(2, 91) = 2.42, p = .095, \eta_p^2 = .050$. Follow-up pairwise comparisons showed that participants in the self-immersed condition reported more reward simulations than participants in the mindfulness, $p = .005$, and unfocused attention, $p = .015$, conditions. The mindfulness and unfocused attention conditions did not differ, $p = .653$.

Hypothesis 4: Do reductions in reward simulations mediate the effect of mindfulness on social media desire? To test the hypothesis that state reward simulations (T2) mediated the effect of condition on Facebook desire, we conducted a bootstrapped indirect effect analysis with 5,000 samples using the PROCESS macro version 2.16.3 for SPSS (Preacher, 2013). Two separate dummy codes were created for the self-immersed and unfocused attention conditions with the mindfulness condition serving as the reference group. The dependent measure was overall Facebook desire, averaged across the T2 and T3 assessments. Baseline (T1) Facebook desire, in addition to the covariate described previously, were included as control variables.

Compared to the mindfulness condition, participants in the self-immersed condition reported more state reward simulations, that in turn predicted changes in Facebook desire, $b_{\text{indirect effect}} = 0.50, 95\% \text{ CI } [0.15, 1.08]$. In contrast, participants in the unfocused attention condition did not report more reward simulations compared to the mindfulness condition; consequently, no evidence for mediation was observed, $b_{\text{indirect effect}} = -0.01, 95\% \text{ CI } [-0.42, 0.34]$.

Ruling out an alternative explanation: Controlling for the association between positive affect and desire. Exploratory repeated measures ANCOVA showed a marginally significant condition-by-time interaction effect for changes in positive affect from T1 to T2, $F(2, 91) = 2.49, p = .089, \eta_p^2 = .052$. The condition-by-time interaction effect for negative affect was not significant, $F(2, 91) = 0.61, p = .547, \eta_p^2 = .013$.

To test the possibility that changes in positive affect explained the mediating effect of reward simulations on Facebook desire, we ran another indirect effect model, but with changes in positive affect (T2 minus T1 scores) as an additional covariate. Controlling for changes in positive affect (and covariate mentioned previously), results showed that the indirect effect of state reward simulations on Facebook desire was still significant in the comparison between the mindfulness and self-immersed conditions, $b_{\text{indirect effect}} = 0.40, 95\% \text{ CI } [.06, .96]$.

Hypothesis 5: Does mindfulness change attitudes toward a Facebook advertisement?

We fit a multivariate ANCOVA with condition as the between-subjects factor and T3 Facebook “liking” and “wanting” as the multivariate dependent variable to test the hypothesis participants in the mindfulness condition would report less positive attitudes toward a Facebook advertisement than participants in either the self-immersed or unfocused attention conditions. This analysis revealed a significant multivariate effect of condition, $F(4, 182) = 2.55, p = .041, \eta_p^2 = .053$. Separate between-subjects tests further showed a significant main effect of condition on wanting, $F(2, 91) = 4.31, p = .016, \eta_p^2 = .087$, and a marginal effect of liking, $F(2, 91) = 2.77, p = .068, \eta_p^2 = .057$. Follow-up pairwise comparisons showed that participants in the mindfulness condition reported that the advertisement made them want to check Facebook less than participants in the self-immersed, $p = .006$, and unfocused attention, $p = .031$, conditions. By contrast, participants’ liking of Facebook following the advertisement was similar across mindfulness and unfocused attention conditions, $p = .379$, and both reported less liking of Facebook compared to the self-immersed condition, $p = .023$ and $.154$, respectively.

Reanalysis of Study 2. As in the main text, T1 (baseline) Facebook enjoyment differed across condition ($p = .049$), so this was included as a covariate in ANOVA and regression models below.

Hypothesis 1: Does exposure to social media stimuli increase desire? This hypothesis was confirmed. Results revealed that Facebook desire (collapsed across conditions) increased from T1 ($M = 2.67, SD = 2.37$) to T2 ($M = 4.20, SD = 2.77$), $t(104) = -6.60, p < .001$. Positive and negative mood did not change significantly, $ps = .915$ and $.932$, respectively.

Hypothesis 2: Do reward simulations boost social media desire? This hypothesis was also confirmed. T2 state reward simulations (collapsed across conditions) were positively correlated with T2 Facebook desire, $r(103) = .70, p < .001$. Desire was also associated with T2 positive and negative affect, $r(103) = .38$ and $.47, p < .001$, respectively. A simultaneous multiple regression with T1 Facebook desire as a covariate showed that state reward simulations, $b = 0.57, p < .001, 95\% \text{ CI } [0.42, 0.72]$, significantly predicted change in Facebook desire from T1 to T2, as did negative affect, $b = 1.03, p < .001, 95\% \text{ CI } [.52, 1.54]$, but not positive affect, $b = 0.42, p = .085, 95\% \text{ CI } [-.06, .89]$.

Hypothesis 3: Does mindfulness reduce social media desire and reward simulations?

Facebook desire. A 3-by-3 repeated measures ANCOVA revealed a non-significant condition-by-time interaction effect, $F(2, 202) = 2.75, p = .066, \eta_p^2 = .026$. Follow-up pairwise comparisons revealed that participants in the mindfulness condition reported less Facebook desire than participants in the immersed condition at T2 and T3, $p = .105$ and $.096$, respectively, holding constant T1 Facebook enjoyment.

As in the main text, we also fit a univariate ANCOVA with condition as a between subjects predictor of Facebook desire, averaged across T2 and T3. In addition to the covariate (T1 Facebook enjoyment), we also included T1 Facebook desire as another covariate. This analysis revealed a main effect of condition, $F(1, 101) = 5.13, p = .026, \eta_p^2 = .048$. Participants in the mindfulness condition ($M = 2.77, 95\% \text{ CI } [2.22, 3.13]$) reported lower overall levels of

Facebook desire compared to participants in the self-immersed condition ($M = 3.64$, 95% CI [3.12, 4.16]).

State reward simulations and decentering. We fit a multivariate ANCOVA with T2 state reward simulations and decentering as the multivariate dependent variable to test the hypothesis participants in the mindfulness condition would report less intense reward simulations and greater decentering than participants in either the self-immersed or unfocused attention conditions. The multivariate effect of condition was significant, $F(2, 101) = 8.61$, $p < .001$, $\eta_p^2 = .146$. Separate between-subjects tests further showed a main effect of condition on state reward simulations, $F(1, 102) = 8.78$, $p = .004$, $\eta_p^2 = .079$, but not state decentering, $F(1, 102) = 0.71$, $p = .401$, $\eta_p^2 = .007$. Follow-up pairwise comparisons showed that participants in the self-immersed condition reported more reward simulations than participants in the mindfulness, $p < .004$, condition.

Hypothesis 4: Do reductions in reward simulations mediate the effect of mindfulness on social media desire? T2 state reward simulations mediated the relationship between condition and Facebook desire (averaged across time 2 and time 3), such that participants in the self-immersed condition reported more reward simulations, that in turn, predicted greater Facebook desire, $b_{\text{indirect effect}} = 0.70$, 95% CI [0.29, 1.29].

Ruling out an alternative explanation: Controlling for the association between changes in affect and desire. Exploratory repeated measures ANCOVA showed a significant condition-by-time interaction effect for changes in negative affect from T1 to T2, $F(1, 102) = 5.11$, $p = .026$, $\eta_p^2 = .048$, and positive affect, $F(1, 102) = 3.26$, $p = .074$, $\eta_p^2 = .031$.

To test the possibility that changes in positive and negative affect explained the mediating effect of reward simulations on Facebook desire, we ran additional indirect effect models, but with changes in positive and negative affect (T2 minus T1 scores) as additional covariates. Controlling for changes in positive and negative affect (and T1 Facebook enjoyment), results showed that the indirect effects on Facebook desire were still significant, $b_{\text{indirect effect}} = 0.41$, 95% CI [0.13, 0.82].

Hypothesis 5: Does mindfulness change self-control? To test the hypothesis that mindfulness would change academic self-control, we fit a logistic regression with condition (self-immersed = 0, mindfulness = 1) as a predictor of time on task (median split). T1 Facebook enjoyment was also included as a covariate, and robust standard errors were used to correct for deviations from normality. Participants in the mindfulness condition spent more time on the math skill-building task than participants in the immersed condition, $OR = 3.35$, $p = .004$, 95% CI [1.48, 7.59]. Compared to participants in the immersed condition, those in the mindfulness condition had 235% greater odds of spending more than the median amount of time solving the math problems, holding constant the covariate.

Likewise, negative binomial regression with robust standard errors showed that participants in the mindfulness condition ($M_{\text{unadjusted}} = 0.54$) made fewer switches between the math and videos compared to those in the self-immersed condition ($M_{\text{unadjusted}} = 1.48$) holding constant the covariate, incident rate ratio = 0.40, $p = .010$, 95% CI [0.20, 0.80]. Finally, multiple regression analysis showed that participants in the mindfulness condition ($M_{\text{unadjusted}} = 37.90$) solved more correct math problems than participants in the self-immersed condition ($M_{\text{unadjusted}} =$

35.69), but this difference did not reach statistical significance, $b = 1.30$, $SE = 2.53$, $p = .609$, 95% CI [-3.73, 6.33].

An indirect effect analysis with 5,000 bootstrapped samples showed that reward simulations also mediated the effect of mindfulness on ADT productivity, such that participants in the immersed condition reported more reward simulations, that in turn, predicted solving fewer math problems, $b_{\text{indirect effect}} = -1.62$, 95% CI [-4.38, -0.25].

Recall that participants also rated how boring it was to solve math problems and how tempted they felt by the videos immediately after completing the ADT. To test whether mindfulness influenced participants' subjective experience during the ADT, we fit a multivariate ANCOVA with condition as the between-subjects factor, T1 Facebook enjoyment as the covariate, and T3 ratings of boredom and temptation as the multivariate dependent variable. This analysis revealed a significant multivariate effect of condition, $F(2, 100) = 3.63$, $p = .030$, $\eta_p^2 = .068$. Separate between-subjects tests further showed a significant main effect of condition on temptation, $F(1, 101) = 5.37$, $p = .022$, $\eta_p^2 = .051$, but not on boredom, $F(1, 101) = 0.81$, $p = .371$, $\eta_p^2 = .008$. Participants in the mindfulness condition reported less temptation to watch videos during the ADT than participants in the immersed, but they did not differ in their ratings of boredom.

Exploratory hypothesis: Does mindfulness decouple the relationship between Facebook desire and academic self-control? To test the hypothesis that mindfulness would decouple the association between Facebook desire and self-control, we conducted a moderated regression analysis using the PROCESS macro version 2.16.3 for SPSS (Preacher, 2013). In this model, T2 Facebook desire was the independent variable, condition (0 = immersed, 1 = mindfulness) was the moderator, and ADT productivity was the dependent variable. We also included T1 Facebook desire and T1 Facebook enjoyment as covariates. This analysis revealed a significant T2 Facebook desire-by-condition interaction, $b = 2.43$, $p = .007$, 95% CI [0.68, 4.19]. A simple slope analysis demonstrated that T2 Facebook desire was a statistically significant predictor of ADT productivity among participants in the immersed condition, $b = -2.14$, $p = .002$, 95% CI [-3.47, -0.82], but not among participants in the mindfulness condition, $b = 0.29$, $p = .693$, 95% CI [-1.17, 1.75].

2. Results of a reanalysis of Study 2 using math problems attempted as another self-control outcome.

In addition to the number of algebra problems solved correctly (productivity), we also recorded the number of problems participants attempted. We included this metric of self-control to test whether individuals in the mindfulness condition attempted more problems, even if they did not correctly solve more problems, than individuals in the self-immersed condition.

This analysis was conducted using the full $N = 127$ sample. We note here that overall accuracy rates did not differ significantly by condition (mindfulness = 94%; self-immersed = 96%), $t(125) = 1.00$, $p = .319$.

Similar to the analysis for productivity, multiple regression analysis showed that participants in the mindfulness condition ($M_{\text{unadjusted}} = 40.57$) attempted more math problems than participants in the self-immersed condition ($M_{\text{unadjusted}} = 36.76$), but this difference did not reach statistical significance, $b = 3.18$, $SE = 2.29$, $p = .168$, 95% CI [-1.35, 7.71].

We also note that results of indirect effect analyses and moderation analyses using number of problems attempted revealed the same pattern of results as the analyses using number of problems solved correctly as the outcome (which were reported in the main text).

3. Scripts for audio recordings in Study 1.

Preamble for mindfulness and self-immersed conditions. While we wait for your Facebook notifications to build, we invite you to do an exercise for fifteen minutes. During this exercise, you will learn a new way of thinking about and approaching Facebook. We developed this approach by conducting research studies with college students like you on their social media use. Over the course of the next 15 minutes, you will try out this new approach with some guidance. Then you will apply it to a few situations. At the end of the study, we will ask you questions about your experience using this approach and your thoughts about Facebook more generally. Keep in mind, that throughout the next 15 minutes, you may hear notification sounds from your Facebook as your friends either “like” or “comment” on your recent status update. Instead of checking these immediately, however, we will use the notification sounds to help you practice this new approach. You will be able to check your notifications at the end of this study.

Preamble for unfocused attention condition. While you wait for your Facebook notifications to build, we invite you to do an exercise for fifteen minutes. Keep in mind, that throughout the next 15 minutes, you may hear notification sounds as your friends either “like” or “comment” on your recent status update. Instead of checking these notifications immediately, however, you will be able to check your notifications at the end of this study.

Mindfulness induction. This is a practice that invites us to relate differently to the experience of cravings or urges to use Facebook or engage in other types of reactive behavior. Often times we experience very strong cravings for social media, which may be accompanied by thoughts or urges to behave in a certain way. And if we are on an “automatic pilot mode,” which many of us often are in much of our lives, we are very vulnerable to reacting to these urges, trying to meet our needs, in ways that might not actually be very useful or helpful to us in the long term. So this is an exercise that will help us learn how to relate differently to experiences with Facebook.

So to begin, we invite you to gently close your eyes for the remainder of the activity. Settle into a comfortable sitting position, sitting with your back straight against the chair, your feet flat on the floor and your hands in your lap or on your knees. Just doing your best to release any tension that you may be holding in your body right now. Maybe relaxing your jaw, your belly. Relaxing your shoulders, so that the breath can flow easily in and out of your body...and just acknowledging right now what you are thinking or feeling. This could be a curiosity about your Facebook. Whatever it is, just notice this. There’s no need to react to it, we’re just seeing what it’s like. Whatever it is, just acknowledge what’s happening. And maybe acknowledge your reaction to what’s happening, “I like this experience.” Or, “I don’t really like this experience.”

Now bring your attention to the changing physical sensations in your lower abdomen as the breath moves in and out of your body. Focus your awareness on the sensations of slight stretching as the abdomen rises with each inbreath, and of gentle deflation as it falls with each

outbreath. Pay attention as best you can to the changing physical sensations in the lower abdomen, all the way in as the breath enters your body, and all the way out as the breath leaves your body. Perhaps also noticing the slight pause at the end of the inbreath, and the slight pause between the end of one outbreath and the beginning of the next inbreath.

Sooner or later you may notice that the mind begins to wander into thoughts, feelings, sensations in the body, daydreams--any number of things. Notice if your mind has wandered into thoughts about Facebook. If your mind has wandered, that is completely OK—this is just what minds do, they wander. When you notice that your awareness is no longer on the breath, acknowledge gently where it has been; “Am I thinking about Facebook? Am I daydreaming?” Then, gently bring your awareness back to the changing physical sensations in the lower abdomen, renewing your intention to pay attention to the breath coming in and going out.

When the mind drifts into thoughts about Facebook--or anything really--we can observe this experience more closely. We can notice, for example, that thoughts and feelings about Facebook come and go, like waves rising and falling in the ocean. And like waves, these thoughts come out of nowhere, they rise, reach a point where they crest, and then eventually they fall and disappear back into the ocean. Thoughts rise up and fade away all on their own.

Notice if you are hearing notification sounds that they might produce a desire or an urge to check your Facebook or you might see images of Facebook popping into your head. Notice if you're feeling excited or curious about who is posting on your status. Sometimes these desires and urges make us feel like we're missing out on something and we feel anxious if we can't check Facebook immediately. It might feel like these urges and emotions will just keep on getting stronger and stronger, until we react to them, until we somehow stop them...or, until we give in to them. But what we know about desires and all intense emotional experiences is that they often rise and if we just stay with them and don't react to them, if we just let them be--by staying calm and using the breath to help us stay grounded--often times these experiences, just like waves, will reach a point where they crest, and then eventually they come down again...they fade...so our job is just to stay with them and ride this wave, almost like we are surfing, staying right on top of this experience. Sometimes it's helpful to use the breath just to stay grounded, almost like our breath is our surfboard, helping us to stay above water, above the experience, instead of being overtaken and wiped out by it.

Now, you will continue with this practice of grounding yourself and noticing the physical sensations of breath that come with each inbreath and outbreath. When your mind wanders--into thoughts or desires or emotions about Facebook or anything else--remind yourself that these thoughts and urges are just temporary waves in your mind; they rise up on their own and they eventually go away on their own. There is no need to struggle to resist them or react to them. There is nothing wrong, nothing needs to be changed. We're learning how to observe these urges and thoughts, to stay above them, so that we're not overtaken by them, so that we can choose to respond differently to them. When you need to, use the breath as an anchor to gently reconnect with the here and now each time you notice that your mind has wandered. Keep with this practice... I'll let you know when it's time to move on to something else.

If your mind has started to wander, just notice this and gently bring your focus and attention back to the breath. Noticing your inhales and you exhales, just continuing to breathe.

Where is your attention right now? Is it on the breath? Are you lost in thoughts about Facebook, or something else? Maybe you're caught up in desire or a strong emotion. Whatever you're experiencing is completely okay. Just simply observe whatever is happening, and then return your attention to the sensations of your breath.

Notice that for the past several minutes now, you have stayed present. You have stayed with your experience, rather than reacting to it. And notice that you always have this choice, when you begin to recognize these cravings and urges to check Facebook, no matter how strong they are or whatever your mind is telling you, you have a choice. You can choose to become aware of these thoughts and see that they are just waves that come and go on their own. It is through this awareness that you can become less likely to react and give into these urges or cravings for Facebook. The waves may continue, and they may continue to rise, but you can stay with this sense of surfing...releasing tension again and again, for as long as you need to and whenever you need to.

Now take a few final deep breaths. We're ready to move on to the next portion of the study. As you complete the next part, try to carry this new approach to thinking about Facebook forward with you, bringing awareness to your reactions and recognizing their temporary nature. When you are ready, slowly and gently open your eyes, and then click the button on the screen to proceed to the next part.

Self-immersed induction. This is a practice that invites us to relate differently to Facebook and our experience of using it. Many college Facebook users report that they have a tendency to just scroll through it mindlessly, not really taking the time to think about why they do it or what they're gaining from it. A common theme students describe sounds like this: "I hear a notification ding on my phone. Before I know it, I pull out my phone and start checking for notifications without really thinking about it. I'm not really engaged in it, but I just scroll and scroll and scroll, looking for the next interesting thing." For many of us, we sometimes lose sight of all the good things that Facebook brings to our lives, the excitement of reading posts, seeing comments or likes from friends, or reconnecting with someone from long ago. So this is an exercise to help us learn how to reconnect with Facebook more fully.

So to begin this exercise, we invite you to gently close your eyes for the remainder of the activity. Settle into a comfortable sitting position, sitting with your back straight against the chair, your feet flat on the floor and your hands in your lap or on your knees. Now, start to imagine yourself opening up Facebook on your computer or on your phone. Where are you normally in this moment? In your room? In a coffee shop? Wherever you are, just put yourself in that environment as vividly as possible. Then, imagine the thoughts or emotions that start to arise. Maybe, you see that you have new notifications. Do you feel excited about these? Are you happy? Maybe you feel anticipation or an urge to check them. Whatever comes to mind, try to vividly relive this experience as much as you can.

Now, imagine yourself actually checking these notifications. How does it feel to know that your friends commented on your status or a photo you were tagged in? Does it feel gratifying? Do you feel a sense of connection to your friends? Really allow your mind to think about the fact that your friends have gone out of their way to make you feel good and share something with you. To validate you. Let your mind wander into these positive thoughts about seeing notifications and posts from friends. Your friends don't have to post anything, but they chose to. They chose to reach out and stay connected to you, so really enjoy these positive feelings.

As you think about these positive experiences, you are learning to reconnect with Facebook, instead of just scrolling through it mindlessly. Considering how long many of us spend on it, learning to engage yourself with this, can help you increase the positive emotions that you feel. In much of our daily lives, we might have the tendency to just mindlessly scroll through Facebook, without taking the time to acknowledge and reflect on how much it helps us stay connected to friends or to the positive emotions that it enables us to have. Maybe think about a time when you were somewhere, say in class, and you couldn't check your Facebook...but you heard the notification ding or felt a vibration from your phone to notify you that friends were liking or commenting on a recent post that you made. How did this feel? Did the anticipation start to build in this moment? Try to relive the feelings that you had, as you waited to check these notifications.

You can think of checking your notifications as being similar to thinking about a much-needed vacation. You spend time planning your trip--like your Facebook posts--and then you imagine how fun it will be to finally be on vacation. You start to project yourself into the trip, playing out how great it will be to spend time with your family or friends, you vividly imagine how relaxing it will feel. In these moments, the anticipation starts to build and you become excited for your trip. Similarly, you can experience this same type of excitement and anticipation for Facebook. You become excited to post and then even more excited when you see your notifications. You allow your mind to wander into thoughts of how good it will feel to check them, to see who has commented on your status or liked your post. You let this anticipation build, so that you approach your Facebook with new excitement and curiosity.

As you sit here and wait for your notifications to build, start to think about who might be posting on your status update right now. What might they be saying? Let your mind go as you think about this. Start to really imagine the likes and comments building up from posting your status. Do you think a lot of people are looking at your post? What might these people be doing right now? Imagine your friends starting to read it. Will they find it interesting? Funny? Weird? Again, ponder how your post has potentially reached so many of your friends and family, and that the simple act of posting something helps you to stay connected to so many people. Think about how good it feels when you hear from them.

Now, you will continue with this practice of reconnecting with Facebook on your own. Think about who might be commenting on your status post. Then, start to broaden your awareness to all the friends you have on Facebook. How many thousands of connections to other people you have because of it. Think of all the groups you belong to, all the invitations you've received from other people, how you've been able to stay connected and stay in touch with friends you don't see very often. Really let your mind go and reminisce about all these connections that wouldn't

be possible without Facebook. Think of all the pictures you've posted, and the funny or interesting comments people made about them. Think of how excited you feel when you know that people have looked at your posts. Again, really let your mind go. I'll let you know when it's time to move on to something else.

Continue to let your mind wander and imagine what is happening with your status update right now. Allow yourself to think about all the people who might be liking or commenting on your post. Let the excitement and anticipation build. There is no need to stop it. Keep with this practice.

If you are hearing notification sounds, that means people are liking or commenting on your status, and the notifications are accumulating. Imagine, how it will feel to check your notifications and see these "likes" and "comments." Really visualize this and imagine the experience as if it is happening right now, in real time.

Great work! We're now ready to move on to the next portion of the study. As you complete it, try to use this new approach of reconnecting to the excitement of Facebook with you. When you are ready, slowly and gently open your eyes, and then click the button on this screen to proceed to the next part.

Unfocused attention induction. So to begin, we invite you to gently close your eyes for the remainder of the activity. Settle into a comfortable sitting position, sitting with your back straight against the chair, your feet flat on the floor and your hands in your lap or on your knees. Now, simply think about whatever comes to mind. Let your mind wander freely without trying to focus on anything in particular. Just let your mind roam as it normally would.

Now simply continue with letting your mind wander and think about whatever you want. I'll let you know when it's time to move on to something else.

Continue letting your mind wander, letting your thoughts go wherever they take you.

Remember to just continue letting your mind wander, and follow wherever it takes you. Just think about whatever comes to your mind. I'll let you know when it's time to move on to something else.

Continue to let your thoughts go. Thinking about whatever you like.

Good job! We are now ready to move on to the next portion of the study where we will see how many notifications you received on your Facebook page. When you are ready, please click the bottom button on this screen to proceed to the next page.

Mindfulness instructions prior to the Facebook advertisement. While you watch the next video, we want you to adopt the new approach you learned and practiced a few minutes ago.

Before you watch the video, let's review everything that you learned today.

You've learned how to observe thoughts, emotions, and urges to check Facebook and how to see these thoughts, emotions, and urges as just temporary mental events that arise and pass away on their own; much like waves on an ocean.

This means that you don't have to react to these urges to check Facebook, or try to push them away, or give in to them. Instead, you can simply recognize that all emotions and desires eventually reach a point where they crest, come down, and fade away entirely on their own...and you can "surf" over top of them.

You've also learned how to focus on the physical sensations of your breath as a way to help you stay connected to these emotions and urges without being overwhelmed by them.

We will now show you a short video advertisement for Facebook. It is important to us that you watch the film clip carefully. However, while watching, we encourage you to use this new approach. In other words, as you watch, try to recognize that any thoughts, emotions, and urges triggered by the video are simply temporary mental events that arise and fall away on their own. Try observing your emotions and urges in a nonreactive way.

Self-immersed instructions prior to the Facebook advertisement. While you watch the next video, we want you to adopt the new approach you learned and practiced a few minutes ago.

Before you watch the video, let's review everything that you learned today.

You've learned how to reinvigorate your excitement for Facebook by reconnecting with all the good things that it brings to your life, like the satisfaction of getting notifications from friends.

With this new approach you are bringing to mind all the positive thoughts, emotions, and desires associated with Facebook, instead of just mindlessly scrolling through it. You are taking the time to acknowledge how much it helps you stay connected to friends and to the positive emotions that it encourages in your life.

You've also learned how to build the excitement and anticipation of checking your notifications by thinking about them like a much-needed vacation. Like the thoughts that arise before a vacation, you allow your mind to wander into thoughts of how good it will feel to check your notifications and to see who has commented on your status.

We will now show you a short video advertisement for Facebook. It is important to us that you watch the film clip carefully. However, while watching, we encourage you to use this new approach. In other words, as you watch, try to fully experience any positive thoughts, emotions, and desires triggered by the video. Let your anticipation and excitement build.

4. Study 2 audio scripts.

Mindfulness instructions prior to the Academic Diligence Task (ADT). While you practice the algebra problems, we want you to apply the new approach you learned and practiced a few minutes ago. Before you start, let's review everything that you learned today. You've

learned how to observe thoughts, emotions, and urges to check Facebook and how to see these as just temporary mental events that arise and pass away on their own; much like waves on an ocean.

You don't have to react to these urges to check Facebook, or try to push them away, or give in to them. Instead, you can simply recognize that all emotions and desires eventually reach a point where they crest, come down, and fade away entirely on their own...and you can "surf" over top of them.

You've also learned how to focus on the physical sensations of your breath as a way to help you stay connected to these emotions and urges without being overwhelmed by them.

Similarly, you can adopt this perspective as you complete the algebra problems. While doing the problems, you may notice thoughts, emotions, or urges to watch the YouTube clips. If this happens, simply recognize that these thoughts, emotions, and urges are temporary mental events that arise and fall away on their own. Try observing any urges and desires toward the YouTube videos in a nonreactive way.

Self-immersed instructions prior to the Academic Diligence Task (ADT). While you practice the algebra problems, we want you to apply the new approach you learned and practiced a few minutes ago. Before you start, let's review everything that you learned today. You've learned how to reinvigorate your excitement for Facebook by reconnecting with all the good things that it brings to your life, like the satisfaction of getting notifications from friends.

With this new approach you are bringing to mind all the positive thoughts, emotions, and desires associated with Facebook, instead of just scrolling through it. You are taking the time to acknowledge how much it helps you stay connected to friends and to the positive emotions that it encourages in your life.

You've also learned how to build the excitement of checking your notifications by thinking about them like a much anticipated vacation. Like the thoughts that arise before a vacation, you allow your mind to wander into thoughts of how good it will feel to check your notifications and to see who has commented on your status.

Similarly, you can adopt this perspective as you complete the algebra problems. While doing the problems, try to fully experience any positive thoughts, emotions, and desires to watch the YouTube clips. Just let your interest for the YouTube clips build up in your mind. Allow your mind to wander and think about how good it would feel to watch the videos.