Full length article

When facebook and finals collide - procrastinatory social media usage predicts enhanced anxiety☆☆

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ABSTRACT

In the digital age we live in, refraining from procrastinatory social media usage, particularly when conflicting with highly valued goal pursuit, can result in failure and subsequent negative psychological outcomes. Despite mounting interest, existing evidence remains correlational and restricted to mundane contexts. To fill these gaps the current two study investigation provides converging ecological and causal evidence for the influence of procrastinatory social media usage on subsequent anxiety. Study 1 used longitudinal unobtrusive measurement of actual procrastinatory Facebook usage (using designated software) together with experience-sampling, during *real-life* academic exam preparation period. Findings showed that enhanced procrastinatory Facebook usage predicted increased levels of anxiety over time. Further evidence provided inferences regarding the likely ordering of this association, by ruling out a reversed directionality between anxiety and subsequent Facebook usage. Providing direct causal evidence, Study 2 created a *laboratory* exam context conceived as highly predictive of academic success, that *directly manipulated* whether actual Facebook usage was procrastinatory or not, prior to examining its influence on anxiety. Supporting predictions, only when Facebook was used instead of studying, it resulted in enhanced anxiety. The present investigation illuminates when and why social media usage leads to adverse psychological consequences.

1. Introduction

The influence of social media on our lives is pervasive. It blurs the boundaries between work and leisure. Consider the typical first year college student, struggling to defend the pursuit of highly important academic aspirations from constant impeding social media notifications. Evidence supporting the potency of this struggle shows that 70% of college students report using social media (McCoy, 2016), during roughly 40% of class time (Ravizza, Uitvlugt, & Fenn, 2017), with 33% of students reporting using Facebook even when it competes with the central goal of studying for their final exams (Rosen, Carrier, & Cheever, 2013).

The growing challenge for students to balance their social media usage with central academic duties has been formally conceptualized as a new form of the classic self-control dilemma (Hofmann, Reinecke, Meier, & Oliver, 2017; Hofmann, Schmeichel, & Baddeley, 2012; Meier, Reinecke, & Meltzer, 2016; Panek, 2014; Reinecke & Hofmann, 2016; Xu, Wang, & David, 2016). Self-control dilemmas are defined as a competition between an immediate low priority impulse and between a distal high priority goal. Self-control dilemmas have been applied to many domains, including eating and weight-related behavior (Danner, Ouwehand, Haastert, Hornsveld, & Ridder, 2012; Konttinen, Haukkala, Sarlio-Lähteenkorva, Silventoinen, & Jousilahti, 2009; Vohs & Heatherton, 2000), school and work achievement (Tangney, Boone, & Baumeister, 2018, pp. 181–220; Tice & Baumeister, 1997; Wolfe & Johnson, 1995), addictive behavior (Heckman, Ditre, & Brandon, 2012; Tang, Posner, Rothbart, & Volkow, 2015), and decision making (Hare, Camerer, & Rangel, 2009; Vohs et al., 2014). Extrapolating the classic dilemma to (post) modern times, there are contexts where acting on the immediate impulse to use social media competes with a distal high

priority goal such as that of studying for an important exam (Hofmann et al., 2017).

A central prediction in the self-control literature argues that succumbing to gratify immediate low priority impulses when needing to work towards long-term high priority goals has negative consequences (Baumeister, 2002; Baumeister & Heatherton, 1996; Hofmann, Kotabe, & Luhmann, 2013). Specifically, it has been argued that using social media at the expense of performing goal directed activities, constitutes an example of procrastination (Hinsch & Sheldon, 2013; Meier et al., 2016). Procrastination has been associated with maladaptive psychological consequences, including enhanced anxiety and distress (Rice, Richardson, & Clark, 2012; Sirois & Kitner, 2015; Tice & Baumeister, 1997).

Although this central self-control prediction appears logical, existing empirical findings from two independent lines of study, only provide correlational evidence, that is also restricted to mundane contexts. Specifically, one line of indirect evidence involving cross-sectional (Meier et al., 2016) and longitudinal (Reinecke & Hofmann, 2016) survey studies showed that students' self-reports of procrastinatory social media usage during academic routine was associated with enhanced academic stress or negative self-evaluation. A second line of indirect evidence comes from laboratory studies. Specifically, several studies found positive correlations between actual procrastinatory social media usage during academic routine (e.g., measuring actual Facebook usage when needing to complete homework in the lab) and between higher levels of negative affect and distress (Calderwood, Ackerman, & Conklin, 2014) or reduced happiness (Brooks, 2015).

These prior studies provide important insights regarding the relationship between procrastinatory social media usage and anxiety during routine. However, without directly manipulating procrastinatory usage, prior studies that examined social media usage *only* in procrastinatory contexts, cannot eliminate an alternative explanation that social media usage would be associated with maladaptive psychological aspects across *all* contexts. Second, transcending the examination of this self-control dilemma beyond mundane contexts is important for conceptual and practical reasons. Conceptually, influential work unpacking the basic ingredients of self-control dilemmas argues that goals are ordered in a hierarchy of importance, and that failing to pursue the most highly valued goal leads to the largest perceived loss of control Kruglanski & Kőpetz, 2010for a review). According to this logic, maladaptive outcomes such as enhanced distress, should be particularly evident in situations when succumbing to procrastinatory social media usage conflicts with pursuing highly valued long-term goals, such as studying for a major exam. From a practical point of view, a significant portion of public concern regarding the negative influence of procrastinatory social media usage was raised particularly in contexts where social media usage undermines goal pursuit that is highly valued by individuals (Kennedy, 2016; Levy, 2014; Pence, 2015; White, 2015).

Building on the two aforementioned lines of study, the current investigation provides for the first time converging ecological (Study 1) and causal (Study 2) evidence for the maladaptive psychological consequences of actual procrastinatory social media usage, in a critically important academic context. In both studies we focused on an exam preparation setting, a critical context in academic life during which using social media instead of pursuing the highly important goal of academic success would lead to adverse outcomes, such as enhanced anxiety.

Extending the first line of survey studies that assessed self-reported procrastinatory social media usage during routine period, Study 1 examined the effect of *actual* procrastinatory social media usage on anxiety during a *challenging real-life academic* context. Specifically, during a three-day period prior to a central exam in students' curriculum, we combined longitudinal unobtrusive measurement of actual social media usage using precise designated software (thus minimizing demand characteristics), together with experience-sampling. Using this approach, we examined our main prediction that enhanced procrastinatory Facebook usage during exam period would be related to subsequent enhanced anxiety, while being able to rule out a reversed directionality between anxiety and subsequent Facebook usage.

Extending the second line of prior laboratory studies, in Study 2 we provide for the first-time causal evidence by experimentally manipulating procrastinatory social media usage and measuring its influence on anxiety, in a laboratory testing context. (Tice, Bratslavsky, & Baumeister, 2001). Specifically, prior to taking a test that was conceived as highly predictive of academic success, one group of participants was encouraged to maximally prepare in order to improve test performance, and a second group was given free time. During that time participants in both groups were left to freely use their Facebook account. Our main prediction was that exclusively in the group that Facebook usage competes with exam preparation, enhanced procrastinatory Facebook usage would lead to enhanced anxiety.

2. Study 1- enhanced procrastinatory facebook usage during exam preparation period is associated with subsequent anxiety. An experience sampling investigation

2.1. Materials and methods

For the experience-sampling design of Study 1, we used multilevel modeling to analyze data that is hierarchically organized with responses from each day nested within participants (see Snijders & Bosker, 1999 for elaborated multilevel design explanations). The two levels of the analysis were the lower, level-1 of responses each day and the higher, level-2 model of participants. Below we report how we determined our sample size, all data exclusions, all manipulations, and all measures in both studies.

2.1.1. Participants

Because multilevel models are flexible, yet subsequently complex, determining appropriate power for them is less straightforward than single-level models (Kreft & de Leeuw, 1998). Simulation-based methods can be useful for calculating power in multilevel designs (e.g. Hox, 2002), but they necessitate estimation of intraclass correlations (ICC), and assumptions about within and between-subject correlations and covariances at each level (Scherbaum & Ferreter, 2009). For the present study estimations were not available given the lack of prior directly related studies.

For that reason, we adopted other multilevel modeling power recommendations (e.g., Scherbaum & Ferreter, 2009; Snijders, 2005) arguing that the limiting determinant of the sample size should be at the highest nesting level (i.e., level-2/participant in our case). Applying those recommendations, and given our single categorical level-2 participant predictor we conducted a traditional power analysis (using G power software, (Faul, Erdfelder, & Buchner, 2007)) for a repeated-measure one-way ANOVA design applying a conventional alpha of .05 and 80% power, and setting a conservative small to medium effect size ($d = 0.20$). The power analysis indicated that a sample of 50 participants was required to detect a reliable effect. We decided to oversample by approximately 20% to account for possible subject attrition that is common in longitudinal designs (Deeg, 2002). Accordingly, 62 participants were able to complete the study before the end of the semester.

Inclusion criteria involved being 18 years or older active undergraduate student, studying for a central exam (with no other scheduled tests during the three-day duration of the study), having an active Facebook account, using Facebook application on a smart phone with an Android operating system (given our software requirements), and being the sole Facebook user on a personal computer (in order to code participants' own Facebook usage).

Following prior studies (Kross et al., 2013; Verduyn et al., 2015), we used an a priori exclusion rate in which we omitted participants who had fewer than 60% observations due to software failure. This resulted in

excluding 11 participants (17.7%, meeting our 20% expected attrition rate). Therefore, the final sample consisted of 51 participants (mean age = 23.94, SD = 2.16; 39 female).

2.1.2. Procedure

All participants provided their written informed consent before the experiment. All experimental procedures were approved by the Institutional Review Board of Tel Aviv University, and were performed in accordance with the approved guidelines. Four days prior to a major exam (i.e., a *mandatory* course in students' curriculum), participants installed two applications, one on their smartphones and another on their personal computers, that unobtrusively and accurately monitored their Facebook usage during the experiment duration. During the actual study, which took place during the three-day period[1] prior to the exam, participants were sent text-messages to their smartphones six times per day between 9:00 a.m. −11:00 p.m. Text-messages were sent at random times within 120–150-min windows. Each text-message contained a link to an online survey where participants rated their current anxiety levels followed by their general affective well-being. Additionally, the last measurement each day contained an extra question regarding the amount of time participants spent on Facebook for studying, in order to control for participants' daily Facebook usage that was not for procrastinatory purposes.[2]

2.1.3. Measures

2.1.3.1. Facebook usage.
For this study (and also for Study 2 below) we focused on *Facebook*, because it remains one of the largest and popular social network platforms for young adults (Broadbandsearch, 2019; Ortiz-Ospina, 2019; Perrin & Anderson, 2019; Smith & Anderson, 2018) Moreover, Facebook is the most empirically studied social network (Błachnio, Przepiórka, & Rudnicka, 2013; Rains & Brunner, 2015; Snelson, 2016; Stoycheff, Liu, Wibowo, & Nanni, 2017). Continuous Facebook usage data from participants' computers were monitored via the software "ManicTime" (ManicTime.), and continuous usage data from smartphones was obtained via the software "APP Usage" (App usage-manage/track usage.).[3] Using designated software has several notable advantages over prior studies: First, the measurement precision is highly accurate in monitoring actual usage in seconds. Specifically, the applications are automatically activated when participants navigate to Facebook on their devices. The counter stops automatically either when navigating out of Facebook, or when the Facebook page is not active, or when no mouse or keyboard activity is detected. Second, the

applications are running in the background and continuously and unobtrusively monitor Facebook usage. Third, the fact that the method for measuring actual social networks usage is not susceptible to reporting biases, decreases threats of exposing and biasing participants' reports to accord with study hypotheses.

2.1.3.2. State maladaptive psychological aspects.
Data was collected through online surveys hosted by the Qualtrics.com website (Provo, UT, USA).. In order to examine maladaptive psychological aspects multiple times a day, we administered single validated items, one tapping on state anxiety level: "How anxious are you right now" (not anxious [0] to very anxious [100]; M = 25.38, SD = 22.11 (Abend, Dan, Maoz, Raz, & Bar-Haim, 2014).), and another tapping on general affective well-being: "How do you feel right now?" (Measuring a core valence dimension - very positive [0] to very negative [100]; M = 28.90, SD = 22.09 (Kross et al., 2013)). Of the two outcome measures, we placed a more central focus on anxiety given that the context of stressful test preparation is more naturally associated with a stress response (Tice & Baumeister, 1997). Importantly, existing studies in academic contexts found more consistent links between procrastinatory social media usage and anxiety than links with general well-being (Meier et al., 2016; Reinecke et al., 2016; Reinecke & Hofmann, 2016).

2.2. Results

2.2.1. Analyses overview

We examined the relationship between Facebook usage and maladaptive psychological outcomes using multilevel modeling to account for the nested data structure. Main analyses examined whether actual Facebook usage time between subsequent time points (e.g., between T0 and T1) predicts changes over time in maladaptive psychological aspects such as anxiety levels or general affective well-being (at T1), while controlling for prior (T0) maladaptive psychological aspects (Kross et al., 2013).[4] Complementary analyses involved reconducting this model while also controlling for non-procrastinatory reported Facebook usage. In addition, beyond examining how participants' natural Facebook behavior affects subsequent psychological states, the cross lagged approach allowed us to also rule out reversed inferences that anxiety influences Facebook usage (see analyses regarding reversed relationships below).

All multilevel analyses were conducted using the **lme4** package in R (Bates, Sarkar, Bates, & Matrix, 2007). Following recommendations from **lme4** package creators (Bates, Mächler, Bolker, & Walker, 2014), Level-1 predictors were grand-mean centered and modeled as fixed effects with slopes not allowed to vary within subjects due to the small numbers of observations per person within day approaching their tests, which would make subject-specific relationships unreliable (Kross et al., 2019; Verduyn et al., 2015), and the level-2 predictor of participant ID was modeled as random effect and included as a random intercept for each subject. Furthermore, prior studies advised *not* to use experience sampling emotion data at the end of one day to predict emotion at the beginning of the next day, due to sleep, longer delays between measurements, and intervening nighttime activities (Kross et al., 2013; Verduyn et al., 2015).

Degrees of freedom and t-tests were estimated using Satterthwaite corrections, and confidence intervals were extrapolated based on these calculations (Satorra & Bentler, 1994). Effect sizes were calculated using r^2 for different models and then converting to Cohen's *d*. During the three-day course of the study participants were prompted six times a day. Of these, participants responded to 902 text-messages resulting in a high average response rate of 92.80%. In addition, when participants did not respond to a text, we used participants' responses to the last text

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[1] To determine the duration of the study, we considered the notion that in Tel Aviv University consecutive tests typically take place four days apart, which leave students three full days to study. A further pilot survey (N = 21) indicated that participants report spending between three to nine days (average = 5.71; SD = 1.67) for studying. Taking these two considerations into account we set the duration of the study to three days prior to an exam, in order to maximize the number of eligible participants.

[2] In addition, participants were asked two questions in a random order to tap their studying habits: what percentage of your time you studied since the previous time we asked (M = 55.42%, SD = 30.11) and what percentage of your time do you plan to study in the next 2.5 h (M = 58.94%, SD = 32.01). The main purpose of the two studying questions was to show our findings do not depend on differential amount of time participants study for the exam.

[3] In addition to total usage, we also measured Facebook activities made by participants (e.g. 'Like' status, comments on pictures, posts on friends' walls, etc.) using the Facebook activity log. As opposed to the Facebook usage measure that captures passive and active aspects, Facebook activities only reflects active Facebook usage (i.e. only activities that facilitate direct exchanges with others). Because recent studies (Verduyn et al., 2015, 2017bib_Verduyn_et_al_2015bib_Verduyn_et_al_2017) do not consistently find that active usage is strongly related to maladaptive psychological outcomes, this Facebook activities measure was not central to the current hypotheses.

[4] Please refer to the supplemental materials to see the all of the full multilevel model equations.

message that they answered to examine the lagged effect of Facebook usage on maladaptive psychological aspects (Kross et al., 2013). After removing 21 responses with missing data, and 147 responses at the beginning of the day that did not have a corresponding lagged anxiety rating, we had 734 observations for analysis.

2.2.2. Is procrastinatory facebook usage associated with subsequent anxiety?

We examined whether people's tendency to use Facebook during the period separating two text messages influenced how anxious they felt at T1, controlling for how anxious they felt at T0. Nested time-lag analyses indicated that the more people used Facebook the more anxious they subsequently felt (b = 0.14, se = 0.05, t (724) = 2.54, p = .011, 95%, CI = 0.03–0.24, d = 0.161). It bears noting that the lower and upper bounds of the confidence interval do not include the value zero.[5] Furthermore, these results remained unchanged when we controlled for reported Facebook usage that was not procrastinatory (b = 0.13, se = 0.05, t(722) = 2.44, p = .015, 95% CI = 0.03–0.23, d = 0.181).

2.2.3. Is anxiety associated with subsequent procrastinatory facebook usage?

The reversed pathway, T1 Anxiety predicting T1-2 Facebook usage, controlling for T0-1 Facebook usage, was not significant (b = −0.01, se = 0.02, t(341) = −0.54, p = .587, 95% CI = −0.06–0.03, d = 0.123), indicating that anxiety is not associated with enhanced subsequent Facebook usage.

2.2.4. Secondary analyses

2.2.4.1. General affective well-being. When we repeated the aforementioned analyses with general affective well-being, we found that increased time on Facebook was only marginally associated with decreased general affective well-being (b = 0.11, se = 0.06, t (721) = 1.96, p = .050, 95% CI = −0.001–0.228, d = 0.054), when controlling for prior general affective well-being. In addition, in contrast to anxiety, this analysis led to confidence intervals that do include the value zero. Consistent with the above anxiety findings, the reversed pathway showed that changes in general affective well-being were not associated with subsequent changes in Facebook usage (b = −0.02, se = 0.02, t (484) = −0.78, p = .442, 95% CI = −0.06–0.03, d = 0.359).[6]

3. Study 2- procrastinatory facebook usage during exam preparation causally leads to subsequent anxiety. A controlled laboratory investigation

Study 1 used experience sampling in order to show for the first time that procrastinatory social media usage is related to enhanced anxiety in a *challenging real-life academic* context. These results remained unchanged, when we controlled for reported time participants used Facebook for studying non-procrastinatory purposes. Study 1 also ruled out a reversed relationship showing that anxiety was not associated with subsequent changes in social media usage.

Although important, Study 1 examined procrastinatory social media usage only during exam preparation period, which cannot eliminate an alternative explanation that social media usage would be associated with maladaptive psychological aspects across *all* contexts.

Furthermore, although lagged analyses enabled drawing inferences about the likely ordering of associations between Facebook usage and maladaptive psychological aspects, the only way to reach causal conclusions is via an experimental approach.

To address these shortcomings, Study 2 adopted a tightly controlled laboratory setting, where we directly manipulated whether actual social media-usage was procrastinatory or not, prior to examining its subsequent influence on anxiety. To that end, we adopted a validated task that measures procrastination when needing to work towards an important test (Tice et al., 2001). Specifically, two participant groups were left to freely use their Facebook account while they needed to complete a central test (high priority goal) they conceived as highly predictive of academic success. However, there was one notable difference between groups. In the "Procrastinatory" (experimental) group, analogous to the context of Study 1, participants were encouraged to maximally use the time before the test to practice. Specifically, participants were told that maximal preparation for the exam could substantially improve their performance. Highlighting for participants the link between maximal preparation and subsequent academic success guaranteed that any time spent on Facebook (instead of studying) would be classified as procrastinatory (see Tice et al., 2001 for more details). In the "Non-procrastinatory" (control) group participants were given free time instead. Additionally, given that the laboratory setting allowed a more complete investigation of our outcomes, we applied the full scales of anxiety and well-being. Our main prediction was that only procrastinatory social media usage would lead to enhanced anxiety.

3.1. Materials and methods

3.1.1. Participants

Sample size was determined using a power analysis (G power software, Faul et al., 2007) applying a conventional alpha of .05 and 80% power. Based on a recent study in our lab that used a linear multiple regression design and found a two-way interaction involving actual Facebook usage, we set a medium effect size, $f2$ = 0.12, (see Sternberg, Luria, & Sheppes, 2018). The power analysis indicated that a sample of 68 participants was required to detect a reliable effect. As opposed to the real-life longitudinal nature of Study 1, the controlled laboratory setting in Study 2 was expected to be associated with no missing values and minimal attrition rates. We therefore did not oversample in Study 2. Inclusion criteria involved being an active undergraduate student, 18 years or older and having an active Facebook account. Of the 68 participants that completed the study, none were excluded (meeting our minimal exclusion expectation. Mean age = 23.47, SD = 2.93; 51 females; 34 participants in the "Procrastinatory-group" and 34 participants in the "Non-procrastinatory group").

3.1.2. Procedure

Participants provided their written informed consent before the experiment. All experimental procedures were approved by the Institutional Review Board of Tel Aviv University and were performed in accordance with the approved guidelines. The experiment consisted of two sessions within a 24-h period. **Session 1:** Participants completed a set of baseline questionnaires that assessed their baseline state-anxiety symptoms and aspects of well-being before the study.[7] Then, in an effort to motivate participants and enhance the saliency to use Facebook in a laboratory task that took place 24 h later in session 2 (see Sternberg

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[5] In contrast to the clear pattern obtained with Facebook usage time, no results were obtained when we repeated the same aforementioned analyses with Facebook activity (dummy coded as 0 = passive, not liking or commenting, 1 = active, liking or commenting at all). Neither the effect of Facebook activity or the interaction between time on Facebook and Facebook activity were significant, bs < 1.50, |ts| < 1.50, ps > .20.

[6] Additional analyses that held constant reported differential study time (both planned and actual study times) did not alter any of the results, all ps < 0.05.

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[7] Participants additionally completed two other questionnaires for pilot purposes. Specifically, given that we wished to explore the future possibility of repeating the present design with specialized populations suffering from depression and Facebook addiction, participants completed the Beck Depression Inventory II (BDI-II) (Beck, Steer, & Brown, 1996) and The Bergen Facebook Addiction Scale (BFAS) (Andreassen, Torsheim, Brunborg, & Pallesen, 2012).

et al., 2018 that used a similar procedure, and see details and relevant analyses below), participants' access to Facebook was deactivated for 48 h by changing their Facebook password. The main purpose of the second 24-h deprivation that started at the end of session 2, was to increase the value and motivation to use Facebook at the laboratory during session 2 (rather than use Facebook at home immediately after the end of the session; see details below). **Session 2:** took place 24 h after the first session. Participants first completed the same questionnaires as in session 1. Then, we adopted a validated deception task that examines procrastinatory behavior (Tice et al., 2001). Participants were told they would complete a 10-min nonverbal intelligence test which is highly predictive of academic and real-life success, where they needed to solve as many mathematical problems as accurately as possible. They were further told that they would receive feedback regarding their quantitative reasoning, analytical abilities, and fluid thinking after the experiment. Participants were then told that during the next 20 min, their Facebook accounts would be temporarily reactivated for their use, following the 24 h of Facebook deprivation (that started at Session 1), and before another 24 h of deprivation (following Session 2). Then, participants were randomly assigned to "Procrastinatory" (experimental) or "Non-procrastinatory" (control) groups. Participants in the "Procrastinatory" group were told they would have 20 min in which they could prepare for the test. They were further encouraged to prepare as much as possible, since preparation could substantially improve their performance. In addition, they were told that during the session they were free to use the web in any way they liked. By contrast, participants in the "Non-procrastinatory" group were told that they would have 20 min of free-time before the test, during which they were free to use the web in any way they liked since no preparation was needed for the test. Based on these differences, for the "Procrastinatory" (but not "Non-procrastinatory" group) Facebook usage competed with the highly valued goal of studying and should lead to enhanced anxiety. Immediately after the 20-min (Procrastinatory or Non-procrastinatory) manipulation, all participants were requested to complete the state anxiety and mood questionnaires (post-manipulation questionnaires), before an additional 10-min break. The information on this 10-min break was provided to participants in advance, in order to minimize the risk that their post manipulation state anxiety ratings would be influenced by the upcoming test. At the end of the 10-min break period, all participants took the brief test. Although the test was described to participants as highly predictive intelligence test, in practice it was a very short test that involved four three-digit multiplication problems that didn't have any predictive abilities. Participants actually took this short test in order to enhance our credibility.[8]

3.1.3. Measures

3.1.3.1. Facebook usage. To increase participants' incentive to use Facebook during the laboratory session we followed studies showing that deprivation increases the value and motivation to act (Epstein, Truesdale, Wojcik, Paluch, & Raynor, 2003). Deprivation procedures are well-established in human and animal studies across many fields such as addictions (Grimm, Hope, Wise, & Shaham, 2001; Hefner, Starr, & Curtin, 2015), decision-making (Chib, Rangel, Shimojo, & O'Doherty, 2009) and caffeine dependence (Juliano & Griffiths, 2004). Importantly, recent studies have used deprivation procedures in the context of internet usage (Osborne et al., 2016). In prior research (Sternberg et al., 2018), for example, we established that a deprivation procedure does not bias naturally occurring social networks usage by showing significant medium sized positive correlations between deprived Facebook

usage time in the laboratory and non-deprived Facebook usage time at home.

After we reactivated participants' Facebook accounts, participants were asked to remain seated in front of a computer for the entire duration. Similar to study 1, we unobtrusively measured Facebook usage time (using 'timeStats' application (timeStats.)).[9]

3.1.3.2. Maladaptive psychological aspects. Similar to analyses of Study 1 we focused on baseline and post manipulation state levels of anxiety and well-being. However, as opposed to Study 1 where we used single items to minimize participants' load during repeated survey responding, in Study 2 we administered full scales of these constructs. Specifically, we administered the complete well-established Spielberger State Anxiety Inventory (STAI-S (Spielberger, 1989)(, which consists of 20 items that assess the intensity of state-anxiety symptoms (M = 38.72, SD = 9.30, Cronbach α = 0.91). In addition to the general affective well-being item collected in Study 1, in Study 2 we also examined "cognitive well-being" using the Satisfaction with Life Questionnaire (SWLS; Diener, Emmons, Larsen, & Griffin, 1985), which consists of 5 items that assess global cognitive judgments of satisfaction with one's life (M = 23.97, SD = 5.26, Cronbach α = 0.85). Because relationships between general Facebook usage and Life-satisfaction were generally found in non-academic contexts (Kross et al., 2013; Verduyn et al., 2015; c. f., Hinich and Sheldon, 2013) for a single finding in an academic context), and because we obtained only marginal effects in Study 1 between procrastinatory social media usage and well-being, these two well-being measures were treated secondary in Study 2.

3.2. Results

Prior to the main analyses, we confirmed that random assignment to the two groups was successfully, manifested in non-significant differences between groups in all pre-manipulation measures (see Table 1, all t's < 1.08, p's > 0.28).

3.2.1. Manipulation check

A straightforward and objective way to show that the intelligence test was conceived by participants as an important test that is highly predictive of academic success, involves examining how long participants in the experimental group spent studying for the exam. Supporting our expectations, participants spent 88% of their time studying (i.e., M = 17:43 min out of 20 min participants were given to prepare. SD = 3:25 min).

Table 1
Pre-manipulation Group Characteristics of the "Procrastinatory" group and "Non-procrastinatory" group. STAI-S (Spielberger State Anxiety Inventory); SWLS (Satisfaction with Life Questionnaire); BFAS (Bergen Facebook Addiction Scale); BDI-II (Beck Depression Inventory II (Beck, Steer, & Brown, 1996)).

Variable	"Procrastinatory" group M (SD)	"Non-procrastinatory" group M (SD)	P value
STAI-S	39.73 (9.41)	40.09 (6.01)	0.87
Affective well-being	6.73 (1.85)	6.63 (2.10)	0.83
SWLS	24.03 (5.29)	23.91 (5.23)	0.93
BFAS	40.56 (14.22)	36.94 (12.88)	0.28
BDI-II	6.73 (7.17)	6.41 (6.01)	0.84

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[8] At the end of the session participants completed another set of maladaptive psychological aspects' questionnaires to ensure that the participants left the experiment in positive mood. Indeed, state anxiety levels after the test were similar to those obtained at baseline (t = 0.44, p = .66).

[9] In addition to Facebook usage time we also measured, as in Study 1, the amount of Facebook activities made by participants. Congruent with our theoretical expectation and given that we did not observe findings with Facebook activity in Study 1, this variable was considered secondary in our analysis.

3.2.2. Analyses overview

The main analyses tested our hypothesis that enhanced Facebook usage in the laboratory will be related to enhanced anxiety levels (while controlling for baseline anxiety) in the "Procrastinatory" (but not "Non-procrastinatory") group. To test the main prediction, we conducted moderation analyses using Hayes PROCESS Model 1 (Hayes, 2012), with bias-corrected bootstrap 95% confidence interval based on 5000 bootstrap samples. Similar to Study 1, anxiety scores at T1 (post manipulation) were used as the dependent variables, continuous time on Facebook was used as the independent variable, and baseline (T0) anxiety as a control variable. To examine the relationship between Facebook usage and anxiety levels in the different contexts, we entered experimental group (Procrastinatory/Non-procrastinatory) as a moderator.

3.2.3. Does procrastinatory facebook usage leads to enhanced anxiety?

Replicating and extending the findings of study 1 and consistent with our prediction, the PROCESS model that examined anxiety levels as an outcome revealed a significant interaction between Facebook usage and experimental group ($t67 = -2.61$, $p < .01$, $b = -0.68$, se = 0.25, 95% CI $= -1.18$- -0.16) (see Fig. 1). It bears noting that the lower and upper bounds of the confidence interval do not include the value zero.

To further interpret this significant interaction, we conducted a follow-up analysis that tested the hypothesis of a relationship between Facebook usage and anxiety symptoms for individuals in the "Procrastinatory" but not "Non-procrastinatory" group. Confirming predictions, follow-up analyses indicated that among individuals in the "Procrastinatory" group (for which Facebook usage competed with highly important goal directed behavior), an increase in Facebook usage was associated with more anxiety ($t (67) = 3.17$, $p = .002$, $b = 0.76$, se $= 0.24$, 95% CI $= 0.28–1.24$). In contrast (and as expected), no relationship emerged between Facebook usage and anxiety among participants in the "Non-procrastinatory" group (for which Facebook usage did not compete with goal directed behavior) ($t 67 = 1.27$, $p = .21$, $b = 0.08$, se $= 0.08$, 95% CI = -0.06–2.7).

3.2.4. Does procrastinatory facebook usage leads to decrease in well-being?

When we repeated the moderation analyses using Hayes PROCESS Model 1 (see above), we did not observe any significant results of our manipulation on affective well-being ($t (67) = 0.54$, $p = .59$, 95% CI $= -0.17–0.30$) or cognitive well-being ($t (67) = 0.54$, $p = .59$, 95% CI $= -0.24–0.41$)[10].
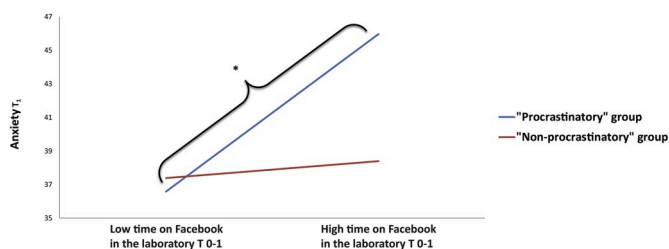

Fig. 1. The relationship between Facebook usage and state-anxiety symptoms at T1 as a function of whether Facebook usage conflicts ("Procrastinatory") or not ("Non-procrastinatory") with goal directed behavior, while controlling for T0 state-anxiety symptoms.

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[10] Consistent with study 1, no results were obtained when we repeated the same aforementioned analyses with Facebook activity as a predictor. Specifically, the Experimental group X Facebook activity interaction predicting state anxiety scores (controlling for baseline anxiety scores) was not significant ($t_{(67)} = -1.01$, $p = .31$,95% CI $= -0.70–0.23$).

4. General discussion

Despite interest, intuitive appeal and empirical efforts, there is a lack of causal evidence of the influence of procrastinatory social media use on maladaptive psychological outcomes. Adopting a self-control perspective, the present investigation aimed to show that succumbing to the immediate impulse of using social media when it competes with distal, highly valued academic goal directed behavior, leads to enhanced anxiety. The current two study investigation, combined experience sampling in a real-life setting with direct experimental manipulation in a controlled laboratory context. We provide converging ecological and causal evidence, showing that using Facebook when needing to study for an important exam leads to subsequent increase in anxiety.

Specifically, Study 1 used experience sampling in a longitudinal real-life academic setting, to show that during a central exam preparation period students' actual unobtrusive procrastinatory Facebook usage was associated with increased anxiety. The results remained unchanged when we controlled for reported time participants used Facebook for studying (i.e. non-procrastinatory Facebook usage). Further evidence ruled out a reversed pathway between anxious responding and subsequent Facebook usage.

To significantly augment the correlational nature of Study 1 that evaluated Facebook usage exclusively when it is procrastinatory, Study 2 provided causal evidence. We created a tightly controlled laboratory analogue of a central academic exam context, and directly manipulated whether actual social media-usage was procrastinatory or not, prior to examining its influence on anxiety. We predicted and found that only when participants had to prepare (as opposed to having free time) prior to an important exam, enhanced procrastinatory Facebook usage resulted in enhanced anxiety.

The "information age" (Giroux, Flecha, Freire, Macedo, & Castells, 1999) we live in is characterized by instantaneous and massive flow of available information. This notion creates self-control challenges that require overcoming strong appetitive urges (Naab & Schnauber, 2016) to use social media in times when it contrasts with goal directed behavior. Self-control dilemmas that have been fruitful in many domains (Danner et al., 2012; Hare et al., 2009; Heckman et al., 2012; Konttinen et al., 2009; Tangney et al., 2018, pp. 181–220; Tice & Baumeister, 1997; Vohs & Heatherton, 2000; Wolfe & Johnson, 1995), have been recently extended to shed light on the influence of procrastinatory social media usage on maladaptive psychological outcomes (Brooks, 2015; Hofmann et al., 2017; Meier et al., 2016; Reinecke et al., 2016; Reinecke & Hofmann, 2016).

Although important, prior studies did not examine the maladaptive influence of procrastinatory social media usage in contexts where it strongly conflicts with highly valued long-term goals, and prior evidence remains indirect regarding the temporal ordering and causal relationship between these two constructs. Accordingly, the present findings transcend prior studies in providing converging and direct evidence for the influence of procrastinatory Facebook usage in context that conflict with high priority goals on anxiety.

Providing precise understanding of the conflict between immediate temptations and between highly important goal directed behaviors, may promote the development of tools to better cope with media related self-control dilemmas. Specifically, adaptive outcomes are expected in tools that aim to increase the motivational strength of distal goals (e.g., test preparation), while decreasing the motivational strength of immediate social media usage temptations. An influential conceptual model (Fishbach & Shen, 2014) further specifies that individuals must first identify the two ends of the conflict, and then adopt self-control strategies. These strategies may include self-imposed penalties on excessive usage (e.g., imposing Facebook deprivation for failing to undertake the central goal), and rewards on preparation (e.g., receiving an extra time on social-media for actually fulfilling the distal goal; Trope & Fishbach, 2000). Additional strategies can involve devaluing the rewarding value of social media usage (Myrseth, Fishbach, & Trope, 2009) by noticing its

subsequent influence on anxiety, and setting realistic test preparation expectations to increase engagement with the goal (e.g., taking breaks after fixed study durations; Zhang & Fishbach, 2010).

Despite the novel features of the study, several limitations warrant comment. First, contrary to our prediction and consistent findings with anxious symptoms, we found less robust links with our well-being outcomes. Although prior studies found consistent links between social networks usage and well-being in non-academic contexts (Hinsch & Sheldon, 2013; Kross et al., 2013; Verduyn et al., 2015, 2017bib_Verduyn_et_al_2015bib_Verduyn_et_al_2017), it could be that the present stressful test preparation context is more naturally associated with anxious symptoms such as tension and worry, and less associated with general withdrawal in well-being. Indeed existing studies in academic contexts find more consistent findings between procrastinatory social media usage and anxiety and distress (Meier et al., 2016; Reinecke et al., 2016; Reinecke & Hofmann, 2016). Despite the null findings with our two distinct components of well-being (general affective and cognitive well-being), future studies should measure other aspects of well-being, that may be associated with procrastinatory social-media usage in academic contexts, such as happiness (Brooks, 2015) or discrete emotions (such as happy-sad, irritable-cheerful, lonely-sociable dimensions, see Calderwood et al., 2014; Reinecke & Hofmann, 2016).

Second, although Study 1 focused on an exam preparation time, when social media usage instead of studying is considered procrastinatory, and although we controlled for reported time participants used Facebook for studying purposes, Study 1 only provides correlational evidence for our hypothesis. To address this shortcoming, Study 2 adopted a well-established procedure that directly manipulates procrastination prior to an important exam (see Tice et al., 2001 for more details), by encouraging participants to use the time before the test to practice, to maximize test performance. Highlighting the link between maximal preparation and subsequent academic success guarantees that any time spent on Facebook (instead of studying) would be classified as procrastinatory.

Third, although Study 2 aimed to provide causal evidence, as with any experimental manipulation, alternative interpretations should be discussed. Specifically, it may be argued that asking the experimental group to prepare for a test may enhance anxiety. Alternatively, it may be argued that telling the control group that they have free time may reduce anxiety. However, in an effort to minimize differential anxiety levels between conditions, participants in both groups were rightfully told that they will be taking an important test at the end of the preparation/free time period. Importantly, we found no average differences between groups in anxiety ratings following the manipulation and immediately prior to the test (t(66) = 0.05, p = .96). More generally, our analytic approach partially overcomes other potential average differences *between* groups, by decomposing the Social Media Usage X Experimental Group interaction, using separate simple slopes that examine separately *within* each group the relationship between social media usage and anxiety. Despite these benefits, future studies should find new ways to manipulate procrastinatory social media usage in order to provide converging evidence for our findings.

Fourth, although our findings provide causal understanding of the relationship between procrastinatory Facebook usage and anxiety, future studies should further explore potential moderators of this relationship. In a recent study we showed, for example, that enhanced Facebook usage was associated with anxious symptoms, particularly among individuals with impaired neural ability to filter out Facebook stimuli from accessing working memory (Sternberg et al., 2018). Additionally, future studies should examine important personality characteristics that may moderate this relationship such as self-control (Meier et al., 2016; Hoffman et al., 2017), self-evaluation (Reinecke & Hofmann, 2016), and academic procrastination (Meier et al., 2016).

Fifth, in both studies we exclusively measured Facebook usage and did not measure any other social media platforms. Although Facebook is dominant among users and researchers, future studies should examine other social media platforms such as YouTube, which is the most popular platform among young college students (Smith & Anderson, 2018).

Finally, in both studies we only focused on procrastinatory social-media usage in a critically important academic exam context. Although a central context in students' life, future studies should extrapolate to other contexts, such as procrastinatory social media usage during work, or during social interactions.

5. Conclusion

In summary, the present findings provide for the first time converging ecological and causal evidence for the influence of actual procrastinatory social-media usage on maladaptive psychological aspects. Transcending prior work, these findings highlight the significant maladaptive influence of procrastinatory social media usage in contexts where it strongly conflicts with highly valued goal pursuit, while also providing causal evidence for this influence. More broadly, this work can open new avenues of researching and promote the development of tools to better cope with media related self-control dilemmas.

Credit Author Statement

N.S. and G.S. developed the study concept. All authors contributed to the study design. Test-ing and data collection were performed by N.S. and N.S., S.C. and B.V. performed the data analysis and interpretation under the supervision of R.L. E.K. and G.S. N.S. and G.S. wrote the paper, and R.L. S.C. B.V. and E.K. provided critical revisions. All authors approved the final version of the paper for submission

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2020.106358.

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