

Agency over Social Media Use can be Enhanced through Brief Abstinence, but Only in Users with High Cognitive Reflection Tendencies

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Highlights

- Agency over social media use is an important predictor of behavioral changes
- I study the effects of several days of social media abstinence on agency
- I use a pre(t1) -post(t2), control (no abstinence)-treatment (abstinence), cognitive reflection (low vs. high) design
- At t1, all participants were invoked to reflect on their agency over social media use
- An increase in perceived agency was produced only in people who experienced abstinence and were high in cognitive reflection

Abstract

Many social media users have lost some agency over the use of these sites. Restoring this sense of agency is important as it can help users live responsibly with the technology, and can serve as a target for therapists treating people with difficulty to control their social media use.

Nevertheless, knowledge about ways to increase people's sense of agency has been limited. In this study I propose that invoking reflections about agency but allowing normal use will likely produce realization about loss of agency, and result in undesirable reduced sense of agency. In contrast, I suggest that if invoking reflections on agency is followed by a brief abstinence attempt, people will process insights on their actual ability to exert control over social media use, which will result in an increase in perceived agency. I further argue that this information

processing will only accrue in people high in cognitive reflection tendencies. A 2 (time: pre vs. post) by 2 (condition: abstinence vs. control) by 2 (cognitive reflection group: low vs. high) experiment with 610 Facebook users showed an increase in agency only among high cognitive reflection participants who experienced abstinence; all other groups showed decline in perceived agency. Implications are discussed.

Keywords: Social media, social networking sites, cognitive reflection, Abstinence, Agency, Perceived Behavioral Control

1. Introduction

Social media have become a popular way for people to communicate with others, connect and socialize with friends, family and strangers, and to share, explore and consume information (Correa, Hinsley, & De Zuniga, 2010). Given their rewarding nature and the repeated exposure of users to such sites, and individual differences in self-control abilities (Özdemir, Kuzucu, & Ak, 2014), some people started using social media sites in a problematic manner, to the point that their use patterns adversely affect various aspects of life (Brooks, 2015; Du, van Koningsbruggen, & Kerkhof, 2018; Hawk, van den Eijnden, van Lissa, & ter Bogt, 2019; Throuvala, Griffiths, Rennoldson, & Kuss, 2019). Such problematic use of social media can be explained from a dual-system perspective, and positioned as a consequence of unsuccessful struggle between strong impulses, governed by system 1, and weak reflective and inhibitory abilities, governed by system 2 (Turel & Qahri-Saremi, 2016; Turel & Qahri-Saremi, 2018).

The fact that people keep on using such sites despite the high potential for major adverse outcomes, can reflect some *loss of agency*, defined as reduction in one's ability to control

relevant actions and their consequences (Moore, 2016). From a dual-system theory standpoint, this loss of agency manifests from an imbalance between the systems reflecting a sensitive (hyperactive) system 1 and a weak (hypo-active) system 2 (Bechara, 2005). In the context of social media, loss of agency captures people's limited ability to control social media use. Indeed, for some users social media use has become a knee-jerk reaction to cues from the environment, such as visual or auditory new message notifications (Wegmann, Müller, Turel, & Brand, 2020). One way to capture the way users perceive their sense of agency over a behavior is by capturing their *perceived behavioral control (PBC)*, defined as beliefs of being able to control a target behavior (Ajzen, 1985). The importance of this concept stems from its ability to influence behaviors (Ajzen, 1991) and behavior change (Godin & Kok, 1996).

While regaining a sense of agency may not be the prime reason for changing one's behavior on social media; and there can be many other reasons (Cao & Sun, 2018), it seems like corrective actions that people take, such as reducing or quitting social media use can help in this regard. Importantly, people engage in both active and proactive efforts to control their social media use, in part, to gain a sense of control (Brevers & Turel, 2019). The current literature on loss of agency (often manifested in reduced behavioral control) has made important progress toward understanding the impacts of this issue. Yet, it is limited in that it has focused primality on the consequences of loss of agency (e.g., addiction-like symptoms), and on trait, state and brain correlates of this loss of agency over social media use (Banyai et al., 2017). Knowledge about ways to alter users' sense of agency over social media use is limited. I aim at addressing this gap, because increasing a sense of agency in social media users can be clinically significant. It can potentially help users to control undesirable behavioral patterns by affording more successful "detox", use reduction attempts, or attempts to take short breaks from using social media

(Osatuyi & Turel, 2020), which can ultimately result in increased wellbeing (Tromholt, 2016).

The mere sense of control, even without intending to quit is appealing and can improve people's wellbeing (Ryan & Deci, 2000).

To do so, I note that perceptions (including about behavioral control) are developed and can be altered through (a) reflection and (b) learning (Ajzen, 2001). This is rooted in the reciprocal determinism idea of social cognitive theory (Bandura, 1986). Even though most studies of this theory focus on how self-efficacy and behavioral control beliefs affect behavior, the reverse path – from behavior to self-efficacy judgements has also been established (Williams & Williams, 2010). This path captures learning from past behavior, and requires reflection coupled with experience. However, many social media users may use limited reflection on agency matters, and may have little experience with abstinence. They tend to use social media automatically, without much reflection (Müller et al., 2016). They generally tend to be insufficiently motivated to engage their reflective brain faculties to inhibit rewarding social media use behaviors, because such reflections are cognitively taxing (Turel & Qahri-Saremi, 2018).

Indeed, substance use treatments have focused on this path by using cognitive remediation, habit modification, and instrumental learning, with techniques such as motivational interviewing to help substance users regain control (Heinz et al., 2020). The efficacy of such approaches to help social media users, though, is yet to be determined. I posit that it may be possible to invoke users to reflect on their agency (and specifically loss of agency) by asking them about it. This is possible because even excessive social media users have functioning reflective brain faculties (He, Turel, Brevers, & Bechara, 2017; Turel, He, Xue, Xiao, & Bechara, 2014). Such reflections may set the ground for changes in one's sense of agency, because users will have a baseline to which they can compare future reflections. This prime may be followed by normal behavior

(unconstrained use) or by actual attempts to exert control over social media use (abstinence attempts).

If this prime is followed by normal, unconstrained use, people will likely realize that their use pattern deviates from social- and self-expected norms (Osatuyi & Turel, 2020) and sense that they do not have the agency they thought they had over using the system. That is, the mere completion of a behavioral control scale followed by using social media can increase accessibility to relevant evaluations and motivation to engage in reflection on the focal construct (Uhlmann & Cohen, 2007), namely agency over social media use. Given that people are generally surprised by how much they use social media and how weak is their control over this use (Osatuyi & Turel, 2020), involving reflection on agency and allowing normal use will likely reduce one's perceived agency. People, regardless of cognitive reflection abilities, will simply realize that they do not have the overestimated control over use they initially assumed to have.

In contrast, exerting effort to avoid using the system (intentionally abstaining) between t_1 , when the reflections on agency are invoked and t_2 is expected to produce different reflections. Instead of reflections about loss of agency, the reflections will evolve around the possibly surprising agency people have when they manage to abstain from social media use. That is, abstaining from social media use can serve to create a positive framing effect (Almashat, Ayotte, Edelstein, & Margrett, 2008) in the process of reflecting on one's agency and help people realize agency gains, rather than focusing on the revealed disappointment with one's actual agency when they do not abstain from use. Thus, actual exercising of agency (abstinence) can serve as learning through experience, which can be instrumental to the updating of one's agency beliefs (Williams & Williams, 2010).

Taken together, I hypothesize that **(H1a)** invoking reflections on one's sense of agency over social media use followed by unconstrained use will result in a reduced sense of agency, and **(H1b)** when the same prime is followed by efforts to exercise agency (abstaining) it will result in an increased sense of agency over social media use.

The learning reflected in H1b is contingent on one's motivation and ability to reflect on the situation and internalize new insights (Andrews, 1988). The ability and motivation to learn from the abstinence experience can be contingent on users' individual differences in cognitive reflection tendencies. Cognitive reflection refers to the tendency to override quick pre-potent incorrect solutions, and engage in deeper and more time consuming reflections that lead to a correct solution (Frederick, 2005). It is therefore a measure of how much people are willing to engage their system 2, when system 1 pushes them to draw conclusions without much reflection (Toplak, West, & Stanovich, 2011). It is an important individual difference, because it can influence reflection and prevent automatic, mindless, responses across situations (Bialek & Pennycook, 2018; Hoppe & Kusterer, 2011).

In the case of social media abstinence, I conjecture that people with low cognitive reflection tendencies will not learn much from the abstinence experience, compared to people high in cognitive reflection tendencies. This is because they have a tendency for reflexive, intuitive and mindless information processing (Barr, Pennycook, Stolz, & Fugelsang, 2015; Risko, Ferguson, & McLean, 2016; Vujic, 2017) . People low in cognitive reflection tendencies are ineffective information processors, and tend to adopt existing views without taking into account new information (Pennycook & Rand, 2019). As such, while abstinence can provide new information regarding one's agency "in action" over social media use, the new information will be more thoroughly processed by people high in cognitive reflection tendencies, and less so by people

with low cognitive reflection tendencies. Such new insights will also not emerge in people who do not go through the abstinence experience (unconstrained use group). Hence, the cognitive reflection tendencies of this group may be less relevant for subsequent agency perceptions.

Taken together, I hypothesize that (**H2**) the increase in agency prescribed by H1b, will only accrue in people who have experienced abstinence and are high in cognitive reflection tendencies (presumably, having a strong system 2).

2. Method

2.1. Participants

A call for voluntary participation was posted on a learning management system. It recruited undergraduate students taking an introduction to statistics course; participation was motivated with bonus points. Inclusion criteria were (1) Facebook use, and (2) being over 18 years old. The study focused on users of Facebook, as an instance of social media sites, because it is a popular social media site, the abstinence from which may be challenging (Tromholt, 2016), but can produce important outcomes (Schoenebeck, 2014). The procedures were approved by the Institutional Review Board of the university. A sample of 610 users (43.3% female) was obtained, after deleting six respondents who completed only survey 1 out of 2, and 16 respondents who failed the attention-check questions. It had an average age of 23.62 (SD=3.36) years. Out of this sample, about 240 students in six sections of a course were randomly assigned to be the control group and another group of about 640 students, who were enrolled in different 16 sections of the same course were randomly assigned to serve as the treatment group. Sample characteristics, divided by condition (normal use vs. abstinence) and cognitive reflection group (low vs. high) are given in Table 1. The rightmost column shows that the groups did not differ in age, Facebook contacts and hours/day, grade point averages, and cognitive reflection tendencies.

Table 1: Sample Characteristics*

	Control (Normal Use) Group (n=185; response rate ~77.1%)			Treatment (Abstinence) Group (n=425; response rate ~66.4%)			<i>p</i> -value for between group comparisons
	Low cognitive reflection	High cognitive reflection	All	Low cognitive reflection	High cognitive reflection	All	
n	130 (70.27%)	55 (29.73%)	185	306 (72.00%)	119 (28.00%)	425	N/A
Sex [Male/Female]	64/66	33/22	97/88	177/129	72/47	249/176	N/A
Age [Mean, Range, (SD)]	23.77, 20-38 (3.26)	22.69, 20-29 (2.30)	23.21, 20-38 (3.10)	23.59, 20-36 (3.36)	23.97, 20-36 (3.83)	23.87, 20-37 (3.84)	0.39
Facebook Contacts [Mean (SD)]	4.65 (1.32)	4.71 (1.60)	4.76 (1.44)	4.44 (1.62)	4.59 (1.52)	4.48 (1.59)	0.17
Facebook Hours/Day [Mean (SD)]	1.43 (1.36)	1.40 (1.31)	1.42 (1.34)	1.46 (1.45)	1.55 (1.51)	1.48 (1.47)	0.60
GPA [Mean (SD)]	2.77 (0.57)	2.87 (0.56)	2.80 (0.57)	2.70 (0.53)	2.76 (0.61)	2.72 (0.55)	0.10
CRT [Mean (SD)]	0.26 (0.44)	2.64 (0.49)	0.97 (1.18)	0.19 (0.39)	2.59 (0.49)	0.86 (1.16)	0.31
Abstinence Days [Mean (SD)]	N/A			5.65 (1.95)	5.97 (1.95)	5.74 (1.96)	N/A

* GPA=Grade Point Average (on a 0-4 scale); CRT=Cognitive Reflection Test (on a 0-3 scale); Age [Days], Facebook Hours/day [Hours/day], GPA, CRT and Abstinence Days [Days] are reported in actual units. Facebook Contacts is reported on a 1-7 Likert scale [1= \leq 10; 7= $>$ 1000].

2.2. Design

The study included t1 and t2 (about one week after t1) surveys completed by randomly assigned control (no abstinence, normal use) and treatment (abstinence) groups. Participants also naturally varied in their cognitive reflection abilities (low vs high). This resulted in a 2 (time: pre vs post, a within-subjects factor) by 2 (condition: control vs. abstinence, a between-subjects factor) by 2 (cognitive reflection group: low vs high, a between-subjects factor) full factorial design.

2.3. Procedure

The control group received no instructions regarding what to do between the surveys. The abstinence group was asked in the consent form to agree to try to abstain from using Facebook

for up to one week¹. It was made clear to them that bonus points will be awarded regardless if they abstain the whole seven days or just part of it. The control group completed survey 2 after it was emailed to participants, about one week after the first survey. The treatment group completed survey 2, which was posted on the learning management system, one week after completing survey 1, or when they resumed use of Facebook (if this happened before the one week period). For ethicality reasons, the study did not enforce abstinence, for example, through taking over people's social media accounts.

Note that the study employed a one week abstinence task for three reasons. First, shorter “breaks”, e.g., for a day, from social media can produce transient discomfort (Elhai, Rozgonjuk, Alghraibeh, & Yang, 2019), which may confound the results. Second, one-week period is commonly used, which makes result comparison feasible (Turel, Cavagnaro, & Meshi, 2018). Third, for convenience reasons, it seems less feasible to ask participants to take longer breaks from social media (Tromholt, 2016).

Cognitive reflection was a naturally occurring factor based on the number of correct answers on the Cognitive Reflection Test (CRT); people who answered fewer than two questions correctly were classified as having “Low cognitive reflection” tendencies, and those with scores of two or more were classified as having “High cognitive reflection” tendencies (Frederick, 2005).

¹ The treatment condition consent contained the following instructions: "In between the surveys, you are asked embrace a personal challenge- to abstain from using Facebook for up to one week (seven days). To do this, we ask that you log out of Facebook on your computer, cellphone, tablet and any other devices, and that you consider uninstalling the app from your phone or tablet. If you find that you absolutely cannot make it the full seven days, please complete survey 2 before you resume use of Facebook."

2.4. Measures

Descriptive data and control variables (age, sex, contacts on Facebook, hours/day on Facebook) were captured in the first survey. Age was measured with a write-in numerical response question, sex was captured by asking individuals to choose their biological sex at birth [0=male, 1=female], Facebook contacts was measured using a Likert scale ranging from 1="0-10" to 7="more than 1000", and Facebook use time (hours/day) was measured with a Likert scale ranging from 1="less than 1" to 7="at least 6". For ease of interpretation, this scale was converted to estimated actual hours, with less than 1 recoded as 0.5, and "at least 6" recoded as 6. GPA in the last semester was used for control purposes, as a proxy for academic abilities. Objective GPA scores were retrieved from the academic portal.

This survey also captured CRT scores by using the three CRT questions (Frederick, 2005). Example question is: "A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost?" A count of correct answers captured the cognitive reflection tendencies of individuals; zero or one correct answers ($n=436$) were coded as "low cognitive reflection" and two or three correct answers ($n=174$) were coded as "high cognitive reflection" (Frederick, 2005). Lastly, survey 1 also captured perceived agency (behavioral control) with three items from (Turel, 2016): "I have control over my use of this website", "I have the ability to control using this website", and "It would be easy for me to control my use of this website" ($\alpha=0.880$). This scale was also captured in survey 2 ($\alpha=0.889$). Change in perceived behavioral control for each respondent was operationalized as the average of scale items at t_2 minus the average of the items at t_1 .

The treatment group received an additional question in survey 2, "How many days did you manage to abstain from using Facebook as part of this study?" with answers ranging from

0.5=less than one day to 7=the whole seven days. It was decided to use self-reports and not time-stamps for the surveys given that time stamps of survey 2 and use resumption can be disjointed events. Importantly, participants had no incentive to cheat and misreport their abstinence duration (equal compensation was given, regardless of abstinence duration). The control group was asked in survey 2, for checking purposes, whether they used Facebook over the last week, since they completed survey 1. Lastly, one attention check was included in each survey (a request to select a specific answer).

2.5. Statistical Analyses

First, descriptive statistics and Pearson correlations were generated with SPSS 27. Next, to examine the hypotheses, data were analyzed using a repeated-measures analysis of variance (RM-ANOVA) in SPSS 27. The model included one within-subjects factor (time), and two between-subjects factors (treatment and CRT group). To allow a deeper examination of the differences in agency observed in the RM-ANOVA model, I also estimated an ANOVA model with the change in agency (difference between t1 and t2) as the dependent variable. It included the condition (control=0 vs. abstinence=1) and cognitive reflection group (low=0 vs. high) as fixed factors.

Last, to further enrich the testing of H1b, the paper reports a mediation model (PROCESS macro, model #4, see Hayes, 2017) applied to the abstinence group only. The model included agency at t2 as the dependent variable, abstinence days as the mediator, and agency at t1 as the independent variable. It also included the five collected covariates as controls. It was expected that if the learning-through-experience hypothesis holds, higher agency at t1 would result in more abstinence days, which in turn, will increase one's sense of agency at t2.

3. Results

All participants in the control condition reported using Facebook over the last week, since survey 1 was completed. A large portion of the abstinence condition group (254, 59.8%) managed to complete the challenge and abstain the whole week. Few participants (7.2%) abstained for about one day or less. The rest (33%) abstained between two to six days. Abstinence days did not correlate with age ($p=0.298$), sex ($p=0.438$), Facebook contacts ($p=0.143$), GPA ($p=0.145$), and CRT scores ($p=0.126$). It did negatively correlate with hours/day of Facebook use ($r=-0.207$, $p<0.001$). This can be interpreted as showing that people who were used to spend many hours on Facebook before the abstinence challenge, found it more difficult to maintain their abstinence during the task, and consequently abstained fewer days.

Correlations among study variables are reported in Table 2. Because none of the potential covariates correlated with changes in agency, subsequent analyses excludes these covariates. Results of the repeated-measures ANOVA model are given in Table 3. The significant three way interaction shows that differences between t1 and t2 depend on treatment and CRT group. The two-way interactions of time with (a) treatment and (b) CRT group show that there are differences in changes in agency between (a) the treatment and control groups, and (b) the CRT groups, respectively. Simple effects analysis revealed a significant reduction in agency in all conditions but the high CRT-abstinent group (from 5.07 at t1 to 5.50 at t2). Time*CRT group interaction was significant in the treatment ($F=34.04$, $p<0.001$, $\eta^2=0.074$), but not in the control condition ($F=0.41$, $p=0.522$, $\eta^2=0.002$).

To better understand the pattern of differences, I calculated ANOVA-based marginal means scores for the difference between t1 and t2 agency. The change in agency was significantly positive only in the Treatment- High CRT condition (0.426, 95% CI= [0.220;0.632]). In all other

conditions, it was significantly negative with 95% confidence intervals below zero. The Treatment- High CRT condition significantly differed (based on confidence intervals, at least at $p<0.01$) from the reductions in PBC observed in the other groups. These differences are depicted in Figure 1. Overall, the significant treatment*time effect combined with the ANOVA results supported H1a and H1b. The significant three-way interaction combined with the ANOVA results supported H2.

Table 2: Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Treatment (0=Control)							
(2) CRT Group (0=Low)	-0.02						
(3) Δ Agency	0.16**	0.19**					
(4) Sex (0=Male)	-0.06	-0.05	-0.08				
(5) Age	0.04	-0.01	0.01	-0.10*			
(6) GPA	-0.02	0.07 [†]	0.01	0.02	-0.06		
(7) Facebook Contacts	-0.06	0.04	0.01	-0.09*	-0.19**	-0.05	
(8) Facebook Hours/Day	0.02	0.02	0.04	0.11**	-0.01	0.02	0.18**

[†] $p<0.10$, * $p<0.05$, ** $p<0.01$

Table 3: Repeated-Measures ANOVA Results

Source	F	Sig.	Partial Eta ²
Time (t1 vs t2)	10.77	0.001	0.017
Treatment (Control vs Abstinence)	7.72	0.006	0.013
CRT group (low vs high)	1.08	0.299	0.002
Treatment * CRT Group	0.005	0.942	0.000
Treatment * Time	22.87	0.001	0.036
CRT Group * Time	13.52	0.001	0.022
Treatment * CRT Group * Time	6.23	0.013	0.010

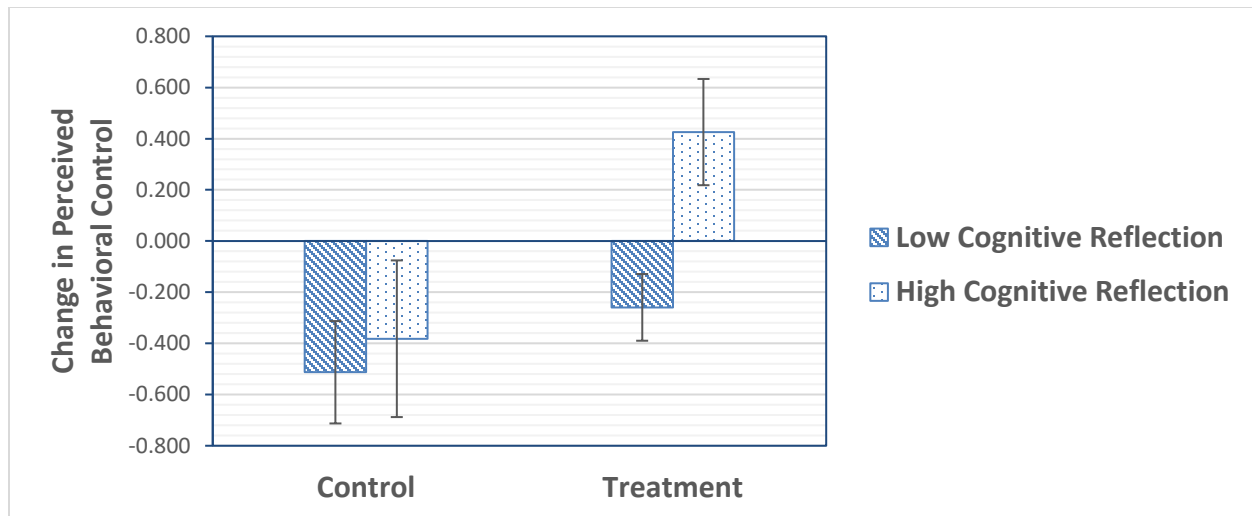


Figure 1: Changes in Perceived Agency in the Treatment and Control Groups, for people with Low vs. High Self Reflection Tendencies.*

* Bars represent 95% confidence intervals. Non-overlapping intervals represent significant differences, at least at $p < 0.01$. Slightly overlapping intervals (less than 50% overlap with one arm of the confidence interval) represent significant differences, at least at $p < 0.05$ (Cumming, 2009).

Lastly, the additional mediation analysis applied only to the treatment group (those who abstained) resulted in the model depicted in Figure 2. The indirect effect of agency at t1 on agency at t2, as mediated via abstinence days was significant (completely standardized $\beta = 0.047$, 95% CI=[0.020;0.082]). These findings imply that agency at t1 drove longer abstinence periods, which is consistent with one path of social cognitive theory. In addition, longer abstinence periods resulted in increased agency at t2, beyond what is explained by agency at t1 and covariates. This supports the learning-through-experience mechanism that underlies H1b and the ability of behaviors (abstinence in our case) to re-calibrate agency assessments, as also prescribed by social cognitive theory (Williams & Williams, 2010). Hours of use per day before abstinence were negatively associated with abstinence duration. This may reflect the inertia of users.

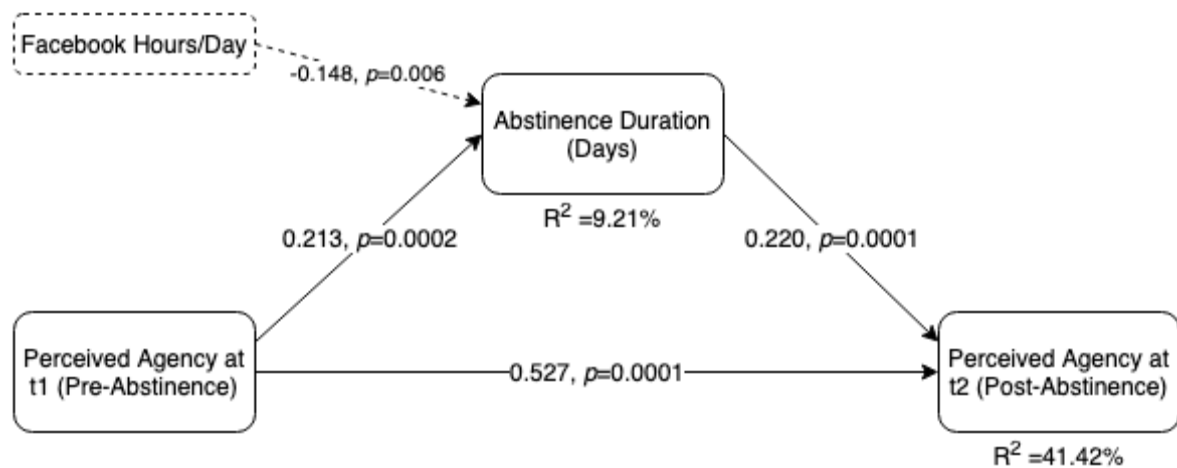


Figure 2: Mediation Model*

* Standardized path coefficients.

4. Discussion

This study aimed at examining a practical way to change people's sense of agency over their use of social media. Improving this agency can allow people to live responsibly with their social media sites and have improved wellbeing. While much research on agency and loss of agency was conducted with regards to bots and avatars (Araujo, 2018; Felnhofer et al., 2018; Hasler, Tuchman, & Friedman, 2013; Kim & Sundar, 2012; Kothgassner et al., 2017) and in the context of substance use (Heinz et al., 2020), there seems to be a need to understand perceived agency over use in the context of social media use and ways to amend it. I proposed that through learning/ information processing stemming from a brief abstention from social media use (up to one week), users can regain and increase their sense of agency, but only if they internalize the insights from the abstinence experience. This internalization requires high cognitive reflection tendencies. At the same time, I suggested that merely invoking people to reflect on their agency over social media use (e.g., through asking them about it in a survey) followed by a natural use

of the system (i.e., with no intervention), will drive realization that people have lost some degree of agency over social media use (Osatuyi & Turel, 2020).

Both of these assertions were supported in a pre-post, treatment-control experiment with people with low and high levels of cognitive reflection. The results demonstrated that a control group that reflected on their agency over social media use but received no abstinence intervention, demonstrated a reduction in perceived agency, presumably through realizing that they possess weaker than initially assumed abilities to control social media use. In contrast, when a brief abstinence intervention was added invoking reflections on agency, users learned that they can exert control over social media use if they want, and this increased their sense of agency. This effect happened only for users high in cognitive reflection tendencies, presumably because this reflection is more effortful and deeper. As such, users with low cognitive reflection tendencies who abstained, failed to internalize the new insights from the abstinence experience, and presented changes in agency perceptions that were similar to these presented by the control group; it was easier for them to maintain the status quo and ignore information that requires effortful processing. Note that reduction in agency was observed in all levels of cognitive reflection in unconstrained use people, presumably because they do not have the same level of new insights to process, like people in the abstinence group.

Examining the abovementioned assertions and the resultant findings are important not only for understating how to increase people's agency over social media use and when this approach works, but also because they can help to understand what happens to people who abstain from social media use. Such abstinence attempts have become popular (Wilcockson, Osborne, & Ellis, 2019); for instance, people know, on average, 3.32 friends who tried to quit using a social media site, at least temporarily (Turel, 2016). Nevertheless, the effects of such abstinence attempts on

various aspects of user lives, including their sense of agency and subsequent behaviors are understudied. This line of work has shown that abstinence attempts can improve people's wellbeing (Tromholt, 2016), reduce their stress (Turel et al., 2018) and change their time perception (Turel & Cavagnaro, 2019).

Here, I extend this view and show that abstinence can change people's sense of agency over social media use, but only if individuals are willing to exert effort to process the new information; i.e., when they have high cognitive reflection tendencies. This finding is not only important because it explains an overlooked outcome of abstinence, and the conditions under which this outcome accrue, but also because it can pave the way for the development of interventions. For example, "detox" from social media has gained momentum as a clinical tool for treating excessive use (Turel & Vaghefi, 2019). Thus, understanding what happens to people undergoing "detox" and finding ways to increase their sense of agency are important future research directions that can build on the findings presented in this study. This study's findings may also inform research on abstinence from other technologies, such as video games (Evans, King, & Delfabbro, 2018; King, Herd, & Delfabbro, 2018; King, Kaptsis, Delfabbro, & Gradisar, 2016), by pointing to a need to consider reflective outcomes, such as changes in perceived agency, after abstinence attempts and to the role of cognitive reflection tendencies in the development of such reflections.

The findings can also inform research on interventions aimed at reducing substance use or problematic gambling, because such interventions often focus on informing people about the nature of their behavior vi-a-vis comparison to others, changing learning and motivation (Heinz et al., 2020; Peter et al., 2019). Hence, the finding here can provide a basis for studying how abstinence from gambling or substance use can inform change learning and motivation processes

to alter gamblers' and substance users' sense of agency. Nevertheless, because the intervention here worked only in people high in CRT, this may present a challenge for substance users and heavy gamblers, because they tend to have impaired system 2. In substance users it is in part due to neurotoxicity; their reflective brain faculties are smaller compared to others, and they do not fully recover, even after long abstinence (He et al., 2018). Similarly, problematic gamblers and heavy users of scratch cards present low CRT scores, compared to others (Stange, Walker, Koehler, Fugelsang, & Dixon, 2018). Excessive social media users, in contrast, typically do not present prefrontal (system 2) impairments (He et al., 2017; Turel et al., 2014). Hence, it is possible that the intervention used here works well with social media users, but may not work well with substance users or problematic gamblers. This remains to be tested in future research.

Another set of insights from this study relates to cognitive reflection and to the cognitive reflection test. Cognitive reflection is a broad concept that goes beyond mathematical efficacy and the ability to inhibit pre-potent easy-but-wrong answers (Castellanos, Sonuga-Barke, Milham, & Tannock, 2006). Yet, the CRT directly captures this narrow operationalization of information processing, which focuses on math skills and pre-potent easy answer suppression (Frederick, 2005). In line with other studies that showed that the CRT, even though narrow in nature, can capture a broad set of cognitive processes and biases that reflect many executive functions (Bialek & Pennycook, 2018; Hoppe & Kusterer, 2011), I show here that it is relevant for processing new insights from effortful abstinence from social media. Thus, the findings suggest that future research on online interactions can benefit from incorporating CRT into models that focus on learning through effortful experiences. While several studies incorporated CRT into political information processing (Kahan, 2012; Pennycook & Rand, 2019) and studies on smartphone use (Barr et al., 2015), studies on, for example, fake news, online reviews, or

security warning messages can benefit from including CRT as a means to explain why some people reflect less than others when processing new information.

In addition, the findings extend the literature on dual system theory as applied to social media use. This literature has mostly focused on how system 2 exerts control over system 1 impulses when preventing problematic social media use behaviors, which stems from an imbalance between the systems (Turel & Qahri-Saremi, 2016; Turel & Qahri-Saremi, 2018). The finding here suggest that the imbalance between systems 1 and 2 may be reflected in low CRT scores. In addition, they show that the imbalance can be relevant beyond problematic use, and can inform reflections on agency. Thus, the findings imply that future research on dual-system of social media use may employ the CRT as a proxy for the imbalance between the systems 1 and 2.

Lastly, it is interesting to consider how this study might inform recent debates on priming. While many studies have used priming (e.g., Bargh, Chen, & Burrows, 1996), how priming works is a controversial topic, results have not always been successfully replicated, and there is an on-going debate in cognitive psychology questioning if cognitive processes can be primed (Voss, Rothermund, Gast, & Wentura, 2013). While in this study I did not compare a primed group to a group that is not (all participants were equally invoked here to reflect on their agency over social media use), it would be interesting to consider in future research whether my procedure actually invoked reflections, and examine the cognitive mechanisms that underlie this.

From a practical standpoint, the findings suggest that asking people about their sense of agency over social media use would, on average, trigger realization that they do not have much behavioral control over use. This can be detrimental in clinical settings, where people seek treatment for excessive use. As such, if questions about agency are posed (which is reasonable to assume in initial discussions with clients), the findings here suggest that therapists should find

ways to compensate for resultant loss of perceived agency, or at least be mindful of this loss. The findings also suggest that therapists interested in increasing users' sense of agency over social media use may employ brief abstinence treatments. When they do so, they should be mindful that such interventions are likely efficacious only in people with high cognitive reflection tendencies, which they can capture with the CRT. The efficacy of such approaches with clinical populations, though, should be examined in future research.

Interpreting the results of this study should be done while acknowledging its limitations. First, the sample was from one country, one sub-population, and focused on users of one social media site (Facebook). Generalizability to other contexts should be established in future research. Second, while CRT is an effective measure of cognitive reflection (Bialek & Pennycook, 2018), it can present sex-differences (Frederick, 2005). In this study, males ($M=0.95$) had slightly higher CRT scores than females ($M=0.83$), but the difference was not significant ($p=0.200$), presumably because all subjects were enrolled in a quantitative course that required reasonable levels of math efficacy. Nevertheless, sex differences in CRT may be more pronounced in other populations. Thus, the effect of sex differences on the internalization of abstinence insights should be studied with other samples that may encompass sex differences in math skills. In addition, other tests of cognitive reflection tendencies, beyond CRT, or even direct measures of brain activation of reflection can be employed in future research in order to extend our findings and tap into a broader and different set of cognitive reflections. Third, abstinence attempts could have side-effects, such as fear of missing out. These should be explored in future research. Lastly, given ethicality and practicality issues, this study did not enforce abstinence, did not request abstinence from all social media, and did not employ objective measures of abstinence duration. While participants had no strong motivation to cheat

(compensation was given regardless of how long they abstained), future research should find ways to measure abstinence objectively in a natural setting.

5. Conclusions

Social media sites can provide highly rewarding experiences that lead in some people to a loss of agency over social media use. I show here that this sense of agency can be restored through brief abstinence, but only in people with high cognitive reflection tendencies. These findings provide important insights for researchers examining the effects of abstinence on social media users, and for therapists treating excessive users.

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