Using Goal Setting with Praise and Antecedent Intervention to Decrease Smartphone-based Social Media Usage

Anna Þóra Gunnarsdóttir Schram[1] & Simon Dymond[1, 2]
[1]Department of Psychology, Reykjavik University, Iceland and [2]School of Psychology, Swansea University, United Kingdom

Smartphone usage may become problematic for many. The aim of the present study was to evaluate the effects of goal setting with praise and antecedent intervention for reducing adults' social media usage on smartphones. Participants seeking to reduce their social media usage were recruited and the dependent variable was the duration, in minutes, of social media application usage. The independent variables were the goal setting intervention with praise and antecedent intervention and the experimental design used was a non-concurrent multiple baseline design across participants. Results showed that the intervention was effective for three out of four participants. As an adjunctive measure, the number of daily steps taken was also measured; no discernible effects were detected. Overall, the findings of the present study indicate the potential usefulness of a combined goal setting and antecedent intervention for reducing self-reported problematic social media usage on smartphones.

Keywords: goal setting, antecedent intervention, social media usage, smartphones.

Globally, smartphone ownership is increasing (Lee et al., 2019), with 77% of American adults reporting owning a smartphone in 2017 (Perrin, 2017). Smartphones allow users to access the Internet and to install a variety of applications (Zheng & Ni, 2010) which gives individuals easier access to information, allowing them to be more socially connected, opening access to many forms of entertainment (e.g., TV, movies, games and reading) and allowing users to engage in remote-working (Oviedo-Trespalacios et al., 2019). Applications that connect people socially are called social media applications and give access to different social media platforms such as Facebook, Instagram, Snapchat, TikTok and Twitter. These platforms are "Internet-based, disentrained, and persistent channels of mass personal communication facilitating perceptions of interactions among users, deriving value primarily from user-generated content" (Carr & Hayes, 2015, p. 8).

Auxier and Anderson (2021) examined social media usage of adults (18 years and older) in the USA and found that 72% used social networking sites in some form, rising from only 5% social media usage in the year 2005. With regards to Iceland, in a survey conducted in 2016 (Gallup, 2016), 94% of respondents reported using social media in some amount and 84% used them daily or more frequently. Most respondents (92%) used Facebook, 58% Snapchat, 38% Instagram, 27% Pinterest, 20% Twitter, 14% LinkedIn and 7% Tinder (Gallup, 2016). Surveys of social media usage of adolescents in Iceland have found that 25% of respondents used social media for four hours or more every day (Palsdottir et al., 2018).

Correspondence concerning this article should be addressed to Simon Dymond (simond@ru.is)

Since the advent of the smartphone, the negative consequences of increased smartphone usage has received increasing empirical attention (Cheever et al., 2014; Clayton et al., 2015). Billieux (2012) refers to problematic use of a smartphone as when an individual is incapable of controlling their phone use and the usage has negative consequences on their daily lives. Numerous diverse negative consequences have been linked to problematic smartphone use, such as problems with sleep, increased self-reported symptoms of depression and anxiety (Demirci et al., 2015), reduced physical fitness (Lepp et al., 2013), neck pain and pain in the shoulders and lower back (Shan et al., 2013; Xie et al., 2016) and decreased function in hands (İNal et al., 2015). In addition, there is an increased danger of being in an accident while driving and using the phone (Cazzulino et al., 2014) or when walking without having complete awareness of one's surroundings (Schwebel et al., 2012; Thompson et al., 2013).

Many smartphone users state that they wish to decrease their usage, particularly of social media applications. Lee et al. (2019) conducted a survey in the UK asking participants about their smartphone usage and almost 40% of people aged 16-75 reported that they were 'sure' or 'pretty sure' that they use their phone too much. In the same survey, participants revealed that when they are trying to control their excessive smartphone use, some of the most popular methods were turning the phone off, putting it down or away, turning off notifications or changing settings to "do not disturb" or "airplane mode".

Reducing such self-reported problematic smartphone usage among typically developing ppipyations, in the absence of a formal, clinical 'diagnosis', is therefore an important challenge for applied behavioural science.

With psychological science and behaviour change, different interventions have been used to treat problematic smartphone usage, such as adapted forms of cognitive behavioural therapy (CBT), incentivised physical activity, and applications designed to manage and record usage (Choi et al., 2020; Ko et al., 2015; Lan et al., 2018; Li et al., 2018; Young, 2007, 2013; Zhong et al., 2020). Studies assessing the effectiveness of CBT rely on smartphone usage sharing the same features as mobile phone dependence (Aboujaoude et al., 2006; Chóliz, 2012; Mei et al., 2018; Tian et al., 2017) and are generally beneficial when included in weekly CBT sessions. Another intervention method is to use physical activity to decrease mobile phone dependence (Zhong et al., 2020). Once established, a new repertoire of physical activity can have reinforcing effects and generalise to new domains that make it subsequently easier to reduce one's smartphone usage (Zhong et al., 2020). For instance, Ko et al. (2015) developed a smartphone application based on Bandura's social cognitive theory (Bandura, 1991) to assist people to decrease their smartphone use with social support. Ko et al. found that participants were able to decrease their smartphone usage significantly and that they also perceived that they had more control over how much the smartphone interrupted their daily lives.

Within behaviour change generally and behaviour analysis more specifically, *goal setting* is an intervention frequently used to reduce problematic behaviour and increase more desirable forms of behaviour (Epton et al., 2017; O'Hora & Maglieri, 2008). Locke and Latham (2002) defined *goal* as "the object or aim of an action, for example, to attain a specific standard of proficiency, usually within a specified time limit" (p.705). Setting a goal or target behaviour has been used to address behaviour change in many areas, such as the school environment (e.g., Bandura & Schunk, 1981; Miller & Kelley, 1994), health-related behaviour (e.g., Alexy, 1985; Hayes & Van Camp, 2015), in organisational settings (e.g., Cunningham & Austin, 2007; Tammemagi et al., 2013) and in sports (e.g., Anshel et al., 1992; Mellalieu et al., 2006). For example, Tammemagi et al. (2013) implemented a goal setting intervention in an analogue work task to model the beneficial effect of goal setting in the workplace. Following baseline, participants either set a high, unattainable goal (high goal condition) or a low, attainable goal (low goal condition) for a computer-based data entry task before a return to baseline phase and a final phase consisting of the alternate goal to the first goal. Results from the final phase demonstrated increases in behaviour during the high goal condition compared to the low goal condition, yet considerable variability was observed participants (i.e., behavioural performance of some improved and deteriorated for others). Other applied studies of goal setting have used general, individualised goals rather than varying the level of goal setting across groups. In a study with a small sample of university rugby union players, Mellalieu et al. (2006) found that self-generated goal setting was effective across a range of topographies throughout an entire season of rugby. Despite these examples, there is limited evidence of the use of goal-setting approaches with other real-world relevant behaviour and none in the context of smartphone usage. One of the aims of the present study was therefore to evaluate the effects of goal setting for reducing self-reported problematic smartphone usage.

To maximise the potential of goal setting to reduce smartphone usage, it may be beneficial to avail of the pre-existing functions of smartphones as a form of antecedent intervention. *Antecedent interventions* involve events or conditions that occur before a target behaviour being altered to evoke behaviour change (Fisher et al., 2013). One way of using an antecedent intervention to produce behaviour change is by manipulating the discriminative stimulus (S^D) present prior to onset of the target behaviour (Fisher et al., 2013). If the S^D is present, then the behaviour is likely to be reinforced (Cooper et al., 2014), while removing the S^D should reduce the probability of that behaviour occurring. In this way, a possible antecedent intervention for smartphone usage might involve disabling or turning off app-based notifications which prompt or alert the user to check their smartphone. Without the availability of notifications, users may be less likely to use their phone and, when combined with goal setting and socially delivered attention (i.e., praise), reductions in behaviour may be maintained.

The purpose of the present, exploratory study was to evaluate, for the first time, using a single-case experimental design, the effect of using goal setting with praise and antecedent intervention to reduce social media usage on smartphones among a self-selected sample of adults in Iceland. A secondary aim was to examine the impact on physical activity of the intervention. We chose to measure any unprogrammed effects on physical activity on the assumption that the reduction in time spent using one's smartphone would be replaced with other, desirable forms of behaviour.

Method

Participants

Participants were four typically developing adults attending Reykjavík University, who owned an iPhone brand smartphone and had expressed interest in decreasing their social media usage. Participants were not made aware of each other and were instructed not to discuss the study with anyone while it was ongoing. Participants were recruited via expressions of interest received to an email sent to students at Reykjavík University. Karen was a 19-year-old female; Hanna was a 19-year-old female; Alex was a 23-year-old male, and Anna was a 21-year-old female. To protect the privacy rights of the participants, pseudonyms were used to identify individuals.

Social media applications in this study are categorized by the iPhone application, *Screen Time,* and included applications such as *Facebook*, *Messenger*, *Instagram*, *TikTok*, *Snapchat*, *Twitter*, *LinkedIn*, *Telegram*, *Discord*, *WhatsApp*, *Messages,* and *Facetime*.

All participants gave prior written consent. Special authorization from the Bioethics Committee at Reykjavík University was not needed.

Setting

The research was conducted in the participant's everyday natural environment (home, university, social settings, etc.).

Materials

The materials used in this study where each participant's self-owned iPhone brand smartphone, with a minimum version operating system of iOS 12. Two inbuilt applications, *Screen Time* and *Health,* were used to measure social media usage (measured as duration) and to count the daily number of steps taken, respectively.

Response Measurements

Measures of social media usage on participants smartphones where obtained. The main dependant variable was the duration of time measured in minutes the individuals spent using social media applications. Usage was measured when participants were looking at or manipulating the smartphone screen with a social media application open. The *Screen Time* feature recorded data on the total duration for all social media usage and broke down how that time was divided between applications. As an adjunctive measurement a second dependant variable was also recorded via *Health*: the number of steps taken by the individual each day of the study.

Experimental Design

A nonconcurrent multiple-baseline across participants design was used (Watson & Workman, 1981) A nonconcurrent component analysis was used to evaluate the effect of the intervention. In baseline, data on the duration of social media usage was measured without any intervention. In the next phase, the first intervention daily goal setting was used where the individual was given praise if the agreed goal was met. In addition, notifications for the two social media applications that counted for the longest duration of usage in baseline were removed. In the second intervention phase, the notification removal was withdrawn but daily goal setting and praise was continued as in the first intervention phase. Follow-up measurement for the duration of time spent on social media was taken for one datapoint for the participant eight days after the second intervention phase.

The intervention was introduced when stability was evident. The first participant to start the intervention was the one who first met stability (in this case, it was Hanna followed by Anna, then Karen, and Alex).

Procedures

A sequential analysis of the independent variables was used to evaluate the effect of both intervention phases. The first independent variable being goal setting with praise and the second being the removal of notifications for the two social media applications. All participants completed all phases of the experiment.

Prior to data collection, the researcher met individually with all participants via video conference for technical support, if needed, and explanation of how measurements would be collected. Participants were shown how to monitor their usage on their smartphones and taught how to screenshot and forward the data to the researcher. This allowed for a remote data collection and to limit the possible effect of meeting in person during the research. All participants were encouraged to request further assistance if needed.

Phases were arranged in such a way that the interventions would be faded out for a more relevant clinical result, starting with inserting both interventions in the first phase and then retracting the more restrictive intervention in the next phase. Each phase lasted until the participants had met the agreed goal for three consecutive datapoints or until data stabilized.

Baseline

Data for baseline was collected by *Screen Time* and *Health* on each participant's iPhone. Each day after the start of baseline measurements, the participants sent a screenshot of their daily phone usage from the day before taken from the applications. Two screenshots had to be sent from *Screen Time* that showed the number of minutes the individual had spent on social media applications and then how that time was divided between applications. At the same time, they would also send a screenshot from *Health* where the number of steps taken each day would be visible. These screenshots where sent via email or text message from participants to the researcher. Any other contact with participants during baseline was minimized to avoid giving feedback and social reinforcement. All data collected was entered into two different frequency graphs each day after data was received by the researcher, one for each dependent variable (number of minutes of social media usage and number of steps taken).

Intervention Phase 1 (INT 1) - Daily Goal Setting with Praise and Notification Removal

Interventions were introduced where goal setting with praise and notification removal was used. A daily maximum social media usage limit was set for all participants in duration of time. The limit was based on the individuals mean baseline behaviour. The researcher met with each participant separately to discuss their daily social media usage limit goal. This goal was required to be a minimum of 30% decrease in duration in social media usage calculated from the mean duration of usage recorded during the baseline phase. Hanna set her goal of maximum social media usage at exactly 30% decrease in duration from her mean baseline measurements or at 143 minutes of usage a day. Anna's goal was a 30% decrease in usage or at 40 minutes a day. Karen set her goal at a 30% decrease or 147 minutes each day and Alex set his goal as a 30% decrease or 150 minutes of social media usage a day.

Participants were encouraged to reach their goals and received praise from the researcher when they succeeded in meeting their goal (i.e., when their usage was at or under the agreed daily limit) consisting of phrases like, for example: "Well done", or "Good job hitting the goal!"

In addition, notifications for the two most used social media applications (information extracted from baseline) were turned off. This way, the participants would not get a notification when something new was going on in those two applications, neither a sound nor any visual signal on their screen. To be able to see what was going on in these two applications, the participants had to press the application on the screen and start it up.

Intervention Phase 2 (INT 2) - Daily Goal Setting with Praise

Goal setting was still in place where participants were encouraged to reach their goal and praised when able to meet it. Notifications for the two most used social media applications were turned on again after removing them in the first intervention phase.

Follow-up

Follow-up measurements were taken on the duration of time spent on social media applications daily. This was conducted eight days after the last INT 2 ended for the last participant that finished the study.

Interobserver Agreement

A student was recruited for interobserver agreement (IOA). The researcher sent the student screenshots of the participants' social media usage duration and the number of steps taken each day. Trial by trial IOA was used, and agreement was calculated by dividing the number of agreements by the total number of trials and multiplying by 100%. Interobserver agreement assessment (IOA) was done on 47% of the overall sessions for all participants. The overall average of agreement for all participants for both dependent variables was 98%. The average of agreement for social media usage was 95% and the average of agreement for steps taken was 100%. For Hanna, IOA was done on 70% of all sessions and the average IOA was 100% for both minutes of social media usage a day and steps per day. For Anna, IOA was done on 44% of all sessions and the average of agreement for minutes of social media usage each day measured at 90% and the average for steps each day was 100%. For Karen, IOA was done on 34% of all session and the average of agreement for minutes of social media usage a day and steps per day was 100%. IOA was done on 37% of all sessions for Alex, with the average of 91% agreement on minutes of social media usage each day and a 100% average on steps each day.

Social Validity

After the last intervention phase for all participants, they were asked to answer an open-ended questionnaire anonymously to assess the social acceptability of the intervention used in this study. This questionnaire was created in *Google Forms* and sent to the participants by email. The questionnaire contained five questions concerning how effective they thought the intervention was, if they intended on continuing with the intervention in some manner, if they were satisfied with their experience in this study, if they would recommend to others to use this method to decrease social media usage and if they had any comments regarding the study.

Results

Results for duration of social media usage each day are presented in Figure 1 for participants across all experimental conditions.

Hanna's Goal Setting and Antecedent

During baseline for Hanna, social media usage a day ranged from 202 - 265 minutes (mean: 216 min) over the baseline. During her first intervention phase (INT 1) daily social media usage decreased in duration, ranging between 135 - 166 minutes (mean: 148 min) per day. After implementation of the second intervention phase (INT 2), daily social media usage decreased further and ranged from 107 - 158 minutes (mean: 132 min) a day over the phase. Both intervention phases effectively decreased social media usage for Hanna, and she met her set daily goal in INT 2.

Anna's Goal Setting and Antecedent Intervention

Anna, social media usage each day ranged from 31 - 116 minutes (mean: 66 min) per day during baseline. After implementation of INT 1, social media usage a day decreased, ranging from 34 - 46 minutes (mean: 39 min) a day. During INT 2 social media usage was ranging from 21 – 47 (mean: 36 min) each day. Both INT 1 and INT 2 had effect on Anna's social media usage causing a visible decrease in usage and meeting her set daily goal in both phases.

Karen's Goal Setting and Antecedent Intervention

During baseline for Karen social media usage per day ranged from 101 - 370 (mean: 210 min) of usage each day. After introducing INT 1, usage decreased and ranged from 106 -117 minutes a day (mean: 111 min) daily. For INT2, Karen's usage stabilized and ranged from 105 – 121 (mean: 111 min) a day. Both intervention phases effected Karen's daily social media usage producing a decrease in usage and Karen meeting her set daily goal in both INT 1 and INT 2.

Alex's Goal Setting and Antecedent Intervention

Alex's daily social media usage in baseline ranged from 114 - 364 minutes (mean: 215 min) per day. After entering INT 1, Alex's usage increased, ranging from 147 - 357 (mean: 240 min) a day. INT 1 did not have the intended effect on social media usage for Alex and produced no decrease in usage.

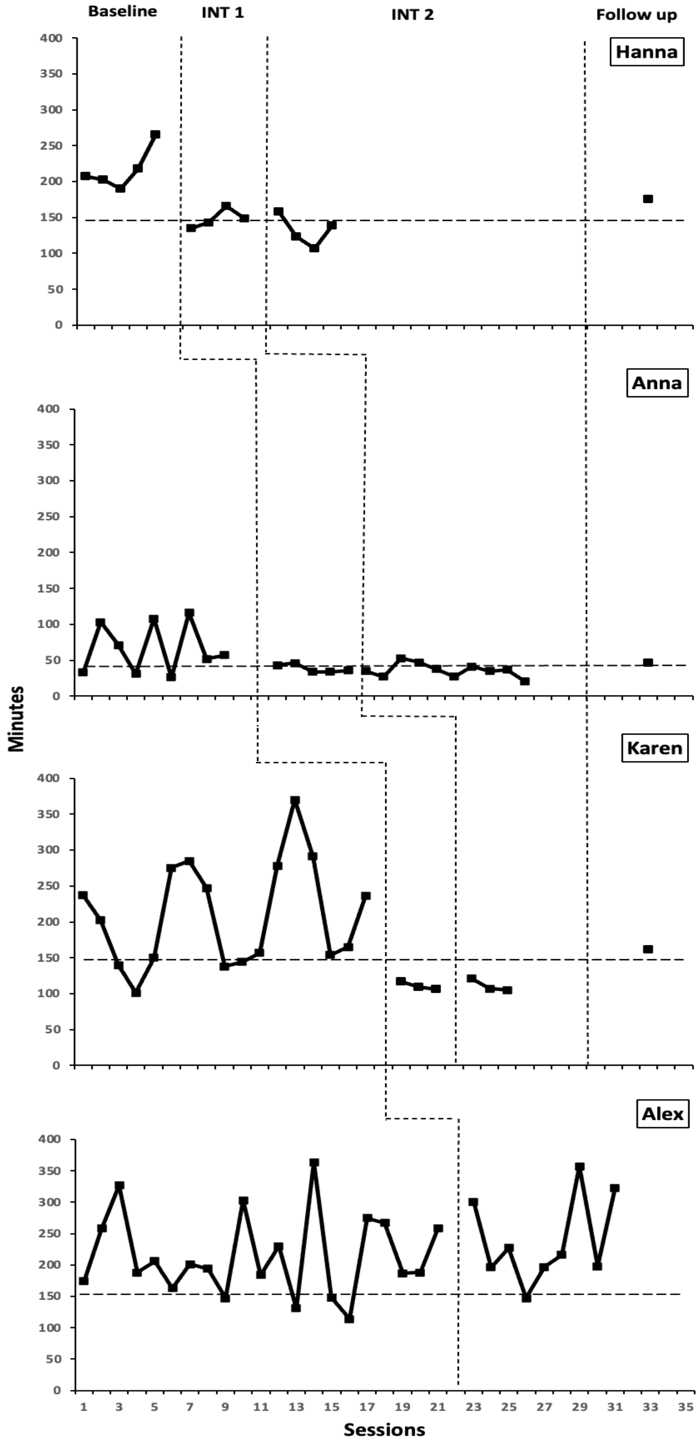

Figure 1. Changes in Daily Duration of Smartphone-based Social Media Usage.
Note: Each participant's set goal of social media usage is marked with a horizontal dashed line.

Follow Up

In Figure 1, follow-up measurements for Anna, Hanna's, and Karen's duration of daily social media usage are presented. Hanna's follow-up measurements were obtained 18 days after finishing the intervention and her social media usage duration was 175 minutes for the day. Anna's follow-up was taken seven days after finishing the intervention and measured at 46 minutes and Karen's follow-up was taken eight days later and measured 161 minutes.

Daily Steps

Results for number of steps taken a day for each participant are presented in Table 1 across all experimental conditions.

For Hanna, the number of steps each day during baseline ranged from 4753 - 7672 steps (mean: 6533) a day. After implementation of INT 1, the number of steps taken a day increased slightly, ranging from 4172 - 8712 steps (mean: 6723) each day. During INT 2, steps a day went up, ranging from 6868 - 20929 with (mean: 11345) a day.

During baseline, the adjacent measurement of the number of steps taken each day for Anna ranged from 326 - 1132 steps (mean: 637) each day in the phase. For INT 1 Anna's number of steps increased ranging from 494 - 6036 (mean: 2045) daily. In INT 2 steps went up and ranged from 403 - 12058 (mean: 2965) a day.

For baseline the number of the number of steps taken each day for Karen ranged from 1089 - 17829 steps (mean: 8743) each day. In INT 1, Karen's steps each day went up and ranged from 10201 - 16737 with the average number of steps being 12438. For INT 2 steps went down and were ranging from 1273 - 8344 (mean: 4129) a day.

For Alex, the number of steps taken each day in baseline ranged from 388 - 4795 steps (mean: 2211) a day. In INT 1 Alex's step count went down and ranged from 922 - 3285 (mean: 1596) a day.

Social Validity

All participants reported that the intervention was effective for decreasing social media usage and all answered that it is likely that they will use the intervention in the future. One individual further explained that even though they thought the intervention

	Baseline		INT 1		INT 2	
	Range	*Mean*	*Range*	*Mean*	*Range*	*Mean*
Hanna	4,753-7,672	6,533 (1,302)	4,172-8,712	6,723 (2,145)	6,868-20,929	11,345 (6,481)
Anna	326-1,132	637 (302)	494-6,036	2.045 (2,270)	403-12,058	2,965 (3,541)
Karen	1,089-17,829	8.743 (5,511)	10,201-16,737	12,438 (3,724)	1,273-8,344	4,129 (3,726)
Alex	388-4,795	2,211 (1,193)	922-3,285	1,596 (974)		

Table 1. Range and Mean (standard deviation) Daily Steps in Baseline, the First Intervention (INT 1) and the Second Intervention (INT 2).

was effective, they were unable to decrease usage due to personal reasons. All reported that they were satisfied with their participation in the study and did not suggest any improvements, and that they would recommend the method to other individuals. The three participants that were able to decrease their social media usage during the intervention phases (Hanna, Anna, and Karen), were asked if they thought they were able to utilize the time they gained after decreasing social media use for other activities. One participant reported using the time for studying, exercising, and relaxing. The next participant said they were able to go on walks and felt more "in the now", and the third answered that they used the time for studying and spending time with family members and co-workers.

Discussion

The purpose of this study was to investigate the effect of using goal setting with praise and antecedent intervention (removing notifications for social media applications) to decrease smartphone-based social media usage in adults. These methods were utilized here for the first time to decrease social media usage on smartphones using established behaviour-analytic methods. The intervention proved overall effective, resulting in a decrease in smartphone usage for Hanna, Anna, and Karen but not for Alex, who did not finish the intervention. The effectiveness of the goal setting intervention is in line with former studies (Epton et al., 2017; Mellalieu et al., 2006; Tammemagi et al., 2013).

For Hanna, social media usage decreased visibly in INT 1 but did not reach the set goal in usage until INT 2. It is right to note that INT 1 for Hanna should have been made longer to see if usage would have kept decreasing and if she would have reached the set goal in the phase. Unfortunately, time limits prevented further data collection. Anna's social media usage decreased after entering INT 1 and remained low through INT 2, meeting her set goal for social media usage in both intervention phases. Karen's usage decreased after INT 1 had been introduced and she met her goal for both intervention phases confidently. Alex's usage did not reduce after starting the intervention and when INT 1 was introduced he revealed to the researcher that special circumstances required him to use social media (i.e., Messages) for the next few days and was sceptical of his ability to decrease his usage at this time. This inadvertent side effect could explain why his social media usage did not decrease after INT 1 was started. After continuing with INT 1, the participant showed no sign of commitment to changing behaviour and thus the researcher ended the intervention for him.When examining the secondary aim of daily social media usage on smartphones and the number of daily steps taken by the individual, no evident relationship was found for the participants (Table 1). This is perhaps not surprising given the response-specific nature of the reinforcement contingencies applied, which were implemented only for goal setting and not daily steps. That is, the duration of smartphone use was targeted, not steps, which would only be expected to change based on transfer of stimulus control or unprogrammed generalization (Stokes & Baer, 1977).

During follow-up measurements for Hanna, Anna and Karen, their usage was marginally higher than their set goal for the intervention phases but for all, it remained lower than the average usage measured in their baseline, possibly indicating a maintenance effect. It would be interesting for future researchers to take follow-up measurements longer after the interventions have ended and to take follow-up data for a longer period. That way it would be possible to see if the effect of the intervention lasted for a longer time after ending the study and to make sure that the one data point taken for follow up measurements was a good indicator of participant's usage after the study has ended.

In terms of social validity, there was an overall satisfaction with the intervention amongst all participants and Hanna, Anna and Karen answered that the time they would have spent on social media was replaced by activities such as studying, relaxing, exercising, spending time with their family and co-workers and one participant expressed feeling more in the "now".

The research design used does not make it possible to rule out that goal setting with praise was the main variable in driving the decreased usage for the participants since there was no notable difference between social media usage in INT 1 and INT 2, with usage even going down when notifications were turned back on for Hanna. Future researchers should investigate adding an intervention phase where only notifications are turned off before starting the goal setting intervention to isolate the deciding factor of the effectiveness of the intervention (Barlow et al., 2009). If goal setting proves as effective on its own, then future interventions can be less intrusive without specifying any other required changes to how participants set up and use their smartphones. However, the purpose of the present research design was to fade out the perceived restrictiveness of the interventions and for the participants to maintain positive behaviour change and to that extent was effective. Indeed, in terms of experimental control, Figure 1 shows clear evidence of changes in level and stability of the target behaviour for all but one participant when the first intervention was introduced. This is in keeping with the assumptions and explanatory power of (non-concurrent) multiple baseline designs which we extended here, for the first time, to the reduction of smartphone usage.

There are several limitations of the present study. First, the inbuilt iPhone feature called Messages was included in the classification of social media in Screen Time. Inadvertently, one participant (Alex) always sent his data through that feature to the researcher. This added an estimated minute or two on to his social media usage each day. Future researchers should make sure to be fully informed of what applications and features are included in the measures of social media. Second, participants were self-selected and their social media usage may not have constituted problematic levels according to conventional indices. Future research replicating and extending these findings should consider pre-screening participants with a standardised assessment of problematic social media use (e.g., Austermann et al., 2021). Third, there were unprogrammed difficulties in adhering the protocols for some participants. Special circumstances for Alex influenced the effectiveness of the implementation of INT 1 that could not be controlled and resulted in needing to end the intervention for him. For Anna, it was revealed after entering the intervention that she had already been utilizing the same form of antecedent intervention as is used in this study, turning off notifications for social media applications, during baseline as well. So, for Anna, INT 1 and INT 2 essentially consisted of the same singular intervention of using goal setting with praise. Even though this affected the structure of the intervention phases for Anna, in some ways this is desired when trying to decrease usage, for the individual to be able to self-manage their behaviour change. Fourth, for the participants who finished the study first, it would have been preferable to continue taking data to monitor if the intervention effects were maintained. However, a follow-up measurement was taken for that same reason and a possible maintenance effect was observed, yet the follow-up measurements were taken rather soon after the last datapoint in INT 2. It would be interesting for future researchers to do a follow-up measurement with a longer time passing after the intervention has ended, before doing a follow-up. A final limitation relates to the measurement of steps, which were only recorded by the Health application when individuals had their phone with them. As a result, bouts of responding, such as in and around one's home or place of study, were not recorded. This measurement challenge may be inadvertently impacted by decreased smartphone usage as participants remove or conceal their phones when trying to limit their usage (which is, itself, a form of antecedent intervention). Further research should investigate the impact of a similar goal setting intervention for increase physical activity, separately relative to an intervention for smartphone usage.

The present findings may have implications for self-management interventions for smartphone usage (Briesch et al., 2019). The applications we used to record data are freely available on smartphones and permit considerable flexibility for user-led self-recording and reporting. Data obtained from these applications may, for instance, be combined with socially-mediated sources of reinforcement like public graphing (Critchfield & Vargas, 1991) or types of rule-following (O'Hora & Maglieri, 2008) to initiate and maintain behaviour change in the absence of external (i.e., experimenter) input. The potential utility of these technologies warrants further consideration in basic and applied behaviour analytic research.

Overall, the findings of the present study indicate the potential usefulness of a combined goal setting and antecedent intervention for reducing problematic social media usage on smartphones. Participants were satisfied with the intervention and most showed sustained reductions in their social media usage. The intervention was unintrusive and easy to implement, hence increasing its potential social validity. Future research should obtain measurements across an extended period after achieving the set goal and allow for extensive follow-up assessments. It may also be helpful for future researchers to carefully review the range of applications included in the Screen Time measure and to systematically vary the presence or absence of disabled notifications to determine whether both goal setting and antecedent intervention are necessary for behaviour change to occur.

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