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## Self-management of Chinese University students' excessive smartphone use

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### Abstract

This study investigated whether self-management can successfully reduce excessive smartphone use to improve quality of life. Two experimental conditions were examined: experiment 1 involved self-management components, and experiment two added a goal-setting component to the self-management intervention. Three Chinese university students aimed to develop self-control of their excessive smartphone use by identifying competing behaviors to reduce their phone usage, improve their sleep behaviors, and overall quality of life. A multiple baseline design with repetition across participants was adopted. Treatment effect scores were calculated using Non-Overlap of All Pairs (NAP). Results indicated that the self-management intervention achieved moderate effects, and the additional of a goal-setting component achieved strong treatment effects, for participants who successfully reduced their excessive smartphone use. This study contributes to the literature on the use of self-management to reduce excessive smartphone use amongst Chinese university students. It also contributes to the literature on the relevance and effectiveness of Applied Behavior Analysis (ABA) interventions in China.

### Keywords:

China; excessive smartphone use; goal-setting; multiple baseline; non-overlap of all pairs; self-management

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## Introduction

Smartphone technology has developed to the extent that mobile phones greatly exceed early notions of telephony as a means of talking to one another, and now enable gaming, instant voice and video calling, messaging, and a myriad of multimedia content. They provide a means to conduct a variety of personal and commercial transactions no longer housed solely in brick-and-mortar venues. Essentially offering the functionality of a powerful pocket-sized microcomputer, smartphone use is widely considered an essential part of daily life (Park, Jeong, & Rho, 2020). While smartphones provide many benefits to their users and enhance the ease of daily living, many gaming and social media apps have the ability to facilitate immediate gratification for little effort, offer escapism, and create a distraction from the tasks at hand. Successfully managing this aspect of smartphone technology presents challenges to many users. An awareness of this challenge is evident in the literature, with Park and colleagues (2020) highlighting that the global popularity of smartphones has also raised concerns surrounding the negative effects associated with problematic smartphone use.

Research has indicated that excessive use of smartphones is often observed by teachers in classrooms and may contribute to students' reduced concentration and engagement in the learning process (Shrivastava & Shrivastava, 2014). Many parents also describe their children's overuse of smartphones outside of school hours (Buabbas, Hasan, & Shehab, 2021). This behavior may interfere with homework, extra-curricular activities, meal times, and sleep routines. Arguably, the phenomenon of overuse of smartphones is comparable to other forms of addictive behavior, whose harmful effects of over-indulgence come at a cost to the individual.

While many compulsions or addictions have been incorporated into the American Psychological Association's Diagnostic and Statistical Manual, vs 5-TR (2022), "mobile phone" or "smartphone" addiction is not currently formally recognized. However, significant interest in smartphone addiction (SPA) has been observed in the academic literature. A PsycINFO titles and abstracts search of the keywords "*smartphone* OR *cell phone* OR *mobile phone*" AND "*addiction*" was conducted in March, 2026. The search was limited to peer-reviewed literature published in English that had employed a "literature review" methodology, and no publication date range limit was imposed. This search identified 65 literature reviews. When further limited to young adulthood, between 18 and 35 years, four reviews were identified (Nambirajan et al., 2025; Méndez, Padrón, Fumero, & Marrero, 2024; Wack & Weinstein, 2021; Hutton et al., 2021). Noticeably, these reviews were all published within the last five years, suggesting a surge in attention to SPA.

Most recently, Nambirajan and colleagues (2025) examined empirical literature that suggested a negative impact on physical health attributed to excessive smartphone use. Their meta-analysis of 10 studies that represented 5,195 participants led to their conclusion that SPA is significantly linked to reduced physical activity among younger populations. These authors highlighted the need for targeted public health interventions and longitudinal studies to mitigate excessive smartphone use as a critical component in promoting active lifestyles.

Méndez et al. (2024) defined SPA as involving the excessive use of smartphones, disrupting users' daily lives. The findings of their review provided evidence for neuroanatomical similarities between internet addiction (IA) and SPA in young adults and adolescents, related to executive functions and reward processing. Elsewhere, Wacks and Weinstein (2021) reported that excessive smartphone use is associated with difficulties in cognitive-emotion regulation, impulsivity, impaired cognitive function, addiction to social networking, shyness, and low self-esteem. They described a variety of medical concerns, including: sleep problems; reduced physical fitness; unhealthy eating habits; pain and migraines; reduced cognitive control; and changes in the brain's gray matter volume. These authors concluded that excessive smartphone use is associated with psychiatric, cognitive, emotional, medical, and brain changes that should be considered by health and education professionals.

A literature review conducted by Hutton and colleagues (2021) focused on interventions to reduce alcohol use in young people, and highlighted that text messaging was an effective intervention component. While their review was considered to be off topic for an investigation into excessive smartphone use, it is noteworthy in that it highlights a positive use of smartphone technology for young adults.

Young adulthood is a period marked by growing independence. For many people, it comes with a strong desire to succeed without relying on others for help. It may be argued that on this basis, many college students will not seek treatment for addictive smartphone behaviors despite an awareness of the impact it has upon their daily functioning, and by extension, upon the academic achievement. As highlighted in the literature, treatment for behaviors of concern is nonetheless vital to optimize health and academic outcomes for this population. Arguably, optimal sleep is the foundation of these outcomes.

Smartphone use often provides immediate gratification and is similar in this regard to many other habit-forming behaviors. Random likes or messages in social media apps provide reinforcement in a variable ratio schedule, which may lead to frequent smartphone checking. This unpredictable nature of rewards, similar to the experience of gambling, may make extinguishing the behavior challenging. Over time, the behavior of smartphone checking may become habitual. Habitual behaviors such as smoking and gambling have been successfully treated using self-management procedures that include techniques like self-monitoring, goal setting, and reinforcement strategies. Self-management interventions support habit reversal through self-regulation, alleviating the need for a therapist (Miltenberger, 2023).

Self-management has been defined as an individual's application of behavior change procedures that produce a desired change in behavior (Cooper, Heron, & Heward, 2020). In self-management interventions, an individual typically acts as both the "manager" who plans, monitors, and controls the procedures, and also as the "managed" individual who displays the target behavior. Cooper, Heron & Heward (2020) explain that both functions are central to an individual establishing self-control over a target behavior. Self-management procedures have been examined in educational settings as a mechanism to teach a new skill, increase a desired behavior, or reduce the occurrence of an undesirable behavior, with a body of research evidence dating back half a century (Ballard & Glynn, 1975; Broden, Hall, & Mitts, 1971; Glynn & Thomas, 1974).

Self-management treatments may be individualized to meet the participant's specific behaviors, environment, goals, and preferences, thereby increasing the likelihood of successful behavior change (Miltenberger, 2023). They typically include some combination of self-monitoring, self-observation, self-evaluation, self-recording, and self-reinforcement components. Several significant benefits to individuals seeking to modify their behavior have been reported, including the promotion of personal responsibility, the ability to generalise to novel settings or behaviors, the ability to maintain behavior change over time, habit control, and their cost-effectiveness (Cooper et al., 2020).

A goal-setting component is included in self-management interventions approximately half of the time (Briesch & Chafouleas, 2009). Goals have been defined as the object or aim of an action that an individual is trying to accomplish (Locke, Shaw, Saari, & Latham, 1981). A goal is generally understood to have been achieved when a certain standard of task proficiency has been met, often within an acceptable time frame (Locke et al., 1981). Building upon their earlier goal-setting research, Locke and Latham (1990) reported that performance can be improved by the use of a goal-setting condition. They specifically noted that goals should be clear and specific, challenging yet achievable, that individuals should be committed to their goal, that a form of feedback exist to support progress tracking, and that complex tasks may require additional training or support to achieve (Locke & Latham, 1990). Briesch & Chafouleas (2009) further indicated that behavioral gains may be greater if students are responsible for setting their own goal.

Little is known about the use of self-management interventions, either with or without a goal setting component, for behavior modification in China. Huang, Lee & Zhang (2022) reviewed

Applied Behavior Analysis (ABA) research published in China and highlighted that university-based ABA program are urgently needed in Chinese universities. They emphasized that single subject designs should be promoted to facilitate the use of techniques they described as “powerful and practical” tools (Huang et al., 2022).

The desire to self-manage personal challenging behaviors may be even greater amongst Chinese university students when compared to their Western contemporaries. Chinese students either in China, or abroad, have been strongly influenced by Confucian values, cultural beliefs surrounding emotional restraint and mental health, and social stigma, resulting in an even greater hesitancy to seek professional help for challenging behaviors. Seeking therapy may be viewed as a weakness or even a failure within the family, or there may be a lack of trust of Western psychology that has only been recently established in China. For these reasons, Chinese students may more readily suffer hardship by internalizing challenges and adopt a self-reliant coping style (Huo, 2014). Individualized self-management techniques may be particularly appealing for students who may mask their personal challenges or be otherwise reluctant to seek outside professional help.

Masters' students studying a 3-credit course in Principles of Behavior Modification in a Sino-foreign university hypothesized that their excessive smartphone use late at night was the cause of procrastination, impaired work productivity, late sleep times, late waking time, and poor sleep quality. Ethics approval for this study was obtained through the universities' Office of Research and Sponsored Programs. All participants signed an informed consent form, and were aware of their right to withdraw from the research at any time. Smartphones can be used in beneficial ways, and avoiding smartphones altogether is arguably an unrealistic response. Developing the self-control to reduce excessive smartphone use is of great importance. Accordingly, the purpose of this research was to examine the effects of applying self-management procedures to reduce students' excessive smartphone use that was self-reported as disrupting their daily activities. Further, the study aimed to explore the use of individualized self-management procedures by Chinese students studying in Mainland China, to further inform the emerging ABA literature in China. The following research questions were developed:

RQ1. Is self-management an effective intervention for reducing excessive smartphone use amongst university students in China?

RQ2. How does the addition of a self-set goal condition affect the self-management of smartphone use amongst university students in China?

## **Method**

### **Participants and Setting**

Two females and one male participated in the current study. All participants were full-time students whose ages fell within the young adult range (18-35 years). All participants were described as Chinese nationals studying in English as a second or other foreign language at a Sino-US university in China. In-person lecture attendance was a compulsory requirement for all courses. All names are pseudonyms. The two females, Meilin and Shuyue, resided in their own private rooms in the student dormitories on campus. Huixin resided in a private apartment off campus. All students were described as typically developing. The intervention took place in the student's private living quarters. All participants reported having concerns regarding excessive smartphone use that interfered with their daily activities.

### **Research Design**

A multiple baseline design with repetition across three participants was adopted. Self-management procedures were taught in lectures during week 9 of the semester, and built upon earlier lectures and assignments that had covered observation and recording of behavior, graphing behavior, reinforcement, punishment, and ethics. To establish self-control over their excessive

smartphone use, participants acted as both the manager and planned their own individualized intervention procedures, and managed who self-administered their own intervention procedures (Cooper et al., 2020). Data was gathered for each participant during a baseline phase, before the introduction of competing responses to their existing smartphone behaviors. Consistent with habit-reversal procedures, a self-training of competing response was then conducted. Following this, data were gathered for the treatment phase, in which each student attempted to adhere to their treatment plan. Students were separated into two experimental conditions based on the intervention plan they developed. In experimental condition 1, Huixin and Meilin employed the components of self-observation (SO), self-recording (SRg), and self-reinforcement (SRt). In experimental condition 2, Shuyue included a self-set goal (SG) component in addition to SO, SRg, and SRt. As this study was conducted during the second half of the final semester, and students left campus upon their graduation, there was no opportunity to collect follow-up data to determine if any intervention effects were maintained over time.

### Calculating Treatment Effect

Visual examination of the data revealed several instances of floor data in baseline, suggesting that a treatment effect score based upon the widely adopted Percentage of Non-Overlapping Data (Scruggs & Mastropieri, 1998) would result in scores of 0%. It appeared that PND was not a suitable treatment effect score for this dataset, as a 0% score was inconsistent with prior visual analysis of the treatment effect. While the Percentage of All Non-Overlapping Data (PAND) (Parker & Vannest, 2009) would correct this, half of the participants' data series contained fewer than the minimum of 20 data points recommended for this algorithm. In earlier research on the appropriateness of calculating treatment effect, Non-Overlap of All Pairs (NAP) developed by Parker and Vannest (2009) was identified as a reliable measure to overcome the floor data limitations of PND, and the minimum data point requirements of PAND. To calculate the NAP scores, phase contrasts of all pairs were evaluated and determined as favorable, tied, or unfavorable. In turn, one point was recorded for a favorable comparison, 0.5 for a tie, and zero for an unfavorable comparison. These points were then totaled and divided by the product of the number of data points in both contrasting phases (representing the total number of comparisons). NAP scores were interpreted using the scale developed by Parker and Vannest (2009). In their scale, a score with the range 0.93 – 1.0 is described as a “strong effect”, 0.66 – 0.92 is described as a “moderate effect”, 0.50 – 0.65 is described as a “weak effect”, and a score below 0.5 is described as a “questionable or no effect” (Parker & Vannest, 2009).

NAP scores were calculated for all phase AB comparisons for all participants. Both the author and a senior mathematics student research assistant performed the calculations independently, for six AB phase comparisons. NAP scores were calculated for A1B1, A2B2, and a final overall arithmetic mean NAP score was also derived. An arithmetic mean NAP score was calculated for Experiment 1 and for the overall research study.

### **Experiment 1: SO; SRg; SRt**

#### Response Definition

The target behavior for Huixin was to reduce the time he spent each day on smartphone entertainment and to replace his habit of aimlessly scrolling with more valuable activities, including academic achievement. This time spent on the smartphone was operationalized as the period from when he picked up the phone to when he put it down completely. During this time, he may

use social media apps, play games, watch short videos or videos, or communicate with friends, family, or colleagues using text, voice, or video software apps. The use of the smartphone for work or study-related activities was not considered an aimless behavior.

The target behavior for Meilin was to reduce the amount of time spent on any electronic devices (smartphone, tablets, or laptops) in the hour before going to bed. Her operational definition involved measuring her total cumulative time, measured in minutes, spent actively using any electronic device with a screen (including but not limited to scrolling through social media, watching videos, playing games, or reading e-books) within the 60-minute period before her intended bedtime.

#### Data Collection

Huixin adopted an ABAB design. A duration recording method was employed to record minutes of device use. During the first Phase A, baseline data were collected for one week to record his natural pattern of device use. The second phase A was a withdrawal return to baseline condition for one week.

Meilin adopted an ABAB research design. During the first baseline period, A1, Meilin recorded the duration of her electronic device use in minutes during the hour before going to bed over the course of five days to establish her current behavioral pattern. A second baseline period, in which the intervention procedures were withdrawn, was repeated for five days.

#### Self-Management Intervention

Huixin identified several competing behaviors that he considered appropriate to replace his excessive smartphone use across every 24 hours. He was also mindful of the need to lower the sense of frustration that may be associated with introducing alternative behaviors. Accordingly, he developed a competitive behavior replacement library that included replacing short videos with e-book reading while commuting, working out, and socializing with friends or family members. Huixin conducted a training rehearsal session and then added a sensory coupling strategy in which he combined white noise and coffee with reading to make his reading time more enjoyable. Huixin measured his daily smartphone use duration using the built-in screen time data app, as well as a manual record log book. Huixin's daily use of his smartphone throughout each 24-hour period was recorded using a manual log record. Huixin noted the date, the duration of smartphone use in minutes, the type of alternative behavior he engaged in, and the duration and description of the alternative behavior he engaged in. He maintained this manual log for 20 days. Huixin also recorded information on a points system, based on the concept of a token economy. In this system, Huixin awarded himself 1 point for every 15 minutes in which he refrained from smartphone use for entertainment. The number of points he earned was also recorded, and he described this system as very motivating for meeting his desired behavior modification goal. However, information about how he redeemed these points was not recorded, other than to note his preferred activities that points could be exchanged for.

Meilin described engaging in a relaxing non-screen time activity as a suitable competing response. She identified three activities she could choose between, which included reading a physical book, performing a light stretching exercise, or practicing deep breathing meditation during the hour prior to bed. Meilin considered all options as beneficial as they promoted relaxation and provided an alternative to the stimulating nature of her electronic devices. In training, she established a protocol to choose one of the three activities. This activity would begin

in the pre-bedtime hour. A cue was set on her smartphone to remind her to start the activity. Meilin identified a preferred positive reinforcer, to allow herself to watch an extra 30-minute episode of her favorite blogger's video the following day if she had successfully engaged in the competing response activity for the entire pre-bedtime hour. She described this as a favorite activity and that this reinforcer would serve as a clear incentive for her to change her behavior. Meilin adopted continuous recording during the observation period. This was facilitated by using the timing app on her smartphone to capture the time of onset of beginning to use electronic devices an hour before going to bed, and the time of offset when she stopped using them, to accurately record her usage. After completing five days of her first baseline phase, she manually recorded the types of competitive response activities she engaged in for each day for 10 consecutive days. During this treatment phase, Meilin also recorded whether she received positive reinforcement for achieving her behavior goal, or negative reinforcement, in which she woke 15 minutes earlier the next day if she did not meet the goal. She suspended her intervention measures in a return to baseline phase for five days, and continued to use the smartphone usage app for an hour before going to bed. Finally, she reintroduced the intervention procedure and continued to record her usage, competitive response, and reinforcement for another 10 consecutive days.

## **Experiment 2: SG; SO; SRg; SRt**

### **Response Definition**

The target behavior for Shuyue was defined as being in bed by 11:30 pm with no smartphone or other screen use and lights off. This was operationalized by using a sleep log and the Sleep Cycle app to monitor the approximate time for the onset of sleep. Meeting the bedtime goal was coded as "Yes", and missing it as "No".

### **Data Collection**

Shuyue adopted an ABAB research design. During the first baseline period, A1, Shuyue recorded her natural bedtime behavior for a period of five days. In this withdrawal research design, a return to baseline condition was implemented in phase A2. Shuyue recorded her bedtime behavior in the second baseline condition for another five days. Shuyue used the Sleep Cycle app to record the time of her onset of sleep.

### **Self-Management Intervention**

Shuyue identified a competing response to her smartphone usage of reading a physical book. She considered this activity to be calming and non-stimulating, noting that in addition to substituting the light-blue light from her phone, she also occupied her hand and attention such that she could not reach her phone. Training for this procedure involved cuing by setting an alarm and promoting habit by preparing her book in advance. Shuyue selected her preferred reinforcement of watching 30 minutes of TV in the afternoon following the successful attainment of her bedtime goal. To maintain her motivation, she also incorporated a larger reinforcer in which, upon achieving her bedtime goal four out of five nights, she would allow herself to purchase a new dress. Shuyue developed a personal sleep log that she maintained throughout all baseline and intervention phases. In addition to recording the date and phase, she recorded her bedtime, phone use after 10:45 pm, whether or not she read a book, and whether or not she met her bedtime goal (recorded as "Yes" or "No"). She also recorded the frequency of her target behavior in each phase.

#### Data Reliability and Inter-observer Agreement

Because of the private nature of bedtime routines, neither a video recording nor a second observer recording session was considered ethically appropriate for the participants of this study. Given the students' maturity and high cognitive ability levels, together with their use of data recording apps in intervention procedures, a permanent product audit of 100% of raw data records was conducted instead of a second data recording method. This process involved checking every participant's data set to ensure that all data values were within a reasonable range, that there were no missing values, that dates, times, and number of minutes were concisely recorded, that extreme outlier data points had an explanatory note, that there were no invalid records, and that each participant adhered consistently to their data collection procedures. Both the author and the student research assistant independently audited the data. A sample participant data set was selected at random and served as a trial permanent product audit. A data audit table was constructed in Excel to guide the audit process for both assessors. Both the author and the student research assistant performed an audit of the trial data and recorded their responses as a "yes" or "no". Next, the two assessors met to verify their records. A 100% agreement was achieved for the data audit trial. Subsequently, all remaining participant data sets were evaluated independently by each assessor. Upon completion of this step, they again met and performed an IOA of each evaluation for all remaining participants. An IOA of 100 % was achieved. The final data audit evaluation results are described in Table 1.

Inter-observer agreements were also calculated for all treatment effect scores. Inter-observer scores were independently calculated on all participant data by both the author and the second assessor. The student research assistant was first trained to perform this calculation using a participant data set drawn at random. Next, a NAP score was calculated using the first participant's data by the author and separately by the student. Following this, the author and the student research assistant met to compare their NAP score, and achieved a 100% agreement. Independently, the student coded the NAP algorithm using Python (version 3) to develop a NAP calculator. He then entered each participant's data into the calculator to produce a NAP for six AB phase comparisons and an arithmetic mean for each participant. Separately, the author performed a hand calculation of all six AB phase comparisons and an arithmetic mean for each participant. Again, following this step, the author and the student met to compare their results. They achieved 100% agreement on all NAP scores for all participants across all six AB phase comparisons and three individual participant scores, 100% agreement on the NAP score for each experimental condition, and 100% agreement on the NAP score for the overall study.

Table 1. Permanent Product Data Audit Evaluation

Criteria	Huixin	Meilin	Shuyue
Reasonable Range	Yes	Yes	Yes
Missing Values	No	No	No
Concise Dates	Yes	Yes	Yes
Concise Times	Yes	Yes	Yes
Concise number of minutes	Yes	Yes	Yes
Outlier explanations	Yes	Yes	Yes
Invalid entries	No	No	No
Consistent recording	Yes	Yes	Yes

## Result and Discussion

### Result

#### Experiment 1.

In experimental condition 1, Huixin and Meilin recorded their smartphone usage in minutes during baseline and intervention phases. Huixin and Meilin adopted an ABAB design and withdrew intervention conditions during the return to baseline phase. They both reintroduced self-management procedures during their second intervention period. Data was then plotted on the behavioral graphs for each participant, as illustrated in Figures 1 and 2.

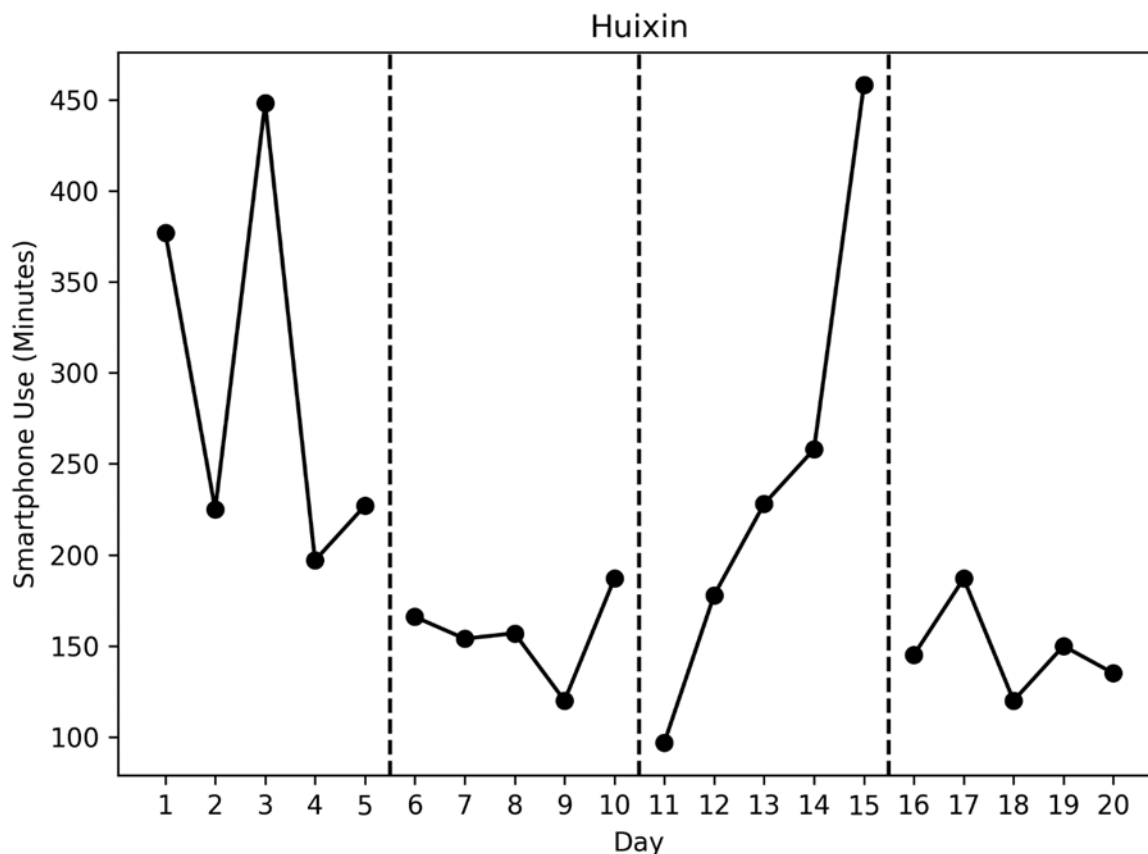


Figure 1. Smartphone Use for Huixin Throughout the Day

The first baseline phase shows that Huixin spent an average of 295 minutes on his smartphone. This immediately halved to an average of 157 minutes upon the introduction of alternative activities, primarily reading, during the first intervention phase. To attempt to rule out confounding variables, Huixin implemented a return to baseline condition. In this second baseline, his average time spent on his smartphone increased to 244 minutes, slightly less than the original baseline condition. Upon reintroduction of alternative behaviors that included physical activities or reading, the average time spent on his smartphone again almost halved to 147 minutes. Huixin employed self-observation, self-recording, and self-reinforcement procedures. Contrary to his original belief that using his smartphone was relaxing, Huixin reported that his excessive smartphone usage, which included social media, short videos, and games, actually made him procrastinate and increased his stress levels. The self-management procedures demonstrated to Huixin that his time spent on entertainment-related smartphone activities far exceeded his expectations and highlighted the severity of his problem. He described looking forward to the second intervention phase and took this as an opportunity to try different activities. Huixin used fragments of time throughout the day to read, rather than view short videos. He also used that time to couple this activity with white noise and coffee drinking to make the reading activity more enjoyable. Huixin self-observed that this strategy helped reduce his craving to use his smartphone.

While Meilin did not specify a uniform bedtime goal for every night of the week to account for natural variations in her schedule, she adopted a strategy to alter her routine in the hour prior to going to bed. The first baseline phase shows that Meilin spent an average of 57 minutes on her smartphone in the hour before going to bed. This immediately halved to an average of 33 minutes upon the introduction of alternative activities during the first intervention phase. These activities included deep breathing, meditation, light stretching, or reading a physical book. In an attempt to account for the potential presence of confounding variables, Meilin implemented a return to

baseline phase. During this second baseline, her time spent on her smartphone increased to an average of 43 minutes. Meilin then reintroduced the intervention condition, and a similar pattern to the first intervention phase was evident. Meilin employed several self-management components that included setting a reminder to self-prompt herself to commence her bedtime procedures, self-recording, and self-reinforcement.

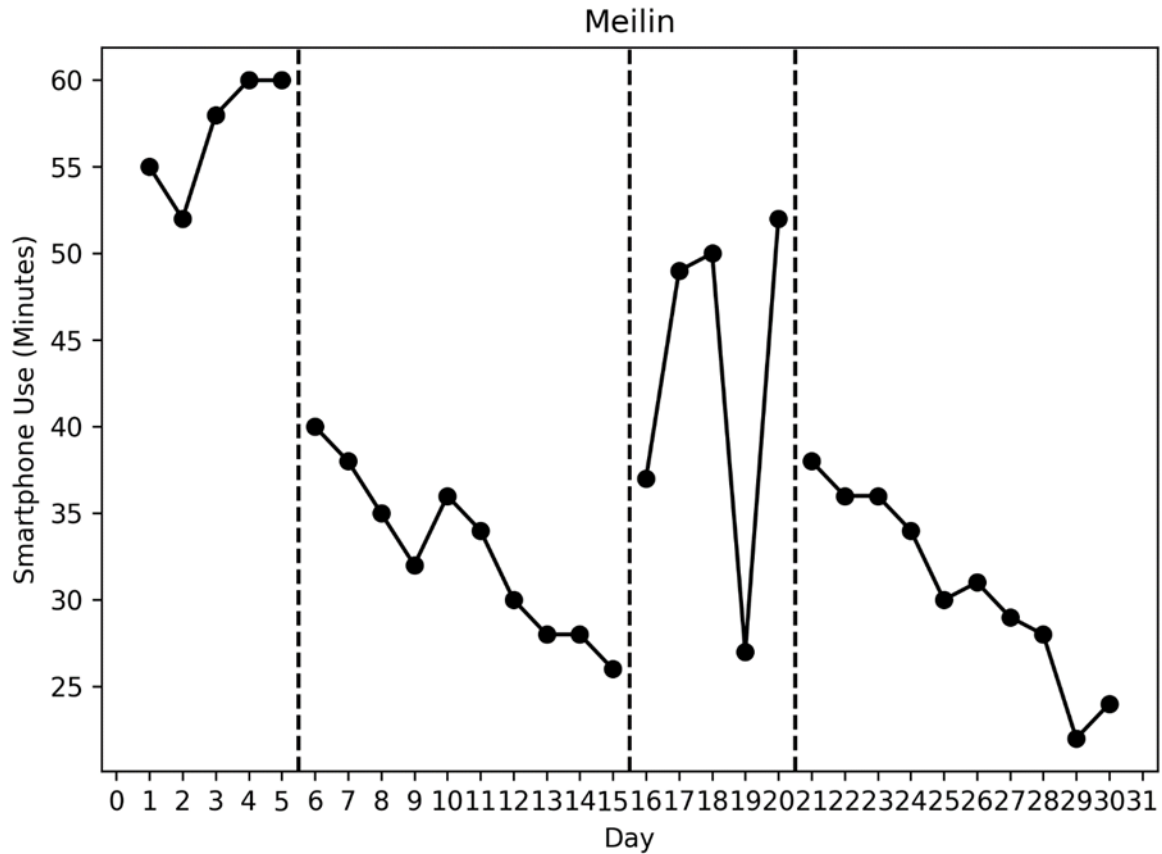


Figure 2 Smartphone Use for Meilin During the Pre-bedtime Hour

Visual Analysis

In Figure 1, the first baseline data phase for Huixin appears variable. As the intervention aimed to reduce a challenging behavior in an environment in which academic achievement is of utmost importance, commencing the intervention was arguably appropriately timed. In the first intervention phase for Huixin, his behavior appears less variable, and a sharp decrease in the number of minutes spent on his smartphone is illustrated. This suggests a clear change in behavior following the introduction of the intervention. Huixin then implemented a return to baseline condition, in which variability is evident, including a behavioral spike during day 15. There is a noticeable increasing trend in the duration of time on his smartphone during this second baseline phase. The reintroduction of intervention in the final phase illustrates a repetition of the decrease in the time Huixin spent on his smartphone. Low variability is noticeable in this second intervention phase. Overall, visual inspection suggests that a functional relationship between the self-management intervention and duration of smartphone behavior is evident. In Figure 2, the first baseline phase data for Meilin illustrate a stable pattern with a slight increasing trend. Introduction of intervention procedures appears appropriately timed. During this first intervention phase, a decreasing trend is immediately evident, indicating a substantial change in the duration of time she spent on her smartphone. A return to baseline phase had been planned. In the second baseline phase, Meilin’s time spent on her smartphone is somewhat inconsistent, though it appears to trend towards her prior baseline levels in the absence of intervention. Upon

reintroduction of intervention procedures, a decreasing trend is again noticeable in Meilin's data. During this second intervention phase, her smartphone behavior returns to a level similar to the first intervention phase. Visual inspection suggests that this replication of effects is indicative of strong experimental control.

#### Treatment Effect

A NAP of 1.0 was calculated for Huixin's first AB phase comparison, interpreted as a strong effect. A NAP of 0.76 was calculated for his second AB phase comparison, interpreted as a moderate effect. Overall, a NAP of 0.88 was calculated and interpreted as a moderate effect. A NAP of 1.0 was calculated for Meilin's first AB phase comparison, interpreted as a strong effect. A NAP of 0.82 was calculated for her second AB phase comparison. Overall, Meilin achieved a NAP of 0.91, which was interpreted as a moderate effect.

#### Experiment 2.

In experimental condition 2, Shuyue set a bedtime goal and introduced an alternative activity prior to sleep as an alternative to her smartphone behavior. She recorded her actual bedtimes and calculated this time difference in relation to her ideal bedtime. Shuyue adopted a withdrawal design ABAB and withdrew intervention conditions during the return to baseline phase. She then reintroduced self-management procedures during her second intervention period. Her data was then plotted on the behavioral graph, as illustrated in Figure 3.

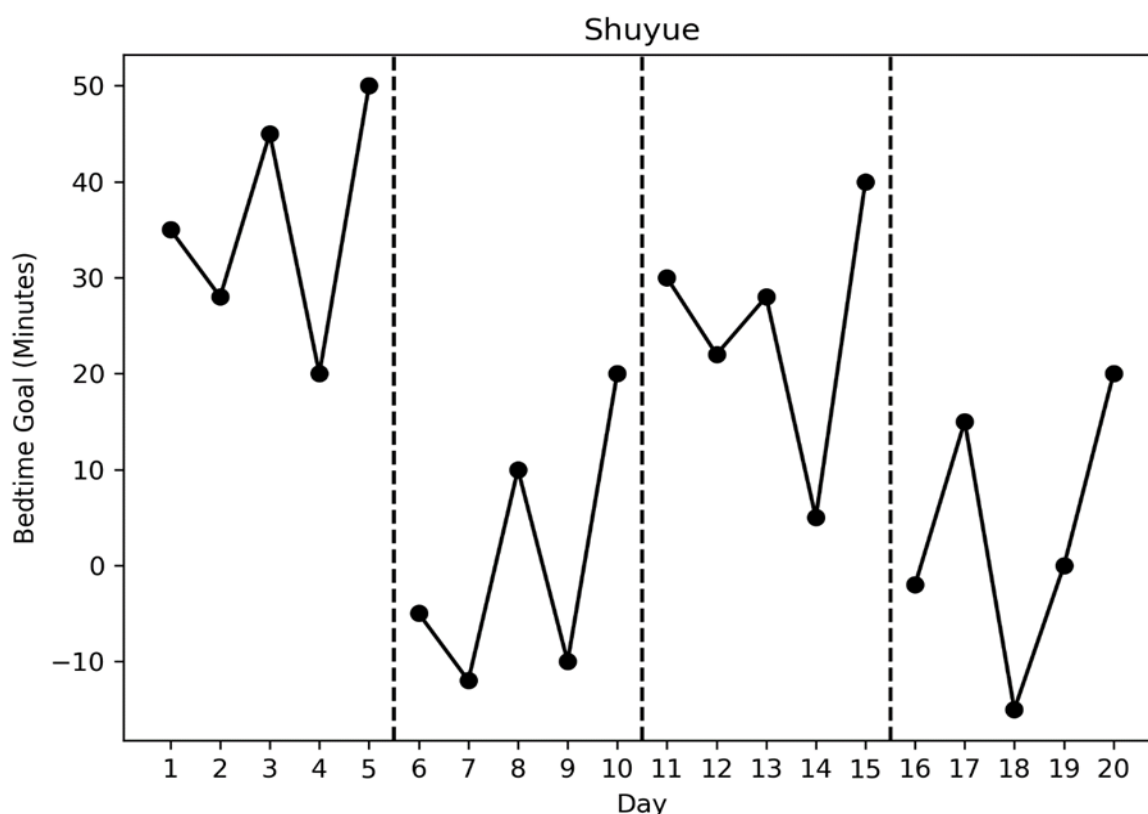


Figure 3. Bedtime Goal Attainment for Shuyue

Shuyue adopted a withdrawal design to examine the effectiveness of establishing a new bedtime routine that did not involve using her smartphone or other electronic devices in bed. She self-set her bedtime goal at 11:30pm, at which time lights and devices would be turned off. To reduce the temptation of using her smartphone she designed an alternative routine that involved reading a physical book at 10:45pm, an activity she considered to be calming and non-stimulating. Shuyue

implemented reading during her first and second intervention conditions. She further noted that by holding the book she kept her hand and mind busy during this time, and made it hard for her to reach her smartphone. Shuyue included self-prompting and cuing components in her intervention, in which she set an evening alarm and prepared her book in advance. She also included a self-reinforcement component, in which she watched 30 minutes of her TV series the following day if she successfully met her bedtime goal. To further motivate herself, she also allowed herself to purchase a new dress as a larger reinforcer upon successfully meeting her bedtime goal on four out of five nights.

#### Visual Analysis

In Figure 3, Shuyue's first baseline data indicated relatively high levels of variability, though no evidence of a trend. Immediately upon the introduction of the intervention, a drop in the level of her behavior is clearly indicated. Variability is also evident in this intervention phase, though it appears that the intervention has had a strong effect. In the second baseline condition, a return to pre-intervention behavior is evident. High levels of variability remain evident. The reintroduction of the intervention procedures again appeared to result in an immediate behavior change. This replication of treatment effects across appears to suggest that experimental control has been established.

#### Treatment Effect Scores

A NAP of 0.98 that was interpreted as a strong effect was calculated for the first AB phase comparison, and a NAP of 0.92 that was interpreted as a moderate effect for the second AB phase comparison. Overall, a mean NAP of 0.95 was derived for Shuyue, and this score was interpreted as a strong effect.

#### Composite Treatment Effect Scores

An overall NAP was calculated for experiment 1 to report on the effectiveness of the intervention, reflecting both participants. The total number of datapoints varied for each of these participants, and further varied within phases. As such, a simple arithmetic mean was calculated. A mean NAP of 0.895 was derived for experiment 1, and interpreted as a moderate effect. With one participant only, the NAP of 0.95 was reported for experiment 2. This was interpreted as a strong effect. The difference in treatment effect between these two experimental conditions was 0.055. An overall treatment effect score for all three participants was also calculated. A mean NAP of 0.913 was calculated and interpreted as a moderate effect.

#### Discussion

This study evaluated the effectiveness of an individualized self-management intervention designed to reduce excessive smartphone use in three young adults in China. It specifically addressed two research questions: firstly, to identify if excessive smartphone use could be reduced by the students' independent use of self-management components. Secondly, the effect of including self-set goals in the self-management intervention was examined. Strength of treatment effect was calculated using NAP, and these quantitative scores were interpreted using established scales to answer these research questions with specificity. NAP treatment effect scores were calculated for each participant, phase contrast, each participant, each experimental condition, and for the overall study.

All three participants successfully reduced their excessive smartphone use through the application of self-management procedures. An overall NAP score for the study as a whole suggested that self-management interventions yielded moderate treatment effects, providing preliminary support for the use of self-management procedures to reduce excessive smartphone use in young adults in China.

The strongest mean treatment effect gains were observed in experiment 2. In this goal-setting condition, one student established an alternative bedtime routine that replaced smartphone use with reading a physical book. She employed a self-management treatment that included SO, SRg, and SRt components as well as self-prompting and cuing to support new habit formation (Miltenberger, 2023). To minimise late-night excessive smartphone use, she set a bedtime goal and recorded the time she went to sleep rather than the amount of time she spent on her smartphone. Further, she maintained her motivation by using a reinforcement schedule that included a larger reward of purchasing a new dress upon successfully meeting her bedtime goal on four of five nights.

During the second intervention phase adopted by two participants in experiment 1, moderate treatment effect scores were calculated. Several reasons may have contributed to this occurrence. Specifically, Huixin recorded a low number of minutes spent on his smartphone during his first day in his second baseline phase as he went out to socialise with friends. This low datapoint effectively reduced the treatment effect score, and did not appear to reflect a failure of the self-management procedure during the second intervention phase. Overall, the NAP score for Huixin indicated a moderate treatment effect attributed to the outlying datapoint in the second baseline phase. However, an increasing trend was observed during this phase, supporting a case for additional baseline data. This is a point of controversy in interventions that target a challenging behavior, and of particular concern when targeting a reduction in a habitual behavior.

A similar phenomenon occurred during the second baseline phase for Meilin. On the fourth night, she recorded a low datapoint, which in turn lowered the treatment effect score for the second phase comparison. Again, it did not appear to reflect a failure of the self-management procedures. While her outlying datapoint was not as extreme as Huixin's, she achieved a moderate treatment effect score overall. This was consistent with her self-reported experience with the self-management procedures.

While the findings of experiment 2 should be treated with caution, the procedure that included a goal condition achieved strong treatment gains. This finding is consistent with the broader K-12 educational literature that has examined the role of a goal-setting component in self-management interventions (Filges, Dietrichson, Bjørn, Viinholt, & Dalgaard, 2022). Elsewhere in the literature, public goal sharing has been researched and reportedly has contributed to increased intervention effectiveness (Locke & Latham, 2006; McEwan et al., 2016). Research has shown that when participants agree to publicly strive for a goal, this can enhance their commitment to goal achievement (Hollenbeck, William, & Klein, 1989; Locke & Latham, 1991). In this current study, the self-set goal condition was kept as the participants' private information. The willingness of the participant to set themselves strict goals and the initial success of this experimental condition opens the possibility of future research that encourages public goal sharing. Future research to include goal setting and public goal sharing in self-management interventions to reduce excessive smartphone use is highly warranted.

Overall, these findings suggest that the self-management intervention led to noticeable reductions in the amount of time spent on smartphones, improved sleep, and improved overall quality of life. All participants used SO, SRg, and SRt, and one participant added a goal-setting component that may have further increased the effectiveness of establishing new habits that reduced the students' dependency on their smartphones. The results of visual analysis suggest that the self-management intervention was successful for all three participants. NAP was calculated to supplement the visual analysis and confirmed that all three participants were successful in modifying their smartphone behavior as desired.

These findings build upon previous literature that has examined excessive smartphone use and emphasized the need to address exercise, sleep concerns, and quality of life (Nambirijian, et al., 2025; Mendez et al., 2024; Wacks & Weinstein, 2021). By promoting greater self-control, goal setting, and behavioral tracking, the intervention empowered participants to take an active role in identifying triggers, managing urges to use their smartphones excessively, and making healthier

choices. Notably, increased happiness, energy, and improved engagement in daily activities were reported by all participants, supporting the role of self-management and self-set goals in developing behavior change.

However, several limitations should be acknowledged. First, the study relied heavily on self-reported data, which is subject to bias, particularly in the context of a socially stigmatized behavior. Students in this current study attempted to overcome this challenge by including data collected from phone apps as well as manual recording logs. Future studies may further reduce the chance of participants reporting “good” data by incorporating additional non-invasive technological data collection methods in lieu of manual recording logs. Additionally, while short-term reversal of habitual behaviors was observed, the sustainability of these changes over time remains uncertain. Long-term follow-up data is needed to determine whether gains are maintained over time. Finally, the number of data points to include in a baseline condition when targeting an addiction is worthy of further research. While the most recent versions of the What Works Clearinghouse SCD standards version 5.0 (2022) suggest gathering six data points in baseline to meet evidence standards (WWC, 2022), earlier versions required five data points (Kratochwill, et al., 2010). Variability in baseline was evident in the current data, supporting the need for additional data. However, treating a challenging behavior has ethical considerations that may outweigh the appropriateness of delaying treatment while ongoing baseline data is collected (Johnston et al., 2006). This may be particularly significant for Chinese students both in China and internationally, where high academic achievement is of utmost importance, and the collection of additional baseline data may cause additional anxiety. Future research to identify an appropriate length of baseline and treatment data for ABA interventions in China appears highly warranted.

Little is known about the influence of reactivity and novelty effects in this current intervention. It is possible that the behavior change observed in this study may have been partially influenced by reactivity to self-monitoring and/ or the novelty of the intervention components. The occurrence of these phenomena has been widely documented (Miltenberger, 2023), and it is plausible that the act of recording smartphone use may in itself have contributed to the reduced engagement, independent of other self-management strategies that were implemented in this intervention. Similarly, the introduction of new routines, goals, or rewards may produce short-term improvements that diminish as novelty fades. These effects may complicate the interpretation of treatment efficacy, particularly in short-duration designs. The roles of both reactivity and novelty are worthy of future research to better understand their role in the behavior modification of excessive smartphone use. This may be implemented by extending intervention phases, incorporating a control comparison condition, or examining patterns of change over an extended time period. A useful control comparison may involve a self-monitoring-only condition, in which participants track their smartphone use but do not receive goal-setting, reinforcement, or other self-management components. This may help determine whether observed behavior changes were due to the full intervention package or reactivity attributed to increased awareness.

Somewhat ironically, technology played a dual role in this study by acting as both the target of behavior change and as a tool for intervention delivery and measurement. Smartphone applications used to track screen time may enhance accuracy relative to self-report alone, but may also have influenced behavior through increased self-awareness. This reactivity suggests the potential of built-in digital wellbeing tools as low-cost, scalable supports for self-management. Simultaneously, a reliance on personal devices introduces the concept of user engagement, which may have a counter effect on the reduction of smartphone use for participants who may tend to frequently check their usage reports. Future interventions may examine the possibility of integrating automated data collection to improve reliability while attempting to circumvent this potential factor that may unintentionally further drive smartphone usage.

Noticeably missing from the individualized self-management procedures devised by the Chinese students is the inclusion of a self-punishment condition. In ABA, punishment can be understood as a consequence that immediately follows a behavior and decreases the likelihood of

that behavior occurring again in the future (Cooper et al., 2020; Miltenberger, 2023). Current behavioral intervention practices in Western environments use punishment as a last course of action, when other components have failed to produce a modification of behavior. As described in the Behavior Analyst Certification Board (BACB) Compliance Code, Section 4.08, behavior analysts recommend reinforcement rather than punishment whenever possible (BACB, 2014). By contrast, from ancient times through to modern governance in Chinese society, punishment has often been used as a first choice to modify or prevent a behavior rather than as a last resort strategy (Pines, 2015). Future research that explores the role of punishment in behavior modification interventions in China is warranted.

Despite these limitations, the results are promising and suggest that self-management interventions can serve as a valuable treatment to remediate excessive smartphone use. Further, the inclusion of self-set goals may increase the effectiveness of the intervention. Self-management of excessive smartphone use may be particularly suitable for individuals with adequate cognition and maturity levels as an intervention that is conducted in a private personal space at night. These interventions may be particularly culturally compatible for Chinese students who value the privacy of challenging behaviors or undesirable habits.

Finally, this study makes a contribution to the emerging body of empirical literature conducted in China using ABA. Overall, the current study has demonstrated that Chinese students can act successfully as managers and manage interventions to reduce excessive smartphone use. This is arguably high in social validity for supporting Chinese students studying in either China or overseas countries.

## **Conclusion**

The findings of this study support the use of self-management as an effective intervention to reduce excessive smartphone usage amongst young adults in China. This research has shown that while self-management alone can be effective, adding a goal condition may further increase the intervention's effectiveness. Independently, young adults can self-manage their smartphone use to develop greater self-control over their excessive smartphone use. In turn, this can result in improvements in physical activity, sleep habits, and daily quality of life. As a widespread social challenge, this procedure has great potential as a low-cost and effective intervention that can be implemented discreetly by students, teachers, and other allied health professionals. The study provides preliminary support for an effective treatment that addresses health and lifestyle concerns previously raised in the literature on excessive smartphone use. Further, this study, whose participants were Chinese university students studying ABA, contributes to the emerging body of behavioral literature conducted in China. Finally, this study addresses the earlier call made by Huang et al. (2024) to include ABA courses in universities in China and provides preliminary evidence of the suitability, success, and future potential of ABA in China.

## **Suggestions**

Self-management procedures grounded in ABA have the potential to support university students in remediating their overuse of smartphones, in turn improving their academic achievement and overall quality of life. This current study may be built upon by future researchers, who may implement the design in a staggered manner across participants to better account for any confounding variables. Future researchers are urged to collect a minimum of six data points across each intervention phase and to adopt a repeated measures design, such as an ABAB design, to support their findings and enable research outputs to adhere to evidence-based standards in ABA designs. Further, the code block included above may be used by future researchers to accurately calculate NAP treatment effect scores, supporting their contribution to an extensive body of ABA literature that has utilized this measure.

Studies with larger and more diverse samples would improve generalizability, while experimental designs that isolate individual components (e.g., goal setting, reinforcement, self-

monitoring) could clarify mechanisms of change. The inclusion of additional data points in baseline and intervention phases, and a measurement of long-term maintenance data at one and three months in a follow-up phase, would not only enhance methodological rigor but may also provide significant information on any long-term effects of the intervention.

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