

## RESEARCH

# An Intervention Utilizing the Salience Principle to Reduce Pharmacy Students' Psychological Attraction to Smartphones

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**Objective.** To determine pharmacy student reactions to and experiences with an intervention based on the principle of salience to reduce psychological attraction and attention to smartphones.

**Method.** For a period of three weeks, participants were directed to change their smartphone's color setting to grayscale mode, turn off social media notifications, remove social media icons from smartphone home screen, and place the device away from their bed when sleeping. A thematic analysis was performed on responses to an anonymous, open-ended survey question that asked participants to record any positive/negative changes to their life and well-being as a result of participating in the study.

**Results.** Thematic analysis revealed 20 unique themes and a variety of notable observations, including a reduction in both smartphone and social media use, reduced allure because of grayscale mode, frustrations caused by grayscale mode, increased productivity, and general improvements in sleep, face-to-face interactions, and overall well-being

**Conclusion.** Results of this study provide initial evidence that changes to smartphone settings and physical placement at night may lead to positive outcomes. Participants reported primarily positive effects regarding well-being and reduced smartphone usage as a result of participating in the study. In many cases, less time on smartphones meant improved sleep, more productivity, more time for social/leisure activities, improved face-to-face interactions, and/or improvement in well-being.

**Keywords:** smartphones, social media, well-being, mental health, sleep

## INTRODUCTION

Pharmacy educators have expressed concern over student well-being and advocated for intentional efforts to improve it.<sup>1-3</sup> One such call has been to examine the potential negative effects that smartphones have on well-being.<sup>4</sup> A rise in reports of college student mental health issues that coincided with the rise in smartphone adoption has prompted some researchers to suggest a causative link.<sup>5</sup> A specific area of concern is *problematic smartphone use*, defined as "an inability to regulate one's use of the mobile phone, which eventually involves negative consequences in daily life."<sup>6</sup> The direction of causality is unknown, but research has shown correlation of problematic smartphone use with anxiety, depression, stress, and decreased well-being.<sup>7-10</sup> Studies have also shown that preventative factors such as sleep are often negatively correlated with problematic smartphone use.<sup>11</sup> Still, the associations between smartphone use and overall well-being

are very nuanced. Why, how, and how much one uses smartphones may influence associated mental health outcomes.<sup>12-14</sup> Certain specific uses of smartphones may even have a positive effect on well-being.<sup>15,16</sup>

Many students have realized an unhealthy attachment to their phones and expressed a desire to use them less often.<sup>17,18</sup> Despite self-professed desire to decrease use, individuals may struggle to break or reduce the attachment.<sup>19</sup> This may in part be due to the inherent design of these technologies, which use psychological processes to capture attention and promote frequent and/or sustained use.<sup>20</sup> Many technology industry insiders have decried smartphone and social media companies use of psychological manipulation to draw and capture user attention and are now heralding approaches to curb "digital addictions."<sup>21</sup> Interventions designed to help users control smartphone use have included both non-technical (eg, digital detoxes) and technical (eg, mobile apps) measures, but there is a need for further exploration.<sup>22</sup>

Different types of studies examining numerous variables and conditions are needed to better understand the complex relationships between smartphones and mental health.<sup>8,23,24</sup> While other studies have focused on efforts

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to reduce reliance on smartphones, the study reported herein was developed to understand how users respond to subtle actions designed to reduce the allure and attachment to smartphones. The theoretical basis for the design was based on the perceptual bias of salience that is often used in behavioral economics research. Salience describes the phenomenon that when one's attention is directed toward a particular portion of the environment, that portion will be elevated regarding judgment and action.<sup>25</sup> In other words, salience takes advantage of a bias that gives more weight and consideration to things brought to the forefront of our attention. Notification features (eg, ringing, vibrating, visual icons) of smartphones are prime examples of the salience principle to capture attention and entice use. Color also plays a role in overt attention<sup>26</sup> and the presence of a smartphone near a person's sleeping area increases the possibility of turning attention toward it during evening and early morning hours. Salience of a person's smartphone and apps can theoretically be decreased by moving the device away from their sleeping area, changing color settings to grayscale, removing social media apps from home screen, and turning off notifications. Based on the aforementioned research regarding salience, recommendations from the Center for Humane Technology,<sup>27</sup> and ease of implementation, we included these four tasks in a wellness intervention at a college of pharmacy. The study sought to elicit participant reactions, attitudes, and perceived effects that this behavioral economics intervention designed on the principle of salience had on students' daily lives and personal well-being. We wanted to know what the participants felt, perceived, and thought while they were going through the study in order to better understand how this type of intervention might be used to reduce users' subconscious attraction to smartphones.

## **METHODS**

During the spring semesters of 2019 and 2020, students enrolled in a required third year management course in the Doctor of Pharmacy (PharmD) program at the University of Kentucky were invited to participate in a series of optional challenges designed to enhance individual well-being.<sup>28</sup> The first challenge, which is the focus of this study, lasted approximately three weeks at the beginning of the semester and involved actions to reduce psychological attachment to smartphones. Specifically, this challenge required participants to change the default color setting for their smartphone screen to grayscale, disable notifications for social media apps, remove social media icons from the home screen, and not sleep with or near their smartphone. Additionally, completion of an anonymous reflective questionnaire administered via Canvas (Instructure, Inc)

learning management system was required to receive one extra credit point (equivalent to 0.2% of overall grade). The focus of the study reported here was to investigate participant reactions to the challenge's effects on their lives as indicated by the following questionnaire item: "Describe any positive or negative changes to your life and/or well-being that you noticed as a direct result of participating in this challenge (open response)." The qualitative study was designed to better understand the depth of experiences of participants during the challenge, as opposed to determining precise effects of the different elements.

We used a thematic analysis protocol as recommended by Braun and Clarke<sup>29</sup> to analyze questionnaire responses. Rather than pre-identify themes to search for, this design allows for themes to emerge from the data, which may reduce investigator bias. This method used an iterative process that involved familiarization with the data, identifying concepts expressed in the data, forming an initial set of themes, reviewing and refining themes, and coding the data with themes. Specifically, each of the three investigators individually read all participant responses while making personal notes of the concepts, ideas, and experiences expressed. As a group, the investigators discussed each of those concepts and categorized them into an initial set of themes that reflected a general sense of what participants articulated in their responses. For calibration reasons, investigators then individually used those themes to code a random 10% of responses before meeting again as a group to revise, refine, clarify, and finalize the set of themes to be used in the analysis. Each theme was given a name and description that explained attributes of the theme. Investigators then used this new set of themes to individually code all responses before meeting as a group to reconcile any differences. During the coding process, each participant response was assigned one or more themes as applicable. Every individually assigned theme that was not unanimous was discussed until consensus was reached. During the reconciliation process, one theme was split into two in order to more accurately reflect the meaning of participant responses. This study received exempt approval from the University of Kentucky Institutional Review Board.

## **RESULTS**

One hundred eighty one of 274 students (66%) participated in the smartphone well-being challenge. Eight responses were removed from the analysis because participants indicated that they did not complete all requirements of the challenge. Demographic information was not collected, but the average age of the student population in those classes was 25 years and 67% were female.

Twenty unique themes emerged from the analysis of the 173 responses. A total of 588 themes were assigned because responses often encompassed elements of more than one of the 20 themes. Five themes were expressed in 25% or more of responses and eight were expressed in 10%-24% of responses. Students reported decreased use of smartphones and social media, the grayscale's effect on their desire and use of smartphones, the positive effect on their overall well-being, as well as a few neutral or negative effects related to the activities. All themes, along with their descriptions, frequencies, and illustrative responses, are presented in Appendix 1.

The effects of turning off social media notifications were reflected across numerous responses. For example, one participant stated, "I noticed that when I turned off social media notifications, I was less frequently checking the apps." A few participants (11%) noted that the elements of the challenge made them more aware of their smartphone usage patterns, which led them to regulate use. "I became conscious of how much time I spent on it every day and throughout the challenge, I was able to use the phone less and less." Several participants explicitly noted specific actions they took to regulate their smartphone usage. Twenty percent of participants expressed that they would continue some or all aspects of the challenge, and 9% stated they took additional measures to reduce usage, such as setting timers, deleting apps, etc.

A second major finding of this study was the effect that changing their phone to a default grayscale setting had on students. Participants alluded to grayscale as a factor that reduced the attraction of casually browsing social media, indicating that session times on social media may have decreased. "I noticed that the grey scale on my phone really did make me want to put it down faster. I noticed spending less time on social media because I was frustrated about not being able to see the pictures in color." Specifically, the visually oriented platform of Instagram was mentioned numerous times as being less interesting. There were also mixed results regarding the effects of grayscale. Several participants cited that grayscale was frustrating because it hampered their ability to use the smartphone productively for activities relying on color (eg, calendars, viewing charts/graphs, etc) "(I)t was a little frustrating when doing certain tasks related to looking at pictures or house hunting." Still others commented on the noticeable difference that grayscale seemed to have on their physical health. Some pointed to headaches and eye-strain, while others cited a positive effect on their vision.

In addition to several of the themes that either relate to or are factors of well-being, 15% of the responses made direct reference to improvements in overall stress, anxiety, depression, etc. "Keeping the notifications off in particular

decreased my anxiety level." Also, pointing to the fact that they were less distracted by their phone, participants observed marked improvement in their in-person relations and communications with those around them. One participant illustrated this point in their response: "The biggest positive change is that my wife and I found that we spent much less time on our phones and became more connected/enjoyed our time together more!" Another well-being related finding was the positive effects of the intervention on sleep. One participant commented, "I found keeping my phone away from my bed helped me fall asleep before midnight, rather than staying up until 1:00 to 2:00 AM looking at random things that caught my attention from social media." Twenty percent of all reflective responses referred to improved sleep quality and/or quantity.

While themes derived from participant reactions revealed overall positive effects, a few responses expressed neutral or negative effects. Two of the lesser-occurring themes revealed no noticeable change (3%) or that participants started using other digital devices (eg, laptops, tablets, etc) more often to compensate (6%). In addition to eyestrain and frustrating aspects of grayscale on productivity-related tasks, more than 10% of responses referred to a fear of missing communications or alarms as a result of turning notifications off and/or not sleeping near their phone. "A negative change that I noticed was I was sometimes scared I was going to 'miss something'."

## **DISCUSSION**

This study sought to determine effects that turning their phone to grayscale mode, removing social media icons from home screen, turning off notifications, and not sleeping with their phone nearby had on students' daily lives and personal well-being. Results provide new information regarding the design of interventions to reduce smartphone and/or social media use in order to improve well-being. Our methods attempted to diminish the appeal of the device and associated media, while approaches that direct participants to voluntarily restrict use of their phones have the potential for withdrawal symptoms.<sup>30</sup> The qualitative analysis of participant descriptions of any positive/negative changes to their lives resulting from the challenge revealed a variety of detailed perceptions of the effects. Overall, student reactions to their experience with this intervention were positive. Themes revealed that participants experienced several benefits with regard to time, productivity, sleep, interpersonal communications, and general well-being. The themes (Appendix 1) themselves are relatively straightforward and easy to comprehend, therefore the remainder of this discussion will focus on what these results mean with respect to existing and future research.

The large percentage of students who reported a decrease in smartphone use was expected but is nevertheless an important finding. As opposed to relying on willpower and self-discipline to reduce nonproductive use of phones, the components of the challenge were designed to alleviate the primary attraction and attention to their smartphone. The themes expressed by students appeared to support that the exercise was an effective way to reduce smartphone usage for a large percentage of participants. The decreased use of social media was likely a major reason why overall smartphone use was down.

Turning social media notifications off was also alluded to as a factor contributing to decreased smartphone use. Without notifications, salience is reduced, and less attention is directed toward the apps. Previous research has shown that notifications provide external cues, which lead to increased phone/app checking.<sup>31</sup> While our study did not attempt to analyze the direct effects of notifications on smartphone and social media use, the results align with research conducted by Du and colleagues,<sup>32</sup> which showed that notifications predict failure to self-control social media use. Social media notifications can be particularly disruptive to users who lack an awareness of the effect or who have poor self-regulatory behaviors.<sup>33</sup> The failure to self-regulate increases the risk of addictive smartphone behavior.<sup>34,35</sup> The measures used to reduce salience may have been more powerful toward those with lower self-regulation capabilities because it removed the frequency of which self-regulation was required. Regarding participant self-regulation of smartphone usage, one of the positive aspects of the study was an increased awareness of smartphone use. This was a somewhat unexpected finding as the design of the challenge did not seek to increase mindfulness. However, mindfulness has been shown to have a positive effect on mental health factors resulting from problematic smartphone use and our results potentially provide insight into those findings.<sup>36</sup> The increased awareness of usage may have influenced some of the participants who took additional measures to reduce usage, such as deleting apps and setting timers. While this study did not try to elicit why students used their phones and social media less, some of the other major themes discussed below provide insight.

A major finding of this study was that changing their phone to a default grayscale setting reduced the visual attraction to their phones. Social media apps such as Instagram and Facebook are appealing in part because of the visual images. Reducing that visual appeal was theorized to reduce usage. Although the popular press<sup>37</sup> is replete with articles extolling the benefits of grayscale mode on reducing social media use, research in this area has been limited. The one published study to specifically examine grayscale mode showed that undergraduate students who

changed their phones to grayscale significantly reduced their screen time by an average of 37.9 minutes each day.<sup>38</sup> The results of our study provide further evidence that grayscale alters the user experience and reduces the appeal of social media use on smartphones. In this analysis, participants also made a distinction between grayscale mode reducing the allure of a smartphone and the frustrating effects that grayscale mode had on usage. The lack of color in certain uses of the phone (eg, color-coded images) may limit the user experience in ways not intended. These different responses to grayscale indicate that its effect on reducing smartphone use is mixed. For many, it is potentially an effective way to remove the appeal of smartphones. However, for others the negative effects on usability and physical health reduce the likelihood that this would be an effective long-term solution to curbing individual smartphone usage.

One of the underlying reasons for conducting this study was to learn if simple measures to reduce smartphone use might affect students' perceptions of personal well-being. Results indicate that there were benefits to well-being for most participants as direct references were made to improvements in overall stress, anxiety, and depression. The exact cause(s) of the improved well-being is unknown as it could potentially be any combination of factors pertaining to distractions, sleep, interpersonal communications, social comparisons, etc. Previous research has yielded mixed results regarding smartphone/social media use and mental health factors. While numerous studies have reported a negative relationship between digital device/media use and well-being, the overall effect sizes are small.<sup>7,8,39</sup> Additional studies are necessary to determine the nuances between smartphone use and mental health.

Related to well-being, another notable theme expressed by participants was that the smartphone challenge positively affected their face-to-face interactions with others. In particular, phones became less of a distraction when in the presence of others and in-person interactions improved. This theme adds credence to previous research showing that smartphone distractions can hamper enjoyment, personal connections, and satisfaction with others.<sup>19,40-43</sup>

Another well-being related finding was the positive effects of the intervention on sleep. When the phone was removed from the immediate sleeping area, students went to sleep faster and experienced fewer sleep disturbances during the night. This was one of the most frequently cited benefits of the challenge, which is not surprising given that numerous research studies have found negative correlations between smartphone usage and sleep.<sup>44-46</sup> Furthermore sleep quality is predictive of positive affect, which may have contributed to our findings regarding perceived improvements in overall well-being.<sup>47</sup>

While study results indicated numerous positive outcomes among participants, it did not appear to eliminate some participants' concerns about missing appointments, urgent texts, etc. This result is not surprising as fear of missing out (FOMO) has been shown to be an antecedent to problematic smartphone use.<sup>48</sup> The themes indicative of negative responses provides insight into how smartphones are interwoven into people's daily activities, including ways that can be simultaneously positive and negative. Unlike other "vices" that have no redeemable qualities, smartphones play an important role in the functioning of modern society.<sup>49</sup> Because of all the positive uses for smartphones, users may concentrate on beneficial uses while ignoring the potential harms.<sup>19,50</sup> This can make it more challenging to address problems associated with smartphones and any intervention that seeks to limit or alter smartphone use should also consider potential unintended effects.

The results of this study can be used when considering measures that can be taken to reduce individuals' smartphone usage to improve facets of their mental health. Because of many people's inability to self-regulate their smartphone usage, recommendations based on elements of the challenge described herein may be more effective because salience of (and thus attention to) the smartphone is reduced. It may be more effective to teach smartphone users how to psychologically circumvent the mechanisms that draw their attention to their phones than to simply encourage them to use smartphones less.

The study has a few limitations. First, there is potential for a sampling bias as the study was conducted on an optional opt-in basis. Certain characteristics that affect one's psychological connection to smartphones or general well-being practices could be under- or over-represented in this sample. Second, the actions required by study participants only lasted a few weeks. A longer time may have resulted in differing, dissipated, or enhanced perceptions. Third, the study only analyzed participant responses to an open-ended question, therefore a participant's experience would only be encompassed in a theme if it was directly expressed in the response. Different methods, such as focus group or individual interviews, could have prompted the participant to reveal more thoughts and perceptions than what they included in their initial response. Finally, because of the self-reporting nature of the study, participant responses could have been influenced by a social desirability bias. The results of this study lay the groundwork for future research that can aid the understanding of links between problematic smartphone use and well-being. First, using the emergent themes of this study, a quantitative approach is needed to document the extent that the outcomes (vs perceived outcomes) occur across an entire sample. Second, individual elements of the challenge (eg, grayscale mode,

turning off notifications, etc) should be examined independently in controlled experiments to quantify their effect on smartphone and social media usage and on different factors of well-being (ie, stress, anxiety, depression).

## CONCLUSION

Pharmacy students who turned smartphone settings to grayscale, turned off notifications, removed social media icons from their home screen, and slept away from their phones reported primarily positive outcomes. In many cases, less time on smartphones meant better sleep, more productivity, more time for social/leisure activities, improved face-to-face interaction, and/or improvement in well-being. Results of this study provide initial evidence that simple changes to smartphone settings and placements at night may produce positive outcomes for those who want to reduce time spent on smartphones.

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Appendix 1. Doctor of Pharmacy Students' Responses Regarding Their Participation in an Intervention That Used the Salience Principle to Reduce Their Psychological Attraction to Smartphones (N=173)

Theme	Description	Example response	N (%)
Smartphone use decreased	Participant's overall time spent on smartphone decreased	"Each week my screen time went down. First by 41%, then 11%, and then 14%"	90 (52)
Grayscale reduced allure	Grayscale made the phone boring and reduced the desire to look at it	"Using gray-scale mode made me feel like my life was a melodramatic series except much less interesting"	58 (34)
Social media use decreased	Participant's overall time on social media decreased	"I immediately noticed a decrease in the amount of time I spent on my phone using social media."	54 (31)
Grayscale was frustrating	Grayscale created frustration and/or discontent when performing activities on the phone in which color played an important role	"However, it was a little frustrating when doing certain tasks related to looking at pictures or house hunting."	51 (29)
Productivity increased	Participant able to focus on school and/or work activities due to checking phone less frequently	"I noticed that I was more productive when studying and working on things because I felt less tempted to reach for my phone every 15 minutes."	43 (25)
Attachment to phone decreased	Participant felt less attached to their phone	"I felt less tethered to my phone"	42 (24)
Will continue aspects of challenge	Participant plans to continue certain aspects of the challenge after it is over	"I'm going to continue leaving my notifications off and not sleeping by my phone."	34 (20)
Sleep improved	Participant fell asleep easier, slept more, and/or sleep quality improved	"(M)y sleep was better! On average I think I gained an hour of sleep every day"	34 (20)
Distractions from phone decreased	Phone became less distracting to participant	"I found that without these constant notifications, I was less tempted to check these apps regularly. For example, I would go much longer without going on Facebook."	32 (18)
Sense of well-being improved	Participant perceived less stress, anxiety, and/or depression	"There was a lot less of the comparison game and negative feelings towards myself. I can't explain how much of a positive impact removing myself from these things has had on me mentally!"	26 (15)
Fear of missing communications and alarms	Participant had increased concerns about missing messages and/or alarms	"A negative change that I noticed was I was sometimes scared I was going to "miss something." The grayscale mode also impacted this the most. Whenever I was on my phone things did not stand out near as much as they did before. Therefore, I was concerned I was going to miss an important email, social media post, or any other important news, etc. As far as I know,	20 (12)

(Continued)

Appendix 1. (Continued)

Theme	Description	Example response	N (%)
		I never missed anything, but there was that tiny worry in the back of my mind from time to time.”	
Quality of face-to-face time improved	Participant paid more attention to those in their physical presence instead of looking at their phone	“I found myself interacting more with the people around versus holding my phone and attempting to look at my phone and hold a conversation.”	19 (11)
Mindfulness of phone and social media use	Participant became aware of time spent on phone and/or social media	“This challenge made me realize just how much I have let my phone take up so much of my time that I could be spending doing so many better things. I realized how many times I pick up my phone and mindlessly check apps like social media.”	19 (11)
Took additional measures	Participant did additional things to reduce distraction of phones	“Additionally, instead of just removing my social media apps, I deleted those that I spent the most time on. I personally feel less “trapped” or that I am wasting time now that they are off my phone.”	15 (9)
Morning routine improved	Participant’s mornings started better without checking smartphone upon waking	“I noticed that by sleeping away from my smartphone, I no longer hit the snooze button when my alarm went off in the morning. Because of this, I feel like I was actually less tired in the morning and had more time in the morning to do things that needed to be done, such as make my bed or do some laundry.”	11 (6)
Transferred screen time to other devices	Participant adapted to challenge by using other devices (ie, laptop, tablet) more	“I was not able to find as much joy as I usually do when I looked at my phone for any reason. When I could not find joy in that I went to my laptop or iPad to fill that gap.”	10 (6)
Time for leisure/social activities increased	Participant able to do other enjoyable things instead of looking at their phone	“The lack of color on my phone led to loss of interest, specifically in social media, much faster than usual, so I was putting down my phone much more often when I did choose to use it, giving me more time with hobbies that were more fulfilling.”	9 (5)
Grayscale hurt eyes	Grayscale feature caused eyestrain/headaches/etc.	“Since grayscale gave me a headache to look at, I tried to avoid my phone.”	8 (5)
Grayscale helped eyes	Grayscale feature relieved eyestrain/headaches/etc.	“I found that using the grey scale feature on my phone actually helped my eyes be less strained.”	7 (4)
No noticeable change reported	Participant sensed no change in their overall well-being or habits	“I already turned off my social media notifications, moved my social media apps to a folder, and didn’t sleep near my phone, so I did not have to make too many changes to comply with the challenge.”	6 (3)