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Is your smartphone a digital security blanket? The influence of phone use and availability on psychological and physiological responses to social exclusion

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by

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ABSTRACT OF THE THESIS

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By

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Master of Arts in Social Ecology

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Objectives: Mobile phones are increasingly becoming a part of the social environment, and when an individual feels excluded during a socially stressful situation, they often retreat to the comfort of their phone to ameliorate the negativity. Thus, this study tests whether smartphone presence does in fact alter psychological and physiological responses to a social stressor. **Methods:** Participants (*N* = 148) were subjected to a peer exclusion stressor. Prior to exclusion, participants were randomized to one of three conditions: (1) phone present with use encouraged, (2) phone present with use restricted, or (3) no phone access. Saliva samples and self-report data were collected throughout the study to assess salivary alpha amylase (sAA), cortisol, and feelings of exclusion. **Results:** Participants in both phone-present conditions reported lower feelings of exclusion compared to individuals who had no access to their phone, *p*=.005. Reported exclusion was not significantly different between phone-present groups. Multi-level modeling of sAA responses revealed that the individuals in the

restricted phone condition had a significantly different trajectory following the stressor compared to the phone use condition (p=.032) and no phone condition (p=.008). Specifically, those in the restricted phone condition showed a decrease in sAA following exclusion, those in the no phone condition showed a gradual increase, and phone users exhibited little change. Cortisol did not respond to the stressor. **Conclusions:** Taken together, these results suggest that the mere presence of a phone (not necessarily phone use) can reduce feelings of exclusion and buffer against the stress of social exclusion.

KEYWORDS: smartphone, alpha-amylase, exclusion, stress-buffering

INTRODUCTION

Technological innovation is the spoon that stirs the pot of dynamic change in society, and no other recent breakthrough has transformed the nature of social interactions as profoundly as the smartphone. The dissemination and widespread adoption of these devices has led to a digital revolution that is just beginning to blossom. This close connection with technology is undoubtedly altering many psychosocial processes, but researchers are only beginning to examine this issue and disentangle the positive and/or negative impacts on health and well-being.

Mobile phone ownership is on the rise across the globe; nearly two-thirds of Americans are smartphone owners (1). These devices will likely continue to become more pervasive in social interactions as people seem to be constantly absorbed in the virtual world available at their fingertips. Thus, it is imperative that we empirically examine the potentially positive ways in which we can use these devices to navigate the space of our lives. Importantly, assessing the physiological effects of technology engagement may have significant implications for health. With this in mind, this study explores one way in which mobile phones may be beneficial: through their ability to buffer psychological and physiological responses to social exclusion.

Mobile Phones & Well-Being

Most psychological research has concentrated on the negative ramifications of technological engagement. Researchers have documented associations between mobile phone use and higher rates of loneliness (2), lower

socioemotional well-being (3), and decreased quality of face-to-face interactions (4,5). Excessive engagement with smartphone technology has been linked to poorer self-reported health in adults (6) and adolescents (7). Phone use has also been connected to a variety of health-related factors such as decreased sleep quality and quantity (8), increased sedentary behavior (9), and exposure to electromagnetic radiation (10). There is even a mounting concern that younger generations are developing unhealthy dependencies with their phones that are indicative of addiction (11)

While it must be acknowledged that phones can detrimentally impact many aspects of well-being, society's engagement with these devices is continually increasing (11). With this inevitable reliance on technology ballooning in front of us, it is important to recognize ways in which phones may be used to potentially augment well-being. Focusing on the positive aspects of mobile phone engagement will allow us to identify the ways in which the constructive power of these devices can be harnessed to foster individual and societal flourishing. With this evidence in mind, and the likelihood that the use patterns will increase, it is critical that research shifts its focus towards the potentially beneficial aspects of mobile phone usage.

Smartphone ownership is generally associated with higher self-reported well-being (1), but the specific reasons as to why are still unclear. A few positive influences have been found in relation to healthcare interventions (12), health-information seeking (13), and maintenance of social connections (14). Smartphone users are able to foster social relationships through engagement

with a variety of communication mediums (e.g., text, social media, video chat) and connect with a range of others outside of their immediate place-based environments. Rather than simply eroding the quality of social relationships through inferior face-to-face communications, the net outcome of mobile technology is likely an increase in social capital (14,15).

Researchers are beginning to pay more attention to potential impacts of mobile phones on well-being, but most of this work relies on self-reported cross-sectional correlational data that assess social outcomes. In addition, scant literature focuses on physical health outcomes or physical responses to stressors in relation to mobile phones. An experimental examination of the influence of mobile phones on physiological responses to stressors may illuminate our understanding about how phones impact well-being and ultimately health.

Social Exclusion and Physiological Stress

One situation in which mobile phones may provide benefits is during stressful encounters of social exclusion. Humans are an interpersonal species with an innate desire to belong and be accepted by their peers (16), and if an individual is faced with social exclusion, negative psychological and physiological consequences often follow (17). Evidence from neuroscience demonstrates that virtual social exclusion activates the same areas of the brain associated with physical pain (18) and is ultimately tied to deleterious health outcomes (19). Social exclusion stress responses can also be captured via self-report, however objective and unbiased physiological biomarkers of stress and arousal may be a more robust way to measure these stress responses.

In one experimental example, participants who were rejected by their peers exhibited significantly higher levels of salivary cortisol as compared to non-excluded individuals (20). Another study demonstrated that pre-school children who were nominated by their classmates as “disliked” exhibited significantly higher levels of cortisol following the exclusion manipulation than those who were nominated as “liked” (21). These studies each assessed salivary cortisol as the primary indicator of physiological responses to the stressor. However, this measure of hypothalamic-adrenal-pituitary (HPA) activation may not be the most appropriate proxy for the type of stress that is associated with peer rejection. Cortisol fluctuations are particularly sensitive to social-evaluative threat (22), but peer rejection paradigms may not elicit the same sort of adrenocortical responses. During social exclusion stressors, individuals may feel ignored, but not evaluated, and therefore exhibit alternate physiological responses.

One laboratory social exclusion paradigm, the Yale Interpersonal Stressor (YIPS) (23), has yielded inconsistent results regarding cortisol reactivity but more promising results in regards to salivary alpha-amylase (sAA). This enzyme is a rapid and reliable marker of autonomic nervous system activity that increases during a variety of stressors (24). In one study using this paradigm, women (but not men) exhibited significant salivary cortisol reactivity when faced with peer rejection (25). In another YIPS study, socially-excluded participants exhibited larger trajectories of sAA as compared to non-excluded individuals, but there were no significant group differences in cortisol trajectories (26). Similarly, sAA was more acutely responsive than salivary cortisol when youths were faced with

peer rejection stressors (27). While cortisol is often considered the gold standard in salivary bioscience stress research, its inconsistency in regards to social exclusion manipulations suggests that it may also be prudent to explore other biomarkers (such as sAA) in order to encompass a multi-dimensional approach and fully understand the mechanisms of exclusion effects on physiological responses to social exclusion.

Why might mobile phones protect against the negative effects of exclusion?

Stress is a prevalent and unavoidable feature of social life, but the way in which stressful stimuli manifest themselves may depend on certain psychosocial or environmental factors that can attenuate the effects. These stress-buffers can exert their influence by either creating contextual circumstances in which stressors are altogether avoided, moderating the intensity of stress reactivity during a stressor, or aiding in recovery after experiencing a stressor. Social support is the most well-documented stress-buffer (28), but other factors such as exposure to natural environments (29), positive affect (30), and calming music (31) impart stress-buffering benefits. In light of the empirical evidence illuminating a wide variety of effective stress-buffers, it is plausible that smartphones may also be used to buffer the harmful effects of stress. Prior evidence shows that smartphone owners often retreat to the comfort of their mobile phones when faced with socially stressful or awkward encounters (1,32), and this may inadvertently be done in an effort to buffer stress.

When an individual engages attentively with a mobile phone, they sometimes drift into a state of “absent presence” where the physical body is present in the here and now, but cognitive awareness is somewhere else (33). This phenomenon may be quite subtle, where simply having a phone present may interfere with the dynamics of a social interaction because of the phone’s symbolic representation as a communication tool (4,5). Phones serve as symbol of a person’s larger social network and can create a micro-fragmented context in which an individual’s consciousness is distracted and split between external social connections and in-person interactions. This temporary escape from place-based reality has usually been considered a negative by-product of technology use (4,5), but that same diverted focus might be beneficial in other contexts such as social exclusion. If an individual encounters negative stimuli during a face-to-face interaction (e.g., social exclusion), they may be able to garner support and feel a greater sense of comfort by engaging with their smartphone. This connection with external social support systems (real or symbolic) may help individuals cope with in-person social exclusion stressors. From this line of reasoning, it seems feasible that smartphones may be beneficial during undesirable social circumstances because of their potential ability to moderate the stress response associated with negative interpersonal interactions.

In these instances, a smartphone may operate as a “digital security blanket” that reduces the stress of social exclusion. Specifically, shifting attention (conscious or unconscious) away from negative environmental stressors and towards symbolic connections offered by phones may mitigate the negativity

stemming from social stress and provide a source of felt security. These effects may be analogous to how a young child uses a security blanket as a tool to improve resilience in intimidating environments (32). Having a smartphone at one's side may be a type of avoidance coping strategy that allows an individual to buffer stress. While this avoidance coping strategy may not seem to be the most advantageous long-term approach for coping with emotional distress, it may provide potent short-term benefits (34) and partially explain why phone use is so pervasive especially in social situations.

THE PRESENT STUDY

This study fills important gaps in the field by addressing physiological stress and health-related outcomes associated with mobile phones. In this current study, we expand the literature on the positive aspects of mobile phones by exploring how phone use and/or presence may be beneficial in certain social contexts. Specifically, we investigate whether smartphones may serve a stress-buffering function in interpersonally stressful situations by potentially providing perceived access to or reminders of more comfortable contextual circumstances.

We manipulated the availability of participants' smartphones and examined the effects of this manipulation on feelings of exclusion and physiological stress between participants. To address our broader question, we investigated whether individuals who can use a phone differ from those who do not have access to the phone. In order to examine some of the mechanistic intricacies of the connection between one's phone and stress, we also included a condition in which participants had their phones but were restricted from using

them. This enabled us to explore whether engaging in activities on one's smartphone is responsible for the potential stress-buffering effects, or whether the simple symbolic presence of a smartphone imparts stress-buffering effects.

Our investigation measured cortisol and sAA with the hopes of providing convergent evidence and/or disentangling the specific mechanisms through which a smartphone might buffer stress from social exclusion. Since sAA is particularly responsive to peer social exclusion, and the literature on cortisol is mixed (26), sAA is considered our primary variable of interest in regards to physiological stress.

Hypotheses

We hypothesize that the presence and use of a smartphone will reduce the physiological stress response and negative feelings associated with social exclusion. Specifically, individuals who are allowed to use their smartphones will report feeling less excluded and have an attenuated physiological stress response (cortisol and sAA) following exposure to a social stressor compared to individuals who cannot use or do not have access to a smartphone. Those who have smartphones in their presence, but are restricted from using them, will feel less excluded and have an attenuated physiological stress response compared to individuals who do not have access to a smartphone. However, those restricted phone users may not reap the same benefits as individuals who do use their smartphones. Furthermore, we hypothesize that sAA will exhibit more consistent responses to exclusion than cortisol given the past literature.

METHODS

Participants

Participants were recruited via the University of California, Irvine (UCI) undergraduate psychology subject pool. A total of 148 participants underwent the study. Two participants were removed for taking hormonal contraceptives or asthma medication, two participants were removed because they inadvertently became aware of the deception and study goals during the experiment, and three were dropped for not completing the entire study. The final sample consisted of 141 participants, ranged from ages 18-32 (M=20.4, SD=2.4), and 84% identified as female. The ethnic population was diverse and representative of UCI's demographics (45% Asian, 30% Hispanic, 12% White, 3% African-American, 10% other). Participants were screened for eligibility and consented to participate. The study was approved by the UCI Institutional Review Board.

Procedures

Participants underwent an approximately 90-minute laboratory session. A cover story was developed to hide the true purpose of the study. Participants were told that researchers were exploring the connection between physical dimensions of their smartphone and personality characteristics. Phones of all participants were confiscated at the beginning of the study under this pretext, which allowed the experimenter to later manipulate the phone conditions without arousing suspicion. The actual participant was joined by two trained confederates (one male, one female) who were ostensibly also participants in the study.

After participants completed a series of questionnaires, the experimenter returned to the laboratory room and collected a baseline saliva sample. Prior to the start of the exclusion manipulation, participants were randomly assigned to one of three conditions using a random number generator. In the phone use condition, the participant's phone was returned to them immediately before the social exclusion manipulation and the participant was encouraged to "*use their mobile phone as they normally would*." In the restricted phone condition, the participant's phone was returned to them immediately before the social exclusion manipulation but they were told to "*please not use it during the study*." Finally, in the no phone condition (control), the participant's phone was not returned until the completion of the study. The third condition was used as the control and served as the primary comparison group.

The experimenter then initiated the social exclusion stressor by leaving the room under the pretext of taking the saliva samples upstairs to a different lab for testing. The participant was now left at a small circular table in a room with two confederates while they waited for the next portion of the study. For the next eight minutes, the confederates socially excluded the participant based on a modified version of the YIPS (23). The two confederates followed a conversation script about a fictional personal connection and employed verbal (e.g., "that's not interesting") and non-verbal techniques (e.g., physically turning away) to exclude the participant from the social interaction. This unobtrusive manipulation simulated real life exclusion conditions and created a stressful context in which individuals may be naturally drawn to using their mobile phone.

Following the exclusion period, the experimenter returned to the room and immediately collected another saliva sample from the participants and administered another self-report exclusion questionnaire. During the remainder of the study, participants submitted three additional saliva samples every 10 minutes to assess post-exclusion recovery. After the completion of the study, the experimenter and the confederates undertook an extensive debriefing with the participant to ensure that the participant suffered no long-term psychological distress from participation in the study.

Measures

Demographics and Possible Covariates. Demographic information including age, gender, ethnicity, socioeconomic status, sleep behavior, body mass index, and mental health were collected.

Self-Report. Participants reported feelings of exclusion, rejection, and isolation immediately before and immediately after the manipulation. Participants were asked to indicate the extent to which each item reflected how they felt "at the moment" from 1 (not at all accurate) to 5 (extremely accurate). The items "rejected, excluded, and isolated" were averaged into a single item of *exclusion* to capture a comprehensive concept of felt exclusion.

Physiological Stress Response. Salivary cortisol and sAA were collected over the course of the study to assess physiological stress responses.

Collection and Assay. Researchers collected five saliva samples at various time points throughout the study (baseline, post-exclusion, and three intervals of ten minutes after the exclusion) using Salivette collection devices (Sarstdedt,

Newton, NC). Experimental sessions were conducted in the afternoon (between 1:00-6:00pm) to control for the diurnal rhythm of sAA and cortisol. Salivettes were stored at -20°C until batch analysis at the end of data collection. Before assaying saliva was centrifuged at 2000g for five minutes. sAA measurement was completed using an enzyme kinetic method (35). Saliva was diluted at 1:625 with ultrapure water, and diluted saliva was incubated with substrate reagent (alpha-amylase EPS Sys; Roche Diagnostics, Indianapolis, IN) at 37°C for three minutes before a first absorbance reading was taken at 405 nm with a Tecan Sunrise ELISA reader (Tecan, Morrisville, NC). A second reading was taken after five minutes incubation at 37C and increase in absorbance was transformed to sAA concentration (U/ml) using "Calibrator f.a.s." solution (Roche Diagnostics) as standard. Cortisol was measured using a commercially available chemiluminescence immunoassay (CLIA; IBL-International, Hamburg, Germany). Inter- and intra-assay coefficients of variation were below 10%.

Statistical Analysis

Analysis of covariance (ANCOVA) statistical procedures were used to test variation across conditions for self-reported exclusion experience while controlling for baseline values. Multi-level modeling was used to evaluate trajectories of sAA and cortisol throughout the study. Previous research has demonstrated that sAA may increase immediately after, but not during stressors (36), hence our analyses focused on post-YIPS sAA response. Based on recommendations in the longitudinal data analysis literature (37), we created a series of statistical models to systematically evaluate whether there were

differences in the sAA and cortisol trajectories of individuals due to condition. Since the values were positively skewed for both markers, they were natural log transformed to approximate a normal distribution. Robust standard errors of the residuals were included in the models of sAA to account for a slight skewness in the distribution of standardized residuals.

First, the amount of outcome variation that exists at each level was examined using an unconditional means model with no predictors entered. Then, an unconditional growth model was evaluated to assess if within-person variation was systemically associated with time (maximum likelihood estimations indicated that quadratic time was the most appropriate to include for sAA, and linear time was most appropriate for cortisol); these were included as fixed and random effects. All continuous variables were centered at their grand mean, and time was centered at the baseline time of saliva collection. Demographic information and potential covariates were inserted into the subsequent models as fixed effects and tested using maximum likelihood estimations, but were eventually removed from the final model because they were not significantly associated with the fixed effects or rate of change. The final conditional growth models included condition, the interaction between these groups and the appropriate form of time.

RESULTS

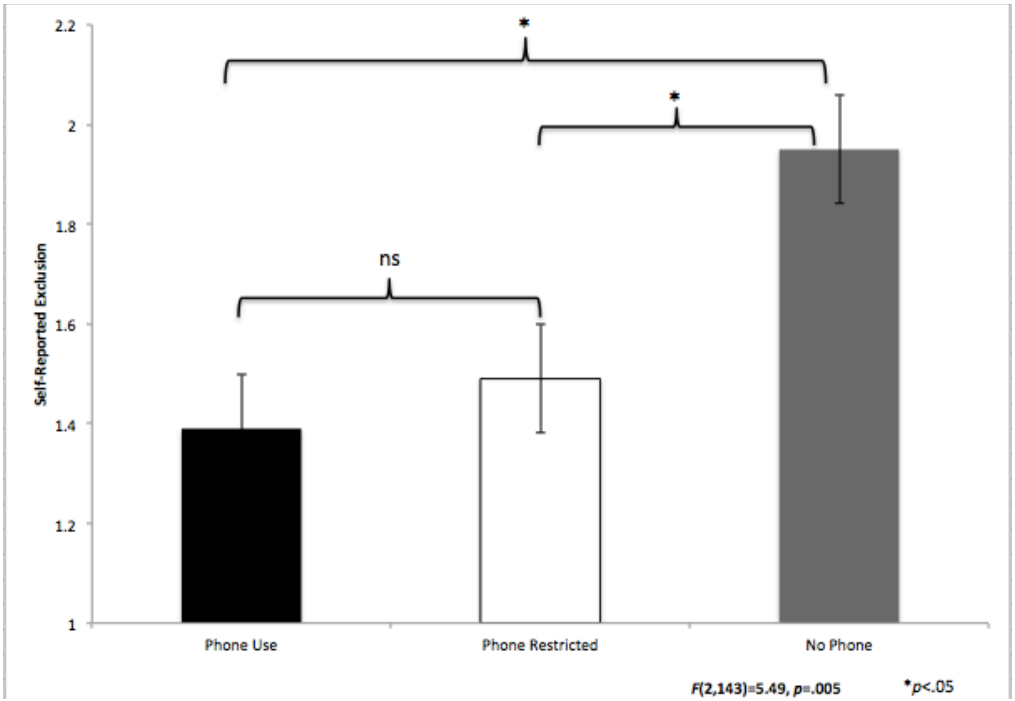
Did participants feel excluded?

A manipulation check comparing self-reported exclusion from before and after the YIPS revealed that participants felt significantly more excluded following exposure to the stressor, $t(143)=5.4$, $p<.001$.

Did self-reported feelings of exclusion differ across conditions?

There was significant between-subject variation in self-reported exclusion depending on phone condition $F(2,143)=5.49$, $p=.005$ (see Figure 1). Individuals without phone access reported the highest levels of exclusion ($M=1.95$, $SD=1.11$), individuals who had their phone in their presence but with restricted use reported lower levels of exclusion ($M=1.49$, $SD=.81$), and individuals who were allowed to use their phones felt the least excluded ($M=1.39$, $SD=.62$). Planned contrasts revealed that individuals in the no phone condition reported significantly different levels of exclusion compared to the phone use condition ($p=.002$) and the restricted phone condition ($p=.017$). However, there were no significant differences between the phone present conditions in regards to felt exclusion ($p>.10$)

Figure 1: Self-Reported Feelings of Exclusion after the Yale Interpersonal Stressor



Did salivary cortisol levels differ over time across conditions?

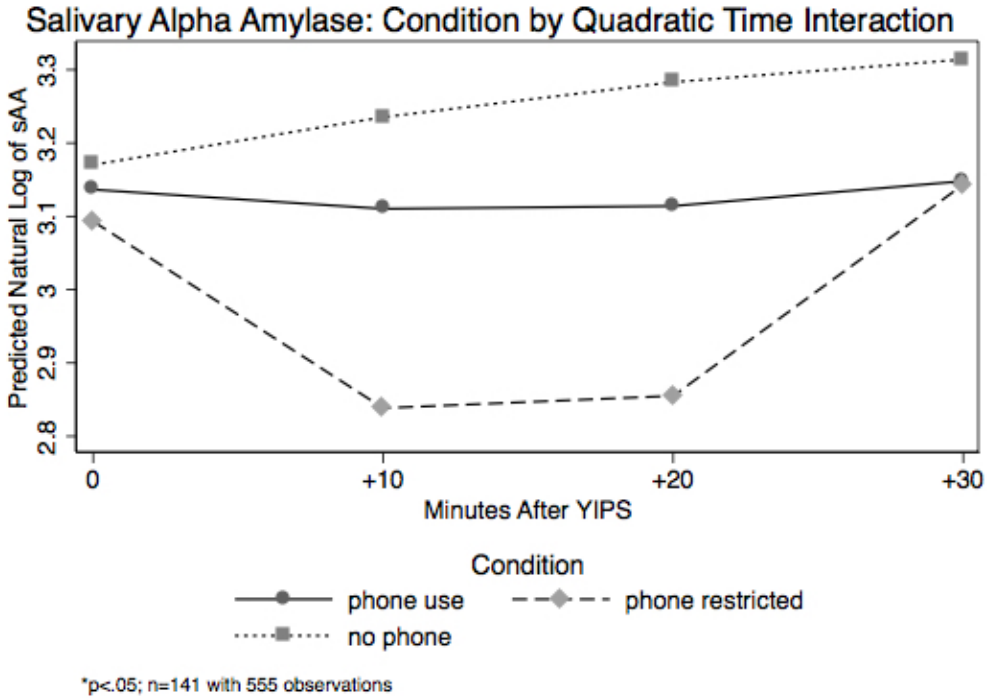
The YIPS did not induce a cortisol response for participants. While individuals in the phone present conditions did exhibit lower levels of cortisol, group differences were not significant (*p>.10*).

Did sAA levels differ over time across conditions?

The unconditional means model determined that 76.6% of the variation in sAA was due to between-person differences while 23.4% of the variation in sAA was due to within-person differences. The unconditional growth model for sAA showed that there was a slight increase in sAA over time (*coefficient*=.05, *SE*=.02, *p*<.001). An omnibus test of interaction effects indicated that the interaction between condition and quadratic time was significant (*p*=0.22), which signifies that the association between sAA and time did depend on condition.

When examining specific differences between the groups, the trajectory of sAA responses over the course of the study for individuals in the phone use condition is significantly different then the trajectory of sAA for individuals in the restricted phone condition (*coefficient*=-.12, *p*=.032). Those in the phone use condition had a relatively flat trajectory, whereas those in the restricted phone condition showed a sharp decrease in sAA responses followed by an eventual increase. There was not a significant difference between the trajectories of responses for the phone use and no phone conditions (*p*>.10). The trajectory of responses over the course of the study for the group who had restricted phone use is significantly different than the trajectory for individuals in the no phone condition (*coefficient* =-.14, *p*=.008).

Figure 2: Salivary Alpha-Amylase after the Yale Interpersonal Stressor



Did adherence to condition influence the results?

In order to understand whether the most critical factor was the "presence" of the phone or the "use" of the phone, we recoded the conditions based on adherence to directions (i.e., if they actually used their phone), which was assessed via visual observations. Regardless of originally assigned condition, we grouped all individuals who did use their phone into one group labeled "phone used"; this included one participant from the restricted phone group who failed to adhere to experimental instructions. We also grouped all individuals who had their phone present but did not use it into the "phone not used" group; this included five individuals from the original phone use condition. The no phone condition remained the same. We tested these three new conditions on feelings

of exclusion, sAA and cortisol and the same pattern of results by condition was maintained. Results indicated that feelings of exclusion significantly varied across the conditions, $F(2,143)=5.40$, $p=.006$. In addition, sAA trajectories significantly differed by condition over time ($p=.025$) and cortisol did not ($p>.10$).

DISCUSSION

Our results indicate that smartphone availability and use influence outcomes related to social exclusion and physiological stress. Individuals who had their smartphones with them felt significantly less excluded as compared to individuals who did not have their smartphones. However, the phone present groups did not significantly differ from each other. The lack of differences in self-report results between participants in the restricted phone group as compared to participants in the phone use group implies that actual engagement with a smartphone is inconsequential for subjective experience and that actually using a phone provides no additional benefit beyond having a phone in one's presence.

Individuals who had their phones but were not allowed to use them had significantly different trajectories of sAA as compared to individuals who had their phones and could use them and individuals who did not have their phones. Those with no phone increased sAA throughout the course of the study, those who used their phone had relatively flat trajectories, and participants who had restricted phone use exhibited a sharp decline and eventual increase of sAA activity following the stressor. This decline of sAA during recovery suggests that the mere presence of a smartphone likely dampened sympathetic nervous system responses following the social stressor. While this effect was only short-

lived, as noted by the eventual increase in sAA by the end of the study, it implies that the presence of a smartphone temporarily imparts stress-buffering benefits. The psychological solace provided by a phone aided in physiological stress recovery, specifically in regards to the autonomic nervous system. To further test the distinctions between phone use and presence, we reorganized the groups into users and non-users and the pattern of results remained the same.

Overall, these results suggest that the *presence* of a smartphone moderates the magnitude of negative outcomes during interpersonally stressful situations. Our analyses did not allow us to conclusively uncover the mechanisms by which these processes operate, but it may be that the comfort and security offered by the presence of a phone is the primary reason for its stress-buffering capabilities. The simple symbolic presence of the phone may provide an emblematic safe-haven that allows an individual to feel less stressed when faced with exclusion. In this way, having a smartphone at your side may be akin to a digital security blanket that buffers stress.

These buffering effects may partially be explained by the capacity of smartphones to temporarily increase resilience to stressful stimuli through their ability to provide an avoidance coping strategy (32). The innumerable functions of smartphones can provide resources to help us overcome the demands of dealing with a stressor. This empowerment offered by our phones may make us feel more secure and able to properly handle stress, similar to how a child's blanket can provide comfort in uncomfortable circumstances (38). This stress-buffering effect may also be due to the association of smartphones with

perceived social support, which is a proven potent stress-buffer (28). Even when we are not using the phone to engage in communicating with family or friends, the phone itself represents a symbolic medium by which we can do those things to contact our social networks. As demonstrated by Misra and colleagues (5), smartphones serve as a symbolic representation of perceived social relationships and provide a sense of connection to wider social networks even when they are not actively used. The representational image of our phone may boost feelings of perceived social support through its symbolic importance as a communication tool and therefore provide a sense of having the adequate resources to cope with the stressor at hand. A child does not engage in activities or have specific uses for a security blanket, rather it is the simple act of having it in their possession that leads to the reduction of stress. Similarly, we found that individuals do not need to use their phones in order to harness the stress-buffering capabilities of their digital security blankets, they just need to have them at their side to reap the symbolic benefits.

Our discussion up to this point has mainly focused on why phones in general reduce feelings of exclusion and sAA levels. But the question remains about why individuals who used their phones displayed higher levels of sAA than individuals who merely had their phones with them. It was hypothesized that phone users would derive more stress-buffering benefits than individuals who had restricted access, but this was not the case. Both conditions reduced sAA responses, but those in the restricted group actually experienced more potent buffering effects. Why does using your phone have different effects than just

having your phone? To address this question, it is important to consider the body of literature about technology use and negative psychophysiological outcomes.

One possible reason why individuals in the phone use condition had higher levels of sAA than individuals in the restricted phone use condition may be that actually *using* a phone can increase stress. The act of sending and receiving text messages can increase heart rate, respiration, and skin conductance (39). These findings imply that using your phone (and specifically texting) increases physiological stress reactivity. Based on follow-up questions about phone activities of the participants in our study, the majority of individuals who used their phones reported texting a friend or family member (n=24). While we do not have any data on the content of the text messages, it can be assumed in some instances the conversation exchanged was stressful in nature (i.e., tasks to accomplish, conflicts to resolve). Thus, it is possible that the act of messaging induced stress, or at least negated the extent of the stress-buffering effects seen with mere phone presence. The next most popular activity for phone users during our study was browsing through social media (n=21). The type of social media activity may also inform why phone users did not see the same benefits as individuals in the phone restricted group. None of the individuals who used social media (mainly Facebook or Instagram) actively posted any material; instead they simply browsed the sites. This passive social media use, in contrast to active use, has been shown to predict declines in numerous well-being outcomes (40). In this way, the passive use of social media by individuals in the phone use condition may have contributed to the lack of positive influences and may provide

another potential reason for why they did not see as many stress-buffering benefits as the individuals who simply had their phones with them. Those actions of texting and browsing social media may have served to exacerbate the negativity felt in their real-world environment of social exclusion.

Another possibility is that the individuals who used their phones felt that they were violating social norms by using their phones in the direct presence of two acquaintances that were engaged in a nearby conversation. The participants who took part in the YIPS were at a small table only three feet in diameter. For those individuals who used their phones, they were blatantly ignoring the conversation partners in their immediate vicinity and may have felt guilty or stressed by these seemingly inappropriate actions. Social psychology research has demonstrated that individuals usually feel compelled to comply with social norms and violating these norms can lead to distress (41). This effect may have been particularly salient in our population because our participants were mainly women, and prior research on cell phone etiquette has suggested that women advocate for more restricted cell phone use in most social situations than men (42). In the context of our study, it is possible that participants who used their phones felt mildly distressed by inappropriately using their phones and therefore had higher levels of sAA in comparison to individuals who simply had their phones in their presence.

There are a variety of limitations that restrict our assumptions about the generalizability of our results. Cortisol levels did not increase following the manipulation and did not significantly differ between groups, so as expected our

conclusions do not encompass the entirety of the stress response. Rather, we can only infer that phone presence influences autonomic stress responses to peer rejection, but not HPA reactivity. In future studies, it would be advantageous to collect a wider range of physiological biomarkers that would help to elucidate the extent to which cell phones serve as buffers to physiological responses to social exclusion. In addition, future studies could test other types of stressors (e.g., social evaluative threat, physical pain) and examine whether the presence of a smartphone influences the responses.

Furthermore, our investigation was limited to studying the specific effects of smartphones, and cannot provide generalizable information about all mobile phones. It is possible that the certain features of a smartphone may be responsible for its buffering abilities, and non-smartphones would not produce the same pattern of findings. All of our participants were smartphone owners, thus our data cannot answer this question.

These findings should not be taken as a green light to encourage individuals to have their phones with them at all times in all situations. Our experiment narrowly focused on one specific environmental context and only demonstrated the stress-buffering capabilities of phones for one physiological system. The initial aims of this study were to explore why individuals use their phones so often in social situations, and our results about the potential stress-buffering capabilities provide only one answer. The interplay between phones, stress and social relationships is continually evolving with the changing technological advancements and societal acceptance of their presence in our

lives. Individuals should seek to maximize their well-being by utilizing phones, but should also be cautious in doing so appropriately.

Despite these limitations, our results show that the presence of a smartphone reduces negative psychological and physiological responses associated with social exclusion. Phones are increasingly becoming integrated into our lives, and as the philosopher Marshall McLuhan once foreshadowed, we may be moving towards an age where technological devices serve as, “extensions of our central nervous system,” pervading all aspects of our lives and surreptitiously influencing the functions of our physical and psychological being (43). Further research must be conducted in order to unpack the intricacies of these relationships, but this study demonstrates one way in which smartphones are beneficial through their ability to act as digital security blankets and stress buffers.

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