Creativity and Smartphone Use: Three Correlational Studies*

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Abstract

Various books and popular media outlets claim that mindless smartphone use can impair creativity, yet few studies have tested this idea. We conducted a survey and three correlational studies focused on *divergent thinking*, the mindful ability to generate creative responses to open-ended problems. Most of the 48,000 participants surveyed thought that smartphone use reduced creativity. This view was consistent with the negative correlations we found between divergent thinking and both screen time and problematic smartphone use (rs $= -.27$ to $-.35$) in an exploratory sample of 62 university students. However, in two pre-registered replications with larger and more diverse samples ($N = 294$ and 16,932), we found at most tiny correlations between measures of divergent thinking or creative achievement and several types of smartphone use (rs $= -.09$ to .09). Thus, the link between smartphone use and creativity may be weaker or more nuanced than is commonly believed.

Keywords: problematic smartphone use, smartphone addiction, screen time, creativity, divergent thinking

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Introduction

According to a narrative popular in print and news media (Cleese, 2020; Pang, 2013; Price, 2018; Zomorodi, 2017), excessive smartphone use can impair creativity. Since boredom and idle time are catalysts of creative thought, filling life's absences with absorbing smartphone stimulation could drown out spontaneous insight. Creativity may thrive in environments devoid of distraction (Stokols, Clitheroe, & Zmuidzinas, 2002); smartphones and their notifications can impair attention (Elhai, Rozgonjuk, Alghraibeh, & Yang, 2019; Kim, Han, Sim, & Noh, 2018; Marty-Dugas, Ralph, Oakman, & Smilek, 2018) which could reduce the mindful noticing and flexible thinking needed for creative output (Bercovitz, Pagnini, Phillips, & Langer, 2017; Pirson, Langer, & Zilcha, 2018). Smartphones may also interfere with *mind wandering* — task-unrelated thinking that often occurs while bored — which plays an important role in generating novel solutions to problems (Agnoli, Vanucci, Pelagatti, & Corazza, 2018; Baird et al., 2012; Mooneyham & Schooler, 2013). Replacing idle mind wandering with mindless smartphone use, then, could theoretically hinder creativity (Duke & Montag, 2017).

Although this narrative sounds plausible, it currently lacks empirical support (Wilmer, Sherman, & Chein, 2017). For example, studies show that smartphone use tends to *positively* correlate with mind wandering (Marty-Dugas et al., 2018; Müller, Sindermann, Rozgonjuk, & Montag, 2021). Complicating this narrative further, mind wandering has several different subtypes, such as deliberate versus spontaneous (Seli, Carriere, & Smilek, 2014), which may vary in their relevance to both smartphone use and creativity (Müller et al., 2021). Depending on how they are used, smartphones may even increase creativity (Rodríguez, Lozano, Mingorance, & Pérez-Mármol, 2020) by promoting activities such as photography (Yeh, Chang, Ting, & Chen, 2020). With global increases in problematic smartphone use (Olson, Sandra, et al., 2022) and phone ownership (Newzoo, 2021; O'Dea, 2021), any effect on creativity could have widespread consequences (Linares & Sellier, 2021).

Creative cognition has two general types: *divergent thinking*, the mindful ability to generate a variety

of novel ideas following an open-ended prompt, and *convergent thinking*, the ability to assess several stimuli to find the best response. One study found a small negative correlation ($r = -.18$) between self-reported smartphone addiction and a measure of divergent thinking involving generating diverse uses for common objects (Upshaw, Davis, & Zabelina, 2021). The same study, however, reported no correlation between smartphone addiction and real-world creative achievement. Other studies have also found no relationships between smartphone use and various divergent and convergent thinking tasks, including designing toys for children (Linares & Sellier, 2021), generating novel responses to picture stimuli (Rodríguez et al., 2020), and completing relevant word associations (Linares & Sellier, 2021).

People's beliefs about this relationship are similarly mixed. In an informal survey following a creativity study, most of the $48,000$ respondents thought that smartphone use reduced creativity (55%; Figure 1), while a minority thought it improved creativity (24%) or had no effect (21%). Just as any technology can be used in helpful or harmful ways, these varied findings and beliefs could reflect differences in phone use. Mindless, passive scrolling through social media feeds may hinder creative pursuits while mindful, intentional seeking of novel ideas could inspire creativity (cf. Upshaw et al., 2021).

To clarify the relationship between creativity and problematic smartphone use, we conducted three correlational studies on the topic. With diverse samples, high statistical power, pre-registered analyses, and different measures of phone use, we find little support for a general relationship between smartphone use and creativity.

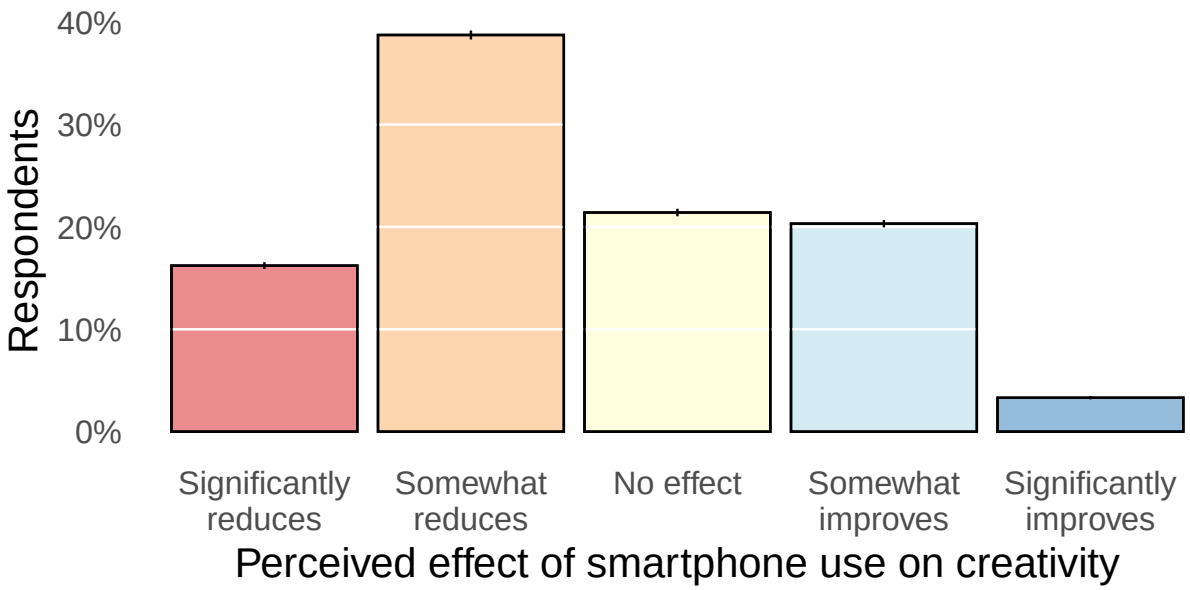

Figure 1: Respondents generally thought smartphone use reduced creativity ($N = 48,000$). We asked them to complete the sentence "Smartphone use probably . . . " in a closed-ended one-question survey following a larger creativity study. Error bars show 95% confidence intervals.

Study 1: Exploratory Correlations

Materials and Methods

Participants

We recruited 62 participants from the McGill University psychology participant pool and from social media postings. To be eligible, participants needed an iPhone which includes built-in screen time tracking. See Table 1 for demographics and means.

Table 1: Means (and SDs) of demographic and outcome variables.

Measure	Study 1	Study 2	Study 3
N	62	294	16,932
Age (y)	20.52 (2.60)	21.64 (2.29)	41.50 (15.36)
Age range (y)	18 to 33	18 to 25	18 to 89
Female	77%	48%	69%
Population	University students	Young adults	Adults
Recruitment area	Montreal, Canada	9 provinces in Canada	143 countries/subdivisions
Study framing	Reducing phone use	Testing creativity	Testing creativity

Measure	Study 1	Study 2	Study 3
Study context	Paid lab study	Paid online study	Unpaid online study
Problematic smartphone use (SAS-SV)	32.61 (8.47)	33.06 (9.14)	27.18 (8.82)
Screen time (h/day)	4.68 (1.97)	4.85 (2.75)	—
Divergent thinking (DAT, usually 50 to 100)	80.48 (6.24)	78.04 (5.96)	82.32 (6.03)
Creative achievement (CAQ, minimum of 0)	—	18.33 (36.72)	—
Habitual phone use (1 to 5)	—	—	4.09 (0.70)
Social phone use (1 to 5)	—	—	3.97 (0.65)
Process phone use (1 to 5)	—	—	3.65 (0.67)

Procedure

Participants visited the lab twice over two weeks to complete smartphone and creativity measures, as part of a larger study on reducing problematic smartphone use (Olson et al., 2022). All participants gave informed consent and received $20 or course credit. The protocol of each study was approved by the McGill University Research Ethics Board II (#451-0518).

Smartphone Addiction Scale — Short Version (SAS-SV). Participants first completed the SAS-SV, the most widely used measure of problematic smartphone use (Olson, Sandra, et al., 2022). The scale has 10 items probing whether phone use interferes with daily life. We made small modifications to the questionnaire for clarity and to reflect current social media apps (Olson, Stendel, & Veissière, 2020). An example item is: "I feel impatient and fretful when I am not holding my smartphone." Participants rate their agreement from 1 (Strongly disagree) to 6 (Strongly agree) for a total score between 10 and 60. The internal consistency was good ($\alpha = .78$).

Divergent Association Task (DAT). Participants then completed the DAT, a 4-min measure of divergent thinking. The task asks participants to list 10 words that are as different from each other as possible in all meanings and uses of the words (Olson, Nahas, Chmoulevitch, Cropper, & Webb, 2021). We then computed the average semantic distance between the words, which correlates

with traditional creativity measures such as the Alternative Uses Task (Guilford, 1950) as well as convergent thinking and problem solving abilities. More creative people generate words with greater distances between them, such as *prickle* and *violin* rather than *shoes* and *office*. Scores typically range between 50 and 100. The task is brief and uses automated scoring, which allowed for large sample sizes in our subsequent studies.

Screen time. Finally, participants showed the experimenter their average daily screen time over the past week, as measured by the iPhone's tracking function (Kaye, Orben, Ellis, Hunter, & Houghton, 2020).

Analysis

We tested for correlations between all three pairs of variables, with an α of .05, non-directional tests, and no family-wise error correction. As in the subsequent studies, we confirmed no curvilinear relationships. Square brackets throughout denote 95% confidence intervals.

Results

There was a negative correlation between divergent thinking and problematic smartphone use during the initial lab visit ($r(60) = -.35$ $[-.55, -.11]$, $p = .005$; Figure 2) as well as two weeks later ($r(58) = -.29$ $[-.51, -.04]$, $p = .024$). Screen time negatively correlated with divergent thinking during the second visit ($r(56) = -.27$ $[-.49, -.01]$, $p = .040$); the sample correlation was similar during the first visit ($r(58) = -.25$ $[-.47, .00]$, $p = .054$). Consistent with the views expressed in the previous survey, there appeared to be a negative relationship between smartphone use and creativity.

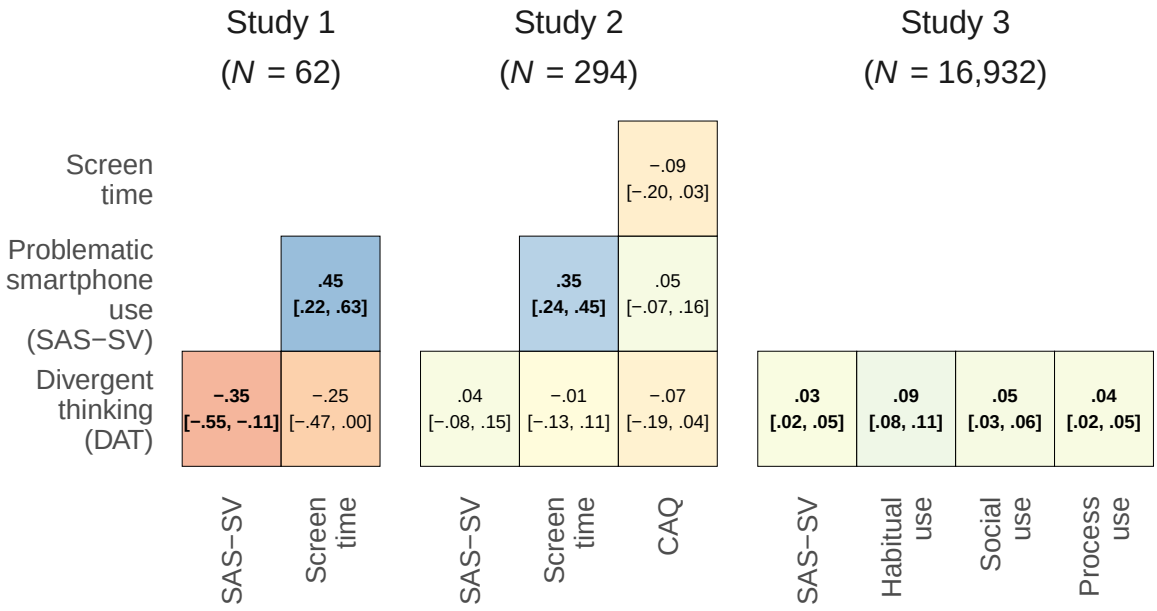

Figure 2: Correlations between smartphone and creativity measures. The negative correlations seen between divergent thinking and both problematic smartphone use and screen time in Study 1 were not seen in Studies 2 and 3 with larger sample sizes. Bold text shows $p < .05$. CAQ = Creative Achievement Questionnaire.

Study 2: Confirmatory Replication

Materials and Methods

Participants

To confirm these correlations in a broader sample, we recruited 305 participants from the Prolific Academic online platform. Participants were pre-screened to live in Canada and be 18 to 25 years old to resemble the Study 1 sample. All needed to own an Apple or Android phone (which both have screen time tracking functions) and have an approval rate of at least 90% on the platform for quality control. Overall, 296 participants completed all of the measures. We excluded 2 participants who scored low on the creativity task ($z < -3$) due to misunderstanding the instructions. An additional 4 were excluded only from the creativity correlations as they did not provide the minimum of 7 valid words needed for scoring. The final sample size included 294 participants.

Procedure

Participants signed up for a study titled "Test your creativity". They first completed the DAT and the SAS-SV ($\alpha = .84$) before reporting their screen time and creative achievement. Participants received $2 for completing the brief study.

Screen time. Participants were asked whether screen time tracking was enabled on their phone. If it was, we asked them to report their average daily screen time in hours over the previous week; if not, we asked them to estimate this number. Those who reported unrealistically high screen time values (≥ 20 hours per day, $n = 12$) were excluded only from the screen time correlations. Unlike the other exclusion criteria, this criterion was not pre-registered but it changed no outcomes of our hypothesis tests.

Creative Achievement Questionnaire (CAQ). Finally, participants completed the CAQ to assess real-world creative achievement across ten domains (e.g., dance, music, and scientific discoveries)

(Carson, Peterson, & Higgins, 2005). Higher scores represent more accomplishments; for example, participants receive 5 points for each national prize in science or medicine. A total score of 0 indicates no training or ability across any of the domains and there is no upper limit. Participants had scores ranging from 0 to 402 with an average of 18.33 ($Mdn = 9$; see Table 1), which was similar to previous samples from the same country (e.g., $M = 13$) (Carson et al., 2005).

Analysis

The design and analysis were pre-registered online (https://osf.io/ztdbk). We tested correlations between all six pairs of the four variables. We used Spearman's correlations for the CAQ scores which were not normally distributed. Consistent with the findings of Study 1, we expected positive correlations between the two smartphone measures and between the two creativity measures, as well as negative correlations across the smartphone and creativity measures. Each test was confirmatory and directional. Our pre-registered sample size of at least 300 gave 90% statistical power to detect correlations that explain half as much variation ($R^2 = .03$) as the weakest correlation seen in Study 1 ($R^2 = .06$).

Results

Unlike in Study 1, there was no relationship between creativity and smartphone use (Figure 2). Neither smartphone measure explained more than 1% of the variation in either creativity measure. Additional exploratory tests showed a similar lack of relationship whether participants reported their objective or estimated screen time, so the low correlations were not simply due to noisy screen time estimates (cf. Kaye et al., 2020).

We saw the expected positive correlation between screen time and problematic smartphone use, but we did not see the expected correlation between divergent thinking and creative achievement. This lack of correlation may be in part because they measure disparate facets of overall creativity. The CAQ, for example, measures aspects such as culinary achievements which are less related to verbal creative cognition. Creative achievement reflects a broader construct of real-life outcomes

depending on various other aspects such as convergent thinking, motivation, resources, and execution. Nevertheless, studies typically find small positive correlations between divergent thinking tasks and creative achievement (Kim, 2008).

Study 3: Confirmatory Replication With a Diverse Sample

Materials and Methods

Participants

To resolve the discrepancy in results across the previous studies, we recruited a broader sample of 16,932 participants from across the world. This sample included only participants who completed all measures, came from unique IP addresses, had no extreme scores ($|z| > 3$), and completed the study in a reasonable amount of time ($z > -3$). Participants came from 143 countries and subdivisions (Table 1), allowing us to test an older and more diverse population who may use their phones differently.

Procedure

Participants who voluntarily completed the DAT online for a larger study were invited to participate in an additional survey on smartphone use. They first completed the SAS-SV ($\alpha = .81$) and then reported (from 1 to 5) their agreement with three types of smartphone use (van Deursen, Bolle, Hegner, & Kommers, 2015): habitual use (e.g., "Smartphone usage is part of my daily routines"; $\alpha = .85$), social use (e.g., "I use my smartphone to contact people through social media"; $\alpha = .65$), and process use (e.g., "I use my smartphone because it is entertaining"; $\alpha = .77$). These questionnaires gave a more nuanced view of their smartphone activities beyond screen time and problematic use. Participants were not compensated for the brief study.

Analysis

The design and analysis were pre-registered online (https://osf.io/2bhzr). We planned to run at least 300 participants after exclusions; many more ended up participating which gave considerable statistical power. We tested for correlations between the DAT and each of the 4 other measures, using Spearman's correlations for the habitual and social use measures given violations in normality. All tests were non-directional.

Results

All correlations were positive yet small, between .03 and .09 (ps $< .001$; Figure 2). As in Study 2, the strongest correlation explained less than 1% of the variation in divergent thinking. Among participants aged 18 to 25, to resemble the demographics of the previous studies, an exploratory test showed that there was no correlation between divergent thinking and problematic smartphone use ($r = .01[-.03, .04]$).

Discussion

Many people believe that smartphones are used mindlessly to the detriment of creativity. Here, however, we saw little evidence for a general relationship between smartphone use and divergent thinking. The negative correlations seen in Study 1 may have been spurious; the creativity measure was exploratory and the sample was small. Studies 2 and 3, with larger and more diverse samples, found at most tiny correlations. These results are generally consistent with other studies finding no relationship between smartphone use and performance on other divergent thinking tasks (Linares & Sellier, 2021; Rodríguez et al., 2020) or creative achievement (Upshaw et al., 2021). The findings echo a pattern found across other relationships with smartphone use, such as depression, sleep quality, and school performance. In each case, controlling for other relevant factors produced correlations smaller in magnitude than initially believed (Bjerre-Nielsen, Andersen, Minor, & Lassen, 2020; Przybylski, 2019; Przybylski & Weinstein, 2017).

The main limitation of our study is that we tested few creativity measures. Although our automated task correlates with standard creativity measures and enabled high statistical power, it only measures one facet of divergent thinking (Olson et al., 2021). Future studies could use broader measures of creativity, such as those capturing convergent thinking (Linares & Sellier, 2021), insight problem solving (Webb, Little, & Cropper, 2016), or creative exploration (Hart et al., 2017). They could also test potential mediators and moderators such as different types of mind wandering (Seli et al., 2014) or mindfulness (Pirson et al., 2018).

Beyond screen time and problematic smartphone use, future studies should examine which apps, used in which ways, promote creativity for which people (cf. Sohn, Krasnoff, Rees, Kalk, & Carter, 2021; Kaye et al., 2020; Rozgonjuk, Sindermann, Elhai, Christensen, & Montag, 2020). For example, general social media use can show either negative (Kühnel, Vahle-Hinz, Bloom, & Syrek, 2017) or positive correlations with creativity (Acar, Neumayer, & Burnett, 2019; Zhou, Mou, Wang, & Wu, 2021), seemingly depending on usage patterns; active posting may be more beneficial than passive scrolling (Upshaw et al., 2021). Although social media use primarily occurs on smartphones (Jeong, Kim, Yum, & Hwang, 2016), general phone use measures may be too coarse to detect a relationship with creativity without accounting for more precise measures such as phone-checking behaviours or app-specific screen times (cf. Rozgonjuk et al., 2020). Studies could also test for correlations at the extremes, such as among people with no smartphone experience (Davidson & Jensen, 2013), those in clinical populations with high levels of problematic use, or people with careers requiring constant creative output. For now, we can conclude that the relationship between smartphone use and divergent thinking is likely weaker or more nuanced than is commonly believed.

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Disclosure statement

The authors declare no conflicts of interest.

Data availability statement

All datasets are available online (https://osf.io/nqrhg/).

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