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Digitally connected, socially disconnected: The effects of relying on technology rather than other people



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ABSTRACT

In less than a decade, smartphones have transformed how, when, and where people access information. We propose that turning to technology for information may lead individuals to miss out on opportunities to cultivate feelings of social connection. Testing this hypothesis, we asked participants to find an unfamiliar building and randomly assigned them to solve this everyday problem either with or without their smartphones. Compared to those who could not rely on technology, participants who used their smartphones found the building more easily but ended up feeling less socially connected. Although having access to smartphones improved participants' mood by making their task easier, this beneficial effect was diminished by the costs to social connection. Our findings provide the first experimental evidence that the benefits of pervasive connectivity may be undercut when technology supplants social interactions.

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1. Introduction

Smartphones are the first thing many Americans report reaching for when they wake up in the morning—beating out coffee or even their own significant others, according to a recent survey (Braun Research Inc, 2015). In the same nationally representative survey, almost half of Americans admitted that they could not go a day without their smartphones. Smartphones provide unprecedented access to information, enabling individuals to harness the full resources of the Internet from anywhere. But could this omnipresent access to information carry unforeseen consequences for the fabric of social life?

Smartphones represent a new branch in the evolution of information technology because of two defining characteristics. First, unlike many other computing devices, smartphones are portable and constantly accessible, pervading people's daily lives (Pew Research Center, 2015). Second, unlike other portable sources of information—from simple cell phones to newspapers and maps—smartphones provide connectivity to limitless information

on-demand, enabling people to solve a wide variety of everyday problems. It is this *pervasive connectivity* that theoretically sets smartphones apart from any preceding information tool. There is a great deal of public debate (e.g., Schwartz, 2015; Turkle, 2011, 2015), but a dearth of rigorous experimental research on the effects of this emerging technological revolution for social and emotional well-being.

Most existing research relevant to the effects of phones on well-being has focused on apps that are explicitly designed to enable people to connect with others through messaging and social media (e.g., Guillory, Hancock, Woodruff, & Keilman, 2015; Hall & Baym, 2012; Pielot, Church, & de Oliveira, 2014; Pollet, Roberts, & Dunbar, 2011; Valkenburg & Peter, 2007). In contrast, very little research has explored whether the use of smartphones for information-seeking (e.g., search engines, Google Maps, Apple Maps) might also influence social outcomes and emotional well-being. And the few existing studies rely on correlational methods, which cannot establish causality (e.g., Kushlev & Proulx, 2016). In the present research, we used experimental methods to investigate how relying on smartphones for information would shape social and emotional well-being. We propose that by enabling people to rely on technology for information anywhere, smartphones may obviate the need for people to rely on each other, thereby leading them to miss out on opportunities to foster a sense of

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connectedness. We explored this idea by asking participants to solve an everyday problem: finding an unfamiliar building either with or without their smartphones. We chose this particular task because people rank finding directions amongst the most indispensable functions of smartphones (Pew Research Center, 2015).

2. Theoretical background and hypotheses

According to the principle of least effort (Ferrero, 1894), organisms tend to seek the easiest way to achieve a given outcome. Applying this principle to information-seeking behavior, Mann (1990) argued that people would tend to rely on the most convenient available method of obtaining information. And due to their portability and connectivity to the Internet, smartphones are nothing if not convenient. Indeed, ‘convenience’ was the most frequently mentioned word amongst U.S. poll respondents asked to describe what they like about their phones (Pew Research Center, 2012). According to the principle of least effort, then, smartphone users should be less likely to rely on other methods of seeking information if they can easily obtain information from their phones. After all, why turn to a friendly stranger for directions to a café when Google Maps is just a finger swipe away? Thus, we hypothesize that when people have access to their phones, they will be less likely to rely on other human beings to obtain information, such as getting directions while looking for an unfamiliar address (Hypothesis 1).

To the extent that individuals rely on technology rather than other people for information, they may miss out on opportunities to satisfy fundamental human needs. Although different motivation theories differ in their specification of basic human needs, social needs feature in virtually all existing models of human motivation (Baumeister & Leary, 1995; Kenrick, Griskevicius, Neuberg, & Schaller, 2010; Maslow, 1943; Ryan & Deci, 2000; Ryff, 1989). In his classic pyramid of needs, for example, Abraham Maslow (1943) theorized that social needs for connection and belonging are fundamental for human flourishing—secondary only to basic survival needs for water, food, and safety. In a recent reformulation of Maslow’s classic pyramid, evolutionary theorists have kept social needs at this central place within the hierarchy of human needs (Kenrick et al., 2010). Furthermore, according to self-determination theory (Ryan & Deci, 2000), a sense of *relatedness* to others is one of only three universal psychological needs that are essential for human flourishing. Similarly, Baumeister and Leary (1995) integrated decades of psychological research to place the *need to belong* amongst the most fundamental human motivations.

Past research has primarily focused on social interactions with strong ties (e.g., family, friends) in satisfying people’s need for social connectedness (e.g., Mehl, Vazire, Holleran, & Clark, 2010; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Vittengl & Holt, 1998; Wheeler, Reis, & Nezlek, 1983). Recent research suggests, however, that even seemingly trivial interactions with strangers and acquaintances can play a surprisingly important role in shaping feelings of social connection (Sandstrom & Dunn, 2014a, 2014b). For example, participants who were randomly assigned to have a brief conversation with the barista at Starbucks left the coffee shop with a greater sense of belonging compared to participants who were assigned to conduct the same transaction as efficiently as possible (Sandstrom & Dunn, 2014a). Thus, if people who have access to their phones are less likely to talk to other people while searching for a building (Hypothesis 1), we hypothesize that they will also experience a lower sense of social connectedness than those who do not have access to their phones (Hypothesis 2).

This detrimental effect of phones on social connectedness, in turn, should have downstream negative consequences for mood. A great deal of research suggests that feeling socially connected is

important for emotional well-being (Cacioppo et al., 2006; Lyubomirsky & Boehm, 2010; Myers & Diener, 1995; Reis et al., 2000; Sandstrom & Dunn, 2014a). To the extent that phones lead individuals to miss out on opportunities to cultivate a sense of connection (Hypothesis 2), we hypothesize that people relying on their phones for directions will experience lower emotional well-being—potentially undercutting the emotional benefits of convenience that technology affords (Hypothesis 3).

3. Study 1

3.1. Overview

In Study 1, we examined the consequences of relying on phones when looking for a building. We randomly assigned participants to a condition in which they could rely on their phones (*phone* condition) or a condition in which they could not rely on their phones (*phoneless* condition).

3.2. Pre-registered hypotheses

We preregistered three central hypotheses on the Open Science Framework (see <http://tinyurl.com/Directions-Study1-Hypotheses>). First, we expected that participants would be less likely to rely on other people if they could use their phones (Hypothesis 1). Second, we predicted that participants would feel less socially connected in the *phone* condition than the *phoneless* condition (Hypothesis 2). Finally, given the central importance of feeling socially connected for emotional well-being, we also predicted that participants in the *phone* condition would report less positive mood compared to those in the *phoneless* condition (Hypothesis 3).

3.3. Study 1 materials and methods

3.3.1. Participants and power

We pre-registered power analyses on the Open Science Framework: <http://tinyurl.com/Directions-Study1-PA>. Based on the most closely related previous research (Sandstrom & Dunn, 2014a), we expected a large effect size of $d = .80$, necessitating a minimum sample size of 84 participants for 95% power. We expected that some participants might not be able to follow instructions due to common phone issues (e.g., poor reception). To ensure a minimum power of 95% given our assumed effect size, therefore, we recruited approximately 15% more participants ($N = 98$). Six participants who were instructed to use their phones failed to do so because of various issues (e.g., no Internet access), and were therefore excluded, leaving a final sample of 92 participants (*Median age* = 19.50, *Age Range*: 17–42; 84% women).

All participants were University of British Columbia students who completed the study for partial course credit. The study was advertised on the UBC Psychology Department’s Participant Pool website and could be taken by any student enrolled in a psychology class regardless of major. After arriving at the lab, all participants provided informed consent. The informed consent and all study procedures were approved by UBC’s Ethics Board.

3.3.2. Procedure

Participants came to our lab individually. We asked if they knew where various buildings on campus were located and sent them to find a building that was unfamiliar to them. We randomly assigned participants to complete this task by using their smartphones (*phone* condition) or without using their smartphones (*phoneless* condition). Aside from this constraint, participants in both conditions were free to use any strategies they wished to find the building, such as asking others for directions, using campus signs/

maps, or simply wandering around. All participants were instructed to leave their belongings in the lab, but participants in the *phone* condition were told to keep their smartphones. All buildings were a 10–12 min walk from our lab; participants were instructed to return the lab if they did not find the building within 30 min. To keep track of time, participants were given basic wristwatches. When participants found their building or returned to the lab, they completed a survey containing our dependent measures. Seven participants (2 in the *phone* condition and 5 in the *phoneless* condition) did not find their building within the allotted time; they were included in the analyses.

3.3.3. Measures

3.3.3.1. Convenience. We assumed that smartphones would be useful in locating the building. To test this assumption, we asked participants to report how difficult it was for them to locate the building (from 0–*not at all* to 6–*very much*).

3.3.3.2. Pre-registered measures. To test Hypothesis 1, we asked participants to indicate how many people they talked to in person while looking for the building (from 0–*None* to 4–*4 or more*). To test Hypothesis 2, we assessed social connectedness with eight items from the Social Connectedness Scale-Revised (Lee, Draper, & Lee, 2001); these items were selected to assess people's general sense of connectedness to other people. To test Hypothesis 3, we measured mood using Schimmack and Grob's (2000) six-item affect valence subscale, which captures the extent to which individuals are feeling pleasant vs. unpleasant (see Table 1 for details and reliability of all measures).

3.3.3.3. Exploratory measures. Our survey also included exploratory measures of tense and energetic arousal (Schimmack & Grob, 2000), trust (using items from the General Social Survey), sense of community (using the Brief Sense of Community Scale; Peterson, Speer, & McMillan, 2008), feelings of agency and communion (adapted from Abele & Wojciszke, 2007), and self-sufficiency (see Table 1 for details of all measures). Finally, we also included a measure of prosocial behavior by dropping pens on the ground while participants were completing the survey and recording whether they offered help (van Baaren, Holland, Kawakami, & van Knippenberg, 2004).

3.4. Results

3.4.1. Convenience

Consistent with our assumption that phones would make the task easier, participants who relied on their phones found it less difficult to locate the buildings, $t(89) = -4.46, p < .001$.¹ All means, standard deviations, and effect sizes for these and subsequent analyses are provided in Table 2.

3.4.2. Pre-registered hypotheses

Consistent with Hypothesis 1, participants who used their phones talked to fewer people to obtain directions than participants who could not depend on their phones, $t(65.97) = -9.32, p < .001$.² Indeed, in the *phone* condition, over 80% of participants searched for the building without ever talking to anyone else, whereas less than 10% did so in the *phoneless* condition. Confirming

Hypothesis 2, we found that people who relied on their phones felt less socially connected than those who left their phones in the lab, $t(89) = -2.10, p = .04$. Contrary to Hypothesis 3, we found no significant difference in mood (i.e., affect valence) between participants who relied on their phones and those who did not, $t(90) = .47, p = .64$ (see Table 2).

3.4.3. Countervailing effects of technology on mood

Given the well-established role of social connectedness in emotional well-being (e.g., Baumeister & Leary, 1995), it is puzzling that we found a condition effect on connectedness but not mood. To illuminate this surprising finding, we next explored whether the negative downstream consequences of lost social connection for mood might have been offset by positive downstream consequences of convenience. To test this mediational hypothesis, we used the PROCESS macro on SPSS21, which uses bootstrapping for constructing confidence intervals for the effects and thus provides less biased tests of statistical significance (Hayes, 2013). In a mediational model using bootstrapping with 50,000 samples, we entered social connectedness and task difficulty as simultaneous mediators of the condition effect on mood. We found that relying on phones had both a negative effect on mood through lower social connectedness and a positive effect on mood through reduced task difficulty (Fig. 1).

3.4.4. Exploratory measures

Consistent with the negative effect of phone use on social connectedness, we found that participants in the *phone* condition felt less trusting toward others than participants in the *phoneless* condition, $t(89) = -2.25, p = .03$ (Table 2). We found no other significant main effects of condition on our exploratory measures, p 's $> .220$.

4. Study 2

4.1. Overview & pre-registered hypotheses

The results of Study 1 suggest that when people rely on technology rather than each other to solve an everyday problem, they may miss out on opportunities to cultivate a sense of social connection. In Study 2, we conducted a direct replication with a larger sample. We expected to replicate the significant effects of condition on social interactions, social connectedness, and trust that we observed in Study 1, and we preregistered these hypotheses on OSF (see <http://tinyurl.com/Directions-Study2-PA1>).

4.2. Study 2 materials and method

4.2.1. Participants and power

Based on the effect size for social connectedness in Study 1 ($d = -.44$), we planned to recruit 220 participants for 90% power. These power analyses were pre-registered on the Open Science Framework (OSF) at <http://tinyurl.com/Directions-Study2-PA1>. Because data collection proceeded more slowly than expected and the study was conducted in the fall when weather conditions in Canada get progressively less amenable to conducting outdoor studies, we added a termination date of October 16, 2015, with the goal of achieving at least 80% power; this corresponded to a minimum sample of 166 participants, which we registered on OSF (<http://tinyurl.com/Directions-Study2-PA2>). By October 16, we had recruited a total of 189 participants. We again excluded participants who failed to comply with the experimental instructions; three participants were instructed to use their phones, but failed to do so, while four participants refused to leave their phones in the lab when asked, leaving a final sample of 182 participants (*Median*

¹ To test differences between conditions, we conducted between-subjects t -tests in SPSS21.

² Degrees of freedom and the t -test value for some tests were adjusted because the Levene's test for equality of variance indicated unequal variances between experimental groups.

Table 1
Measures.

Measure	Cronbach's α : Study 1; Study 2	N of Items	Operationalization	Response Options
Social Connectedness	.86; .84	8	I felt close to people. I felt distant from people. (R) I didn't feel related to people. (R) I felt like an outsider. (R) I saw myself as a loner. (R) I was in tune with the world. I saw people as friendly and approachable. I felt disconnected from the world around me. (R)	1–Strongly disagree 7–Strongly agree
Sense of Community	.94; .94	6	I can get what I need from the UBC community. The UBC community helps me fulfill my needs. I have a good bond with others in the UBC community. I belong to the UBC community. I feel like a member of the UBC community. I feel connected to the UBC community.	1–Strongly disagree 7–Strongly agree
Trust	.60; .71	3	Generally speaking, would you say that most people can be trusted, or that you cannot be too careful in dealing with people? How much do you trust strangers? If you lost a wallet or purse that contained two hundred dollars, how likely is it to be returned with the money in it, if it was found by a stranger?	1–You cannot be too careful in dealing with people 2–Most people can be trusted 1–Cannot be trusted at all 5–Can be trusted a lot 1–not at all likely 2–somewhat likely 3–very likely
Affect: Valence (Mood)	.92; .87	6	(pleasant + good + positive) – (unpleasant + bad + negative)	0–not at all; 6–very much
Affect: Tense Arousal	.90; .84	6	(calm + relaxed + at rest) – (tense + jittery + restless)	0–not at all; 6–very much
Affect: Energetic Arousal	.87; .80	6	(awake + wakeful + alert) – (tired + drowsy + sleepy)	0–not at all; 6–very much
Self-sufficiency	.84; .58	2	Self-sufficient; independent	0–not at all; 6–very much
Agency	.79; .75	6	active; competent; self-confident; dynamic; assertive; efficient	0–not at all; 6–very much
Communion	.79; .78	6	friendly; empathetic; likable; understanding; helpful; reliable	0–not at all; 6–very much

Notes. We computed an overall trust composite by first standardizing each of the three items and then computing the mean of the resulting z-scores.

age = 20, Range: 17–29; 68% women).

4.2.2. Procedure and measures

The recruitment procedures and experimental design were identical to Study 1: Participants were asked to find an unfamiliar building on campus either by using their phones (*phone* condition) or without using their phones (*phoneless* condition). All of those who relied on their phones located their assigned buildings, whereas eleven participants (12%) who left their phones in the lab failed to locate the building. These participants were included in the analyses. At the end of the study, participants completed the same questionnaire as in Study 1 (see Table 1 for details).

Additionally, we measured the interest/enjoyment people experienced when searching for the building (Ryan, 1982) and assessed the usefulness of phones more objectively by recording the time it took participants to find the building. To simplify the procedure, we eliminated our exploratory measure of prosocial behavior.

4.3. Results

4.3.1. Convenience

Consistent with Study 1, participants in the *phone* (vs. *phoneless*) condition found searching for the buildings to be less difficult, $t(155.46) = -8.19, p < .001$ (see Table 2 for descriptives, effect sizes,

Table 2
Effects of relying on smartphones for information.

		Study 1			Study 2			Meta-Analysis
		Phone M (SD)	Phoneless M (SD)	Cohen's <i>d</i> [95% CI]	Phone M (SD)	Phoneless M (SD)	Cohen's <i>d</i> [95% CI]	Cohen's <i>d</i> [95% CI]
Central Measures	Difficulty	1.54 (1.63)	3.18 (1.86)	-.95 [-1.30; -.59]*	1.15 (1.31)	3.13 (1.86)	-.124 [-1.47; -1.01]*	-1.14 [-1.39; -.88]*
	# Social Interactions	.29 (.68)	2.36 (1.30)	-2.00 [-2.22; -1.78]*	.30 (.82)	2.29 (1.25)	-1.90 [-2.05; -1.75]*	-1.93 [-2.22; -1.64]*
	Connectedness	4.55 (1.18)	5.03 (1.00)	-.44 [-.66; -.22]*	4.62 (.95)	5.02 (.98)	-.42 [-.56; -.28]*	-.43 [-.67; -.19]*
Exploratory Measures	Mood	3.03 (2.26)	2.80 (2.42)	.10 [-.38; .57]	3.33 (1.53)	2.74 (1.99)	.33 [.08; .59]*	.25 [.01; .49]*
	Tense Arousal	-1.18 (2.60)	-.67 (2.77)	-.19 [-.73; .35]	-2.01 (2.07)	-.75 (2.40)	-.57 [-.89; -.24]*	-.44 [-.68; -.20]*
	Energetic Arousal	2.57 (2.05)	2.83 (2.18)	-.13 [-.56; .30]	2.19 (2.02)	2.64 (2.06)	-.22 [-.52; .07]	-.19 [-.43; .05]
	Trust	-.17 (.78)	.17 (.66)	-.48 [-.63; -.33]*	.002 (.72)	-.003 (.87)	.01 [-.11; .12]	-.15 [-.39; .09]
	Sense of Community	4.63 (1.20)	4.96 (1.38)	-.26 [-.52; .01]	4.81 (1.16)	4.84 (1.86)	-.02 [-.19; .15]	-.10 [-.34 .14]
	Agency	3.83 (1.06)	3.93 (.89)	-.10 [-.30; .10]	3.78 (.88)	3.90 (.95)	-.13 [-.26; .0]	-.12 [-.36; .12]
	Communion	3.26 (.91)	3.46 (1.00)	-.21 [-.40; .01]	3.36 (1.04)	3.34 (.82)	.02 [-.12; .15]	-.06 [-.30; .18]
	Self-Sufficiency	4.64 (1.05)	4.39 (1.28)	.22 [-.02; .45]	4.56 (.92)	4.17 (1.24)	.36 [.21; .52]*	.31 [.08; .55]*
	Prosocial Behavior	48.9%	53.5%	NA	NA	NA	NA	NA
	Interest/Enjoyment	NA	NA	NA	4.77 (1.16)	4.90 (1.20)	-.11[-.28; .06]	NA

Notes. The scores for affect vary from -6 to +6 because composite scores are calculated by subtracting the reverse items of each scale from the other items (e.g., feeling bad is subtracted from feeling good). Meta-analytic effects were calculated with a fixed effect method using Cumming's ESCI software for conducting meta-analyses of Cohen's *d* based on two independent groups (Cumming, 2013). Percentages for prosocial behavior indicate percent of people who offered help with picking up the pens. * indicates a significant effect at two-tailed $\alpha = .05$ or lower. The raw data for both studies can be obtained at <http://tinyurl.com/Directions-Study-Data>.

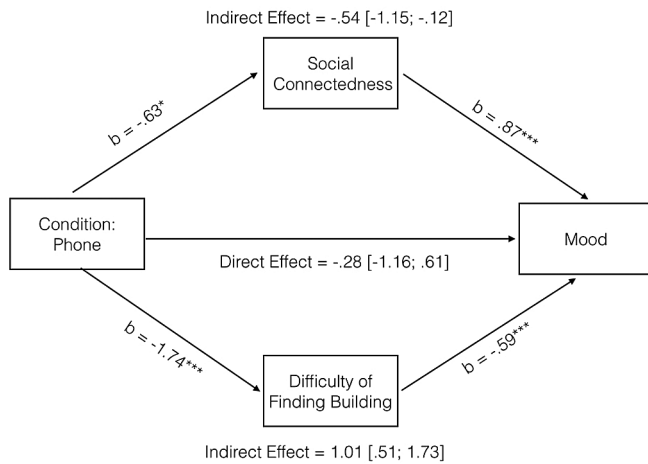


Fig. 1. Indirect effects of relying on phones on emotional well-being through social connectedness and difficulty of finding the building (Study 1). Notes. All b 's represent unstandardized regression coefficients obtained through bootstrapping using 50,000 resamples (Hayes, 2013). The range in brackets represents the 95% confidence interval of the indirect effect. * $p < .05$; ** $p < .01$; *** $p < .001$.

and confidence intervals). Participants relying on their phones also located the buildings faster ($M = 12.28$ min, $SD = 4.32$) than those who left their phones at the lab ($M = 16.44$ min, $SD = 7.31$), $t(122.29) = -4.44$, $p < .001$, Cohen's $d = -.71$, 95%CI [-1.01; -.39].

4.3.2. Pre-registered hypotheses

We expected to replicate the significant effects of condition on social interactions, social connectedness, and trust that we observed in Study 1. As in Study 1, participants who used their phones talked to fewer people to obtain directions than participants who could not depend on their phones, $t(153.94) = -12.67$, $p < .001$. Again, over 80% of people in the *phone* condition searched for the building without ever talking to anybody, while less than 10% did so in the *phoneless* condition. Replicating our central finding from Study 1, we found that people in the *phone* condition felt less socially connected than those in the *phoneless* condition, $t(180) = -2.80$, $p = .006$. There was, however, no effect of condition on trust, $t(172.67) = .05$, $p = .96$ (Table 2).

4.3.3. Countervailing effects of technology on mood

Participants in the *phone* condition reported more positive mood compared to those in the *phoneless* condition, $t(167.14) = 2.21$, $p = .03$ (Table 2). Still, using mediational analyses through PROCESS for SPSS21 (Hayes, 2013), we explored whether the social costs associated with relying on phones may have limited the emotional benefits that phones conferred. Replicating the findings of Study 1, we found that relying on phones had both a negative effect on mood through lower social connectedness and a positive effect on mood through reduced difficulty (see Fig. 2). After accounting for the role of social connectedness and difficulty, condition did not significantly predict mood.

4.3.4. Exploratory measures

We found no significant effects of condition on our exploratory measures of agency, communion, sense of community, energetic arousal, or interest/enjoyment p 's $> .14$ (see Table 2). Compared to those in the *phoneless* condition, participants who could rely on their phones felt less tense arousal, $t(180) = -3.80$, $p < .001$, and more self-sufficient, $t(163.71) = 2.43$, $p = .02$.

4.3.5. Meta-analysis of studies 1 and 2

Next, we conducted a meta-analysis across Studies 1 and 2 (see Table 2). This meta-analysis confirmed that participants in the *phone* (vs. *phoneless*) condition were less likely to interact with other people and ended up feeling less socially connected. At the same time, relying on phones made it much easier to find the building, resulting in a small net positive effect on mood across the two studies. Out of our exploratory measures, we found two significant meta-analytic effects of condition, whereby people who relied on their phones felt less tense and more self-sufficient.

5. General discussion

In an initial study and a larger direct replication, we found the first experimental evidence that relying on smartphones for information may compromise opportunities for social connection. Compared to people who were not allowed to use their phones to find a building, those who could rely on their phones talked to fewer people and ended up feeling less socially connected. Of course, phones also conferred an important benefit by reducing the difficulty of this everyday task, with positive downstream consequences for participants' overall mood. This beneficial effect on mood, however, was partially undercut by the insidious effect of phone use on social connection.

5.1. Implications

Social connection has earned a prominent place in the pantheon of essential psychological needs (e.g., Baumeister & Leary, 1995; Ryan & Deci, 2000), but theory and research have traditionally focused on the role of close relationships in promoting this basic human need (e.g., Nelson, Kushlev, & Lyubomirsky, 2013; Reis et al., 2000; Ryff, 1989). Our findings add to a growing body of research documenting the surprising power of casual interactions with acquaintances and strangers to make people feel more socially connected (Sandstrom & Dunn, 2014a & 2014b; Wesselmann, Cardoso, Slater, & Williams, 2012). Interestingly, both theory (e.g., media richness theory, media naturalness theory; Daft & Lengel, 1986; Kock, 2004) and research (e.g., Kross et al., 2013; Park et al., 2016; Verduyn, Ybarra, Résibois, Jonides, & Kross, 2017) suggest that computer-mediated communication does not provide an

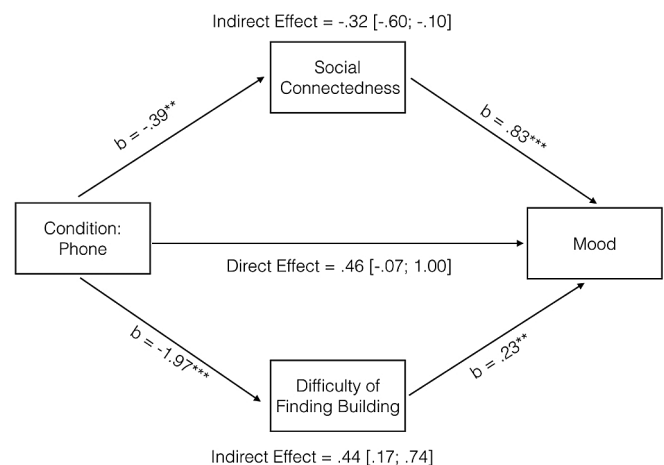


Fig. 2. Indirect effects of relying on phones on emotional well-being through social connectedness and difficulty of finding the building (Study 2). Notes. All b 's represent unstandardized regression coefficients obtained through bootstrapping using 50,000 resamples (Hayes, 2013). The range in brackets represents the 95% confidence interval of the indirect effect. * $p < .05$; ** $p < .01$; *** $p < .001$.

equivalent substitute for real, face-to-face social interactions. Going beyond past research, our findings demonstrate that when technology supplants even trivial face-to-face social interactions, people can miss out on opportunities to satisfy their basic need for connection.

This finding is important given that new technologies are increasingly poised to replace casual social interactions. In 2016, for example, Starbucks added a feature to its app that enables customers to place orders through their smartphones, rather than waiting in line and placing an order with the barista. While this new method of obtaining one's morning dose of caffeine is more convenient and efficient, it potentially obviates the need to talk to any actual people. Our findings suggest that this might lead customers to miss out on an easy opportunity to cultivate a sense of connection while getting their coffee. By appreciating the value of social connection, organizations and designers can consider how to deploy new technologies in ways that are sensitive to psychological needs. For example, although Starbucks could maximize convenience by placing mobile orders near the entrance—allowing customers to grab their drinks and go without talking to anyone—our research points to the value of placing the drinks near a friendly barista who could briefly greet customers, thereby balancing convenience with connection.

More broadly, our research underscores the importance of considering what might be lost in the immediate (i.e., non-digital) social environment when people engage in digital activities. Recent research has shed light on the psychological consequences of engaging in specific activities from Facebook to email (e.g., Kross et al., 2013; Kushlev & Dunn, 2015; Park et al., 2016), but almost no research has examined how these activities affect and are affected by the immediate social context. Checking Facebook during a business trip, for example, might make a working mother feel more connected to her family and friends back home—but checking Facebook during a family dinner might produce the opposite effect. Thus, future research should examine when digital behavior—from information consumption to computer-mediated communication—complements or interferes with the psychological benefits people can gain from their nondigital environment. This research goal is particularly pressing given that improvements in sensor technology may soon enable smartphones to automatically adapt their settings according to the social context (e.g., disabling notifications during family meals).

5.2. Limitations and future directions

We first address two potential limitations of our methodology, and then consider several key questions that remain to be addressed by future research. First, given the intense cultural speculation surrounding smartphones, our studies could have been subject to possible demand characteristics: Participants in the phone condition may have reported lower social connection due to their *beliefs* about the detrimental effects of technology. But when we presented a separate sample of 102 participants with a description of the task faced by participants in either the phone condition or the phoneless condition, no differences emerged in how socially connected they expected to feel.³ These findings cast doubt on the possibility that our main findings could be explained by demand characteristics. Second, although we only included participants who reported following our instructions to use (or not use) their phones, we lacked an objective measure of compliance. Of course, because we locked participants' phones away in the phoneless condition, we can be certain that they did not access

their own phones. Still, it is conceivable that participants could have borrowed someone else's phone, but such noncompliance would have only diluted our effects.

The present research has several additional limitations, providing important directions for future research. First, our reliance on convenience samples of younger users limits our conclusions mostly to people who grew up with smartphones. Future research should examine whether people who grew up in a world without smartphones would be more likely to seek information from strangers even when they have access to their phones. Second, our conclusions are limited to situations in which people are looking for concrete information, such as the location of a building. It would be interesting to explore whether people are more likely to rely on others when looking for more subjective information, such as recommendations for restaurants, cafés, or bars. Third, in contrast to our other measures, our measure of trust showed low internal consistency (perhaps due to the small number of items). This might help to explain our inconsistent results on trust across the two studies; it would therefore be worthwhile for future research to include longer measures of trust. Fourth, we did not include personality measures such as extraversion, which could have moderated the effects of experimental condition. Interestingly, recent research shows that even introverts benefit from acting in extraverted ways (e.g., Fleeson, Malanos, & Achille, 2002; Sandstrom & Dunn, 2014b), but that introverts may underestimate these benefits (Zelenski et al., 2013). This points to the hypothesis that introverts may be especially inclined to rely on their phones for information, making them especially vulnerable to declines in social connectedness due to missed opportunities to engage with others.

Finally, in interpreting our results, it is important to note that we intentionally conducted these studies in a context where people could safely and effectively navigate the situation either by relying on technology or other people. We would not expect our results to extend to situations in which other people are unavailable or unwilling to help. That said, recent research suggests that people may often underestimate strangers' willingness to engage in casual social interactions. Far from the idyllic setting of a college campus, people taking public transit in Chicago were instructed to try talking to a stranger on their commute (Epley & Schroeder, 2014). Although participants predicted that less than half of their fellow commuters would be willing to talk to them, no one actually reported getting snubbed. Chatting with strangers also provided an emotional boost that people failed to foresee. Likewise, Flynn and Lake (2008) found that individuals systematically underestimated how willing strangers would be to help them in response to a variety of in-person requests for information or other assistance. Because seeking information from phones (vs. other people) eliminates the perceived risk of social rejection, individuals may be overly inclined to rely on technology—thereby missing out on opportunities for social connection across a broad range of contexts.

6. Conclusion

Over 100 years ago, French philosopher Guillaume Ferrero postulated the Principle of Least Effort: Organisms tend to seek the easiest way to achieve the greatest outcome (Ferrero, 1894). Our findings provide evidence for the social costs of the Principle of Least Effort. By easily accessing information on smartphones, people may forgo opportunities to foster a sense of connection through casual social interactions.

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³ Data available at: <http://tinyurl.com/Directions-Forecaster-Data>.

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