Article

Environment and Behavior
1–24

DOI: 10.1177/0013916514539755
eab.sagepub.com

The iPhone Effect: The Quality of In-Person Social Interactions in the Presence of Mobile Devices

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Abstract

This study examined the relationship between the presence of mobile devices and the quality of real-life in-person social interactions. In a naturalistic field experiment, 100 dyads were randomly assigned to discuss either a casual or meaningful topic together. A trained research assistant observed the participants unobtrusively from a distance during the course of a 10-min conversation noting whether either participant placed a mobile device on the table or held it in his or her hand. Using Hierarchical Linear Modeling, it was found that conversations in the absence of mobile communication technologies were rated as significantly superior compared with those in the presence of a mobile device, above and beyond the effects of age, gender, ethnicity, and mood. People who had conversations in the absence of mobile devices reported higher levels of empathetic concern. Participants conversing in the presence of a mobile device who also had a close relationship with each other reported lower levels of empathy compared with dyads who

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were less friendly with each other. Implications for the nature of social life in ubiquitous computing environments are discussed.

Keywords
mobile devices, face-to-face social interaction, hybrid places, third places, naturalistic field experiment

> iPhone Effect: Shortly after one person in the group brings out their iPhone, the rest follow suit, ultimately ending all conversation and eye contact.
>
> Urban Dictionary
> (http://www.urbandictionary.com/define.php?term=iphone%20effect)

Introduction

On September 23 2013, Nikhom Thephakayson repeatedly pointed and waived a .45-caliber pistol on a San Francisco light rail. Engrossed in their phones, not a single passenger among the dozens on the train noticed until he fired a bullet into the back of Justin Valdez, a sophomore at San Francisco State University (O'Connor, 2013). How can we explain the ostensible obliviousness of those San Francisco light rail passengers?

Over four decades ago, Milgram (1970) explained the restricted social and moral involvement of urbanites with fellow city dwellers as an adaptation to urban overload. To cope with the experience of overloading metropolitan conditions urbanites conserved their "psychic energy" (Simmel, 1950) by developing adaptive mechanisms such as allocating less time for each input, ignoring low priority inputs, and filtering out inputs, so that only superficial forms of engagement with others were possible. The erosion of social responsibility and estrangement from their social and physical surroundings were interpreted as consequences of individuals' adaptations to urban overload.

In the intervening decades since Milgram published his theory of urban overload, the world has undergone fundamental and transformative changes. One of the drivers of this change is the rapid growth of the Internet and mobile communication technologies (Stokols, Misra, Runnerstrom, & Hipp, 2009). In the early 20th century, extremely dense and populous cities with heterogeneous residents were the purported origins of urban overload (Simmel, 1950; Wirth, 1938). In 21st-century global cities, unprecedented opportunities for access to information and communication through mobile communication technologies impose new neurological, psychological, behavioral, and health burdens on people (Carr, 2011; Gergen, 2000;

Klingberg, 2008; Misra & Stokols, 2012a; 2012b; Turkle, 2012). In effect, information and communication technologies have created a new category of sensory overload, called *cyber-based overload* (Misra & Stokols, 2012a).

In contrast to place-based sources of sensory stimulation, cyber-based overload originates from information and communication transactions from networked technologies such as smartphones, laptops, and computers. Indications of cyber-based overload include feeling overwhelmed by the large volume of communication and information one must process on a day-to-day basis, forgetting to respond to messages, and feeling compelled to multitask (Misra & Stokols, 2012a). An emerging body of research has focused on the socio-cognitive implications of multitasking and divided attention (Cain & Mitroff, 2011; L. Lin, 2009; Ophir, Nass, & Wagner, 2009; Pea et al., 2012). Another line of research and theory has focused on the societal and cultural implications of our increasingly technologically mediated environments (Gergen, 2010; Turkle, 2012). However, little research has connected these two distinct but related theoretical and empirical areas of research on the psychosocial ramifications of the Internet. This study bridges this gap by examining the impact of divided attention on real-life social interactions. The first part of the article considers earlier empirical work on divided attention, multitasking, and cognitive overload. Next, we draw on theoretical propositions of the social and cultural impacts of mobile devices. Finally, we develop integrative hypotheses linking these heretofore separate lines of theory and research concerning the relationship of the presence of mobile communication technologies on the level of interpersonal connectedness and empathetic concern during face-to-face interactions in real-life naturalistic settings.

Cognitive Implications of Divided Attention, Multitasking, and Information Overload

Building on Miller's (1956) and Sweller's (1988) foundational work on working memory and information processing, numerous studies have investigated the implications of information and communication technologies on thinking. Cognitive overload resulting from the division of attention demanded by information and communication technologies taxes individuals' working memory, amplifying distractedness, and making it difficult for them to distinguish between relevant and irrelevant information (Cain & Mitroff, 2011; Klingberg, 2008; L. Lin, 2009; Ophir et al., 2009). Experiments and field studies on the impacts of multitasking on cognitive abilities have found that divided attention limits information acquisition (Rockwell & Singleton, 2007) and leads to poorer retention and learning (Hembrooke &

Gay, 2003; Poldrack & Foerde, 2008). Online hypertext-based reading environments in which readers multitask by jumping from one hyperlink to the next, or are engaged in two or more concurrent tasks have been linked with learning and comprehension impediments in laboratory experiments (DeStefano & LeFevre, 2007; Miall & Dobson, 2006; Niederhauser, Reynolds, Salmen, & Skolmoski, 2000).

Field studies in organizational environments have revealed the extent of the fragmentation of knowledge workers' work routines caused by information and communication technologies (González & Mark, 2004; Mark, González, & Harris, 2005; Mark, Gudith, & Klocke, 2008). Workers routinely check for new email every 5 to 10 min (Renaud, Ramsay, & Hair, 2006), frequently switch between multiple tasks, and deal with many interruptions and information streams, disrupting their thoughts, weakening their memory, increasing error proneness, impeding understanding, and inhibiting their capacity for deep thought, concentration, critical analysis, and imagination (Carr, 2011; Foerde, Knowlton, & Poldrack, 2006; Greenfield, 2009; Jackson, 2008; Misra & Stokols, 2012a; Ophir et al., 2009).

Some research indicates that multitasking does not inhibit familiar, routine, and automatic activities that require less cognitive effort (Just, Keller, & Cynkar, 2008). Other studies have concluded that multitasking can be improved with practice (Dux et al., 2009; Jaeggi, Buschkuehl, Jonides, & Perrig, 2008; Ruthruff, Van Selst, Johnston, & Remington, 2006). However, a growing body of research focusing on the effects of cell phone use, such as texting, dialing numbers, and talking on cell phones, on individuals' attentive capacities during habitual concurrent tasks is at odds with these findings. In driver simulations tests, for example, individuals engaged on cell phones have been found to perform significantly poorly compared with people listening to music, books on tape, conversing with a passenger, and even those who were legally drunk (Drews, Pasupathi, & Strayer, 2008; Hunton & Rose, 2005; Klauer et al., 2014; Strayer & Drews, 2007; Strayer, Drews, & Crouch, 2006). In a recent field study, Hyman, Boss, Wise, McKenzie, and Caggiano (2010) found that even in routine activities such as walking, cell phone users moved more slowly, changed directions more frequently, were less likely to acknowledge other people, and more likely to exhibit "inattentional blindness"—lower likelihood of noticing distinctive stimuli in their environment (Simons, 2000)—compared with individuals engaging in the other activities not involving cell phones. These researchers conclude that the attentional impediments caused by mobile phones are more likely to occur in tasks involving higher levels of cognitive effort and processing by working memory (Fougnie & Marois, 2007). Talking or texting on the cell phone is one such cognitively demanding activity that has demonstrated negative outcomes even when attempted simultaneously with routine tasks.

Despite these cognitive strains, we are enamored by our mobile communication technologies. We rely on their ability to respond to our needs and interests in a highly complex, fast-paced technological society. We seek out the pleasures they grant—speed, connectivity, and freedom—however, trivial, irrelevant, illusory, and short-lived they may be (Madell & Muncer, 2007; Wang & Tchernev, 2012). Only now are we beginning to understand the social and cultural reverberations of the distributed attention enabled by mobile communication technologies.

Socio-Cultural Implications of Divided Attention

To be sure, many 20th century technologies, such as the radio, the television, air travel, and the automobile, have had a corrosive effect on face-to-face interpersonal and community processes (Mumford, 2010; Ong, 1982). But networked technologies are unique *intellectual technologies* (technologies that extend the abilities of our brain such as the printing press, radio, and television) because they subsume other intellectual technologies (Carr, 2011; Gergen, 1992, 1996). Our smartphone is our personal computer, watch, map, television, telephone, and more recently our emotional sensor and behavioral modifier (Carroll et al., 2013; Culp-Ressler, 2013). Moreover, networked technologies are distinctive in that they enable us to be in a persistent state of "absent presence," or the split consciousness created by mobile technologies such as smartphones, tablets, and laptops with Wi-Fi connectivity in which one is physically and perceptually present but immersed in a technologically mediated world of elsewhere (Gergen, 2002; Stone, 2007). In fact, interpretive research on the social behaviors of mobile users has found that mobile phone users occupy multiple social spaces sometimes with conflicting social norms: the physical space of the mobile phone user and the virtual space of the mobile phone conversation (Palen, Salzman, & Youngs, 2000). Several interpersonal implications follow from the expansion of the diverted consciousness created by mobile devices, the most pertinent being "micro-social fragmentation" (Gergen, 2003) and "horizontal relationships" (Gergen, 2002).

Micro-social fragmentation. Mobile communication technologies are symbols of one's relational ties (Gergen, 2003). They provide an unrestricted sense of connection to wider social and organizational networks even when they are on "silent mode" and not in active use (Mazmanian, Orlikowski, & Yates, 2005; Plant, 2001; Srivastava, 2005). In a study of Taiwanese college students, cell phones were found to facilitate the symbolic proximity to valued persons, strengthen familial bonds and social relationships, and expand their psychological neighborhoods by providing instant membership in a social community (Wei & Lo, 2006). Furthermore, they enable individuals to effectively manage multiple loyalties simultaneously (work, family, and different social groups) relatively unconstrained by space and time (Geser, 2004). One can communicate with a social group or an individual, regardless of proximity or location, thereby elevating a spatially distant relationship over proximal, face-to-face relationships (Gergen, 2002). Indeed, Geser (2006) found that a large proportion of couples repeatedly interrupt their meals to check for text or voice messages while eating together. Similarly, Humphreys (2005) found in a year-long observational study on mobile phone use in public places that people rarely ever used their phones to make a call. Most often they seem to play with their phones, checked to see if they are "on" or "off," or checked for messages. In an in-depth observational study of coffee shop patrons preceding this field experiment, we found that, on average, many individuals in pairs or small groups checked their phones every 3 to 5 min regardless of whether it rang or buzzed, often held their phones, or placed them on table in front of them (Misra & Genevie, 2013). Recent studies have found that a large percentage of individuals experience what has been termed as the "phantom vibration syndrome"—perceived vibrations from a device that is not really vibrating (Drouin, Kaiser, & Miller, 2012; Y.-H. Lin, Lin, Li, Huang, & Chen, 2013).

These imagined vibrations as well as people's constant urge to clasp and monitor their phones are signs of their perceptual sensitivity to their mobile devices and the impulse to be tuned in to instantaneous information and communication access and exchange at all times. However, this apparent sense of connection with far flung social and organizational networks and an outward sense of control over information flows come at the cost of withdrawal from local and proximal interactions and resentment among in-person friends and colleagues (Humphreys, 2005; Mazmanian et al., 2005). In a large-scale qualitative investigation, Turkle (2012) has revealed that the multiple *spatio-temporalities* enabled by mobile computing can impede face-to-face conversations by directing attention away from immediate interpersonal experiences and making other relationships, interests, and concerns more salient.

Horizontal relationships. One of the concomitants of the expanding domain of divided attention in our technologically mediated environments is a cultural shift to *horizontal relationships*—an expanded network of superficial and shallow relationships that do not command the dedicated time, effort, attention, and commitment of *vertical relationships* that progress gradually over time and require long-term effort, commitment, and sacrifice to cultivate (Gergen, 2002). Conversational styles encouraged by smart technologies are brief, to the point, and easily communicated. They rarely support the exploration of complex ideas or deep feelings further propelling the transformation of culture toward "sound-bite relationships" (Gergen, 2003; Turkle, 2012). A recent study investigating the neural correlates of admiration and compassion concluded that introspective processing is required for individuals to comprehend the psychological states of others and empathize with them. This type of introspective thought process necessary for understanding culturally shaped social knowledge is slower and requires additional time compared with the rapid, multitasking, and parallel processing in technologically mediated environments (Immordino-Yang, McColl, Damasio, & Damasio, 2009).

An important connective theme emerges from these two research domains and theoretical propositions. The physical context of social interactions has been fundamentally altered by mobile communication technologies. Mobile devices such as smartphones, cell phones, and tablets are *social nuclei*—symbols of individuals' relational networks—diverting their attention and orienting their thoughts to other people and places outside the immediate spatial context. This split consciousness invited by mobile devices has the potential to constrain in-person social interactions and relationships. Following one of the fundamental forms of inter-individual influence, social facilitation (Triplett, 1898; Zajonc, 1965), we posit that the mere presence of a mobile device (representing relational networks) will increase individuals' arousal levels, cause distraction leading to *distraction conflict* (Sanders, Baron, & Moore, 1978), and thus impede the quality of complex tasks such as in-person conversations. Distraction conflict refers to the attentional conflict that occurs when the individual is interested in paying attention to multiple stimuli simultaneously. The task or stimulus unrelated to the individuals' primary task is referred to as the distraction. Distraction conflict only occurs when the pressure to pay attention to each input is equal and the individual's cognitive capacities to do so are inadequate. In other words, because of the symbolic value assigned to smart devices in our contemporary technological society and the manner in which these devices are used to stay in the constant flow of information, their mere presence, as *environmental cues* can distribute individuals' attention and guide the behavior of those who are nearby without their awareness. In fact, a recent laboratory experiment tested this idea. The mere presence of a cell phone placed innocuously in the visual field of participants was found to interfere with closeness, connection, and relationship quality in dyadic settings (Przybylski & Weinstein, 2013). However, the influence of the presence of mobile communication technologies beyond cell phones on real-life relationships in naturalistic settings is yet to be investigated experimentally. Moreover, these laboratory findings need to be explained in the context of existing theory and research.

This study is the first to test the theory of micro-social fragmentation (Gergen, 2003) on interpersonal relationships. It does so by extending Przybylski and Weinstein's (2013) laboratory experiment and the qualitative research on the influence of mobile technologies on social behavior in public places in three ways: (a) It examines the relationship between the presence of a wide range of mobile communication technologies such as smartphones, cell phones, tablets, and Wi-Fi connected laptops and notebooks and the quality of in-person interactions; (b) It uses naturalistic social settings where mobile devices are commonly present; and (c) It investigates the relationship between the presence of these technologies and the nature of interactions in real-life relationships, paying special attention to their influence on close and distant relationships.

Given the findings of prior research on the effects of mobile devices on people's ability to focus their attention, their negative impacts on interpersonal relationships, and Przybylski and Weinstein's (2013) findings regarding the adverse effects of the presence of mobile phones on face-to-face interactions among strangers engaged in a conversation in a laboratory setting, we expected that the presence of mobile devices would be associated with a lowering of feelings of interpersonal connectedness during face-to-face social interactions in naturalistic environments (Hypothesis 1). We also hypothesized that the visible presence of mobile technologies would be related to lowering of empathetic concern in dyadic settings (Hypothesis 2). We further predicted that the presence of smartphones, cell phones, laptops, or other similar types of mobile communication technologies would be linked with poorer relational outcomes (lowered interpersonal connectedness (Hypothesis 3); and diminished empathetic concern (Hypothesis 4) for individuals reporting a closer relationship with their conversation partner, as compared with those participants who were less interpersonally close with each other. As in the Przybylski and Weinstein study, we examined which conversational contexts have the most bearing on this relationship. Replicating Przybylski and Weinstein's experiment, we investigated this by manipulating the content of the conversation to be either casual or meaningful. We hypothesized that mobile devices would be linked to lower levels of interpersonal connectedness (Hypothesis 5) and empathetic concern (Hypothesis 6) during a meaningful discussion as compared with a casual conversation, in which little self-disclosure is expected to take place.

Method

To design the field experiment to test the aforementioned hypotheses, we conducted a preliminary reconnaissance study to ascertain the appropriate setting for the field experiment (Misra & Genevie, 2013). Because the goal of the study was to assess the relationships between the presence of mobile devices and the quality of face-to-face social interactions in real-life relationships and naturalistic social settings, we decided to conduct the study in coffee shops and cafes. Coffee shops are an appropriate setting for this study because people increasingly use such settings for work and socializing while simultaneously using mobile technologies. Trained research assistants visited a number of coffee shops and cafes in the Washington D.C. Metropolitan Region and rated each location along a number of key dimensions: size, layout, capacity, design features (lighting, fixtures, decor, arrangement of furniture), density of the location at different time periods, the types of activities that occurred in the location including activities involving the use of mobile devices, and the characteristics of the patrons (age range, gender, ethnicity). Five Washington D.C. Metropolitan Region (Alexandria, Arlington, and Washington, D.C.) coffee shops were comparable along these dimensions; Coffee shops that were of equivalent size, had a similar layouts, decor, and design features, had correspondent levels of density at the time periods during which data were collected, and where the types of activities that occurred were alike were selected for the study.

Participants and Procedure

Because we were interested in the level of interpersonal connectedness in dyadic settings, coffee shop customers in groups of two were approached for this study at selected coffee shops in Alexandria, Arlington, and Washington, D.C. Potential participants, if 18 years or older, were requested to participate in a study about the nature of social interactions in coffee shops. The dyads were approached as they entered the coffee shop and began to order their drinks. Once they agreed to participate in the study and had picked up and paid for their drinks, they were asked to be seated on two chairs with a table in between them. Efforts were made to seat participants in similar types of seats and within the same general zone within the study site. An appropriate area within the coffee shop was chosen, so that the confederate could observe the participants unobtrusively from a distance.

Two hundred participants, 100 dyads (109 female, 91 male; $M_{age} = 33.38$ years, $SD = 12.18$; 72% Caucasian), were recruited for the study. Participants were randomly assigned to one of two conditions: (a) casual content of conversation or (b) meaningful content of conversation. We used a modified version of a relationship formation task adapted from previous research meant to emulate the content of many real-life conversations (Aron, Aron, & Smollan, 1992; Przybylski & Weinstein, 2013). Participants in the casual conversation condition were instructed to "discuss their thoughts and feelings about plastic holiday trees." Those assigned to the meaningful conversation condition were asked to "discuss the most meaningful events of the past year." Dyads were asked to spend 10 min discussing the topic together seated on two chairs across each other in the coffee shop. The research assistant informed the participants that they would be alerted when 10 min were complete.

As the participants engaged in the conversation on the given topic, a trained research assistant observed the participants unobtrusively from a distance. The content of individuals' conversations was not recorded. Only participants' non-verbal behavior was observed and noted. The research assistant filled out an observation record sheet noting whether either participant placed any type of mobile device (e.g., smartphone, cell phone, laptop, tablet, etc.) on the table or held it in their hand during the 10-min span. At the conclusion of 10 min, participants were requested to fill out a brief survey that required approximately 5 min (per participant) to complete. An electronic version of the survey was loaded on a tablet, which was used to complete the survey by participants. The tablet was not visible to the study participants during the course of the 10-min conversation. It was presented to the participants at the conclusion of the experimental portion of the study. Participants had the option of completing the survey using a paper-based version of the same survey if they requested it. Each participant received a US$4 gift coupon for use at the same coffee shop at the conclusion of the experimental procedures.

Measures

Independent Variables. The presence of a mobile device, type of conversation, and conversation partner closeness were the independent variables in this field experiment. Degree of psychological closeness (conversation partner closeness) between participants was measured using the Inclusion of Other in Self Scale (Aron et al., 1992), which we modified to fit the requirements of this study. Participants were instructed to select one of seven increasingly overlapping circle pairs representing the closeness between themselves and their conversation partner, where 1 = *not at all close* to 7 = *extremely close* (Figure 1; $M = 5.72$; $SD = 1.39$).

Dependent variables

Connectedness. A six-item version of the connectedness subscale of the Intrinsic Motivation Inventory (IMI) (McAuley, Duncan, & Tammen, 1989) with items ranging from 1 (*not at all true*) to 7 (*very true*) was used to measure feelings of interpersonal connectedness during the conversation. The

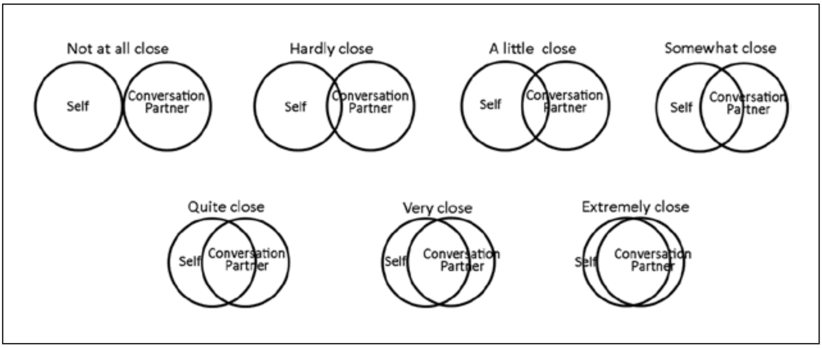

Figure 1. Modified version of the Inclusion of Other in Self scale (Aron et al., 1992).

connectedness subscale of the IMI has been used in prior research to measure feelings of interpersonal connectedness during social interactions in newly formed and committed relationships over time (e.g., Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Przybylski & Weinstein, 2013). The scale included the following items: "I felt a sense of connectedness with my conversation partner"; "I felt close to my conversation partner"; "I felt really distant to my conversation partner"; "I'd like a chance to interact with my conversation partner more often"; "It is likely that my conversation partner and I could become better friends if we interacted a lot"; and "I felt I could really trust my conversation partner" (M = 5.27; SD = 0.69; α = .73).

Empathetic concern. Empathy was measured with the eight-item Empathic Concern Scale (Davis, 1980, 1995; Reis, Clark, & Holmes, 2004) on a 7-point Likert-type scale, where 1 = *not at all true* to 7 = *very true*. Items such as, "To what extent do you think your conversation partner missed the key meaning of the topic you discussed?" and "To what extent did your conversation partner make an effort to understand your thoughts and feelings about the topic you discussed?" were included (M = 5.75; SD = 0.75; α = .91).

Control variables. In addition to age, gender, and ethnicity of the participants, we controlled for positive and negative affect of the participants. Positive and negative affect was assessed using the nine-item Emmons Mood Indicator (Diener, Larsen, Levine, & Emmons, 1985) to account for the potential confounding effect of overall mood on relational outcomes. Items included pleased, anxious, and frustrated (M = 3.96; SD = 0.58; α = .82), paired with a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*extremely*).

Table 1. Summary Statistics for All Study Variables in the Presence and Absence of Mobile Devices.

	Mobile devices			
	Presence		Absence	
Variable	*M*	*SD*	*M*	*SD*
Connectedness	5.05	0.76	5.36	0.64
Empathetic concern	5.51	0.91	5.85	0.66
Mood	4.01	0.59	3.94	0.58
Closeness	5.28	1.65	5.90	1.23
Age	31.43	11.46	34.15	12.42
Gender	Number	%	Number	%
Male	34	58.6	75	52.8
Female	24	41.4	67	47.2
Ethnicity	Number	%	Number	%
Asian	9	15.52	11	7.75
African American	6	10.34	4	2.82
Middle Eastern	1	1.72	3	2.11
Native American	1	1.72	1	0.70
Non-White Hispanic	4	6.90	6	4.23
Pacific Islander	1	1.72	0	0.00
Caucasian	32	55.17	112	78.87
Other	4	6.90	5	3.52

Results

Descriptive Statistics

Table 1 presents the overall means and standard deviations of ordinal and interval variables and the percentages for the categorical variables in this study under the conditions of presence and absence of mobile devices. Table 2 presents the intra-class correlations among study variables.

Data Analytic Strategy

Analyses required accommodations for nesting persons within dyads (assuming non-independence between the two interacting conversation partners).

Table 2. Intra-class Correlations Among Study Variables With Means and Standard Deviations Along the Diagonal (N = 200).

Variable	1. Connectedness	2. Empathy	3. Mood	4. Closeness	5. Age
1. Connectedness	5.27 (0.69)				
2. Empathy	.51*	5.75 (0.75)			
3. Mood	.34*	.41*	3.96 (0.58)		
4. Closeness	.49*	.38*	.18*	5.72 (1.39)	
5. Age	−.05	.07	−.04	−.03	33.38 (12.18)

*p < .05 (two-tailed).

Analyses were therefore conducted with Hierarchical Linear Modeling (HLM; Raudenbush & Bryk, 2002). Unconditional models with random intercept were first assessed to determine whether there existed sufficient variance between- and within-dyads. Intra-class correlation derived from these models showed that for connectedness, the difference between average connectedness scores across dyads accounted for 45.11% of the total variance and was found to be significant ($p < .05$). For empathy, the difference between average empathy scores across dyads accounted for 27.2% of the total variance and was found to be significant ($p < .05$).

We specified a Hierarchical Linear Model by adding the following factors as fixed effects to the fully unconditional random intercept model, measured at either the dyad level or the individual level: Presence of mobile device (mobile device present: 1; mobile device absent: 0), and conversation topic (casual: 1; meaningful: 0) were measured at level 2 (dyad level); while covariates (gender, age, ethnicity, and mood) and conversation partner closeness (scaled 1-7) were measured at level 1 (individual level). The estimation method used was Restricted Maximum Likelihood (REML).

For the outcome variable, *connectedness*, our HLM reduced the variance by 45% at the dyad level and by 22% at the individual level. For the response variable, *empathetic concern*, our HLM model reduced the variance by 84% at the dyad level and by 2% at the individual level. Please refer to Table 3 for information on the variance components for the unconditional and specified HLM in this study.

We conducted a likelihood ratio test to check whether our model significantly improved the unconditional model. For the response variable *connectedness*, −2 multiplied by the log likelihood for the unconditional model was 1,097.88, and it was 804.67 for our full model. So the deviance between the two models was 293.22 ($p < .05$), which indicates that our model is significant compared with the unconditional model. For the response variable

Table 3. HLM Results: Estimates (Unstandardized *b* slopes) of the Variable Effect and *t* Tests for the Estimates for the Outcome Variables of Connectedness and Empathetic Concern (*N* = 200).

Random effects	Connectedness		Empathetic concern	
Variance component	Unconditional model	Specified model	Unconditional model	Specified model
Dyad-level (Level 2)	7.81	4.33	12.55	1.97
Individual-level (Level 1)	9.50	7.42	33.66	32.97

Fixed effects	Connectedness			Empathetic concern		
Variable	*b*	*SE*	*t*	*b*	*SE*	*t*
Intercept	18.66	2.37	7.87*	23.85	4.35	5.48*
Gender of participant (female)	0.18	0.27	0.66	0.35	0.54	0.64
Ethnicity of participant (Overall *F* test)	NA	NA	0.83	NA	NA	1.03
Age of participant	−0.02	0.02	−0.69	0.04	0.05	0.77
Mood/affect	0.19	0.06	3.16*	0.49	0.11	4.28*
Device absent	0.85	0.37	2.28*	0.94	0.59	1.59*
Partner close	1.31	0.24	5.55*	1.74	0.40	4.36*
Partner close × Device absent	−0.13	0.24	−0.55	−1.08	0.41	−2.61*
Topic casual	0.06	0.37	0.15	−0.29	0.60	−0.48
Device absent × Topic casual	−0.18	0.38	−0.47	0.38	0.62	0.61

Note. For ethnicity, none of the eight levels were found to be significant. We report the overall *F* statistic in the interest of space. NA = not applicable; *SE* = standardized error; HLM = Hierarchical Linear Modeling.
*$p<.05$
R^2 = .72 for the HLM in which "connectedness" was the outcome variable.
R^2 = .43 for the HLM in which "empathetic concern" was the outcome variable.

empathetic concern, −2 multiplied by the log likelihood for the unconditional model was 1,239.14, and it was 916.04 for our full model. So the deviance between the two models was 323.10 ($p < .05$), which again indicates that our model is significantly compared with the unconditional model.

Hypothesis Testing

Of 100 dyads, 29 dyads had mobile devices present whereas 71 dyads did not have any mobile devices present during the 10-min conversation. Table 3 presents the results of the HLM analyses in which we examined the relationship of the *presence of mobile devices, conversation partner closeness*, and *conversation topic* on the outcome variables of *connectedness* and *empathetic concern*, controlling for age, gender, ethnicity, and mood of participants. Degrees of freedom were computed using the Kenward–Roger correction for mixed models. The advantage of using this type of degree of freedom is the increased accuracy of the distribution of the test statistics because it accounts for the increased variability from the estimation of random effects, especially when the data are unbalanced (Kenward & Roger, 1997).

Relationship between the presence of mobile devices and interpersonal connectedness. As predicted, we found a significant and positive main effect of the absence of mobile devices on levels of connectedness between dyads above and beyond the effects of age, gender, ethnicity, and mood, $b = 0.85$, $t(77.8) = 2.28$, $p < .05$. Table 3 shows a positive significant main effect of conversation partner closeness on the level of connectedness, $b = 1.31$, $t(118.7) = 5.55$, $p < .05$. Contrary to our hypotheses, we did not find a significant interaction effect between the presence of a mobile device and conversation partner closeness for the outcome variable of connectedness. Similarly, no significant interaction effect was found between the presence of a mobile device and conversation topic on the dependent variable of connectedness.

Relationship between the presence of mobile devices and empathetic concern. Dyads who had conversations without any smartphones or other mobile technologies reported higher levels of empathetic concern for their conversation partners above and beyond the effects of age, gender, ethnicity, and mood, $b = 0.94$, $t(64.4) = 1.59$, $p < .05$.

Empathetic concern was expected to be lower for dyads that are closer to each other for conversations in the presence of mobile devices. A significant main effect was found for the relationship between conversation partner closeness and empathetic concern, $b = 1.74$, $t(100.2) = 4.36$ $p < .05$; so empathetic concern increased with reported closeness between conversation partners. We found, as expected, that the presence of mobile devices is linked to lower levels of self-reported empathetic concern among dyads reporting a friendlier relationship with each other compared with those who are less friendly with each other, $b = -1.08$; $t(100.9) = -2.61$, $p < .05$. The interaction plot between presence of mobile communication devices and conversation partner closeness for the outcome measure of empathetic concern is depicted in Figure 2.

Our final hypothesis that the presence of mobile devices would be associated with diminished levels of empathetic concern during meaningful conversations compared with casual interactions was not supported by the data.

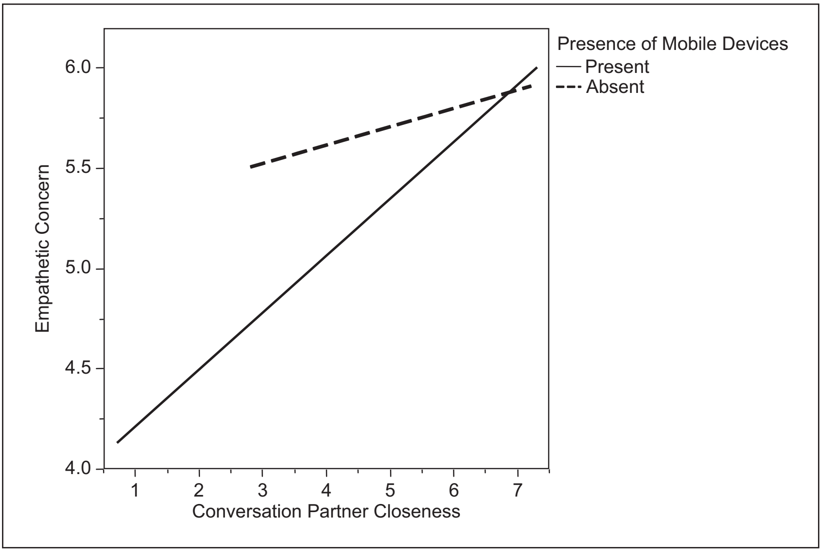

Figure 2. Interaction plot between presence of mobile device and conversation partner closeness for the outcome variable of empathetic concern.

Discussion

This study presents field experimental evidence of some of the unfavorable implications of the presence of mobile devices on the character of face-to-face interactions. If either participant placed a mobile communication device (e.g., smartphone or a cell phone) on the table or held it in their hand during the course of the 10-min conversation, the quality of the conversation was rated to be less fulfilling compared with conversations that took place in the absence of mobile devices. The same participants who conversed in the presence of mobile communication devices also reported experiencing lower empathetic concern compared with participants who interacted without distracting digital stimuli in their visual field. The relationship between the presence of mobile devices and empathetic concern was more pronounced for participants who reported a closer relationship with each other compared with those who were less familiar with each other. We, however, could not replicate the significant interaction between the type of conversation and the presence of mobile devices on interpersonal connectedness and empathetic concern in a naturalistic setting.

Two related explanations are advanced for these findings based on the theories and earlier empirical research framing this study. First, mobile phones hold symbolic meaning in advanced technological societies. Even when they are not in active use or buzzing, beeping, ringing, or flashing, they are representative of people's wider social network and a portal to an immense compendium of information. In their presence, people have the constant urge to seek out information, check for communication, and direct their thoughts to other people and worlds. Their mere presence in a socio-physical milieu, therefore, has the potential to divide consciousness between the proximate and immediate setting and the physically distant and invisible networks and contexts. The permeable and fluid pervasive computing environments of our technological society and the array of behavioral demands they create thus dramatically change the socio-physical context of face-to-face communication. In these permeable and micro-fragmented contexts, we are in a constant *state of poly-consciousness* in which multiple relationships and settings can be the focus of one's attention at any given time regardless of location or context. In this context of "relational multiplicity" (Gergen, 2000), in-person interactions are not more important or do not take precedence over online conversations. Thus, even without active use the presence of mobile technologies has the potential to divert individuals from face-to-face exchanges, thereby undermining the character and depth of these connections. Individuals are potentially more likely to miss subtle cues, facial expressions, and changes in the tone of their conversation partner's voice, and have less eye contact when their thoughts are directed to other concerns in the presence of a mobile device. These non-verbal and verbal elements of in-person communication are important for a focused and fulfilling conversation.

Second, as our relational networks are widened through the increasing use of and dependence on information and communication technologies, we accumulate a very large stock of relationships often spanning large distances geographically. Consequently, the time and energy that is available for any one relationship decreases. The few strong, committed, and deep relationships are replaced by a broad array of weak ties (Gergen, 2002). Moreover, the slow processing powers and capacity for thoughtful reflection and empathy may be diminished with increasing immersion in technological environments (Immordino-Yang et al., 2009). One of the implications of the increase in *horizontal relationships* (Gergen, 2002) is the lack of focused attention to any one interaction context. In the "floating worlds" (Gergen, 2003) created by the presence of mobile communication technologies and the potential for access to a wide range of relationships and information at all times, individuals' thoughts are directed to other places, people, and contexts. The result is diminished quality of the "here and now" interactions with co-present others. People who are closer to each other are more irked by the presence of mobile devices, possibly because they expect complete attentiveness of persons who mean so much to them (Geser, 2006; Humphreys, 2005; Mazmanian et al., 2005). In more distant relationships, perhaps partial attentiveness may be more likely to be tolerated.

The results should be viewed within the constraints of the naturalistic features of the experiment. First, this study did not manipulate the independent variable (presence or absence of the mobile device), so we are unable to make causal inferences. Second, it is possible that the personal characteristics of individuals who placed a mobile device on the table or held it in their hands explain the relationships we have found. However, we do not think this is likely because we accounted for the mood of participants in our statistical models. Moreover, we were able to replicate the results of Przybylski and Weinstein's (2013) laboratory experiment. Third, this study only examined whether either participant placed a mobile device on the table or held it at any point during the course of the conversation, but not the number of times participants touched or handled their mobile devices. The number of times a mobile device was touched or handled may have an impact on the quality of conversation and this question should be investigated in future research on the topic. Fourth, this study does not test the proposed explanatory mechanisms underlying the relationship between the presence of mobile devices and connectedness and empathetic concern. Future studies need to probe more deeply into the explanatory mechanisms of this interesting relationship. Similar studies need to be conducted in home environments to investigate how mobile technologies influence interpersonal relations within residential environments. Furthermore, longitudinal studies combining interpretive and experimental methods in which the nature of conversations among family members is tracked over time would further illuminate these initial findings.

Limitations notwithstanding, this research makes three key contributions. First, it provides a real-world replication of Przybylski and Weinstein's (2013) laboratory experiment. Second, it contributes to the empirical work on the consequences of divided attention caused by multitasking in information and communication environments. Consistent with the findings of simulation, field experimental, and laboratory studies on divided attention and multitasking, we find that controlled and effortful tasks like having a conversation are impeded by the distracting presence of mobile technologies. Third, this study is the first to test the theory of micro-social fragmentation in a real-life interpersonal context, where space is conceptualized in relational terms rather than a geographically delimited area (Gergen, 1992; Harvey, 1989; Massey, 1993).

As virtual worlds increasingly permeate our place-based physical environments, we must question what their consequences will be for our personal and collective lives. As our appetite for technological progress continues, critical scrutiny of the social, psychological, and cultural implications is paramount. Smart technologies offer the possibility of instantaneous and continuous global communities where knowledge is shared, opinions are contributed, relationships are rekindled, expressions of support are enhanced, and social movements are spawned. Ubiquitous computing technologies can function centripetally, where communities based on common interests and values can be realized, in contrast to centrifugal intellectual technologies such as the TV and radio (Gergen, 1996; Meyrowitz, 1985). But these new global communities deserve closer examination, for as this study finds, they may emerge at the cost of face-to-face interpersonal relationships. It is hoped that the empirical and conceptual resources supplied by this study promote a collective deliberation on the direction of our networked society.

Acknowledgment

The authors acknowledge the helpful comments and suggestions of Drs. Sasi Misra, Daniel Stokols, Patrick Roberts, and Chitvan Trivedi, on earlier versions of this article.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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