Original Article

Staying Informed and Bridging "Social Distance": Smartphone News Use and Mobile Messaging Behaviors of Flemish Adults during the First Weeks of the COVID-19 Pandemic

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Abstract

The authors explore patterns of smartphone use during the first weeks following the outbreak of the coronavirus disease 2019 pandemic in Belgium, focusing on citizens' use of smartphones to consume news and to communicate and interact with others. Unique smartphone tracking data from 2,778 Flemish adults reveal that at the height of the outbreak, people used their smartphone on average 45 minutes (28 percent) more than before the outbreak. The number of smartphone pickups remained fairly stable over this period. This means that on average, users did not turn to their smartphones more frequently but used them longer to access news (54 percent increase), social media apps (72 percent increase), messaging apps (64 percent increase), and the voice call feature (44 percent increase). These smartphone use patterns suggest that smartphones are key instruments that help citizens stay informed, in sync, and in touch with society during times of crisis.

Keywords

COVID-19, coronavirus, smartphone use, mobile news, mobile messaging

In March 2020, Western Europe found itself at the beginning of the coronavirus disease 2019 (COVID-19) pandemic. Schools, universities, stores, bars, and restaurants were closed, and social life came to a halt in response to governments' lockdown measures. These lockdown measures asked citizens to "socially distance" themselves from others to "flatten the curve" of infections. In this study we examine whether, during this period of social distancing, smartphones may have served as a "window to the world" through which people stayed informed and bridged geographical distance. To that end, we look at how people used their smartphones while dealing with the social implications of the outbreak. We thereby describe broader patterns of increased communication and information consumption during an unfolding disaster. On smartphones, a great number of otherwise distinct activities converge. Studying their use in an emerging crisis situation can help understand citizens' behavior changes during the pandemic in a more encompassing way. This information can be insightful for policy, for instance, with regard to the provision of infrastructure for mobile connectivity.

COVID-19 is not the first virus to require individuals to self-quarantine. The baby boom generation may remember school closings and quarantine measures in response to local polio outbreaks in the 1950s (see Agerholm 1953; Shell 2009), and more recently, the Mexican government shut down public life to contain the spread of the H1N1 virus (Matus-Mendoza and De Rycker 2013). The COVID-19 crisis, however, appears unique in at least two respects. First, although mortality rates are relatively low, the long incubation period and high degree of infectiousness of COVID-19 require social distancing measures to be in place

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for a long time. The implications of having to maintain distance from colleagues, friends, and family members for a prolonged period of time are anticipated to be more far-reaching than during previous outbreaks. Second, the COVID-19 outbreak is the first pandemic to occur in a fully globalized network society (Castells 1996), in which so-called digitally native generations such as the millennials and generation Z have been fully socialized within a digital environment and therefore can make full use of digital media to keep informed, stay in touch, and participate in society (Ohme 2019b; Vanden Abeele 2016). Although the implications of social distancing measures are severe, many citizens in the current digital society may thus be better equipped to deal with them.

Digital media such as smartphones might help people cope with the COVID-19 crisis. Smartphones offer instant and ubiquitous access to information and help people coordinate their everyday work, family, and social life (Castells et al. 2009; Vanden Abeele, De Wolf, and Ling 2018). They also allow users to consult the latest news (Van Damme et al. 2020) and to express and share their thoughts, concerns, and opinions on social media platforms, thereby offering opportunities for "digital citizenship" and "connective actions" (Bennett and Segerberg 2012; Ohme 2019a). In times of crisis, people may rely on these affordances of smartphones more than in regular times.

In this study, we explore this question by homing in on the smartphone use of 2,778 Flemish adults and examining how it evolves over time, as the COVID-19 crisis unfolds. We draw our data from mobileDNA (https://mobiledna. be), a mobile application that aims to give users insight into their smartphone use by logging their app activity and displaying that information in a dashboard. mobileDNA tracked smartphones continuously when the pandemic hit Western Europe. As a result, we can provide insights into how digital communication patterns unfold in Belgium during a situation that for many citizens was characterized by great uncertainty. Given the similar course of the outbreak in most Western European countries, data in this study can work as a blueprint to understand the communication behavior of European citizens during the early days of the COVID-19 crisis.

The contribution of this study lies in its investigation of how, at the aggregate level, smartphones were used during times of crisis, thereby being one of the first studies to draw a detailed picture of citizens' communication behavior in the early days of the COVID-19 pandemic. We distinguish among key smartphone-based activities, such as mobile messaging, news use, social media use, and voice calls. By comparing pre- and post-COVID-19 periods, we are able to estimate the volume of mobile communication that is a direct result of the crisis situation itself. Moreover, we explore how aggregated smartphone use evolves over time and is tied to certain key events during the crisis.

Smartphone Use as Window to the World

If there is one technical device that comes close to mapping human behavior these days, it is the smartphone (Raento, Oulasvirta, and Eagle, 2009). The exceptional situation during the outbreak of COVID-19 begets questions about the specific opportunities and challenges mobile connectivity brings.

In our contemporary society, smartphones tend to be the most used devices (Silver 2019). The ubiquitous nature of mobile communication makes it possible to rely on smartphones for myriad communicative, informational, and entertainment activities anywhere, anytime (Vanden Abeele et al. 2019). Therefore, the average amount of smartphone use per day has steadily increased over the past few years. For instance, in a recent study conducted before the COVID-19 outbreak, Sewall et al. (2020) looked at the amount of phone use that was logged by iPhones' screen time feature and found that a sample of Amazon Mechanical Turk users in the United States used their smartphones on average 3.7 hours a day. Similarly, among a sample of smartphone users with characteristics representative of the Dutch population, Ohme et al. (forthcoming) found that people on average use their smartphones 4.28 hours per day. We might expect people's average daily smartphone use to increase when social distancing measures are in place, as their smartphone screens function as windows to the world through which they can keep in touch with their social networks and society at large using various applications. Average daily use time may provide a measure that represents the importance of smartphone use during the exceptional times of the COVID-19 outbreak in Belgium. Hence, we first ask,

> On an aggregate level, how often and for how long do citizens use their smartphones during the height of the COVID-19 crisis?

Prior research has shown that external shocks and times of crisis increase people's need to communicate and seek information (Dutta-Bergmann 2004; Macias, Hilyard, and Freimuth 2009). Especially when a crisis situation affects their personal situations, people engage in communicative and information-seeking behaviors for the cause of uncertainty reduction (Procopio and Procopio 2007). The COVID-19 outbreak can be said to be such a crisis, as it quickly evolved to affect all major areas of public life and private life. Therefore, it has likely led to increased uncertainty among most people, which in turn may have generated an immediate need for information and a wish to keep in touch with loved ones.

In many cases, the relationship between an evolving crisis and the level of communicative and information-seeking activities can only be drawn on the basis of retrospective assessments, such as the use of survey data. It is therefore unclear what share of communicative changes

can be attributed to the crisis situation itself. Because of ongoing data collection, we are in the fortunate position to be able to compare aggregate levels of smartphone communication in normal times compared with times of crisis. This enables us to model the development of mobile communication patterns over time and estimate the volume of increase for various types of mobile communication. We therefore ask,

> How did smartphone use at an aggregate level develop in the first four weeks of the COVID-19 outbreak compared with precrisis times?

Being and Getting Informed

In today's digital media environment the spread of information has become highly dynamic: news updates are published immediately, as a result of accelerated information cycles in journalism enabled by growing digitalization (Stroud, Peacock, and Curry 2020). Most citizens have established information routines that are built on real-time information they can access on their smartphones anywhere, at any time (Van Damme et al. 2019). In normal times, 58 percent of the Belgian population receives news on their smartphones, which is on a par with online news use on desktop PCs (Newman 2019). Given the decrease in accessing news via laptops and PCs, accessing news on smartphones becomes increasingly important for the level of political knowledge in society and thereby also determines other democratic key factors, such as political participation (Ohme 2020). Levels of news consumption therefore may not only reveal citizens' need for information but also reflect how they engage with society during special times.

A crisis such as the COVID-19 outbreak, however, can disrupt information routines. On one hand, users may increase their news use, as it gives them real-time access to information to which they can "flexibly align" (Bertel 2013) themselves better to the new circumstances. Smartphones play an important role in this process of alignment. They allow citizens to stay informed about the unfolding of a situation, no matter the time or where they are. Being informed may reduce fears and may make it easier for people to foresee developments and to react accordingly (Boyle et al. 2004). An increase in news consumption can therefore signal that citizens are informing themselves about recent development, which may contribute to their self-protection and the protection of others. Although this could be considered an adequate reaction to recent developments, people may on the other hand also increase their news use for other reasons. Previous studies indicated that especially mobile news consumption is prone to routine: in normal times, people already reach for their news apps automatically, out of habit and boredom (Costera Meijer and Groot Kormelink 2014; Molyneux 2018). Such news consumption may have less of an impact on citizenship.

In some cases, mobile communication infrastructures may also help governments reach citizens as quickly as possible, which can be crucial in crisis situations (Veil, Buehner, and Palenchar 2011). In some cases, governments can contact citizens directly, for instance via "alert systems." More often, however, news organizations are intermediaries that relay information from the government to its citizens, for instance, by broadcasting or reporting on press conferences. If citizens are either intentionally or habitually constantly accessing information via mobile news apps and on mobile social media platforms, information released by the government can disseminate quickly. Public authorities do not have to rely solely on word-of-mouth transmission or scheduled newscasts to disseminate news, although these remain important. They can spread their messages quickly and in a direct, detailed, and thereby more fact-oriented manner, which can lead to immediate responses from the public. For instance, in the Netherlands, on March 15 at 5 p.m., the Dutch government announced that cafes and restaurants would close at 6 p.m. that same day. Within minutes, people had lined up in long queues in front of coffee shops to stock up on marijuana (Heyblom 2020). This example illustrates that many citizens engage in real-time news consumption, enabling them to flexibly align to an ad hoc situation.

During the COVID-19 crisis, momentary increases in browser and dedicated news app use when important messages are communicated may reflect such real-time information consumption. For example, on March 12, there were rumors that the Belgian national security council would announce severe lockdown restrictions, including the closure of bars, restaurants, and schools. People anticipated that a press conference would take place in the early evening. Eventually, however, the press conference announcing the first set of "lockdown lite" measures took place around 10:30 p.m. We are able to zoom in on smartphone news use during this key event of the outbreak. To understand how smartphones have been used during the COVID-19 crisis to help people to be informed and get informed, we ask the following research questions:

> How did the use of smartphones for news access develop during the outbreak of COVID-19?
> How were smartphones used for synchronous access to news around key events during the COVID-19 crisis?

Bridging "Physical Distance"

Most European governments responded to the exponential increase in cases of COVID-19 by placing restrictive sanctions on public gatherings and social activities in an attempt to keep people from infecting one another. *Social distancing* is currently used as the term to describe the desired outcome of these restrictions. Several people have observed that the term *social distancing* is misleading, as what governments are asking for is that people maintain distance from one

another physically, not socially. On the contrary, mediated social interactions are not only allowed but also encouraged by various governments as a surrogate for face-to-face contact. Limiting social interaction is known to be exceptionally hard for social human beings (Umberson and Karas Montez 2010). Especially in times of crisis, access to one's social network can be crucial to obtain and share information and provide help and social support (Stephens, Robertson, and Murthy 2020). As such, mediated interpersonal communication may be particularly important to people to cope with the current crisis. Smartphones integrate a number of communicative possibilities. Citizens can communicate directly with their social networks through mobile messaging, audio or video calls, and the use of social media platforms. We therefore ask,

> How frequently do citizens use mobile messaging, calling, and social media as communicative means to personal contacts in times of crisis?

In our daily lives, mobile messaging in particular plays an important role as a tool for upholding social contacts. Mobile messaging affords near synchronous communication (Rettie 2009). This is a form of text-based communication whereby individuals can contribute to conversations at their own convenience. Brevity in responses is sanctioned, and because there are no formal openings and closings, conversations can go on for days, weeks, and, in the case of family or friend group chats, even months or years. As such, the low-threshold nature of mobile text-based conversations facilitates a fragmented pattern of digital connectedness whereby multiple short interactions are carried out all throughout the day and can even be multitasked with other activities such as TV viewing and conversations, both online and face-to-face (Licoppe 2004). These multiple combinations of information intake and creation exemplify how mobile media contribute to the uniqueness of each individual's communication trajectory. We therefore ask,

> How were smartphones used for synchronous communication with others around key events during the COVID-19 crisis?

Methods

Data Collection

The data used in this study were collected using mobileDNA, a smartphone logging tool for Android phones. The mobileDNA client application is freely available in the Google Play Store (https://play.google.com/store/apps/details?id=be.ugent.mobiledna&hl=en). Installing it enables users to gain insight into their day-to-day smartphone use, which is visualized in an online dashboard. On this dashboard, mobileDNA uncovers individual behavioral patterns, such as the time of day reflecting the highest number of pickups (i.e., unlocking the home screen), or the proportion of

use linked to specific app categories. Users complete an informed consent procedure when installing mobileDNA. This procedure informs them of the fact that their pseudonymized[1] data can be used for academic research purposes. mobileDNA is fully compliant with the European General Data Protection Regulation.

mobileDNA registers several types of information (called indices), some of which depend on the permissions given by the user. In this study, we analyzed app events, which reflect foreground activity of individual applications. A Python-based Web scraper was used to categorize the apps according to their genre listings in the Google Play Store. Table 1 provides a more detailed breakdown of all parameters, logged or annotated, that were used in the present study.

Sample

For the purpose of the present study, we extracted all available data between February 1, 2020, and March 31, 2020. Next, these data were filtered, retaining only those IDs with at least two weeks' worth of log data. The resulting data frame contained 20,512,567 app events, stemming from 2,783 unique users. With a penetration rate of 63 percent, Android is the most used operating system in Flanders (Vandendriessche and De Marez 2020). Because users can install and use the app anonymously, we cannot provide detailed demographic information for the entire sample. It should be noted, however, that although extensive research is sparse, most studies suggest only minor differences between Android and users of other operating systems. In comparison with iOS users, Android users are more likely male, are slightly older, and spend less time using applications on their phones (Götz, Stieger, and Reips 2017). Looking at demographic data from a subsample of 798 participants,[2] the ages of the unique users clustered around the 20- to 30-year bracket. If this subsample is representative of the entire sample, this implies that there are some important deviations in comparison with the average population. The reader should therefore interpret descriptive information as nonrepresentative of the entire Flemish population. A second important remark is that we focus on aggregated patterns of behavior rather than idiosyncratic behavior change. This implies that our findings do not provide information about interindividual variability in observed behavioral changes. In other words, although we may see a general increase in smartphone use aggregated over all individuals, it may be the case that there was a decrease for some and a sharp increase for others.

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[1]Individual users are represented by alphanumeric codes that cannot be traced back to personally identifiable information, such as names or e-mail addresses.

[2]Submitting personal information via the mobileDNA app is voluntary. Although this ensures broad levels of participation, it restricts knowledge about sample characteristics.

Table 1. Logged and Annotated Parameters.

Parameter Name	Description	Data
ID	Alphanumeric code representing a single user	Raw
Application	Name of the app being opened	Raw
Start time	Start time of (foreground) activity	Raw
End time	End time of (foreground) activity	Raw
Notification	Boolean variable indicating whether the activity was initiated with the tap of a notification (e.g., when responding to a WhatsApp message)	Raw
Session	Number of the session this app event belongs to, based on Unix epoch time stamp of session initiation	Raw
Category	App category, as scraped from the Google Play Store	Annotated

Table 2. Comparison of Average Daily Smartphone Usage Before (February) and After (March) the COVID-19 Outbreak.

	Daily Smartphone Use Before and After COVID-19 Outbreak						
	February		March				
	M	*SD*	*M*	*SD*	*df*	*t*	Increase (%)
Smartphone use duration (min)	166.7	110.5	190.4	123.7	2104	−20.9***	14.2
Smartphone pickups total	49.8	31.1	50.6	32.1	2104	−2.8***	1.6
Session duration (min)	4.2	5.1	4.8	6.7	2081	−8.4***	14.1
News app use duration (min)	9.9	10.7	13.0	13.3	1000	−9.8***	31.1
News apps opened	5.2	5.1	7.3	7.3	1000	−15.8***	41.5
Notification from news apps opened	1.3	.4	1.8	.9	416	−15.4***	38.5
Messaging duration (min)	27.4	30.7	36.5	36.5	2068	−19.8***	33.4
Messaging apps opened	41.5	41.7	47.5	44.9	2068	−13.8***	14.3
Notifications from messaging apps opened	11.2	13.8	13.6	16.3	1983	−14.0***	21.4
Social media app use duration (min)	42.2	38.7	52.1	47.7	1910	−20.1***	23.3
Number of times social media apps opened	27.7	30.2	31.9	35.4	1910	−12.2***	15.1
Notifications from social media apps opened	3.1	3.6	3.6	4.8	1421	−6.2***	16.1
Duration of (video) calls (min)	6.1	6.9	8.9	10.2	1605	−14.9***	44.2
Number of times calling apps opened	6.1	5.2	6.6	5.7	1605	−4.5***	6.9

Note: COVID-19 = coronavirus disease 2019.
***$p < .001$.

Measures

On the basis of the raw log data described earlier, a number of measures were calculated using a custom-made Python script. The first set of measures relates to users' overall smartphone use: a "pickup" represents a smartphone session from the moment the screen is activated to the moment the screen is deactivated. Note that in one pickup, multiple apps may be used consecutively and recurrently. "Duration" represents the total time for which the screen was activated. "Apps opened" refers to the number of times individual apps were opened. Note that multiple occurrences of these app events may take place within one pickup session. Finally, "notifications opened" represents the number of times an app was opened by tapping on an incoming notification for the app.

Next to this first set of measures, we calculated app category–specific measures by applying relevant measures to particular categories of applications. For example, "news apps opened" refers to the number of times dedicated mobile news applications were opened, "duration messaging apps" represents the total duration spent on various mobile messengers (e.g., WhatsApp, Facebook Messenger), and "notifications from social media apps opened" describes the number of times social media applications (Instagram, Twitter, Facebook, etc.) were opened by tapping incoming notifications for these applications. The Appendix provides an overview of which apps were included in which app categories.

Results

Our first research question asked whether the COVID-19 outbreak disrupts mobile communication routines. The analysis of the smartphone use data of Flemish adults revealed that this was the case. In March 2020, users used their smartphones on average for 190 minutes a day. In February 2020, before COVID-19's appearance in Belgium, this figure was at 166 minutes. Thus, we see that smartphones were on average used 24 minutes longer per day, representing a significant increase of 14.5 percent (see Table 2). Figure 1 shows
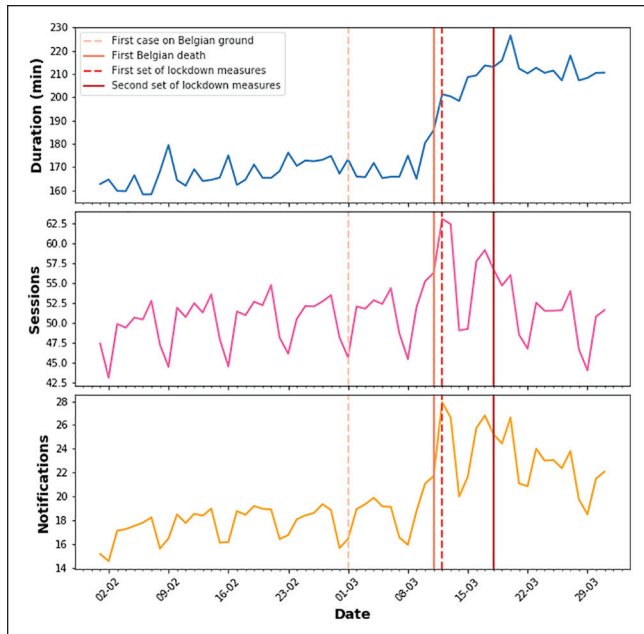
Figure 1. Increase in smartphone use (duration, pickups, answered notifications) before and after the coronavirus disease 2019 outbreak.

that from March 10 to 24, spanning the phase when several lockdown measures were announced and the number of individuals testing positive for COVID-19 rose quickly, the average user used his or her smartphone even more, at 213 minutes per day (an increase of about 47 minutes, or 28 percent compared with the 166 daily minutes in February; see Figure 1). On March 20, the average use duration approached 230 minutes, which is about one hour more per day than during normal times (Figure 1).

Interestingly, the number of smartphone pickups remained fairly stable over this period. In February, the average number of use sessions (i.e., from unlocking to locking the phone) was approximately 50, while in March it was about 51 (Table 2). This means that at an aggregate level, users turned to their smartphones as frequently during the crisis as before, but during the crisis they used the phones for longer periods of time. The data on the duration of individual pickups support this; when we look at the average duration of one phone pickup, we see that in February a pickup lasted on average only 4.2 minutes, whereas in March the average pickup had a duration of 4.8 minutes, an increase of more than 14 percent.

Second, we were interested in the level of mobile news use among citizens during the COVID-19 outbreak. Figure 2A shows that people[3] increasingly relied on their smartphones to obtain information. For example, on February 28, before the first Belgian was diagnosed with COVID-19,

people on average accessed dedicated news apps 7.6 times per day, spending on average 13 minutes on them. On March 10, this number had increased to 11.3 pickups (a 49 percent increase), with a daily average duration of approximately 20 minutes (a 54 percent increase) (Figure 2A). If we compare the averaged numbers in February and March overall, the number of times news apps were opened increased by 41 percent, while the duration of dedicated news app use increased by 31 percent (Table 2). An almost similar pattern is visible for how often users opened push messages sent by dedicated news apps. Between February and March, this number had increased from 1.3 to 1.8 messages, a 41 percent increase. Interestingly, Figure 2A shows that on March 1, the day when the first COVID-19 case in Belgium was confirmed, there was a notable increase in opened push messages from news apps, indicating the possibility that many smartphone users may have learned or informed themselves about the case through news app push messages.

Taken together, these numbers suggest a pattern of increased news consumption, which may result from increased information needs and/or strengthened habitual news consumption. The numbers provided here likely underestimate true news consumption on mobile devices, given that research shows that many individuals browse for mobile news via social media platforms and their mobile browsers rather than dedicated news applications (Ohme 2020). Implicit support for this thesis can be found when we look at overall mobile browser activity data, usually an example for covering various information needs (Nelson and Lei 2018). In these data, we see a similar increase in average use (Figure 2B): the number of times a browser app was opened increased steadily in March and reached a high point on March 12, the day when lockdown measures were imposed.

During the COVID-19 crisis, several public authorities gave press conferences to inform the public about the state of affairs and imminent decisions. By disseminating this information via mobile communication channels, news organizations can reach citizens quickly and inform them almost in real time about the latest updates through their smartphones. We find evidence of this by looking at news app use on March 12, when the national security council announced the first lockdown restrictions, including the closure of bars, restaurants, and schools. People anticipated that a press conference would take place in the early evening. Eventually, however, the press conference announcing the "lockdown lite" measures took place at about 10:30 p.m. News app use in the late evening hours of that day showed a surge at the time of the press conference for the average number of news apps used[4] (see Figure 3). Interestingly, the duration of a mobile news use session peaks only after the press conference, indicating that people turn to news apps at

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[3]Among our total sample, 1,001 participants had at least one news app installed on their phones.

[4]The increase in news app use during the same period is not visible for the day before and after March 12.
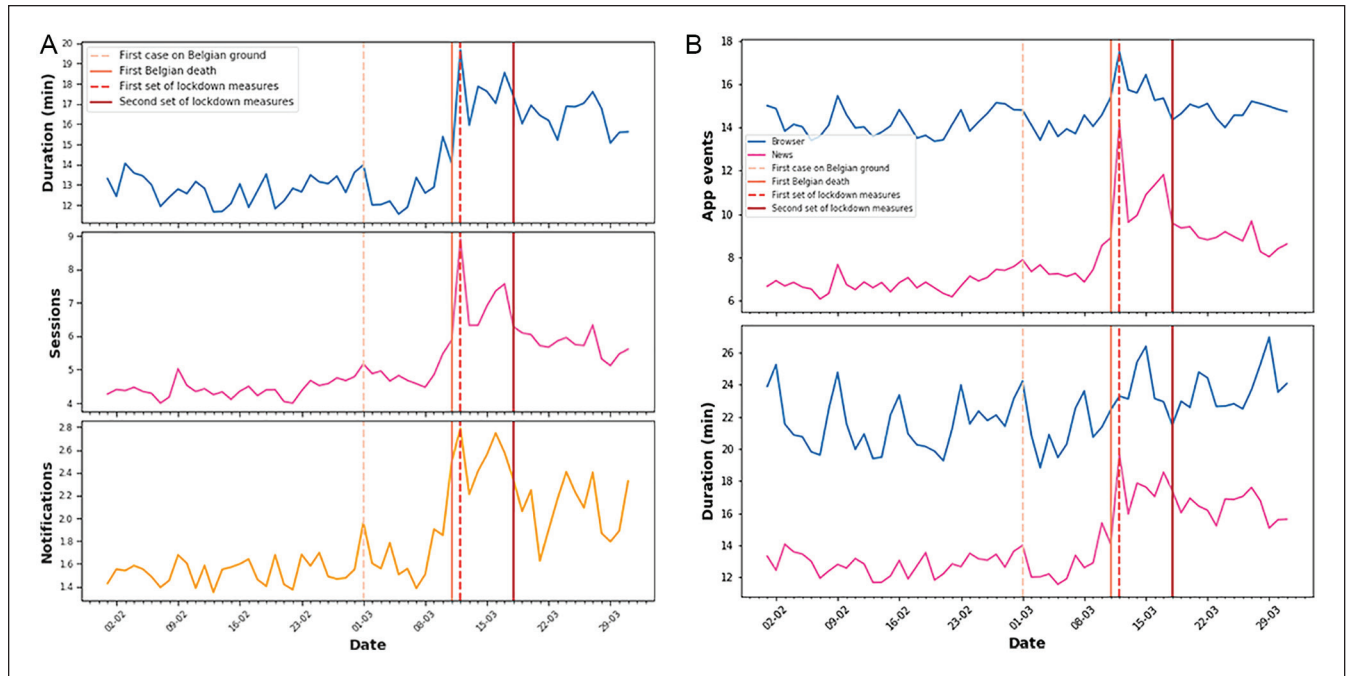
Figure 2. (A) Duration, pickups, and answered notifications of news apps before and after the coronavirus disease 2019 (COVID-19) outbreak. (B) Apps opened and duration of news app and mobile browser use before and after the COVID-19 outbreak.
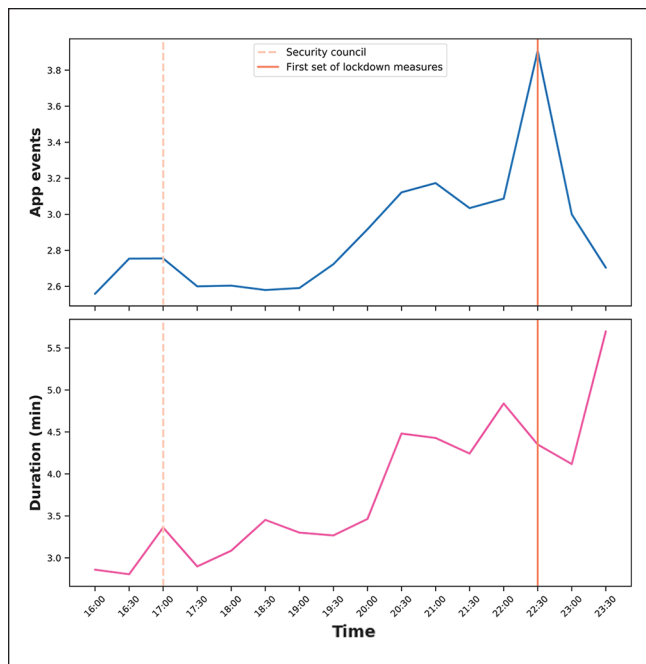
Figure 3. News app use as response to major press conference on March 12.

the same time updates by the government are released, potentially to receive background and evaluation of information from official news sources, who in these extraordinary times appear to have reclaimed their traditional role as gatekeepers (Figure 3).

Third, we asked to what extent smartphones in times of crisis can help bridge "physical distancing" by providing access to one's social network. We answered this question by first looking at both the frequency and duration of use of mobile messaging apps such as WhatsApp, Telegram, and Facebook Messenger. Compared with February, the average numbers of communication via text messages and messaging apps increased substantially. Figure 4A shows a steep increase in these aggregate numbers over time: on average, the duration of smartphone conversations increased by 33 percent to 37 minutes per day (Table 2). Interestingly, communicative behavior appears linked to the occurrence of key events. On February 28, a noneventful day, people opened their messaging apps approximately 48 times on average, for a total daily duration of approximately 31 minutes; on March 12, when the first phase of the shutdown was announced, this increased to 67 times (an increase of 42 percent), for a total daily duration of approximately 51 minutes (a 64 percent increase) (see Figure 4A). We also see an increase in people's activities on the main social media platforms (such as Facebook, Instagram, and Twitter): on February 28, these apps were opened 31.7 times on average, for an average duration of 48 minutes. On March 15, this increased to an average of 40 app openings (up by 26 percent), for a total duration of 72 minutes (up by 50 percent), although this could partly be attributed to the weekend, when people generally use their smartphones more (see Figure 2B). The data again suggest increased activity surrounding key events. If we zoom in on March 12, the day of the press conference that communicated a partial lockdown of the country, we see that
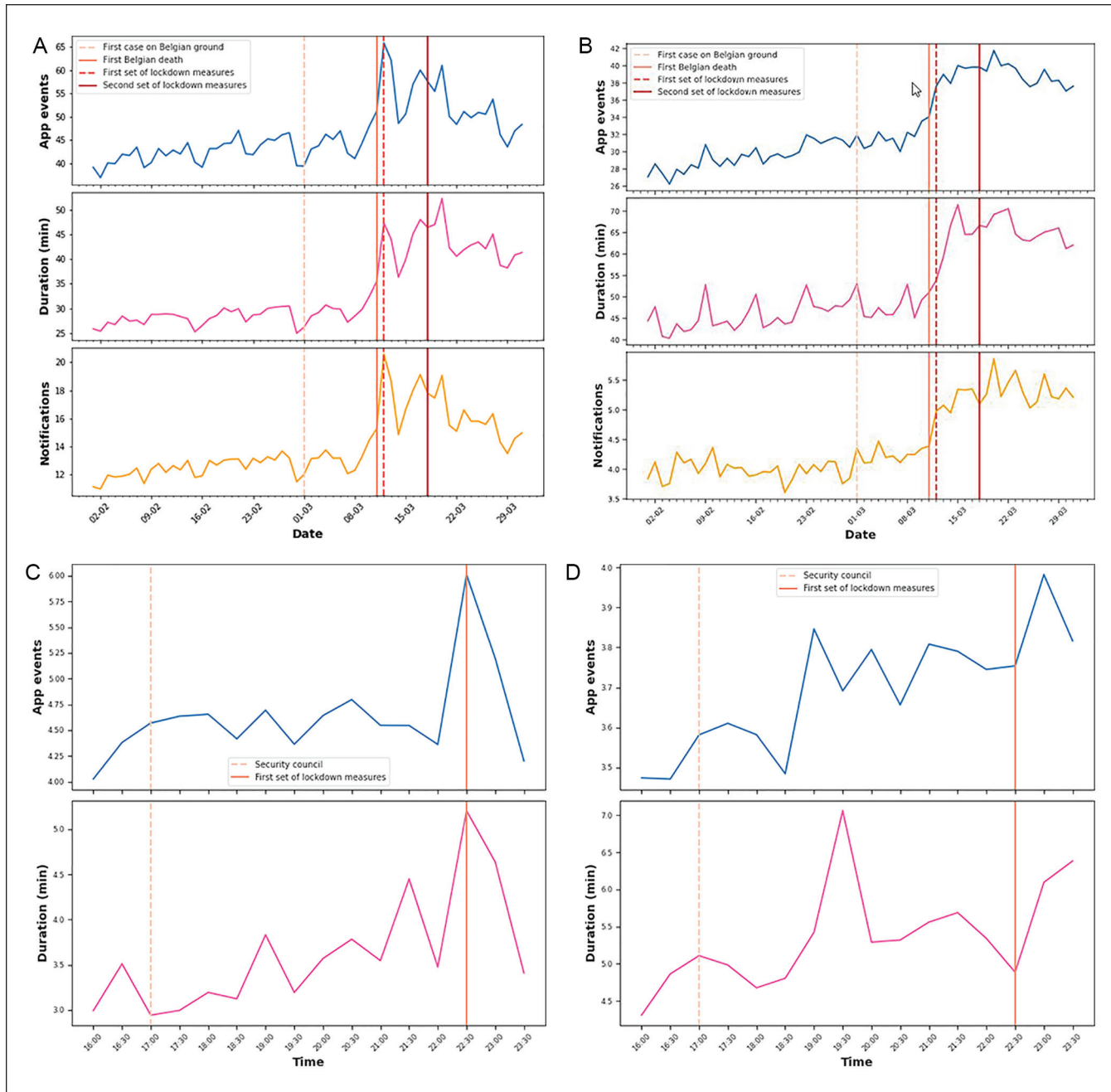
Figure 4. (A) Development of mobile messaging before and after the coronavirus disease 2019 (COVID-19) outbreak. (B) Development of mobile social media use before and after the COVID-19 outbreak. (C) Mobile messaging around major press conference on March 12. (D) Mobile social media use around major press conference on March 12.

mobile messaging peaked during the moment of the press conference, while social media use goes up just at the end and after the press conference (Figures 4C and 4D). Given that people use messaging apps for communication with interaction partners to whom they are close, while social network sites such as Twitter and Facebook are instead used for weaker social ties (Bayer et al. 2016), this finding suggests that people first have a need to communicate with close-tie contacts via messaging apps such as WhatsApp and Facebook

Messenger and text messages and only afterward gather responses from a broader social network on platforms such as Facebook, Instagram, and Twitter.

It is illustrative here to zoom in even more on the WhatsApp use of one individual on March 12 (Figure 5). WhatsApp is typically used in a highly fragmented manner, with multiple short interactions taking place within a relatively short time span. This fragmented pattern is visible in the daytime communication pattern of this one person (see Figure 5). After a

Figure 5. Communicative responses on WhatsApp near to major press conference March 12 by one prototypical individual.

break around dinner time, this pattern intensifies, however, up to the moment when the press conference begins (10:30 p.m.). Immediately after the press conference ends, the messaging behavior intensifies further. Here, we see that there are few incoming notifications, which suggests that the user was engaged in one or more quasi-synchronous conversations for an atypically long amount of time.

Because of its text-based nature, mobile messaging is still a relatively cue-poorer channel of communication compared with voice and video calls that may be higher quality substitutes for face-to-face interactions with family members, friends, and coworkers (cf. Daft and Lengel's [1986] media richness theory). We see a modest increase in the average length of mobile messaging sessions: the share of app events for which mobile messaging apps are used for 5 minutes or more without app switches or screen inactivity increased from about 1.5 percent on February 28 to 2.3 percent on March 17 (Figure 6B). As we can see in Figure 6B,

the trend of longer messaging sessions on smartphones continues during the whole month of March. This may point to longer, synchronous text-based messaging sessions and/or may represent an increase in the amount of voice or video calls performed with mobile messaging apps. The number of voice and video calls does not appear to drastically increase (8 calls on February 28 vs. 11 calls on March 17). However, we see a substantial increase in the duration of (video) calling (8 minutes on February 28, 16 minutes on March 17; see Figure 6A). Overall, the number of calls increases in March by only 7 percent up to 6.6 calls per day, while the duration increases by 44 percent from 6 to 9 minutes on average (Table 2).

Discussion

By relying on a large-scale sample of smartphone tracking data, we explored whether smartphones were used
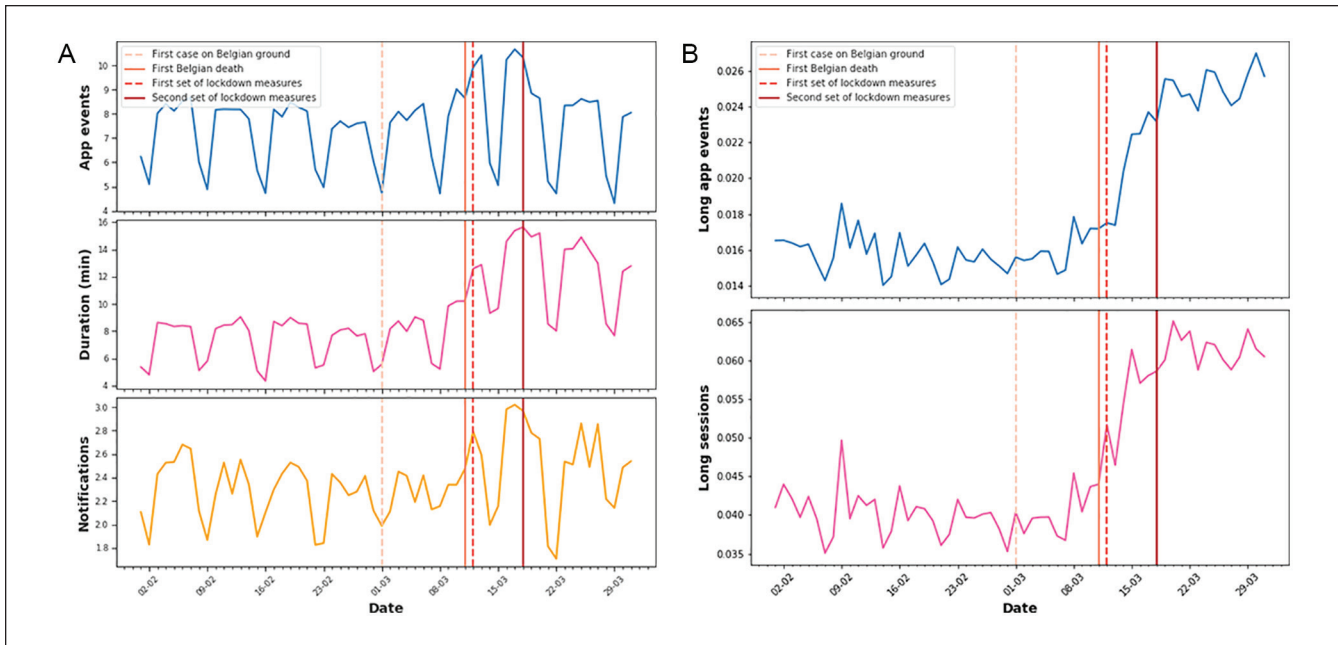
Figure 6. (A) Call-related app use before and after the coronavirus disease 2019 (COVID-19) outbreak. (B) Long sessions (more than five minutes) of mobile messaging before and after the COVID-19 outbreak.

differently in the early days of an enduring, global crisis that affected everyone than before. The findings of the study point to an increase in the use of smartphones during the first weeks of the COVID-19 outbreak. The unique mobileDNA data used in this study revealed a steep increase in the frequency and duration of news access in the early days of the crisis, especially around key events during the outbreak. This finding suggests that smartphones were used to obtain immediate access to information. Moreover, the study findings suggest that the immediacy of information can produce immediate responses, as near synchronous communication with close-tie contacts. In a slower information cycle, in which a lack of mobile communication makes information less readily available, such flexible alignment would be less likely to occur.

These findings contribute to knowledge about mobile news use by showing that smartphone access to current-affairs information is not only convenient in more normal times (Nelson 2020; Van Damme et al. 2019) but becomes a crucial access point to information in times of crisis. The descriptive nature of this study, however, does not provide information regarding citizens' motivations for consulting mobile news or on their responses to it. With respect to motivations, for instance, it remains unclear whether news consumption was motivated by boredom or a need for information. And with respect to responses, our study does not reveal whether the news updates contributed to uncertainty reduction or whether they might have been experienced as "news overload," potentially triggering negative emotions such as anxiety.

We observed interesting smartphone use patterns around key events such as the press conference announcing the first lockdown measures. However, the observed time series does not provide proof that these events "caused" the witnessed communicative patterns. It would be interesting if prospective interview studies on media consumption during the coronavirus crisis include asking interviewees to reflect on their media use surrounding these key events, to corroborate what our data suggest.

Although people's acting on the basis of readily available official information may lead to undesirable consequences such as hoarding, this ubiquitous access to the latest information may still afford a more controlled maneuvering through a situation. We hope that ongoing questionnaire and interview studies will take this research question to heart so that we can gain deeper insight into how precisely individuals flexibly align to crisis situations and what role digital media use may play in that process.

Although our study shows that smartphones were an important means to access information in a time of crisis, we cannot say much about the quality of being informed through mobile access, given that the mobileDNA data do not make it possible to make claims about what type of news was consumed or about how information was received and processed. It is possible that higher levels of news consumption reflect a mechanism to cope with uncertainty or result from people's accessing information in a habituated way, without much in-depth processing. Additional research is needed to examine whether smartphones were indeed used for greater and more in-depth engagement with the

latest news (Matsa 2016). If yes, this would be important. After all, a growing body of research suggests that the way people access news on smartphones can have different outcomes for political learning and subsequent concepts, such as political participation (Dunaway et al. 2018; Dunaway and Soroka 2019; Ohme 2020). We therefore hope to see other studies address this issue.

In normal times, digital communication is known to be a useful and important add-on that supplements face-to-face interactions. It is likely that when the strictest physical distancing measures were in place, people's face-to-face conversations were drastically reduced. In Belgium, for instance, citizens could not have face-to-face contact with people living in different households. This study revealed that when these strict physical distancing measures were imposed on people, digital communication increased. This finding suggests that communication technologies shifted from a convenient supplement to a necessary substitute for face-to-face interactions. Hence, the existing digital infrastructure and habituated digital social communication routines people have established over the past decades have partly shaped their coping process and thereby also potentially the progress of this unusual situation that was concerning for so many.

The events around the COVID-19 outbreak were a national concern in many countries and followed a similar pattern of announcements and measures. On the basis of our unique database of smartphone tracking data, we cannot claim representativity for the general population, and when interpreting these results, one must keep in mind that we present aggregated rather than idiosyncratic results. Nonetheless, the comparison in use before and after the crisis started indicates that smartphone behavior changed. It is conceivable that these changes in communication patterns are comparable with changes in other national contexts, although local contexts may also play a role. For instance, in South Africa, the government relied on the country's Disaster Management Act to issue a special amendment that prohibited telecommunications providers from increasing prices across their products during the duration of the crisis (Republic of South Africa, Department of Communications and Digital Technologies 2020). This ruling may affect smartphone use during the crisis. Hence, future research should be attentive to local contexts.

Importantly, our study suggests an integration of information behaviors and social communication during the crisis. News consumption was often immediately followed by or interspersed with communicative activities. It is possible that news exposure thus immediately received a social evaluation in citizens' social networks. Given that mobile messaging apps are "close tie" technologies, this evaluation is conceivably sought foremost from the inner circle of personal contacts (Cui 2016). Social media platforms that connect citizens to their broader social networks (e.g., Facebook) and society at large (e.g., Twitter) were not accessed immediately but only in the hours after the press conference, when the use of

news and messaging apps was on the decline. In sum, the findings of this study suggest that during the first weeks of the COVID-19 crisis, smartphones served as tools of information diffusion, activity, and communication in times of physical distancing. Although digital infrastructures such as smartphones are not free from problems—for example, their contribution to the spread of disinformation (Singh et al. 2020), panic or anxiety, and the disparities in their access and use—the patterns found in news app use and the use of mobile social platforms such as Facebook, Twitter, and WhatsApp indicate that physical distancing does not necessarily lead to disinformation or social distancing. Although additional research is needed, this study shows that in this first fully digital pandemic, means of digital communication that have been tested and rehearsed for years at least appear to be effective tools to help individual citizens get through these remarkable times. In light of this observation, the findings of this study point to the importance of safeguarding the infrastructure needed for mobile connectivity, as well as the need for policy surrounding these infrastructures and how they operate during times of crisis.

Appendix

List of Applications per Category.

Category	Application
News	Nieuwsblad
	VRT NWS
	HLN
	De Standaard
	De Morgen
	Het Belang van Limburg
	Metro
	Flipboard
	Feedly
	Google News
	Persgroep Topics
	Bing News
	VRT.NU
	NOS
	De Telegraaf
	AD Nieuws
	De Volkskrant
	Reuter News
	South China Morning Post
	Washington Post
	BBC News
	CNN
	Sky news
	Le Monde
	El Pais
	The Guardian
Browser	Chrome
	Android browser

Appendix (continued)

	Firefox
	Opera
	Edge
	Samsung browser
	Ecosia
	Brave
	DuckDuckGo
	Tor Browser
Messaging	Messenger
	Snapchat
	WhatsApp
	Hangouts
	Discord
	Telegram
	Viber
	Google Messages
	Android MMS
	Textra SMS
	Pulse SMS
	Chomp SMS
	Samsung SMS
	NextSMS
	MySMS
	Supertext
	MSMS
	Texty
	HTC SMS
	ICQ
	Disa
Social media	Facebook
	Twitter
	LinkedIn
	Instagram
	Foursquare
	Pinterest
	Tumblr
	Reddit
	Tinder
	TikTok
Calling	Android call
	Google dialer
	Samsung call
	Telenet Triing
	Samsung Smart Call
	Hangouts call
	Next dialer
	Drupe
	Simpler Dialer
	Beep
	Skype

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References

Agerholm, M. 1953. "Epidemic Poliomyelitis and Its Prevention." *The Lancet* 265(6780):287–92.

Bayer, Joseph B., Nicole B. Ellison, Sarita Y. Schoenebeck, and Emily B. Falk. 2016. "Sharing the Small Moments: Ephemeral Social Interaction on Snapchat." *Information, Communication & Society* 19(7):956–77.

Bennett, W. Lance, and Alexandra Segerberg. 2012. "The Logic of Connective Action." *Information, Communication & Society* 15(5):739–68.

Bertel, Troels Fibæk. 2013. "'It's Like I Trust It So Much That I Don't Really Check Where It Is I'm Going Before I Leave': Informational Uses of Smartphones among Danish Youth." *Mobile Media & Communication* 1(3):299–313. https://doi.org/10.1177/2050157913495386

Boyle, Michael P., Mike Schmierbach, Cory L. Armstrong, Douglas M. McLeod, Dhavan V. Shah, and Zhongdang Pan. 2004. "Information Seeking and Emotional Reactions to the September 11 Terrorist Attacks." *Journalism & Mass Communication Quarterly* 81(1):155–67.

Castells, Manuel. 1996. *The Rise of the Network Society*. New York: John Wiley.

Castells, Manuel, Mireia Fernández-Ardèvol, Jack Linchuan Qiu, and Araba Sey. 2009. *Mobile Communication and Society: A Global Perspective*. Cambridge, MA: MIT Press.

Costera Meijer, Irene, and Tim Groot Kormelink. 2015. "Checking, Sharing, Clicking and Linking." *Digital Journalism* 3(5):664–79.

Cui, Di. 2016. "Beyond 'Connected Presence': Multimedia Mobile Instant Messaging in Close Relationship Management." *Mobile Media & Communication* 4(1):19–36.

Daft, Richard L., and Robert H. Lengel. 1986. "Organizational Information Requirements, Media Richness and Structural Design." *Management Science* 32(5):554–71. https://doi.org/10.1287/mnsc.32.5.554

Dunaway, Johanna, Kathleen Searles, Mingxiao Sui, and Newly Paul. 2018. "News Attention in a Mobile Era." *Journal of Computer-Mediated Communication* 23(2):107–24.

Dunaway, Johanna, and Stuart Soroka. 2019. "Smartphone-Size Screens Constrain Cognitive Access to Video News Stories." *Information, Communication & Society* 23(2):107–24.

Dutta-Bergman, Mohan J. 2004. "Interpersonal Communication after 9/11 via Telephone and Internet: A Theory of Channel Complementarity." *New Media & Society* 6(5):659–73.

Götz, Friedrich M., Stefan Stieger, and Ulf-Dietrich Reips. 2017. "Users of the Main Smartphone Operating Systems (Ios, Android) Differ Only Little in Personality." *PLOS ONE* 12(5):e0176921. https://doi.org/10.1371/journal.pone.0176921

Heyblom, Olaf. 2020. "Nieuwe Coronamaatregelen: Nederlanders Hamsteren Massaal Wiet en Hasj." Retrieved August 3, 2020. https://www.ad.nl/binnenland/nieuwe-coronamaatregelen-nederlanders-hamsteren-massaal-wiet-en-hasj~a861b1ba/.

Licoppe, Christian. 2004. "'Connected' Presence: The Emergence of a New Repertoire for Managing Social Relationships in a Changing Communication Technoscape." *Environment and Planning D: Society and Space* 22(1):135–56.

Macias, Wendy, Karen Hilyard, and Vicky Freimuth. 2009. "Blog Functions as Risk and Crisis Communication during Hurricane Katrina." *Journal of Computer-Mediated Communication* 15(1):1–31.

Matsa, Katerina Eva. 2016. "Facebook, Twitter Play Different Roles in Connecting Mobile Readers to News." Pew Research Center. Retrieved August 3, 2020. http://www.pewresearch.org/fact-tank/2016/05/09/facebook-twitter-mobile-news/.

Matus-Mendoza, Mariadelaluz, and Antoon De Rycker. 2013. "Mexico City and the H1N1 Health Crisis." Pp. 395–434 in *Discourse and Crisis: Critical Perspectives*, edited by A. De Rycker and Z. M. Don. Amsterdam, the Netherlands John Benjamins.

Molyneux, Logan. 2018. "Mobile News Consumption." *Digital Journalism* 6(5):634–50.

Nelson, Jacob L. 2020. "The Persistence of the Popular in Mobile News Consumption." *Digital Journalism* 8(1):87–102. https://doi.org/10.1080/21670811.2019.1612766

Nelson, Jacob L., and Ryan F. Lei. 2018. "The Effect of Digital Platforms on News Audience Behavior." *Digital Journalism* 6(5):619–33.

Newman, Nic, with Richard Fletcher, Antonis Kalogeropoulos, and Rasmus Kleis Nielsen. 2019. "Reuters Institute Digital News Report 2019." The Reuters Institute. Retrieved August 3, 2020. https://reutersinstitute.politics.ox.ac.uk/sites/default/files/2019-06/DNR_2019_FINAL_0.pdf.

Ohme, Araujo, de Vreese, and Piotrowski. Forthcoming. Mobile Data Donations: Assessing Self-Report Accuracy and Sample Biases with the iOS Screen Time Function. *Mobile Media & Communication*.

Ohme, Jakob. 2019a. "Updating Citizenship? The Effects of Digital Media Use on Citizenship Understanding and Political Participation." *Information, Communication & Society* 22(13):1903–28.

Ohme, Jakob. 2019b. "When Digital Natives Enter the Electorate: Political Social Media Use among First-Time Voters and Its Effects on Campaign Participation." *Journal of Information Technology & Politics* 16(2):119–36.

Ohme, Jakob. 2020. "Mobile but Not Mobilized? Differential Gains from Mobile News Consumption for Citizens' Political Knowledge and Campaign Participation." *Digital Journalism* 8(1):103–25.

Procopio, Claire H., and Steven T. Procopio. 2007. "Do You Know What It Means to Miss New Orleans? Internet Communication, Geographic Community, and Social Capital in Crisis." *Journal of Applied Communication Research* 35(1):67–87.

Raento, Mika, Antti Oulasvirta, and Nathan Eagle. 2009. "Smartphones: An Emerging Tool for Social Scientists." *Sociological Methods & Research* 37(3):426–54.

Republic of South Africa, Department of Communications and Digital Technologies. 2020. "Amendment of Electronic Communications, Postal and Broadcasting Directions Issued under Regulation 10(8) of the Regulations Made under the Disaster Management Act, 2002 (Act No. 57 of 2002)." Retrieved June 24, 2020. https://www.ellipsis.co.za/wp-content/uploads/2020/05/200511-Amendment-of-Electronic-Communications-Postal-and-Broadcasting-Directions.pdf.

Rettie, Ruth. 2009. "SMS: Exploiting the Interactional Characteristics of Near-Synchrony." *Information, Communication & Society* 12(8):1131–48.

Sewall, Craig J. R., Todd M. Bear, John Merranko, and Daniel Rosen. 2020. "How Psychosocial Well-Being and Usage Amount Predict Inaccuracies in Retrospective Estimates of Digital Technology Use." *Mobile Media & Communication*, 1–21. https://doi.org/10.1177/2050157920902830

Shell, Marc. 2009. *Polio and Its Aftermath: The Paralysis of Culture*. Cambridge, MA: Harvard University Press.

Silver, Laura. 2019. "Smartphone Ownership Is Growing Rapidly around the World, but Not Always Equally," https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/

Singh, Lisa, Shweta Bansal, Leticia Bode, Ceren Budak, Guangqing Chi, Kornraphop Kawintiranon, and Colton Padden, et al. 2020. "A First Look at COVID-19 Information and Misinformation Sharing on Twitter." *arXiv*. Retrieved August 3, 2020. http://arxiv.org/abs/2003.13907.

Stephens, Keri K., Brett W. Robertson, and Dhiraj Murthy. 2020. "Throw Me a Lifeline: Articulating Mobile Social Network Dispersion and the Social Construction of Risk in Rescue Communication." *Mobile Media & Communication* 8(2):149–69.

Stroud, Natalie Jomini, Cynthia Peacock, and Alexander L. Curry. 2020. "The Effects of Mobile Push Notifications on News Consumption and Learning." *Digital Journalism* 8(1):32–48.

Umberson, Debra, and Jennifer Karas Montez. 2010. "Social Relationships and Health: A Flashpoint for Health Policy." *Journal of Health and Social Behavior* 51(1):54–66.

Van Damme, Kristin, Marijn Martens, Sarah Van Leuven, Mariek Vanden Abeele, and Lieven De Marez. 2020. "Mapping the Mobile DNA of News: Understanding Incidental and Serendipitous Mobile News Consumption." *Digital Journalism* 8(1):49–68.

Vanden Abeele, Mariek, Ralf De Wolf, and Rich Ling. 2018. "Mobile Media and Social Space: How Anytime, Anyplace Connectivity Structures Everyday Life." *Media and Communication* 6(2):5–14.

Vanden Abeele, Mariek M. P. 2016. "Mobile Youth Culture: A Conceptual Development." *Mobile Media & Communication* 4(1):85–101.

Vandendriessche, K., and Lieven De Marez. 2020. "Digimeter 2019." Retrieved August 3, 2020. https://www.imec.be/nl/expertises/imec-digimeter/digimeter-2019.

Veil, Shari R., Tara Buehner, and Michael J. Palenchar. 2011. "A Work-in-Process Literature Review: Incorporating Social Media in Risk and Crisis Communication." *Journal of Contingencies and Crisis Management* 19(2):110–22.

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