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Two Levels of Digitalization and Internet Use Across Europe, China, and the U.S.

CHRIS CHAO SU[1]
JUN LIU
University of Copenhagen, Denmark

BAOHUA ZHOU
Fudan University, China

Although studies acknowledge that the level of digitalization in the media domain plays an important role for Internet use, conceptual and operational ambiguities remain as to whether digitalization speaks to an infrastructural attribute of societies and countries or instead refers to digitized media preferences and use of individuals. Using survey data from Europe, China, and the United States, this study examines both micro (individual) and macro (infrastructural) levels of digitalization and their interaction effects on use of the Internet. Through multilevel regression modeling, this study reveals that individual-level digitalization negatively relates to Internet news consumption, but positively relates to use of the Internet for other purposes. In addition, it shows that infrastructural-level digitalization only positively and significantly affects the use of the Internet for news consumption and for work-related purposes. The study further reveals cross-level interactions of digitalization on Internet use.

Keywords: digitalization, media use, infrastructure, individual, comparison

Digitalization continues to penetrate all spheres of society, if to varying degrees. The imbrication of digital technologies with social, cultural, and political life in a global context is exemplified by media audiences continuing their move beyond traditional media outlets to digital devices (e.g., Napoli, 2011; Schrøder, 2015). A large and growing body of research has demonstrated the impact of the transformation

Chris Chao Su: chris.su@hum.ku.dk
Jun Liu: liujun@hum.ku.dk
Baohua Zhou (corresponding author): zhoubaohua@yeah.net
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from analog to digital formats on the intensity and velocity of organizing daily activities through the Internet in different national and cultural contexts (e.g., Hesmondhalgh & Meier, 2018; Lüders, 2008; Scolari, 2009). Nevertheless, three issues remain underexplored in the extant literature.

First, research to date has tended to focus on either a single digital media type (e.g., social media) or all media types as a whole, failing to explicate the difference between various legacy media and their digital formats. In other words, different media types and their digitized modes, each with its own communication characteristics and affordances, may entail disparate trajectories of use in people's lives. For instance, according to the Pew Research Center (2017), 59% of U.S. adults in 2017 described cable connections as their "primary means of watching TV," whereas only 28% chose online streaming services, and 9% cited digital antennas. Communication practices differ significantly across various media platforms, as these practices "are bounded by people's perceptions of what technologies can do, material or digital features that literally structure what can be done with them, and behaviors that emerge and evolve in relation to technologies" (Kreiss, Lawrence, & McGregor, 2018, p. 19). The continued coexistence of digital media audiences with significant numbers of traditional media users is further confounded if we take age, gender, and country differences into consideration. While audiences choose, access, and adopt digitized media content, they practice both legacy and emerging media habits (Madianou & Miller, 2012; Orlikowski, 2000).

Second, previous studies have mostly focused on demonstrating how the digitization of media content relates to changes in people's daily experiences, that is, the shift from offline activities to online practices (Miranda, Young, & Yetgin, 2016; Newell, 2012; Tilson, Lyytinen, & Sørensen, 2010). Yet, if the process of digitalization along with computerization transforms all content and formats of media into digital bits of 1s and 0s, it remains unclear to which level of the media domain digitalization refers. The ambiguity of this key term hinders a conversation about research on digitalization as, at once, an infrastructural or macro-level phenomenon and digitized media use (Tilson et al., 2010). Different from most existing studies that explore variables of digitalization, our study addresses the relationships among different levels of digitalization, media habits, and Internet use in everyday life.

Third, most studies on the digital divide and digital inequalities (e.g., Sassen, 2012) have drawn on secondary data, producing a less than nuanced picture of people's media use and preferences. Through a cross-national survey in five selected countries in Europe, the United States, and the Chinese mainland, this study is one of the first to investigate similarities and differences at different levels of digitalization, media habits, and Internet use across countries.

In the sections that follow, we first present a review of the literature on digitalization, which leads into the research questions and hypotheses. Second, we lay out our methodology. Third, we present our findings, discuss potential explanations, and reflect on our conclusions.

Revisiting and Operationalizing Digitalization in the Media Domain

Broadly defined, digitalization refers to "the structuring of many and diverse domains of social life around digital communication and media infrastructures" (Brennen & Kreiss, 2016, p. 5). Scholarship has

evolved into two strands to explore phenomena of digitalization. One strand, which uses the terms *digitalization*, *digitization*, and sometimes *digital transformation* interchangeably, refers to the technical and material process of converting analog data into digital forms (e.g., Dellarocas, 2003; Tilson et al., 2010). Digitalization here denotes both a process of computerization and a transformation of all contents and formats of communication into digital bits of 1s and 0s. For instance, studies have addressed the digitalization of mass media (Miranda et. al, 2016) and other media industries (Hesmondhalgh & Meier, 2018), the convergence of old and new media forms (Newell, 2012), and the digital transformation of media organizations (Tambini, 2015).

The second strand of research tackles manifold sociotechnical phenomena and the adoption of digital information and communication infrastructures in broader social contexts. This research directs attention in particular to the diffusion of Internet and other ICTs as global communication infrastructures and resulting changes in the adoption and development of telecommunications in specific regions or countries (e.g., Gruber, Hätönen, & Koutroumpis, 2014; Kim, 2011). For instance, considering digitalization as an institutional arrangement, studies have investigated how digitalization is related to infrastructural-level factors, including telecommunications and regulatory infrastructures (e.g., Andonova, 2006; Billon, Lera-Lopez, & Marco, 2010; Chinn & Fairlie, 2007). Along similar lines, academics, policy makers, and government reports have advocated an agenda of developing and reviewing the digital facilitation of the processing power of online information flows, storage capacity, networked distribution systems, and communication bandwidth, all around the vision of a ubiquitous digitalized infrastructure driven by economic forces and new types of business models (e.g., Nieminen, 2016; Roller & Waverman, 2001).

Studies have also explored patterns of digitalization in different domains of life, such as social relationships (Hülür & Macdonald, 2020), journalism and news consumption (Swart, Peters, & Broersma, 2017), health services (Gebre-Mariam & Bygstad, 2019), and workplace interactions (Harteis, 2017).

Although much ink has been spilled in understanding digitalization from different aspects, the extant literature suffers from an ambiguity in the conceptualization and operationalization of digitalization. First, the term *digitalization* has been used interchangeably and confusingly to address both the digitization of macro-level material infrastructures and the digital transformation of micro-level media use in the context of people's daily lives. Second, and due to the lack of a clear delimitation of the term *digitalization*, existing studies fail to differentiate the unit of analysis, whether the macro-level computerization and technological development or the emergence of digital forms of media consumption. This leads to a third issue, namely, that analyses have confounded country-level developments of infrastructures and individual-level preferences for using particular media types. Therefore, a systematic reconceptualization and operationalization of digitalization is required to distinguish these different levels of digitalization and their implications for media use.

To fill the gap, this study operationalizes digitalization in the media domain along two dimensions: (1) a micro, individual level of digitalization that captures individual media users' turn from legacy media toward digital media of all kinds, and (2) a macro, infrastructural level of digitalization that reflects the development of ICTs, the digital scaffolding of media, and the adoption of digital infrastructures as sociotechnical phenomena in society.

Individual-Level Digitalization and Internet Use

As a resource, communication technology might lead to more equalization, but its use nonetheless depends on people's dispositions, including social status, experience, and skills. According to Bonfadelli (2002), Internet use, in comparison with traditional media such as newspapers and television, requires not only enabling technologies, but also more active and skilled users. DiMaggio, Hargittai, Celeste, and Shafer (2004) argue that access to a media technology is never enough to ensure its multipurpose use; rather, the conditions and contexts of use would play key roles and should be emphasized by research. People incorporate digital technologies into their lives in the context of interconnected social factors; technologies are not separate entities, independent of people's lives (e.g., De Reuver, Nikou, & Bouwman, 2016; Sujon, Viney, & Toker-Turnalar, 2018). In the same vein, past digital experiences and skills are important factors influencing people's Internet use and online activities (e.g., Hargittai & Hinnant, 2008). Zillien and Hargittai (2009) argued that Internet users of higher social status are typically are more experienced and have more digital skills, and thus systematically benefit from the Internet, as compared with those of lower status and with less experience, who use the Internet in less effective and less profitable ways. In the context of social media, Correa (2016) noted how Internet skills are related to different types of Facebook use among "digital natives."

To emphasize the importance of individuals' practices of media use, Wilson (2000) specifically distinguished between "formal access" (i.e., infrastructural, physical availability) and "effective access" in the terms of overcoming the digital divide. The latter refers to agency-level dynamics, such as affordable connectivity and diffusion of the skills people need to benefit from the technology. Similarly, scholars of the second-level digital divide and digital inequalities have demonstrated that divides in Internet use continue to expand, even after physical, infrastructural access has become universal (DiMaggio, Hargittai, Neuman, & Robinson, 2001). Research on the digital divide should therefore shift its focus from material, infrastructural-level access to digital technologies to the ways in which different segments of a population make use of these technologies.

This study departs from the fact that digital media have the ability to remediate the use of traditional media—including print media, radio, and television—because "the digital computer can reproduce or simulate all other known media" (Jensen, 2013, p. 217). Some studies have emphasized that to fully understand how audiences use news, we should look at media holistically rather than concentrating on the use of only a few media (Swart et al., 2017)—how people use various media in their lives from a relational rather than discrete perspective. According to the theory of polymedia (Madianou & Miller, 2012), media users tend to perceive media devices as a communicative environment of affordances. Users assess and appropriate what different media may do for them and how these media complement each other; how people use traditional media may also influence the way they use the Internet. Orlikowski (2000) coined the term *technology-in-practice*, implying that the users of technologies constitute and reconstitute the structure of the technologies they use. "Continued habitual use of a technology will tend to reenact the same technology-in-practice, thus further reinforcing it over time so that it becomes taken for granted" (Orlikowski, 2000, p. 410). Zillien and Hargittai (2009) further used Bourdieu's (1984) classic concept of habitus to refer to those factors besides basic sociodemographics that might influence the detailed patterns of Internet use: the quality of the technical access, digital experience, and topic-specific interests, among

others. In short, without denying the dynamics of agency in the appropriation of media technologies, we recognize that the material aspect, "physically manifested in the technology," not only interacts with but also shapes people's performance of media consumption beyond being "simply an artifact or part of the technological context" (Volkoff, Strong, & Elmes, 2007, p. 843; also see Marres, 2012; Siles & Boczkowski, 2012). In this perspective, we suggest that the digitalization of traditional media may contribute to the habitus with which users engage in online activities. Furthermore, digital skills, technical competency, and Internet-related knowledge are hardly learned independently from people's other media experiences. Following these arguments, we propose positive relationships exist between individual-level digitalization and four commonly examined types of Internet use in people's lives—following news and current affairs, pursuing personal interests, performing practical tasks, and accomplishing work-related purposes. Therefore, our first four hypotheses (H1–H4) are:

H1–H4: Individual-level media use digitalization is related to using the Internet to follow news and current affairs (H1), for personal interests (H2), for practical matters (H3), and for work-related purposes (H4).

Media materiality is at the center of another theoretical tradition examining the influence of individual-level digitalization and considering various media types. Scholars who focus on media materiality argue that the media technology itself, not the content it carries, influences how people use media and how they are affected by media (Kittler, 1999; McLuhan, 1964). Following this approach, we explore whether differences exist in Internet use in terms of individual users' experience with different digitized media types. Given the lack of empirical investigation into this issue, we ask the following research question (RQ):

RQ1: Are there any differences in terms of the relationships between individual-level digitalization of the use of different media—print media, radio, and television—and Internet use?

Infrastructural-Level Digitalization and Internet Use

Similar to individual-level digitalization, the literature on infrastructural-level digitalization has focused on whether and how digitalization on a macro level can contribute to people's lives on and with the Internet, especially in relation to infrastructural convergence and digital divides. On the one hand, because of the digital convergence of media infrastructures, the material infrastructure of communication has come to afford a single superstructure that facilitates all kinds of Internet use simultaneously by providing high fidelity and high bandwidth through fiber-optic cables transmitting in high-quality huge amounts of digital content at extremely high speeds. A cross-national study that measured indexes of ubiquity, affordability, reliability, speed, and usability for the mass adoption of digital technologies in 150 countries from 2004 to 2010 suggested that the level of infrastructural digitalization contributes to the well-being of a population and that high levels of digitalization contribute to covering human needs and providing basic services (Katz & Koutroumpis, 2013).

On the other hand, the literature on digital divides has highlighted the importance of Internet access, use of digital devices, and engagement in online activities, referring to the knowledge gap hypothesis, which suggests that those with the most digital (and other) resources are privileged and will

benefit from digitalization first and most (Pearce & Rice, 2013; van Dijk, 2005). Scholars have also noted that the profound effects of digital divides are felt across life domains (e.g., Vicente & Lopez, 2010; Wyatt, Henwood, Hart, & Smith, 2005). Although previous studies have revealed the inequality related to access to digital resources, they generally agree that the digitalization of material infrastructures contributes to the efficiency, productivity, and coordination of daily activities through the diffusion of broadband technologies, lower costs of living in relation to different social institutions, and reciprocal communicative systems (Sassen, 2008). In line with previous research, we hypothesize that infrastructural-level digitalization can facilitate and, therefore, foster individuals' Internet use in life, including for news consumption, personal interests, practical matters, and work-related purposes. Our next hypothesis is:

H5: The higher a country's macro, infrastructural level of digitalization, the more frequently its citizens use the Internet for different purposes in life.

Furthermore, DiMaggio et al. (2001) underlined,

> Technologies shape themselves to the contours of local priorities and ways of life: Just as some less developed countries were vanguard adopters of sound cassettes and cell phones, some may embrace the Internet relatively quickly, especially as wireless transmission creates convergence between Internet and cell phone technologies. (p. 313)

An acknowledgement of the difference between infrastructures and practices sensitizes us to the less direct, yet relevant, relationship between digitalization as a macro level of institutional arrangement and as the micro-level practices of Internet use. In other words, while existing scholarship has generated rich and nuanced analyses of digitalization at different levels, a lack of dialogue between studies on a macro, infrastructural level and those on a micro, daily-life level hinders a comprehensive understanding of the interaction between different levels of digitalization: infrastructures and individual uses.

Few studies have thus far investigated the relationship between individual-level digitalization and Internet use with reference to macro-, country-level infrastructural digitalization. Cuervo and Menéndez (2006) documented ICT infrastructures and costs and the availability of online public services that define the digital divide among European Union countries. Similarly, Chinn and Fairlie (2007) identified income differentials that account for cross-country disparities in personal computer and Internet penetration.

Billon, Marco, and Lera-Lopez (2009) demonstrated additional factors with diverse impacts on digitalization patterns. GDP, the service sector, education, and governmental effectiveness shape the pattern of digitalization in countries registering higher levels of ICT adoption. In contrast, in developing countries, population age and size of the urban population are positively associated with ICT adoption, while Internet costs have a negative impact. Through a multivariate analysis with a sample of 142 developed and developing countries, Billon and colleagues (2010) found that factors on several distinct levels contribute variously to differences in the adoption of ICTs, with income being a more significant factor for middle-digitalization countries, and for high-income countries, quality of regulation and infrastructure (for similar studies, see Hargittai, 1999; Vicente & López, 2006). These authors further proposed that different combinations of technologies may lead to "diverse models of digitalization in different countries" (Billon et

al., 2010, p. 40). With a model comprising six factors and their aggregation for measuring levels of digitalization, Corrocher and Ordanini (2002) compared 10 developed countries between 2000 and 2001. The comparison showed the U.S. to be the fastest country in terms of country-level digitalization, whereas Italy seemed to be one of the slowest countries, with Germany in the middle. Still, this topic is almost unexplored; few cross-country comparative studies of the relationship between individual user behavior and macroscopic analyses of infrastructural factors of digitalization have been conducted. Therefore, our second research question (RQ2) is:

RQ2: Do the direct effects of individual-level digitalization on the use of the Internet for different purposes vary according to the macro-, country-level digitalization on telecommunication infrastructure?

To summarize, Figure 1 presents the research framework and depicts the relationships among two levels of digitalization and four aspects of Internet use in life.

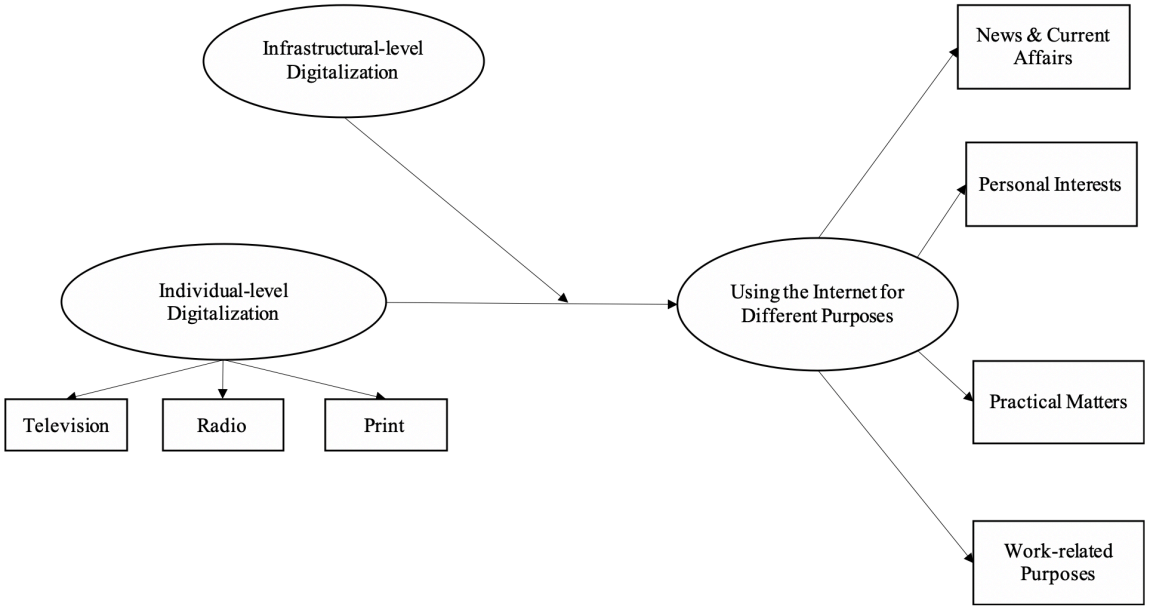

Figure 1. Research framework.

Data and Method

Sampling

Many media scholars have used a comparative perspective to examine media and Internet use across countries (e.g., Livingstone, 2003), using either a most similar design (e.g., Su & Zhang, 2019; Verboord, 2017) or a most different design (e.g., the West and the East; see Park, Baek, & Cha, 2014). To address our focal variable of digitalization and for the sake of generalizability, a mixed-systems approach (Frendreis, 1983) is employed in this study, combining the most similar (i.e., European countries) and the

most different (the West and China) strategies. The sample was derived from a population survey on media consumption conducted in the summer of 2018 by YouGov, with online questionnaires in Denmark (*N* = 1,514), Germany (*N* = 1,517), Hungary (*N* = 1,507), Italy (*N* = 1,516), the United Kingdom (*N* = 1,615), and the U.S. (*N* = 1,517), and by Fudan University on the Chinese mainland (*N* = 1,617) at the end of 2018. A total of 10,803 questionnaires were completed. Although we recognize that perceptions of media shape media use (e.g., Ardèvol-Abreu & Gil de Zúñiga, 2017; Gil de Zúñiga, Weeks, & Ardèvol-Abreu, 2017), in this study, we zero in on actual media use. Considering overall ICT infrastructure diffusion, Denmark has the highest indicator value among the seven chosen countries according to the International Telecommunication Union ICT Development Index, followed by the UK, Germany, and the U.S. (on the same level), Italy, and Hungary; China has the lowest indicator value (International Telecommunication Union [ITU], 2019).

Measures

Media use. To measure individual media use, respondents were asked how much time they spend on different media, both traditional and digital media, including (1) traditional live television; (2) television programs on streaming services; (3) traditional radio broadcasting; (4) individual radio programs or podcasts through streaming services, websites, or apps; (5) print versions of magazines; (6) physical books; (7) audiobooks; and (8) e-books. The wording of the questionnaires used in different countries was translated and adjusted by local scholars with concrete examples for clarification. For example, in the U.S., we illustrated streaming TV with media service providers such as Netflix, HBO Now, Hulu, YouTube, iTunes, and Amazon Prime and explained the individual radio programs and podcasts by listing examples such as Spotify, Podcast Addicts, and Pocket Cast. Respondents indicated their weekly use frequency of media (from 1 = *never or rarely* to 8 = *every day*) for eight questions regarding the mentioned media types.

Individual-level digitalization. Three indices were calculated to measure individual-level digitalization for different media: (1) television, dividing the use frequency for streaming TV by the use frequency for traditional TV; (2) radio, dividing the frequency of listening to podcasts by the frequency of listening to traditional radio broadcasting; and (3) print media, dividing the sum of use frequencies of listening to audiobooks and reading e-books by the sum of use frequencies of reading magazines and books in print. Thus, each respondent had three ratio scores: television use digitalization (*M* = 1.32, *SD* = 1.78), radio use digitalization (*M* = .87, *SD* = 1.24), and print media use digitalization (*M* = 1.01, *SD* = .94). Last, an overall index to measure individual-level digitalization (*M* = .84, *SD* = .69) was created by dividing the total use frequency of all traditional media (i.e., broadcast television, traditional radio broadcasting, print versions of magazines, and physical books) by the total use frequency of all digital media (i.e., streaming TV, podcasts, audiobooks, and e-books). Rather than simply asking about the extent to which respondents consume digital media or traditional media in general, our measurements count each specific media type, which helps to create a more valid index for individual-level digitalization than those of previous studies. Descriptive results are summarized in Table 1.

Table 1. Descriptive Results of Individual-Level and Country-Level Variables in Seven Countries.

	China	Germany	Denmark	Hungary	Italy	UK	U.S.
N	1,617	1,517	1,514	1,507	1,516	1,615	1,517
Level 1							
Individual-level digitalization							
Television	1.73	1.03	1.58	1.10	.91	1.35	1.49
	(1.93)	(1.62)	(2.08)	(1.41)	(1.15)	(1.92)	(2.01)
Radio	1.24	.67	.86	.90	.73	.79	.86
	(1.16)	(1.08)	(1.41)	(1.14)	(1.12)	(1.32)	(1.35)
Print media	1.36	.96	.93	.86	.83	1.04	1.05
	(.96)	(.80)	(.91)	(.72)	(.77)	(1.17)	(1.08)
Overall	1.22	.67	.87	.80	.65	.78	.82
	(.81)	(.62)	(.79)	(.57)	(.43)	(.73)	(.68)
Internet use purposes							
News	5.45	5.19	5.68	5.56	5.49	5.09	5.03
	(1.91)	(2.57)	(2.28)	(2.25)	(2.25)	(2.70)	(2.67)
Personal interests	4.02	5.28	5.52	5.74	5.56	5.68	5.45
	(2.71)	(2.38)	(2.27)	(2.03)	(2.18)	(2.12)	(2.33)
Practical matters	2.77	2.99	4.18	4.69	3.49	4.09	3.89
	(2.54)	(2.81)	(2.72)	(2.68)	(2.68)	(2.70)	(2.84)
Work-related	2.35	2.55	3.12	4.43	3.80	2.57	2.63
	(2.58)	(2.86)	(2.99)	(2.86)	(2.95)	(2.87)	(2.93)
Level 2							
Infrastructural-level digitalization							
Internet users (%)	57.70	89.74	97.32	76.07	74.39	94.90	89.00
IPTV subscriptions (millions)	255.06 (18.28%)	3.40 (4.13%)	.74 (12.92%)	.81 (8.43%)	.61 (0.10%)	15.40 (23.05%)	10.33 (3.15%)
DSL Internet subscriptions (millions)	6.15 (0.44%)	25.00 (30.34%)	1.05 (18.24%)	.73 (7.60%)	15.03 (25.37%)	20.74 (31.04%)	21.83 (6.65%)
International Internet bandwidth per Internet user (bit/s)	27,722	53,756	87,136	60,929	33,968	418,135	107,865
Estimated proportion of households with Internet access at home	59.57%	89.90%	92.66%	83.31%	71.7%	93.99%	62.67%
Composited scale (standardized)	−.89	.25	.47	−.33	−.47	1.44	−.52

Note. Both IPTV subscriptions and DSL Internet subscriptions are normalized based on the population size of the country as the percentage indicated in the parentheses.

Infrastructural-level digitalization. Adopting a measure from previous studies (Katz & Koutroumpis, 2013; Katz, Koutroumpis, & Callorda, 2014), this study used five indicators chosen from the World Telecommunication/ICT Indicators Database (ITU, 2019) that presents valid statistics for the selected countries: (1) Internet users (%) estimates and surveys the proportion of individuals using the Internet based on results from national surveys; (2) IPTV subscriptions (in millions) refers to the number of subscriptions to Internet protocol television (IPTV); (3) DSL Internet subscriptions (in millions) measures the number of Internet subscriptions using digital subscriber line (DSL) services to access the Internet; (4) international Internet bandwidth per Internet user (bit/s) reflects the sum of the capacity used by all Internet exchanges offering international bandwidth; and (5) estimated proportion of households with Internet access at home (%) divides the number of in-scope households with Internet access by the total number of in-scope households. These five indicators were selected to reflect cross-country progress along the infrastructural digitalization development path (Katz & Koutroumpis, 2013). To measure the overall digitalization progress of each country, a composited scale of infrastructural-level digitalization was calculated by summing the standardized scores of all country-level indicators for each country. Table 1 summarizes the descriptive results of the indicators.

Using the Internet for different purposes. Based on a scale from 1 (*never or rarely*) to 8 (*every day*), respondents indicated how many days in a typical week they use the Internet: (1) to follow news and current affairs on a local, national, or global scale (such as political and economic affairs, sports updates, cultural events, and celebrity coverage; M = 2.81, SD = 2.55); (2) for personal interests (e.g., to pursue hobbies, browse around, or look up information out of curiosity; M = 1.37, SD = 1.31), (3) for practical matters (e.g., to get directions, find out where to eat, or check the weather forecast; M = 1.83, SD = 1.90); and (4) for work-related purposes (e.g., reading/sending e-mail, searching for information, or using a workplace intranet; M = 4.31, SD = .66). Table 1 summarizes the descriptive statistics regarding uses of the Internet for different purposes across countries.

Demographics. Collected information included gender (female = 0, male = 1, male = 46.6%); age (1 = 18–29, 2 = 30–39, 3 = 40–49, 4 = 50–59, 5 = 60–74; M = 3.04, SD = 1.44); education (1 = primary education, 3 = upper secondary education, 6 = master's level or above education; M = 3.56, SD = 1.37); household income per year compared with the average income in the country (1 = low, "2 = medium, 3 = high, M = 1.96, SD = .75); occupation (1 = office job, 2 = service job, 3 = physical work, 4 = student); and urbanization (1 = village, 2 = town, 3 = city).

Results

To identify the general pattern of how two levels of digitalization influence a person's Internet use in everyday life in selected countries, this study adopted a series of multiple linear regressions in the individual-level analysis and multilevel modeling in the mixed-level analysis (multilevel regression modeling [MLM], also referred to as hierarchical linear modeling [HLM]). MLM takes into account both within- and between-group variances (a.k.a. random effects) for nested data with more than one level of structure while assessing the fixed effects of predictors (Hayes, 2006). By doing so, the model variances can be estimated more accurately in consideration not only of individual variances, but also of the structural variances within subjects; this is particularly beneficial for the present research, with respondents from different countries.

More specifically, countries are different in terms of their contextual traits, such as economy, culture, and telecommunication infrastructures, which may influence the results. MLM further addresses the relationships between variables while controlling for such country-level differences.

Individual-Level Digitalization on Various Internet Use Types

The first set of hypotheses proposed that individual-level digitalization is related to using the Internet to follow news and current affairs (H1), for personal interests (H2), for practical matters (H3), and for work-related purposes (H4). To test these hypotheses, linear regression analyses were performed for each type of media use digitalization, the overall media use digitalization, and each purpose of Internet use. All models included sociodemographic variables (gender, age, education, income, occupation, and urbanization) as controls, along with the three key variables of the individual-level digitalization in the study: television use digitalization, radio use digitalization, and print media use digitalization. Omnibus tests showed that all models examining overall individual-level digitalization and the frequencies of using the Internet for different purposes were significant, but models concerning specific types of use digitalization were partially significant (Table 2). News consumption on the Internet was positively predicted by television use digitalization (β = .03, $p < .001$) and negatively predicted by both print media digitalization (β = −.39, $p < .001$) and overall individual-level digitalization (β = −.19, $p < .001$). H1 was supported. For using the Internet for personal interests, the models showed that radio (β = .03, $p < .01$) and print media digitalization (β = .38, $p < .001$) and the overall digitalization (β = .20, $p < .001$) were significant predictors. H2 was hence supported. Although overall individual-level digitalization significantly predicted using the Internet for practical matters (β = .28, $p < .001$), print media digitalization was the only significant, and also the strongest, predictor of Internet use (β = .53, $p < .001$) among the three media types and all other regression models. H3 was supported. Using the Internet for work-related purposes was predicted by television use digitalization (β = .10, $p < .001$) and radio use digitalization (β = .02, $p < .05$), as well as by overall digitalization (β = .10, $p < .001$). H4 was supported. These results were also confirmed in the fixed effects of individual-level predictors as shown in the MLM (Table 3). In terms of explanatory power, the model predicting practical matters explained the most variances (R^2= .30 / .10), while the model predicting work-related purposes explained the fewer variances (R^2 = .04 / .04). The first set of analyses can also address RQ1; the relationships between the individual-level digitalization of different media (i.e., television, radio, and print media) and Internet use demonstrate more differences than similarities, as reported in Table 2.

Table 2. Multiple Linear Regression Models Predicting Media Use Digitalization and Internet Use for Four Different Purposes.

	Individual-level digitalization				Using Internet for different purposes			
	Television	Radio	Book	Overall	News	Personal	Practical	Work
Demographics								
Gender	−.02	.01	.03**	.02*	.12***	.01	−.03*	−.02
Age	−.32***	−.21***	−.07***	−.42***	.15***	−.05***	−.03**	−.10***
Education	.07***	.02	−.02*	.03**	.20***	.03**	.08***	.09***
Income	−.03***	−.03**	.04**	−.02	−.01	.05***	.05***	.003
Occupation	.02*	.02*	.04**	.03**	.01	−.03**	−.07***	−.004
Urbanization	.02	.01	.05***	.03**	.03***	.03**	.01	.07***
ΔR^2	*.11***	*.05***	*.02***	*.18***	*.07***	*.02***	*.02***	*.03***
Individual-level digitalization (a)								
Television					.03***	−.002	−.004	.10***
Radio					.003	.03**	−.007	.02*
Print					−.39***	.38***	.53***	.02
ΔR^2					*.15***	*.14***	*.28***	*.01***
Individual-level digitalization (b)								
Overall					*−.19***	*.20***	*.28***	*.10***
ΔR^2					*.03***	*.03***	*.08***	*.01***
Adjusted R^2(a)	.12***	.05***	.02***	.18***	.22***	.16***	.30***	.04***
Adjusted R^2(b)	–	–	–	–	.10***	.05***	.10***	.04***

Note. Standardized regression coefficients were reported.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Infrastructural-Level Digitalization on Internet Use

H5 proposed that the infrastructural-level digitalization is related to the frequencies of using the Internet for different purposes. The hypothesis was partially supported by the respective unstandardized betas predicting news and current affairs ($b = .49$, $p < .05$) and work-related purposes ($b = .05$, $p < .05$), but not for the other two purposes of Internet use (Table 3).

Multilevel Modeling of Two Levels of Digitalization on Internet Use

First, unconditional models in MLM[2] were employed to test the intraclass correlation (ICC) for the four types of Internet use in life. ICC is a measure of the degree of dependence among data, with value 0 indicating independent or not-nested data structure and value 1 for dependent or fully nested structure. The ICC results showed that 6% and 4% of the variance, respectively, in news and work-related purposes can

[2] R package "nlme" was used to conduct the multilevel modeling and estimate the mixed effects (Finch, Bolin, & Kelley, 2019).

be accounted for by the country-level differences, while the results accounted for hardly any or marginal variances regarding personal interests and practical matters.

Second, random-slope and random-coefficient models were employed for each dependent variable. At level 1 (individual level), overall individual-level digitalization served as input or predictor, along with other control variables such as gender, age, education, income, occupation, and urbanization. At level 2 (country level), infrastructural-level digitalization, the random effects of the intercepts, and slopes of the overall individual-level digitalization were modeled. In addition, the interaction between the two levels of digitalization was modeled. The results are summarized in Table 3.

Table 3. Multilevel Regression Models Predicting Internet Use for Four Different Purposes.

Predictors	Model 1 News & Current Affairs	Model 2 Personal Interests	Model 3 Practical Matters	Model 4 Work-Related Purposes
Independent Variables				
IV1: Individual-level digitalization	−.64***	.43***	.93***	.12***
IV2: Infrastructural-level digitalization	.49*	.07	.02	.05*
Interaction: IV1 * IV2	−.29**	.02	−.22	.02*
Controls				
Gender	−.60***	.01	−.13***	−.02*
Age	.05*	.03**	.13***	−.04***
Education	−.00	.00	−.00	.00
Income	.00	−.01*	−.01**	−.00
Occupation	−.02***	−.02***	−.02***	−.01**
Urbanization	−.01**	.00	.00	−.01**
Intercept	3.57***	1.30***	1.62***	4.50***
Random effects				
Intercept variance (τ00)	.24	.01	.08	.08
IV1 to DV slope variance (τ11)	.04	.01	.07	.02
ICC	.06	.004	.01	.04
Marginal R^2/ Conditional R^2	.08/.12	.05/.06	.10/.13	.06/.10

Note. The maximum likelihood method was used for estimation. Predictor variables are unstandardized estimates of the fixed effects. All predictors and control variables have been centered according to the grand means. N= 10,546. ICC = intraclass correlation.
*p < .05. **p < .01. ***p < .001.

After controlling for the fixed effects of other control variables, as well as the random intercepts and slopes across countries, the individual-level digitalization that predicted Internet use for different purposes was consistent with the results shown in the previous linear regressions. On average, individual-level digitalization negatively predicted Internet news consumption and positively predicted the other three

Internet uses. It is noteworthy that the interaction term was only significant for two aspects of Internet use: negatively for news (b = −.29, p < .01) and positively for work-related purposes (b = .02, p < .05). Considering the directional relations between individual-level digitalization and the dependent variables, both interactions showed enlarged effects, but in a reversed manner. To further ensure that the interaction term was not due to sampling error, a chi-square test was conducted to compare models with and without the interaction term, respectively, for the two significant models. The results were significant for both news, $\chi^2(1) = 42.64$, p < .01, and work-related purposes, $\chi^2(1) = 14.19$, p < .05; namely, there was a significant interaction between the two levels of digitalization for predicting the frequency of using the Internet to follow news and current affairs and the frequency of using the Internet for work-related purposes. The interactions are plotted in Figure 2a and Figure 2b. As the infrastructural-level digitalization increased, the impacts of individual-level digitalization on Internet news consumption (negative impact) and Internet use for work-related purposes (positive impact) increased, though country-level predictors in general positively influenced Internet use in life.

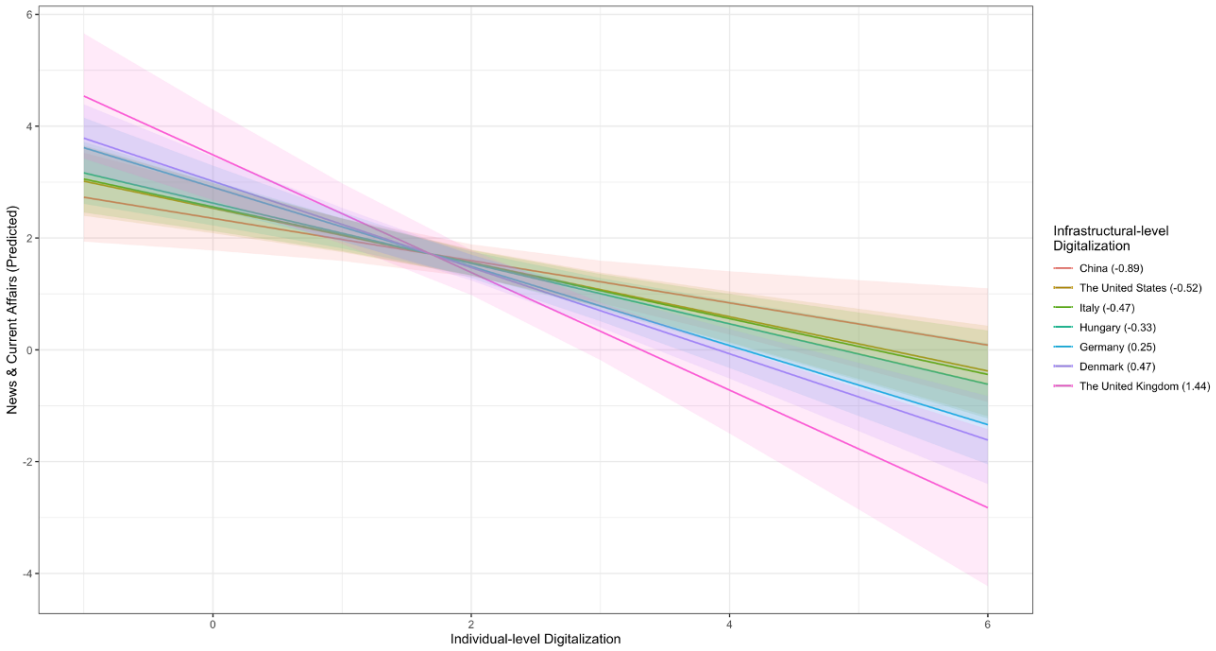

Figure 2a. Interaction effects of individual-level and infrastructural-level digitalization on Internet news consumption.

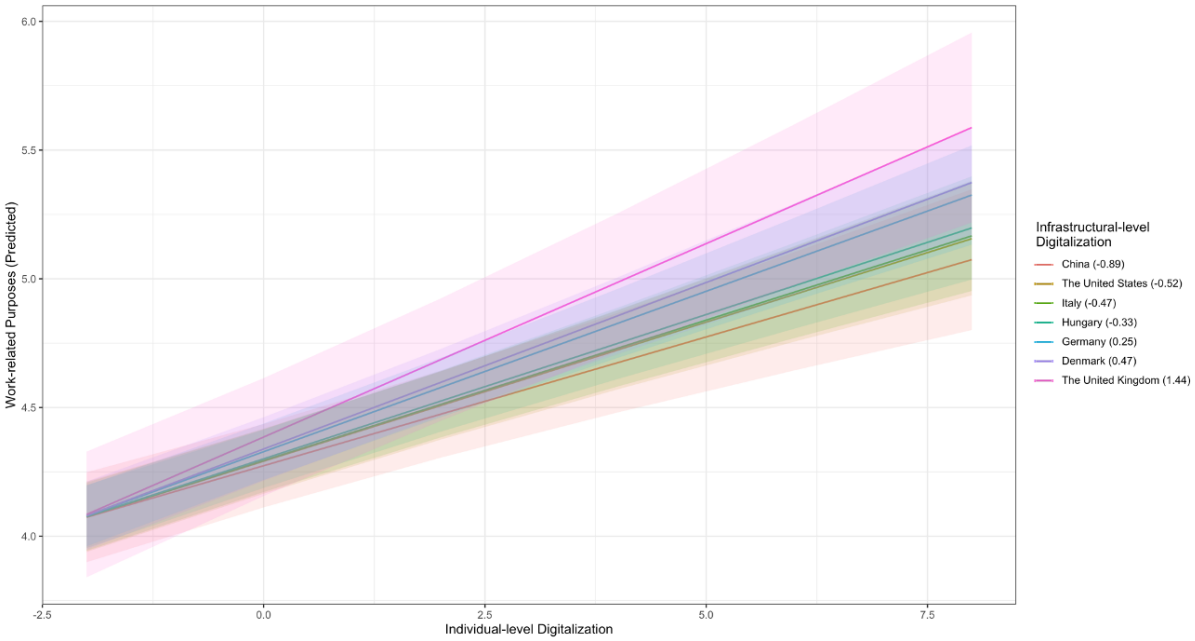

Figure 2b. Interaction effects of individual-level and infrastructural-level digitalization on using the Internet for work.

The random effects give a sense of the variation of individual-level digitalization and its relationships with different aspects of Internet use across countries because all the predicting variables have been centered. As shown in Table 3, the variance of average Internet news consumption across seven countries is the highest (24% of variance of the intercepts is attributed to country difference after controlling for all the predictors and controls), whereas average Internet use for personal interests does not vary much across countries (only 1% of variance is due to country difference). Compared with the intercepts, the variance of slope is less salient; practical matters is the highest, accounting for 7% of the country-level variance. Thus, the impact of individual-level digitalization on different aspects of Internet use is quite similar across all seven countries; that is, the validity of the identified patterns is largely supported.

Concluding Discussion

As elaborated, our study revisits and operationalizes the term *digitalization* in terms of both the macro, infrastructural level and the micro, individual level. For macro-level digitalization, we focused on the development of ICTs, digital scaffolding of media, and the adoption of digital infrastructures as sociotechnical phenomena in society; for micro-level digitalization, we examined individuals' shift of media use from legacy to digital media.

Based on this operational clarification, we found that the development of digital infrastructures does not necessarily entail a corresponding increase in individuals' use of digital media and of the Internet. More specifically, first, our cross-national empirical data substantiated the importance of differentiating two

levels of digitalization. As illustrated, the UK has the highest index of infrastructural-level digitalization, while China has the lowest. However, of the seven countries, on the individual level of digitalization, China comes out as the highest ranking country, with the UK ranking fifth. The regression analyses on the relationships between two levels of digitalization and use of the Internet further supported the significance of differentiating two levels of digitalization. Whereas individual-level digitalization represents the most important factor and exerts a substantial impact on all aspects of Internet use, infrastructural-level digitalization only facilitates two aspects of Internet use—Internet news consumption and work-related use. This again is a reminder that the expansion of material digital infrastructure in a society is far from enough to ensure its multipurpose use by individuals. Instead, individual-level digitalization serves as an important indicator of intervening factors such as digital skills and experience, which may offer better explanations of use of the Internet.

Second, our study advances the study of digitalization by elaborating three kinds of digitalization at an individual level, and four aspects of Internet use. For individual-level digitalization, our analysis measures the use of digital versions of three different types of legacy media—television, radio, and print media—which previous digital media studies have treated as undifferentiated clusters. The regression results reveal the relatively weak influence of the digitalization of radio compared with television and print media. It is also worth noting that the digitalization of print media relates negatively to Internet news consumption, but positively to using the Internet for personal interests and for practical matters. One plausible explanation is age. The statistical results indicate that older respondents tend to spend more time using the Internet for news but not for other purposes, while they also use legacy print media more frequently than its digital formats. Such stratification of age groups might explain why Internet news consumption comes out as the only online behavior found to be negatively correlated with the use of digitized versions of legacy media. Another potential explanation is that news consumption might be a distinctive aspect of online activities. Although legacy media are increasingly digitized, the functions and features afforded by traditional news media differ from those of other digital services and perhaps cannot be simply be transferred to the digital realm.

Third, the findings show that media convergence and the digitalization of different legacy media do not occur evenly or equally. Our empirical results confirm that the differences between media technologies matter when it comes to their influence on Internet use. As scholars of media materiality have argued, the media technology itself may influence how people use, and how they are affected by, media (Kittler, 1999; McLuhan, 1964). The differentiation of four aspects of Internet use also proved meaningful: Online news consumption is negatively correlated with the individual-level digitalization, whereas the other three kinds of Internet use are positively influenced by individual-level digitalization; only news consumption and work-related Internet use are significantly correlated with infrastructural-level digitalization; and no such influence on Internet use exists for personal interests or practical matters. A plausible explanation is that different aspects of Internet use require different resources, knowledge, skills, and media habits. Compared with personal interests and practical tasks, which could more easily be served by other technologies, the circulation of news, public affairs, and work-related information depends more crucially on ICTs and digital infrastructures.

Fourth, this is one of the first studies to examine the interaction effects of digitalization as a macro-level institutional arrangement and as a micro-level characteristic of individuals' media and Internet use. As

infrastructural-level digitalization increases, the impact of individual-level digitalization on Internet news consumption (negative impact) and Internet use for work-related purposes (positive impact) similarly increases, though country-level predictors in general positively influence Internet use. More specifically, the interaction effects identified by the proposed model feature four subgroups within the sampled countries: (1) China, representing the smallest impact of infrastructural-level digitalization on the relationship between individual-level digitalization and Internet use, (2) the U.S., Italy, and Hungary, where infrastructural-level digitalization slightly enhances the individual-level relationship, (3) Germany and Denmark, exhibiting a moderate influence of infrastructural-level digitalization on the individual-level relationship, and (4) the UK, which represents the greatest intensification of the individual-level relationship due to macro-level digitalization. These findings indicate that infrastructural-level digitalization not only may influence individuals' Internet use, but also may enhance the salience of the individual-level digitalization of media use. The interactions between the macro and micro levels might be such that macro-level digitalization prepares a social atmosphere in which more individuals become digital media users who in turn encourage their peers to do the same in a process that reinforces itself over time. This perspective returns research to the theoretical discussion outlined at the outset of this article—that is, how to conceptualize and operationalize digitalization at the macro and micro levels, and how to approach their interactions.

Fifth, the cross-country design of this study, with data from seven countries, enables a robust understanding of digitalization and Internet use; the study complements previous research (e.g., Gruber et al., 2014; Kim, 2011; Newell, 2012; Tambini, 2015) by combining analyses of individual-level media use habits and a comprehensive range of online activities with a macro-level perspective on the development of digital infrastructures, thus providing a common ground for further research. In addition, looking beyond Internet use by focusing on a single society or a set of similar societies (Gebre-Mariam & Bygstad, 2019; Kim, 2011), the study relied on a research design that combined most similar countries (five European countries) and most different countries (China and the West) to model country-level or contextual variance with reference to infrastructural indicators (ITU, 2019). These comparative findings hold further implications for other national contexts.

In summary, unlike extant literatures that focus on Internet use as such or explain Internet use only by sociodemographic factors such as digital divides, the present study contributes to a wider theoretical discussion of Internet use by conceptualizing and operationalizing digitalization at both macro and micro levels, by investigating their interactions, and by employing a cross-national comparative design. The findings, to some extent, resonate with the argument that some researchers (e.g., Livingstone, 2003) have advanced: The country, or nation-state, should be considered one among multiple categories or levels of comparative research, rather being "taken for granted."

The present findings have several limitations. First, although our study employs a comparative research design, our analyses cannot rule out an inverse relationship between the two levels of digitalization in other countries. Future studies should include more countries to comparatively investigate the relationship between the two levels of digitalization. Second, the measurements regarding individual-level digitalization of print media do not include legacy newspapers and their digital formats (online news portals and mobile news applications). Such exclusion helps to avoid multicollinearity between the independent variables and the dependent variables of Internet news consumption. Further research, however, could construct more

nuanced measurements to investigate the news domain in the digital world. Third, the analytical approach was designed to test the relationship between digitalization and Internet use while controlling for sociodemographic variables—an approach that may underestimate the moderating or mediating role of key control variables such as age, gender, and income. Future studies should examine the confounding effects of sociodemographic variables within the proposed research framework. Although we acknowledge this limitation, the employment of MLM does amount to a rigorous test of the theoretically built associations. Last but not least, both infrastructural development and micro-level digitalization may differ between metropolises (first-tier cities) and rural areas within countries such as China or the U.S. Although the variance within countries was not the focus of the present study, future studies may explore national heterogeneity alongside cross-national similarities and differences.

References

Andonova, V. (2006). Mobile phones, the Internet and the institutional environment. *Telecommunications Policy, 30*(1), 29–45.

Ardèvol-Abreu, A., & Gil De Zúñiga, H. (2017). Effects of editorial media bias perception and media trust on the use of traditional, citizen, and social media news. *Journalism & Mass Communication Quarterly*, *94*(3), 703–724.

Billon, M., Lera-Lopez, F., & Marco, R. (2010). Differences in digitalization levels. *Review of World Economics, 146*(1), 39–73.

Billon, M., Marco, R., & Lera-Lopez, F. (2009). Disparities in ICT adoption. *Telecommunications Policy, 33*(10–11), 596–610.

Bonfadelli, H. (2002). The Internet and knowledge gaps. *European Journal of Communication*, *17*(1), 65–84.

Bourdieu, P. (1984). *Distinction*. Cambridge, MA: Harvard University Press.

Brennen, J. S., & Kreiss, D. (2016). Digitalization. In K. B. Jensen, R. T. Craig, J. D. Pooley, & E. W. Rothenbuhler (Eds.), *The international encyclopedia of communication theory and philosophy* (pp. 1–11). Hoboken, NJ: Wiley.

Chinn, M. D., & Fairlie, R. W. (2007). The determinants of the global digital divide. *Oxford Economic Papers, 59*(1), 16–44.

Correa, T. (2016). Digital skills and social media use. *Information, Communication & Society*, *19*(8), 1095–1107.

Corrocher, N., & Ordanini, A. (2002). Measuring the digital divide. *Journal of Information Technology, 17*(1), 9–19.

Cuervo, M. R. V., & Menéndez, A. J. L. (2006). A multivariate framework for the analysis of the digital divide. *Information & Management*, *43*(6), 756–766.

Dellarocas, C. (2003). The digitization of word of mouth. *Management Science*, *49*(10), 1407–1424.

De Reuver, M., Nikou, S., & Bouwman, H. (2016). Domestication of smartphones and mobile applications. *Mobile Media & Communication, 4*(3), 347–370.

DiMaggio, P., Hargittai, E., Celeste, C., & Shafer, S. (2004). Digital inequality. In K. Neckerman (Ed.), *Social inequality* (pp. 355–400). New York, NY: SAGE Publications.

DiMaggio, P., Hargittai, E., Neuman, W. R., & Robinson, J. P. (2001). Social implications of the Internet. *Annual Review of Sociology*, *27*(1), 307–336.

Finch, W. H., Bolin, J. E., & Kelley, K. (2019). *Multilevel modeling using R*. Boca Raton, FL: CRC Press.

Frendreis, J. P. (1983). Explanation of variation and detection of covariation. *Comparative Political Studies, 16*(2), 255–272.

Gebre-Mariam, M., & Bygstad, B. (2019). Digitalization mechanisms of health management information systems in developing countries. *Information and Organization, 29*(1), 1–22.

Gil de Zúñiga, H., Weeks, B., & Ardèvol-Abreu, A. (2017). Effects of the news-finds-me perception in communication: Social media use implications for news seeking and learning about politics. *Journal of Computer-Mediated Communication*, *22*(3), 105–123.

Gruber, H., Hätönen, J., & Koutroumpis, P. (2014). Broadband access in the EU. *Telecommunications Policy*, *38*(11), 1046–1058.

Hargittai, E. (1999). Weaving the Western Web: Explaining differences in Internet connectivity among OECD countries. *Telecommunications Policy*, *23*(10-11), 701–718.

Hargittai, E., & Hinnant, A. (2008). Digital inequality. *Communication Research*, *35*(5), 602–621.

Harteis, C. (Ed.). (2017). *The impact of digitalization in the workplace* (Vol. 21). Cham, Switzerland: Springer.

Hayes, A. F. (2006). A primer on multilevel modeling. *Human Communication Research, 32*(4), 385–410.

Hesmondhalgh, D., & Meier, L. M. (2018). What the digitalisation of music tells us about capitalism, culture and the power of the information technology sector. *Information, Communication & Society*, *21*(11), 1555–1570.

Hülür, G., & Macdonald, B. (2020). Rethinking social relationships in old age. *American Psychologist, 75*(4), 554–566.

International Telecommunication Union. (2019). The World Telecommunication ICT indicators database. Retrieved from https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx

Jensen, K. B. (2013). Definitive and sensitizing conceptualizations of mediatization. *Communication Theory*, *23*(3), 203–222.

Katz, R., & Koutroumpis, P. (2013). Measuring digitization. *Technovation*, *33*(10–11), 314–319.

Katz, R., Koutroumpis, P., & Callorda, F. M. (2014). Using a digitization index to measure the economic and social impact of digital agendas. *Info, 16*(1), 32–44.

Kim, D. (2011). New regulatory institution for the convergence of broadcasting and telecommunications. *Government Information Quarterly*, *28*(2), 155–163.

Kittler, F. A. (1999). *Gramophone, film, typewriter*. Palo Alto, CA: Stanford University Press.

Kreiss, D., Lawrence, R. G., & McGregor, S. C. (2018). In their own words. *Political Communication, 35*(1), 8–31.

Livingstone, S. (2003). On the challenges of cross-national comparative media research. *European Journal of Communication, 18*(4), 477–500.

Lüders, M. (2008). Conceptualizing personal media. *New Media & Society*, *10*(5), 683–702.

Madianou, M., & Miller, D. (2012). *Migration and new media*. London, UK: Routledge.

Marres, N. (2012). On some uses and abuses of topology in the social analysis of technology (or the problem with smart meters). *Theory, Culture & Society*, *29*(4-5), 288–310.

McLuhan, M. (1964). *Understanding media*. London, UK: Routledge.

Miranda, S. M., Young, A., & Yetgin, E. (2016). Are social media emancipatory or hegemonic? *MIS Quarterly*, *40*(2), 303–329.

Napoli, P. M. (2011). *Audience evolution*. New York, NY: Columbia University Press.

Newell, J. (2012). Old objects, new media. *Journal of Material Culture*, *17*(3), 287–306.

Nieminen, H. (2016). Digital divide and beyond. *European Journal of Communication*, *31*(1), 19–32.

Orlikowski, W. J. (2000). Using technology and constituting structures. *Organization Science*, *11*(4), 404–428.

Park, J., Baek, Y. M., & Cha, M. (2014). Cross-cultural comparison of nonverbal cues in emoticons on twitter. *Journal of Communication, 64*(2), 333–354.

Pearce, K. E., & Rice, R. E. (2013). Digital divides from access to activities. *Journal of Communication, 63*(4), 721–744.

Pew Research Center. (2017). *About 6 in 10 young adults in U.S. primarily use online streaming to watch TV*. Retrieved from https://www.pewresearch.org/fact-tank/2017/09/13/about-6-in-10-young-adults-in-u-s-primarily-use-online-streaming-to-watch-tv

Roller, L. H., & Waverman, L. (2001). Telecommunications infrastructure and economic development. *American Economic Review*, *91*(4), 909–923.

Sassen, S. (2008). *Territory, authority, rights*. Princeton, NJ: Princeton University Press.

Sassen, S. (2012). Interactions of the technical and the social. *Information, Communication & Society*, *15*(4), 455–478.

Schrøder, K. C. (2015). News media old and new. *Journalism Studies*, *16*(1), 60–78.

Scolari, C. A. (2009). Mapping conversations about new media. *New Media & Society*, *11*(6), 943–964.

Siles, I., & Boczkowski, P. (2012). At the intersection of content and materiality: A texto-material perspective on the use of media technologies. *Communication Theory*, *22*(3), 227–249.

Su, C. C., & Zhang, X. (2019). Circulating mobile apps in Greater China. *International Journal of Communication, 13*, 2355–2375.

Sujon, Z., Viney, L., & Toker-Turnalar, E. (2018). Domesticating Facebook. *Social Media + Society*, *4*(4), 1–12.

Swart, J., Peters, C., & Broersma, M. (2017). Navigating cross-media news use. *Journalism Studies, 18*(11), 1343–1362.

Tambini, D. (2015). Five theses on public media and digitization. *International Journal of Communication*, *9*, 1400–1424.

Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Research commentary—Digital infrastructures. *Information Systems Research*, *21*(4), 748–759.

van Dijk, J. A. (2005). *The deepening divide*. Thousand Oaks, CA: SAGE Publications.

Verboord, M. (2017). Internet use and cosmopolitanism in Europe. *Information, Communication & Society, 20*(3), 460–481.

Vicente, M. R., & López, A. J. (2006). Patterns of ICT diffusion across the European Union. *Economics Letters*, *93*(1), 45–51.

Vicente, M. R., & López, A. J. (2010). A multidimensional analysis of the disability digital divide. *The Information Society*, *26*(1), 48–64.

Volkoff, O., Strong, D. M., & Elmes, M. B. (2007). Technological embeddedness and organizational change. *Organization Science, 18*(5), 832–848.

Wilson, E. J. (2000, May). *Closing the digital divide*. Retrieved from http://www.internetpolicy.org/briefing/ErnestWilson0700.html

Wyatt, S., Henwood, F., Hart, A., & Smith, J. (2005). The digital divide, health information and life. *New Media & Society*, *7*(2), 199–218.

Zillien, N., & Hargittai, E. (2009). Digital distinction. *Social Science Quarterly*, *90*(2), 274–291.