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JEL: M30, O33, J14
Original scientific article
https://doi.org/10.51680/ev.37.1.3

Received: October 10, 2023
Accepted for publishing: January 9, 2024

EXPLORING SMARTPHONE-RELATED DIGITAL DIVIDE AMONG SOUTH KOREAN OLDER ADULTS

Abstract

Purpose: One of the crucial steps towards fully grasping the benefits of smartphone use for all is to explore the existence of a digital divide and its relationship to different outcomes of smartphone use. In so doing, this study explored the smartphone-related digital divide among South Korean older adults in terms of access, use and outcomes.

Design/methodology/approach: In-person interviews using questionnaires were conducted to collect the data from a total number of 372 older adults aged 60 and above in eleven community centers in the Seoul Metropolitan area in Korea, 223 of whom owned a smartphone.

Results: This study found that most participants use smartphones to communicate with personal relationships and support system. There were, however, differences among groups related to gender, age, and ICT training in terms of the extent of smartphone usage and participation in virtual communities. In three age groups of 60+, 70+ and 80+, a younger cohort and those with ICT training had higher smartphone literacy, harnessing the potential of smartphones. Those who used smartphones to stay connected to their social group and for entertainment showed a lower level of loneliness.

Conclusion: This study shows that older adults (i.e., 60+) are not a homogenous group when it comes to using smartphones. There are distinct differences in older smartphone users, especially in the age groups 60+, 70+ and 80+. Older adults should be encouraged to use smartphones for better connectivity with their social groups and entertainment, potentially decreasing their feeling of loneliness.

Keywords: Older adults, digital divide, smartphone, loneliness, South Korea

1. Introduction

Digital literacy stands for "the ability to harness the potential of digital tools" (IFLA, 2017), which is an essential precondition of digital inclusion in today's information society. To be digitally literate means that one can use technology to its fullest effect efficiently, effectively, and ethically to meet information needs in personal, civic, and professional lives (IFLA, 2017). However, according to Gann (2019), the three main barriers to digital inclusion are lack of access, skills, and motivation. These are found to influence older adults' use of the internet and smartphones (Juznic et al., 2006). These barriers lead towards the division between 'haves' and 'have-nots' in terms of digital access and skills, which is aptly described as the *grey digital divide* (Juznic et al., 2006; Millward, 2003; Morris & Brading, 2007).

Although research into internet and ICT use among older adults has been rapidly growing over the last two decades (for example, Álvarez-Dardet et al., 2020; Friemel, 2016; Hill et al., 2015; Morris & Brading, 2007; Schehl et al., 2019; Vroman et al., 2015), relatively little research has been undertaken into smartphone-related digital divide among older adults (Hong et al., 2018). So far, the primary focus of digital divide research has been on internet access (e.g., the first-level digital divide) and internet skills and use (e.g., the second-level digital divide) (Scheerder et al., 2017). However, recent studies suggest that more focus needs to be placed on the third-level digital divide, where tangible outcomes of internet use are highlighted (Scheerder et al., 2017).

One of the most important features of smartphones is internet connectivity, which enables 24/7 connectivity through either apps or a mini browser for countless purposes, including searching for information, connecting to a social network, or downloading music, videos, and related content (Anshari et al., 2016, p. 719). Past research into older adults and smartphones examined perceived difficulties and usability (Barnard et al., 2013; Petrovičič et al., 2018), use and dependency (Park et al., 2013), or privacy concerns and attitude (Ketelaar & van Balen, 2018). Positive outcomes of smartphone use for older adults include a wider range of activities such as social networking, shopping (van Deursen & Helsper, 2015; Vroman et al., 2015) and an improved quality of life thanks to the smartphone apps designed to help manage health of older adults (Doughty, 2011; Joe & Demiris, 2013; Steinhubl et al., 2013). However, previous studies also show that older adults tend to use their mobile devices primarily for two activities: making/receiving phone calls and texting (Fernández-Ardèvol, 2011; Renaud & Biljon, 2010), indicating that the growth in smartphone ownership among older adults does not equate with increased ability or willingness to harness the full potential of smartphones.

Our focus on South Korea (hereafter Korea) derives from it being one of the most wired countries in the world with the highest internet penetration rate at 96% (Poushter et al., 2018) and the highest-ranked country in the OECD 2019 Digital Government Index (DGI) (OECD, 2019). Smartphone ownership was recorded among 95% of Korean adults (Silver, 2019). However, internet use and smartphone adoption among Korean older adults continue to lag behind those of younger generations. People aged 65 and above in Korea account for 14.8% of the country's population (Statistics Korea, 2019), only 59.9% of whom reported internet use and only 65.2% smartphone ownership (NIA, 2018). These statistics testify to the existence of the grey digital divide, which we wish to explore further.

Therefore, this study aims to explore Korean older adults' smartphone use and digital divide across groups, differing in gender, age, and ICT training. According to van Dijk (2005), an individual's characteristics (e.g., age, gender, intelligence, and health) are indicators known in digital divide literature to influence technology access, use, the extent of resources, and the amount of time available for digital activities. A unique aspect of the current study is that it examines the differences in smartphone use, skills, and outcomes across three age groups: 60+, 70+ and 80+, and sheds light on similarities and differences *within* this cohort rather than *in comparison to* younger cohorts. In digital divide literature, 80+ is a rarely researched demographic.

2. Literature review

2.1 The three levels of the digital divide

Research has found three different levels of the digital divide: the first-, second-, and third-level (Scheerder et al., 2017). The first level of the digital divide concerns physical access to the internet, and this has previously dominated digital divide

research and theory (van Dijk, 2018). This initial focus has shifted beyond mere access to the skills and use, which is the second-level digital divide. More recent studies explore the third-level digital divide, whereby researchers focus on the benefits and outcomes of using digital media, discussing the context and effects of digital media (non)use (van Dijk, 2018).

Research on the first-level digital divide found that internet access is unequally distributed among individuals with different demographic characteristics, such as age, gender, socio-economic status, ethnicity, and geography (e.g., Helsper, 2010; Mossberger et al., 2003). These factors also determine skills and use, which represent the second-level digital divide. For example, Blank and Groselj's (2014) study on three main dimensions of internet use revealed that age, educational level, and employment status cause a large proportion of the differences in the second-level digital divide. In other words, the first- and second-level digital divide have similar determinants, although the relative influence of these determinants depends on the type of skills and use measured (van Deursen & van Dijk, 2011). The growth in adoption and connectivity worldwide (e.g., internet and smartphone) has made the digital divide discourse based on access (the first-level digital divide) less relevant and the focus shifted to digital skills and differences in use (the second-level digital divide) (Scheerder et al., 2017). In this regard, researchers distinguished between mere skills to operate devices and literacy, harnessing the potential of digital tools (Mossberger et al., 2003; van Deursen & van Dijk, 2011). In recent years, there has also been a growing interest in the outcomes of internet, ICT, or digital technology use, namely, the third-level digital divide. For example, studies explored digital exclusion (Formosa, 2013), associations between internet use and loneliness (Stockwell et al., 2020), and the relationship between digital divide determinants and outcomes from internet use (van Deursen et al., 2017).

2.2 *Loneliness and depression: exploring connections with digital technologies among older adults*

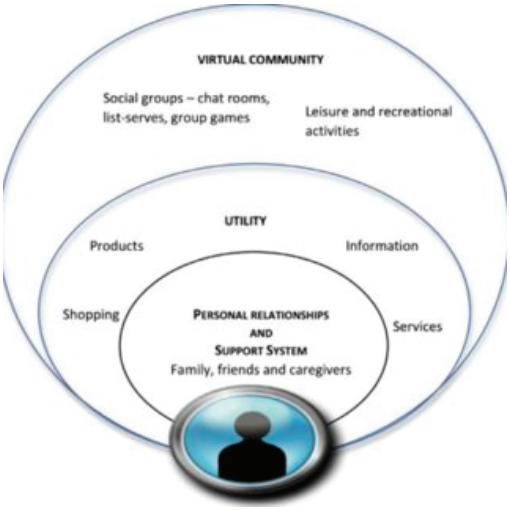
According to Jopling (2015), loneliness is a complex concept, whose causes and consequences are impossible to determine without reference to the individual and their own values, needs, wishes, and feelings. Not only does loneliness involve psychological and social aspects relating to age, gender, marital status, social contacts, interests, friendships, health, and cognition, it also is a cultural construct and a lifestyle issue (Dakers, 2018). In addition, loneliness is a fluid experience - it can come and go over a short time or persist in the longer term (Goodman et al., 2015). In other words, the subjective experience of feeling lonely can be chronic for some, and for others, it is a transient or fleeting experience. As loneliness is a subjective psychological perception about the number of social contacts that one has compared to what one would like to have, it differs from social isolation, which is the objective absence of social contacts and social connectedness (Goodman et al., 2015). Meanwhile, loneliness and depression are very closely associated with each other. Loneliness has a significant impact on psychological health and wellbeing, as loneliness contributes to both psychological distress and depression (Goodman et al., 2015). In a similar vein, depression, security, age, occupation, smoking habits, and income level were found influential in the emergence of loneliness among older adults (Aylaz et al., 2012).

The relationship between the use of digital technology and its impact on loneliness and depression is of particular relevance in this study. Due to its complexity, it is challenging to examine a direct cause-effect relationship between one's use and engagement of digital technology and the level of loneliness. So far, findings have been inconclusive (Song et al., 2014, p. 447). While some argued that internet use and computer-mediated interaction might benefit users in decreasing loneliness and depression (Carpenter & Buday, 2007; Shaw & Grant, 2002), other studies found precisely the opposite (Moody, 2001; Morgan & Cotten, 2004). Regarding smartphones, no association was found between smartphone use and severity of loneliness, depression, or anxiety (Rozgonjuk et al., 2018). Furthermore, there are methodological concerns such as how best to approach such an individual and personal experience with quantifiable measures that allow generalizability. For example, the way older people use the internet is as important as the amount of time they spend on the internet (Sum et al., 2008). This indicates that a qualitative, in-depth, and exploratory approach is needed as much as a quantitative and measurable one.

2.3 *Conceptualizing the digital divide through the information and communication technology social networking model*

Vroman et al. (2015) conceptualized the use of ICT among older adults and proposed a socio-ecological model (Fig. 1). It provides a useful theoretical framework for this study on three grounds. Firstly, it offers a way to interpret the attitudinal and motivational patterns of older adults' smartphone literacy, addressing the issues of use and skills (the second-level digital divide) and outcomes (the third-level digital divide). Secondly, it considers individual preferences and inherent values that may lead to either self-initiation of or resistance to smartphone use. Thirdly, it is a person-centered model that affords a contextualized appreciation for older adults' reasons and needs for ICT, which is suitable for the purpose of this study to explore smartphone literacy and its implications on individual psychological factors such as loneliness and depression.

Figure 1 Information and communication technology social networking motivation model



Source: Vroman et al. (2015, p. 165)

At the core of this three-tiered, person-centered model (Figure 1) is the older adult with his or her attitudes, needs and ICT capacity (Vroman et al., 2015, p. 163). The first level - personal relationships and support system - reflects one's primary interest, need, and most frequent use pattern - social networking activities with family and friends. This level is considered as the level with the greatest personal salience for older adults. Past research into older adults' smartphone use shows that older adults tend to use their mobile devices primarily for two activities: making/receiving phone calls and texting (Fernández-Ardèvol, 2011; Renaud & Biljon, 2010). However, we would like to understand to what extent these findings apply to Korean older adults and if so, with whom they mostly communicate via smartphones. This leads us to the second-level digital divide research question:

RQ1. How do older adults use their smartphones in terms of frequency and duration of daily use, and with whom?

The next level - utility - shows that older adults use ICT for various functions: for example, accessing information about products and services and conducting daily tasks such as shopping. Progress from the first to the second level may occur due to the exchanges between family and friends (e.g., hyperlinks via email). Previous research highlighted some positive outcomes of smartphone use for older adults: these include a wider range of activities such as social networking, shopping (van Deursen and Helsper, 2015; Vroman et al., 2015) and an improved quality of life thanks to smartphone apps designed to help manage health of older adults (Doughty, 2011; Joe & Demiris, 2013; Steinhubl et al., 2013). However, despite the growth in smartphone ownership among older adults, their ability to harness the potential of smartphones still varies. Therefore, we aim to investigate further the second-level digital divide by asking the following research question:

RQ2. How skilled are older adults in using a smartphone by type and frequency of various smartphone functions used?

The final level - virtual community - represents the stage in which an older adult makes connections with their virtual community, that is, the least personally intimate social network. Examples of activities at this level are sharing common interests and further connectivity through online group activities such as interactive games and book clubs. What we are interested in is finding out the outcomes of Korean older adults' use of smartphones in relation to its impacts on levels of loneliness and depression. Hence the next research question addresses the second and the third digital divide.

RQ3. How do smartphone use and skills among older adults influence levels of loneliness and depression?

The theoretical model proposed by Vroman et al. (2015) was developed from quantitative analyses, which may not fully encapsulate older adults' experiences, as pointed out by Hill et al. (2016). Furthermore, older adults are not a homogeneous group in terms of their digital technology use due to the differences in their past employment, motivation, and existing knowledge (Lee & Coughlin, 2014). However, the strengths of Vroman et al.'s model, as described earlier, outweigh the weaknesses and most importantly, this model provides a useful framework to explore and analyze potential outcomes of smartphone use (the third-level digital divide) on individuals such as a correlation between smartphone use or skills and loneliness and depression.

3. Methods

3.1 Procedure and measures

An in-person interview method using questionnaires was employed to address the above research questions. Older adults aged 60 and above were interviewed in eleven community centers in the Seoul Metropolitan area in Korea in March 2018. Firstly, the usage frequency of various mobile phone functions was collected based on a 5-point-scale (1 = never, 5 = very often). Mobile functions include making/receiving calls, sending/receiving texts, taking pictures, clock/alarm, calculator, calendar/diary, social network sites (such as Facebook, Katok, etc.), entertainment (such as watching a movie/drama, listening to music, playing games), internet search, GPS (car/driving navigation), taking memo, etc. Secondly, in terms of the frequency of social contacts, participants were asked about the frequency of contacts via mobile phone communication with their children, siblings, and friends, on a 10-point-scale (0 = no contact, 9 = almost every day). Thirdly, we also examined whether a participant had any ICT training because researchers considered ICT training as an important factor to determine older adults' satisfaction and connectedness with family and community (Feist & McDougall, 2013). Fourthly, to measure loneliness, we utilized a three-item measurement tool developed in the UK (Jopling, 2015). This tool is designed to measure loneliness using a 5-point-scale (1 = strongly agree; 5 = strongly disagree) across the following three items: I am content with my friendships and relationships; I have enough people I feel comfortable asking for help at any time, and My relationships are as satisfying as I would want them to be. Fifthly, the Patient Health Questionnaire-9 (PHQ-9) was used to measure the level of depression. PHQ-9 was translated into Korean in 2008 as a self-report form of measurement tool developed to diagnose depression at the primary care facility in 1999, with its validity and reliability confirmed (Han et al., 2008; Park et al., 2010). Eight items were measured on a 4-point-scale (0 = not at all; 3 = almost every day). Lastly, health-related information was measured using Speake et al.'s (1989) Subject Health Status. It consists of three items related to current health perception, past comparative health perception, and peer comparison health perception. For each item, we asked participants to assess their health using a 5-point-scale (1 = very bad; 5 = very good).

3.2 Participant demographics

The data were collected from a total number of 372 older adults, 223 of whom owned a smartphone. The latter was used in this study to explore the second- and third-level digital divide. The average age of the participants (N=223) was 73.87 years. A total of 61.9% of smartphone owners were female. Most of the participants were either married (61.4%) or widows/widowers (30.5%), with two to four children (83.9%). However, many of them were living in one- or two-member households (70.4%). The majority of them were religious (77.1%), and the largest group were Christians (33.2%). Most of the participants were retired (83.9%), with an average income of 1.41 million KRW (approximately 1,285 US dollars). Regarding the knowledge and skills in technology, slightly more than half of the participants (56.5%) had received ICT training.

Table 1 Demographic profile of smartphone owners

Variable	Options	Frequency (N)	Percentage (%)
Age (years)	60 - 69	55	24.7
	70 - 79	127	57.0
	80 and above	41	18.4
Gender	Male	85	38.1
	Female	138	61.9
Marital status	Married	137	61.4
	Separated	7	3.1
	Divorced	9	4.0
	Widowed	68	30.5
	Never married	2	0.9
Religion	None	51	22.9
	Christian	74	33.2
	Catholic	39	17.5
	Buddhist	50	22.4
	Won Buddhist	1	0.4
	Other	8	3.6
Retired	Yes	187	83.9
	No	36	16.1
ICT education	Yes	126	56.5
	No	97	43.5

Source: Authors' work

4. Results and discussion

4.1 Exploring the first- and second-level digital divide among Korean older adults

The first and second research questions in our study were formulated to gain insight into how older adults use their smartphones in terms of frequency and duration of daily use, and with whom, and how skilled they are when it comes to the type and frequency of various smartphone functions used. We asked participants to reveal how often they use their smartphones, how frequently they use various functions, and how frequently they communicate with various individuals and groups using smartphones. The results reveal that the Korean older adults, on average, spend 1 hour and 46 minutes per day on their smartphones. However, their usage duration varies up to 2 hours and 3 minutes per day, indicating differences in the average amount of time older adults spend using their smartphones (the longest duration reported was 12 hours and 9 minutes). Moreover, the results reveal that older Korean adults aged between 60 and 69 years spend on average 2 hours per day on their smartphones, while those aged 80+ spend 40 minutes less than their younger peers.

In addition, we observed the differences in using various smartphone functions (see Table 2). Smartphones were used mostly to make or receive calls, which makes older Korean adults no different from their European peers (Fernández-Ardèvol, 2011). Other basic functions such as texts, photos, clock/alarm, calendar/diary, and social networking services (SNS) were used occasionally, while many entertaining functions that enable listening to music, playing games, and watching movies were rarely explored. This makes a stark contrast to smartphone use by other age groups in Korea. Park et al. (2013) found that most Koreans use numerous advanced features and functions of smartphones such as information searching, emails, music downloads,

maps, schedule management, SNS and gaming. Further analysis of differences in the use of smartphone functions in relation to demographic characteristics showed some interesting results. In particular, female older adults were found to play games more frequently (ΔM = 0.55, p = 0.002), while male older adults used the navigation function more frequently (**ΔM** = 0.40, p = 0.031).

Table 2 Details of smartphone functions used and communication activities

		Group									
		All (N=223)		Male (N=85)		Female (N=138)		95% CI			
	Variables	**M**	**SD**	**M**	**SD**	**M**	**SD**	**Lower**	**Upper**	**t**	**p**
Functions used[a]	Making/receiving calls	4.35	1.00	4.40	1.02	4.32	0.99	-0.19	0.36	.618	.537
	Sending/receiving texts	3.75	1.41	3.79	1.39	3.73	1.42	-0.33	0.44	.268	.789
	Taking pictures	3.45	1.31	3.37	1.38	3.50	1.28	-0.49	0.23	-.717	.474
	Clock/alarm	3.36	1.55	3.37	1.57	3.35	1.54	-0.40	0.45	.115	.909
	Calendar/diary	3.35	1.46	3.31	1.43	3.37	1.48	-0.47	0.34	-.325	.746
	SNS (Facebook, Katok, etc.)	3.15	1.64	3.15	1.65	3.15	1.64	-0.46	0.46	-.009	.993
	Calculator	2.79	1.52	2.82	1.51	2.77	1.53	-0.37	0.48	.250	.803
	Entertainment (listening to music)	2.74	1.55	2.60	1.53	2.83	1.56	-0.67	0.19	-1.081	.281
	Taking memo	2.68	1.50	2.69	1.48	2.67	1.51	-0.40	0.44	.092	.927
	Internet search	2.68	1.56	2.72	1.56	2.65	1.57	-0.37	0.50	.297	.767
	GPS (car/driving navigation)	2.05	1.39	2.30	1.42	1.90	1.36	0.01	0.79	2.032	.043*
	Playing games	1.86	1.37	1.52	1.09	2.07	1.49	-0.91	-0.20	-3.085	.002*
	Entertainment (movie/drama)	1.79	1.26	1.75	1.15	1.81	1.33	-0.41	0.30	-.323	.747
Communication with[b]	Children	7.41	1.89	7.12	1.93	7.57	1.85	-0.97	0.07	-1.708	.089**
	Friends/neighbors/societies	7.33	1.93	7.07	1.95	7.48	1.91	-0.94	0.13	-1.490	.138
	Brothers/sisters/relatives	6.16	2.16	5.59	2.06	6.49	2.15	-1.51	-0.30	-2.938	.004*
	People from the community centers	6.61	2.60	6.43	2.64	6.72	2.58	-1.06	0.48	-.751	.454
	Spouse	7.64	2.10	7.96	1.77	7.36	2.32	-0.08	1.27	1.731	.086**
	Religious groups	6.12	2.60	5.83	2.47	6.25	2.66	-1.38	0.55	-.855	.394

Note: *p ≤ 0.05, **p ≤ 0.10. [a]Measured on a 5-point scale, 1 = never, 5 = very often. [b]Measured on a 10-point-scale (0 = no contact, 9 = almost every day).

Source: Authors' work

The results from Table 2 also show that the participants used their smartphones to mostly communicate with their children and friends, approximately once a week. Somewhat surprisingly, their spouses were their frequent point of contact. This might be due to the fact that just over 60% of the participants were married and living with spouses. In comparison to their female counterparts, Korean male older adult were found to communicate with their spouses more frequently (ΔM = 0.60, p = 0.086), while they communicated with their children and relatives less frequently (p = 0.089 and p = 0.004).

When observing differences among those who had or did not have ICT training and how they use their smartphones, the results revealed that compared to those without ICT training, those with ICT training indicated a higher level of frequency regarding the use of most functions, except making/receiving calls (ΔM = -0.048, p = 0.724) and clock/alarm (ΔM = -0.227, p = 0.289). Additionally, the group with ICT training used smartphones more often to communicate with their siblings and relatives (ΔM = 0.657, p = 0.031).

Table 3 Differences between age groups to determine the second-level digital divide

		Age groups							
		60-69 (N=55)		70-79 (N=127)		80+ (N=41)		ANOVA	
	Variables	M	SD	M	SD	M	SD	F	p
Functions used[a]	Making/receiving calls	4.58	0.71	4.30	1.01	4.17	1.22	2.313	.101
	Sending/receiving texts	4.16[3]	1.03	3.94[3]	1.30	2.63[1,2]	1.61	19.212	.000
	Taking pictures	4.02[2,3]	1.03	3.45[1,3]	1.27	2.68[1,2]	1.44	13.465	.000
	Clock/alarm	3.91[2,3]	1.26	3.35[1,3]	1.54	2.65[1,2]	1.67	7.981	.000
	Calendar/diary	3.87[2,3]	1.28	3.34[1,3]	1.40	2.68[1,2]	1.61	8.040	.000
	SNS (Facebook, Katok, etc.)	3.75[2,3]	1.43	3.14[1,3]	1.59	2.36[1,2]	1.74	8.629	.000
	Calculator	3.08[3]	1.49	2.89[3]	1.47	2.08[1,2]	1.51	5.756	.004
	Entertainment (listening to music)	2.96	1.54	2.72	1.50	2.51	1.71	.970	.381
	Taking memo	3.06[3]	1.51	2.71[3]	1.44	2.08[1,2]	1.48	14.990	.000
	Internet search	3.42[2,3]	1.45	2.67[1,3]	1.55	1.72[1,2]	1.23	5.041	.007
	GPS (car/driving navigation)	2.34[3]	1.55	2.12[3]	1.37	1.49[1,2]	1.10	4.578	.011
	Playing games	2.08[3]	1.52	1.93[3]	1.40	1.33[1,2]	0.90	3.781	.024
	Entertainment (movie/drama)	1.88	1.36	1.78	1.23	1.71	1.23	.219	.803
Communication with[b]	Children	7.60	2.05	7.30	1.91	7.49	1.57	.538	.585
	Friends/neighbors/societies	7.39	2.10	7.36	1.73	7.13	2.31	.251	.778
	Brothers/sisters/relatives	6.23[3]	2.18	6.42[3]	2.04	5.22[1,2]	2.29	4.388	.014
	People from the community centers	6.35	2.86	6.63	2.45	7.00	2.73	.580	.561
	Spouse	7.88	1.81	7.70	2.06	6.84	2.69	1.701	.186
	Religious groups	5.80	2.43	6.36	2.53	5.82	2.98	.717	.490

Note: $p \leq 0.05$. [a]Measured on a 5-point scale, 1 = never, 5 = often. [b]Measured on a 10-point-scale (0 = no contact, 9 = almost every day). 60-69 = Group 1; 70-79 = Group 2; 80+ = Group 3. The superscript '1' indicates a statistically significant difference (at $p<0.05$) from group 1. The superscript '2' indicates a statistically significant difference (at $p<0.05$) from group 2. The superscript '3' indicates a statistically significant difference (at $p<0.05$) from group 3.

Source: Authors' work

In our sample, we had three different age groups of Korean older adults. By observing differences among them, the ANOVA results reveal some interesting findings (see Table 3). The youngest among older adults (e.g., aged 60-69) were the most frequent users of most smartphone functions, except for making or receiving calls (p = 0.101), watching movies (p = 0.803), and listening to music (p = 0.381). The latter puts them shoulder to shoulder with other groups as they all used smartphones frequently to make or receive calls, and their smartphones were least used for watching movies or listening to music. Further, Tukey's posthoc tests have indicated that most differences were found between those aged 80+ and the other two groups, both in the functions used and in communicating with their brothers, sisters, and relatives.

Overall, our findings testify to the evidence that Korean older adults used smartphones to keep up with family and friends. This reflects older adults' primary interests and needs, which corresponds to Vroman et al.'s (2015) primary level of communication – social networking activities with family and friends are considered as the level with the greatest personal salience for older adults. Moreover, there were significant differences among age groups and groups with or without ICT training, indicating younger and more ICT educated to use more smartphone functions and spend more time connecting with family and friends. These differences lead us to confirm the existence of the first- and second-level of the grey digital divide among Korean older adults and that not all have the ability to harness the potential of smartphones.

4.2 Exploring the third-level digital divide among Korean older adults

The third research question was formed to bring a better understanding of how older adults' smartphone use and skills, with considerations of overall health, influence levels of loneliness and depression. We asked participants to self-indicate whether they feel lonely and depressed and to evaluate their overall health. The results showed that participants did not feel lonely or depressed and that they perceived themselves to be in a moderate health condition (see Table 4). However, some differences between the sexes were observed. Males indicated to be less happy with their current relationships (ΔM = 0.29, p = 0.046) and that they did not have enough people to ask for help when needed (ΔM = 0.41, p = 0.009). In addition, females felt slightly more tired (ΔM = 0.23, p = 0.070), yet indicated a higher level of overall health (ΔM = 0.28, p = 0.075). We also wanted to observe whether there were any differences between a group that received ICT training and a group without any ICT training. There were no statistically significant differences in how they reported on loneliness, depression, and overall health. Moreover, the same was observed for different age groups. The ANOVA test results showed no statistically significant differences among the three different age groups.

Table 4 Details of a smartphone owner's perception of loneliness, depression and overall health

		Group									
		All (N=223)		Male (N=85)		Female (N=138)		95% CI			
	Variables	M	SD	M	SD	M	SD	Lower	Upper	t	p
Loneliness (reversed)[a]	My relationships with others meet my expectations.	2.32	1.10	2.39	1.04	2.27	1.13	-0.18	0.42	.779	.437
	I have enough people that I can ask for help when needed.	2.20	1.12	2.45	1.10	2.04	1.10	0.10	0.70	2.652	.009*
	I am happy with the current relationships with friends and others around me.	2.05	1.05	2.22	1.06	1.93	1.03	0.01	0.57	2.009	.046*
Depression[b]	Disturbed sleeping patterns	.94	1.05	0.84	1.06	1.00	1.05	-0.45	0.12	-1.133	.258
	Feeling tired	.70	.91	0.56	0.86	0.79	0.93	-0.48	0.02	-1.823	.070**
	Losing appetite, losing weight or overeating	.50	.83	0.42	0.81	0.55	0.85	-0.37	0.09	-1.195	.233
	Disinterested in things, no pleasure/fun	.50	.77	0.58	0.82	0.46	0.73	-0.09	0.33	1.139	.256
	Depressed, annoyed, frustrated	.50	.79	0.49	0.75	0.50	0.81	-0.22	0.21	-.087	.930
	Hard to focus on newspaper or TV	.38	.76	0.38	0.74	0.38	0.77	-0.20	0.21	.040	.969
	Feeling that I am letting down myself or family	.31	.64	0.35	0.71	0.28	0.60	-0.11	0.25	.790	.430
	People around me can notice that my movement is sluggish, or my speech is too slow, or agitated or hyper	.23	.55	0.25	0.56	0.21	0.55	-0.11	0.19	.523	.601
Overall health[c]	Better than my peers (the same age group)	3.83	1.17	3.74	1.20	3.89	1.15	-0.47	0.17	-.932	.352
	Overall good health	3.70	1.17	3.52	1.22	3.80	1.13	-0.60	0.03	-1.788	.075**
	Worse than in the past (reversed)	3.30	1.20	3.27	1.24	3.33	1.18	-0.38	0.27	-.334	.739

Note: *p ≤ 0.05, **p ≤ 0.10. [a]Measured on a 5-point scale, 1 = strongly agree, 5 = strongly disagree. [b]Measured on a 4-point-scale (0 = not at all, 3 = almost every day). cMeasured on a 5-point scale (1 = very bad, 5 = very good).

Source: Authors' work

To observe whether smartphone usage skills were connected to loneliness and depression, we performed two linear regression analyses (using the Enter method) to predict loneliness and depression based on smartphone functions used. A significant regression equation was found for loneliness [$F(20,52) = 1.637$, $p = 0.079$, $R^2 = 0.386$]; it was shown that loneliness was negatively influenced by making or receiving calls ($\beta = -0.267$, $p = 0.048$) and watching movies ($\beta = -0.344$, $p = 0.058$), but it was positively influenced by the use of memo function ($\beta = 0.283$, $p = 0.097$). On the other hand, no

statistically significant equations were found for depression and the evaluation of overall health. Overall, our findings testify to the evidence that Korean older adults perceive themselves to be in moderately good health and not depressed or lonely. The latter could also be attributed to their skills and use of smartphones. That is, a different set of smartphone functions were associated with reducing the feeling of loneliness. Similarly to the studies of van Deursen and Helsper (2015), and Vroman et al. (2015), these findings support the idea that smartphones can benefit older adults. More importantly, smartphone use was shown to help users reduce loneliness, corroborating the results obtained in the computer-mediated setting studies of Carpenter and Buday (2007) and Shaw and Grant (2002).

5. Conclusion

For the last few decades, we have witnessed many benefits from the internet in terms of enhancing global connectivity and communication. This has been even more amplified by the use of smartphones, which enable 24/7 connectivity in various situations, places, and settings. However, one of the crucial steps towards fully grasping the benefits of smartphone use *for all* is to explore the existence of the digital divide and its relationship to different outcomes from smartphone use. In so doing, this study explored smartphone use, skills, and outcomes of Korean older adults. The importance of this study lies in the fact that it sets the basis for understanding the three levels of the digital divide, with a specific focus on unfolding differences across three age groups: 60+, 70+ and 80+, rather than comparing these groups to younger generations.

In our study, a questionnaire-based in-person interview method was used with the aim to understand 'if', 'how', and 'why' older adults aged 60 and above in the Seoul Metropolitan area use smartphones. The results of our research bring to light all three levels of the grey digital divide, exposing differences among older adult groups in fully harnessing the potential of the smartphone. More specifically, our results show that smartphones are owned by the majority of older adults but the group not owning a smartphone is still prominent. Among those owning a smartphone, the devices are predominately used to make and receive calls from their children, friends, and spouses. Hence, we found evidence that older adults in all three age groups used smartphones in Vroman et al.'s (2015) primary level of communication with personal relationships and support system. This was the most frequently used pattern of connecting with friends and family, reflecting primary interests and needs of older adults. This finding also makes Korean older adults no different from their European peers, which may help generalize the use of smartphones cross-culturally.

Moreover, we found evidence of the other two levels of smartphone use according to Vroman et al.'s (2015) model. Younger older adults were much more prone to using all other smartphone functions compared to their older peers, making them champions of smartphone literacy. Functions such as games and navigation were rarely used but when they were used, user profiles were different: more female participants played games on smartphones, whereas more males used the navigation function. In terms of connecting with virtual communities, SNS activity was rarely shown. This indicates older adults' shyness or reluctance or lack of literacy to engage with the least personally intimate social network such as online interest groups. Although it was not at the level of a virtual community, those who had ICT training were more confident in communicating with a broader range of people via smartphones. For example, those who had ICT training used smartphones more frequently to communicate with their siblings, relatives, and people from their community centers. This confirms previous research findings that ICT training facilitates users to acquire and improve digital skills and competence.

Lastly, this study also contributes to a better understanding of the benefits of using smartphones among older adults. Our results found evidence that using smartphones to stay connected to their social group and for entertainment such as watching movies aids in decreasing the feeling of loneliness. Nowadays, this finding is even more relevant due to COVID-19 pandemic, which resulted in a majority of the world's population being confined to self-isolation, strict social distancing rules and avoidance of in-person contact with members outside the household. Also, older adults were shown to be the group most jeopardized by the pandemic. Hence, using smartphones to stay connected with their social groups and to be entertained is even more critical to reducing loneliness that may come as a result of the pandemic. However, our study was conducted two years before the virus outbreak,

making this finding a good starting point to test these pandemic-related assumptions.

Our study is not without limitations. Those who used various smartphone functions were a minority so that it is hard to generalize the exact impact of smartphone use and literacy on an individual's psychological factors. Due to the sample size and the participant demographics, our findings have limited applicability. The same age groups that own a smartphone but live in rural areas may result in different findings. In addition, a more detailed investigation into the type of ICT training, length, and intensity of the training will provide more practical lessons for making suitable training programs for older adults. Future research can also examine, both at the micro- (individual) and macro- (societal) level, different experiences of digital technology engagement (e.g., tablets and wearable technology) among older adults and how society can better prepare literacy training programs for more beneficial outcomes.

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