Methodological strategies to understand smartphone practices for social connectedness in later life

Mireia Fernández-Ardèvol[1], Andrea Rosales[1], Eugène Loos[2], Alexander Peine[3], Roser Beneito-Montagut[1,4,5], Daniel Blanche[1], Björn Fischer[6], Stephen Katz[7], and Britt Östlund[6]

[1] Internet Interdisciplinary Institute (IN3) and [4] Computer Science Dept., Universitat Oberta de Catalunya / Open University of Catalonia, Barcelona, Catalonia, Spain
[5] School of Social Sciences, Cardiff University, Cardiff, UK
{mfernandezar, arosalescl, rbeneito, dblanchet}@uoc.edu

[2] Utrecht University School of Governance and [3] Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, The Netherlands
{e.f.loos, a.peine}@uu.nl

[6] Department for Biomedical Engineering and Health Systems, Royal Institute of Technology, KTH, Stockholm, Sweden
{bjorfisc, brittost}@kth.se

[7] Sociology Dept., Trent University, Peterborough, ON, Canada
skatz@trentu.ca

Abstract. Digital practices in later life are not yet well understood. Therefore, this paper discusses the framework for a research design project that aims at tracing differences and similarities in how older adults use their smartphones in circumstances in and outside their homes in Spain, the Netherlands, Sweden, and Canada. The research questions of this international research project focus on the extent to which digital mobile practices relate to perceived social connectedness among older adults aged 55-79 years old. While studies have shown that the subjective experience of 'being connected' supports continued wellbeing in later life, there remains an insufficient understanding of the processes through which digital mediated social interaction is effective for social connectedness. The analytical framework of the project prioritizes the co-constituency of (digital) technology and ageing, and takes digital practices in everyday life as its entry point. The main data collection tool will be the tracking of smartphone activity of 600 older adults (150 per country) during four weeks. An online survey and qualitative interviews will gather data about the meanings of the quantified digital practices, and how they shape (if they do) the participants' connection to the world. This approach will allow us not only to get insight into what older adults say how they used their smartphone but also to gain insight into their real-life daily use. The assessment of the challenges, strengths, and weaknesses of the methods contributes towards an accurate and appropriate interpretation of empirical results and their implications.

Keywords: Tracking · Log data · Survey data · Interviews · Mixed methods · Research design · Older adults · Later life · Smartphones · Digital practices

1 Introduction

In gerontechnological research, technologies are often regarded as mere solutions to age-related needs and problems by offering compensatory aids and supports [1, 2]. However, we contest this positioning of technological advancements as it has been associated with a deficit model of ageing and promote, instead, a critical model of socio-gerontechnology (S-G) as an alternative. This model combines traditional gerontechnology with insights from Social Studies of Science & Technology (STS) [3–6], and views ageing, technology and the social context as inextricably linked and mutually emergent (rather than separate entities [7]). Further, S-G emphasizes how technologies are contextualized and made meaningful within the lived realities of later life and the interplay between users, technology and social change [8]. Technologies only gain their characteristics over time as they are domesticated and embedded in society [9]. Hence, rather than remaining in the background, in our perspective on S-G, older persons and their immediate environments are central to the development of meaningful technologies for later life.

First launched in the 1940s, mobile phones started to be commercialized more prominently in the 1980s [10]. Since their massive consumer uptake in the late 1990s [11], they have become essential, everyday devices in most countries [12]. We consider this technological movement as part of a domestication process. Haddon [13] states that: "The earliest public and most cited reference to the concept of domestication was Silverstone, Hirsch and Morley [14], which appeared in a collection of some of the first empirical studies of ICTs. The metaphor of 'domestication' came from the taming of wild animals, but was here applied to describing the processes involved in 'domesticating ICTs' when bringing them into the home." (p. 17) [15–18]. Hartmann [19] also argues that domestication approaches, actually developed before mobile media were popular, vary amongst researchers, such that "some have tried to develop the domestication concept further, others have asked critical questions about its applicability to the mobile context, while yet others have simply applied the approach to a new set of – mobile – media." (p.42).

Hartmann introduced the notion of 'mediated mobilism' [19] to connect mobility to social domestication through 'concurrency' and 'momentum' "as the combination of possibility and actuality in both the social and the technological. The latter in particular underlines how mediated mobilism relates to the concept of domestication: all of the above are affordances and possibilities, but they need to be enacted and interpreted by users in order to develop fully" (p.47). Some of these affordances are related to the fact that the mobile phone is a personal device that usually moves with the individual [20]. It allows perpetual contact [21] and creates a 'lifeline' with the user's personal support network [12, 22]. In the case of older individuals, digital communication devices are not necessarily assistive technologies [23]. They are part of the communicative ecology, defined by Foth [24] as "the context in which communication processes occur" (p.9), which refers to the whole structure of (digital) communication tools in individual's everyday life. In this sense, mobile phones are not used in isolation and often operate as an extra layer of (mediated) communication [25], if used.

Older individuals, rather than being passive users of (digital) technology, play an active role by domesticating reconfiguring, modifying or rejecting it in their everyday life. They also create meaning and incorporate technological domestication interactively within their lifestyles [26–28]. Research has demonstrated that older individuals have and often do execute their capacity to contribute to technological development and shape their technological environment [29, 30] by actively adapting the technology to their specific circumstances [31–33]. They choose to reject or not participate in the development of (digital) technologies, even while commercial messages portray older adults quite differently from how they might see themselves [34–37]. Further, from STS studies we have learned that where older adults are accused of technological 'wrong' or 'non-use,' that in reality there are reasonable and deliberate acts to defy the embedded meanings in the technology [38, 39]. Thus, not using a given technology is one way that older individuals articulate their expertise about their own lives, in the same way that attribute new meaning to those technologies they decide to use. Therefore, older individuals express their agency and autonomy through their use and non-use of technology and such expression are key to our perspective.

Our research in theorizing about the co-constitution of ageing and technology [40], steers away from the interventionist logic that characterizes mainstream approaches that reduce the lives of older people to being inputs and outputs of gero-design technologies and conceptualizing later life according to instrumental pre-defined tasks [41–43]. In contrast, co-constitution of ageing and technology highlights that ageing and technology are already intimately linked and mutually shaped (for a recent overview of empirical studies, see [44]).

Within this framework, our international research project aims to discover the uses of the smartphone within the everyday lives of 600 older adult individuals (150 x 4) 55-79 years old in four countries: Spain, the Netherlands, Sweden, and Canada. While our interest is on the third age [89], part of the participants in this research does not belong to this category as they are younger. However, by considering younger ages, it is possible to understand the differences between cohorts to have a more focused perspective on the intersection of digitization and ageing [90].

A tracking of smartphone logs over the period of four weeks in 2019 will be complemented by self-reported information [45] collected via an online survey and through qualitative interviews. This paper will present a framework for a research design project that aims at tracing differences and similarities in how older adults use their smartphones in various cultural contexts and to achieve a theoretically informed, realistic perspective on the impact of such devices in the lives of older adults, while taking into account that users create meaningful spaces for new devices in already existing digital and social arrangements [13, 18, 37, 46, 47]

We will analyze the everyday practices and motivations of (mobile) device usage by older adults, an area of knowledge currently underdeveloped in our view [48]. By looking at digital usages –and non-usages– that may be innovative, we will question widespread stereotypes of older users as passive recipients of existing technologies and designs [49]. Of particular interest is whether mobile digital communication fosters or hampers meaningful social connections; that is, the subjective experience of being connected, as meaningful social connections are essential ingredients for well-

being (in later life). In this vein, the main research question asks to what extent digital mobile practices relate to the reported social connectedness among older adults aged 55-79 years old in the four selected countries.
Section 2 of the paper discusses a key analytical issue: social connectedness potentially afforded by digital communication technologies. Section 3 focuses on the challenges of using smartphone logs as the main data source. Section 4 discusses the research design and the characteristics of the population under study. Section 5 finishes with the conclusion.

2 Social connectedness and digital technologies

At this point, much research has been devoted to the potential of digital technologies to connect older people to the world around them. However, there is still a gap in the evidence to demonstrate the impact of such technologies on problems of social isolation and loneliness. Although some gerontological literature on social relationships has shed some light on the effects of the internet on social isolation, there is not enough understanding of the processes and mechanisms through which mediated social interaction is effective for social connectedness [50]. We know that older adults differ in their inherent need for social connection and their singular ability to manage feelings of exclusion. We also know that an ecological framework is needed to assess and determine the risk factors at different levels: individual, relationships, community and societal [51]. These aspects can then affect how older adults interact with others and what they expect of these social interactions at different levels, which in turn can lead to compounding a feeling of loneliness or isolation. It is a multifaceted phenomenon and studying its intersections with current digital technologies adds a layer of complexity.

Based on the ecological framework drawn out here, we conceptualize connectivity (or connectedness) as being a fundamentally social –rather than cognitive– phenomenon. Thus, instead of only considering the lack of social connection or social isolation as an individual problem (loneliness), our suggestion is to treat meaningful social connections as essential supports of health and wellbeing in later life. Such an approach informs our methods and instruments as well as the development and testing of a new tool for data collection about the nature of social connectedness.

Our approach relies on research from social gerontology that offers new understandings into the multiple and diverse ways older people experience social connectedness, isolation and loneliness [44, 52–54]; as well as on research about technological innovations in later life [7, 40, 47]. We suggest looking at four interrelated dimensions that depict the experience of social connection in later life from an ecological perspective: (i) individual traits, (ii) personal relationships or networks, (iii) community connections, and (iv) societal engagements (Figure 1).

The **individual traits** that shape social connectedness emerge from factors of age, gender, health and wellbeing, living arrangements, and life course events or transitions. We focus on the demographic characteristics, health and wellbeing, living arrangements and, given the interest of the project in digital technologies, we include

the ‘ways of being connected’ as a relevant dimension to explore. **Personal relationships or networks** refer to both the quality and quantity of an individual’s personal relationships. Having various direct and constant personal relationships increases the opportunities of getting support, while having frequent contact with others supports health and wellbeing [55]. Personal relationships or networks are comprised of several overlapping activities including frequency of contact with close friends, family or neighbors.

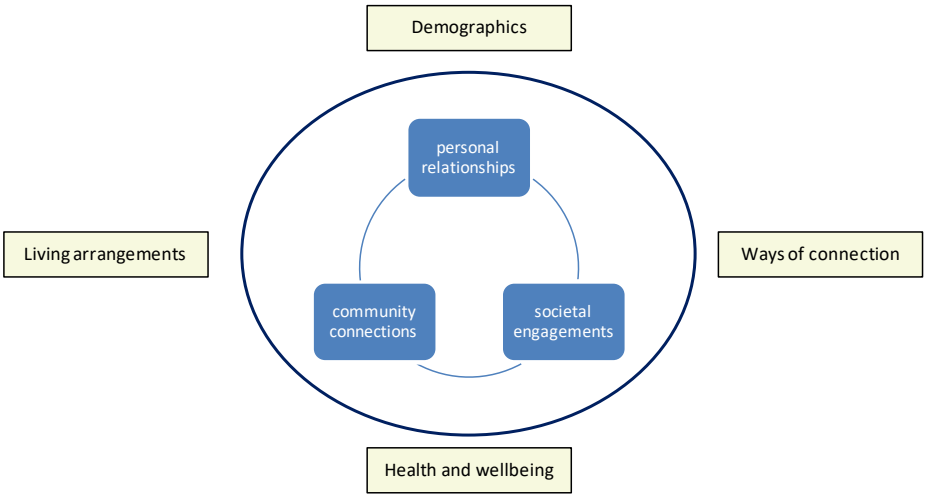

Figure 1. Social Connection Conceptualization

Community connections are the activities that happen outside the home and connect individuals across associations, neighborhoods and various communities. These community connections are usually interrelated with personal networks, but involve a stronger commitment and can enhance social connectedness in ways different from personal relationships; for example, through collective feelings of group belong. We consider the last dimension, **societal engagements**, to be one of connectedness to the broader society or the world around us. The role of media and digital technologies is crucial in this respect because of where it engages older people to feel part of the social body as a whole in ways that are relevant for connectivity. Of course media and digital technologies can also serve to alienate and marginalize older people.

A person may experience discrepancies between their actual connections and the subjective experience of being connected to varying degrees and intensity at any of the dimensions described in (ii), (iii) or (iv). Yet, there are a range of individual factors (i), such as socio-demographics, living arrangements, health, and wellbeing, as well as the means of connection that might have an effect on the experience of discrepancies in the aforementioned dimensions. Consequently, enrichment in one or more dimensions could potentially affect the social connection of older people.

The individual circumstances and the three types of connectivity (personal relations, community connections, and societal engagement) have been broadly studied in gerontology. However, the research on the study of the interrelation of these with the ways of being connected, including digital technologies. is more scarce and the research project we describe here aims to contribute in this area.

3 Smartphone logs: practicalities of data collection

Our international research project will analyze smartphone logs collected employing a tracking tool. The social sciences acknowledge the relevance of smartphones for conducting research [56] and logs are byproduct data commonly available as part of the big data revolution [57, 58]. Research relying on smartphone logs ranges from the particular analysis of the smartphone use [59] to more general digital mediated practices [60], sometimes focusing on specific age groups, such as teenagers [61] or older adults [48, 62, 63]. There is research interest in the mitigation of information overload for users while interacting with the smartphone [64] and on how the context of use affects the usage of mobile-based communication services [65]. Mobile logs can help to identify problematic usage [66] and overuse [67], and inform the analysis of the influence of socioeconomic status on smartphone usage [68]. However, logs face some limitations that must be taken into account for an appropriate interpretation of tracked use. In what follows, we discuss selected issues relevant to our research project, which we group under two categories: data interpretation and data biases.

3.1 Data interpretation

Data interpretation is a central feature of big data analyses because logs are byproduct data that are not designed in response to particular research goals [69]. Digital logs are the raw data of apparently non-intrusive methods for data collection [70, 71]. They appear to be objective records for measuring digital usage that overcome the limitations of traditional data collection methods that are only able to gather reported use [72], but their interpretation faces some important limitations. One weakness is where smartphone logs are treated as solely human behaviour [62, 73], although in most occasions they are a mixture of human and automated or programmed activities – as we argue elsewhere [62]. Smartphone logs collect information on when and for how long the screen has displayed an app [59, 64, 67, 74, 75], but this does not necessarily mean that the user was interacting with the device. The timeout feature can keep the screen on even when the user stops interacting with the device. Logs duration, in this case, depends on the screen timeout – a feature the user can define as a general device setting.

Other features and settings would shape the information which logs provide, including the ambient display, interactive notifications, priority notifications and the unlocking system(s) the user defines. In particular, the ambient display turns the screen on and opens the app whenever there is an incoming notification. Tracking

systems interpret this feature as an activity of the smartphone, but it would be inaccurate to infer it corresponds to actual users' activities in all instances.

In a similar strand, analyses usually assume that logs report data from a single user. However, in richer Western societies, some users regularly share their smartphone with relatives, as in the case of parents of young children who do not have their own device and couples with one member having limited interest in smartphones. Shared use is difficult to grasp, and it becomes more relevant when logs are used for psychometric predictions, e.g. [76–78], as they refer to a single user. Therefore, similarly to the questioning of self-reported use not being 'objective data,' tracked use also faces interpretive challenges as it is a proxy of usage not fully representing actual human use.

3.2 Data biases

Data biases respond to technical issues, as tracking systems are not universal. First, available research does not analyze all the operating systems (OS) equally, as they impose different working conditions, in general and for tracking systems in particular. Despite some exceptions that involve the two most popular smartphone operation systems, Android and iOS [e.g., 61], or do not provide information about the operating systems included in their sample [e.g., 76, 79] most studies tend to focus on a single operating system. In this second case, most focus on Android [48, 59, 60, 64, 66, 67, 78, 80], while fewer papers track iOS [68] devices. Minority OS, like Symbian, are seldom analyzed [65]. While we have not found a discussion on such selection, our previous experience [62, 81] made it clear that different operating systems allow the collection of different information. In general terms, Android is more likely than iOS to allow tracking software(s) to function on their devices fully. This common practice of focusing only on one operating system seems to come with a bias, as the socio-demographic characteristics of diverse smartphone OS are different [e.g., 11]. One research study of personality traits found few differences between Android and iOS users that might have been due to socio-demographic differences [82]. Another issue is that tracking systems do not grant compatibility with all OS versions. The oldest and newest OS versions might be beyond the scope of particular tracking softwares. Most studies do not provide information on the particular versions of the OS compatible with the tracking system, which prevents researchers from evaluating the biases created by this technical issue – an exception is [73].

Other biases in data appear beyond technicalities. In this sense, recruitment systems usually apply snowball sampling procedures [59, 73, 83] without a reflection on the analytical consequences of generalizing results based on them. Of relevance is that demographics tend to be left out of the discussion. Beyond some exceptions [48, 62], most studies do not collect demographic data and while some papers do not discuss this lack of information [60, 61, 76], others justify it in their design. Some authors choose not to collect demographic data, like gender or age data, to grant privacy and personal security [59]. Others, instead, argue that the extra steps necessary to collect personal data, such as the provision of informed consent, would reduce the willingness of individuals to participate in the research [73]. Thus, following a big data ap-

proach, they prefer to have large amounts of data at the expense of quality and representativeness of diverse kinds of users.

4 Research design

The first and second author defined the international research project discussed here, which benefits from the experience of previous studies [62, 84–86].This research is part of a larger project, Being Connected at Home - Making use of digital devices in later life (BConnect@Home) (https://www.researchgate.net/project/BCONNECT HOME-Making-use-of-digital-devices-in-later-life), coordinated by the third and fourth author. As one of its parts, the results of this study will inform the other parts of BConnect@Home. At least one member of the four partner institutions participated in the discussions that fine-tuned the survey questionnaire and interview outline. This process, led by the first author, aimed at facilitating the appropriation of the tools by the international research team and, therefore, to foster future analyses and results relevant for the different participants in their respective areas of interest.

4.1 Universe under study

The aimed universe of study corresponds to online older adults aged 55 to 79 year old living in Canada, the Netherlands, Spain, and Sweden. Regarding **age**, this research analyzes cohorts that were born between 1939 and 1963, a group that spans a period of 25 years. In general, a cohort is a social group that shares critical experiences within the same period, with the year of birth being the variant most used by gerontologists and social scientists. Cohort scholars argue that members of the same (birth) cohort share common experiences due to their shared historical and biographical locations, which imprints certain characteristics onto its members that distinguishes them from other cohorts [87]. These cohort differences have been associated with social change, whether as a cause, a consequence, or both [88]. While in general terms, the BConnect@Home project is interested in the third age [89], part of the older adults in this research do not belong to this category as they are younger. However, by considering younger ages, it is possible to understand the differences between cohorts to have a more focused perspective on the intersection of digitization and ageing [90]. The definition of an upper threshold on age (in this case 79 years old) responds to technical limitations, as the companies that manage online panels do not expect to be able to reach older old individuals, whose levels of internet (mobile) access tend to be comparatively lower (see Table 1).

The number of older adult citizens online is on the rise, as is the use of smartphones. Available data worldwide show that although older population have lower internet uptake rates compared to younger age groups, their adoption rates are increasing at a fast pace; and growth rates are particularly faster among younger older adults [11, 91–93]; and mobile phones follow a similar path of growth [11, 92, 93]. However, the age digital divide remains comparatively higher in countries where the internet is less spread out [11].

The **geographical scope** in this project is selected to provide ample diversity regarding internet and smartphone use in later life and, thus, to enrich the analysis. As Table 1 shows, Sweden and the Netherlands are the two countries with higher internet use and higher mobile internet use at all ages for which information is reported. Canada ranks high in internet use at every age, both slightly below the Nordic countries and clearly above the EU average and Spain. Regarding smartphones, Canadian data are on ownership instead of mobile internet usage, which is usually higher than mobile internet access [e.g., 11]. Despite this difference and the fact that direct comparison is not possible, smartphone ownership in Canada is lower than mobile internet use in Sweden and Canada. Finally, Spain is the country with lower levels of internet adoption, which are below the EU average. Mobile internet use, however, is above the EU average. Also, the ratio between mobile internet and internet, which measures the comparative popularity between the two forms of access, is higher in Spain than in the rest of the countries considered, except in the 55-64 age group, where Sweden ranks the first. Of interest are the lowest values of this ratio for Canada, mainly justified by the higher mobile telecommunication price structure [96]. In this case, the mobile digital divide increases comparatively more in Canada and narrows more in Spain. Older adults in Spain would be more likely to go online with their smartphone, while older adults in Canada would be more likely to rely on other devices for online connection.

Table 1. Internet and smartphone (internet) diffusion in the studied countries. Total population and selected age groups.
Descendent order of internet use.

Unit: %	Total	55-64	65 - 74	75+
Sweden [(1)]				
(a) Internet users	97	97	86	..
(b) Mobile internet users	84	82	52	..
(b)/(a)	0,866	0,845	0,605	..
The Netherlands[(1)]				
(a) Internet users	96	96	86	..
(b) Mobile internet users	84	76	53	..
(b)/(a)	0,875	0,792	0,616	..
Canada[(2)]				
(a) Internet users	91	91	81	50
(b) Smartphone owners	76	69	..	18
(b)/(a)	0,835	0,758	..	0,360
EU[(1)]				
(a) Internet users	85	75	54	..
(b) Mobile internet users	63	42	24	..
(b)/(a)	0,741	0,560	0,444	..
Spain[(1)]				
(a) Internet users	85	75	45	14
(b) Mobile internet users	76	60	30	8
(b)/(a)	0,894	0,800	0,667	0,571

.. Not available.
[(1)] Year 2017. Individuals who accessed the internet in the last 12 months [92]. Individuals who used a mobile phone or a smartphone to access the internet [94]. EU, as for its current composition (28 members). Total refers to population aged 16 to 74.
[(2)] Year 2016. Individuals who used the internet last month [95]. Individuals who own a smartphone [93]. Total refers to population aged 15 and older.

4.2 Instruments for data collection

Planned for early 2019, we will proceed with data collection and follow a sequential mixed-methodology [97]. It will begin with the collection of the smartphone logs during four weeks of a sample of 150 individuals in each country (600 in total). The samples will resemble the distribution of the online population aged 55 to 79 (broken down by age and gender). The research then will follow with an online survey addressed to the whole sample, and finishes with the qualitative, semi-structured interviews with 15 individuals per country (60 in total, 10% of the total sample). With the survey and the interviews we will gather reported use, opinions and perceptions, which constitute essential information for an appropriate interpretation of the smartphone tracked use and their meanings for participants. The data collection process relies on a marketing research company with access to an online panel of consumers in each country. Those panels, managed enterely online, reward participants for their time. They allow usual sampling processes for online fieldwork and comparability at an international level. In some countries, the marketing company

gains access to the panel via a (third) local partner. However, all the data collection tools are the same in every country, with adaptations in language, contextual information, and ethical requirements and procedures.

Participants' **recruitment** follows the usual strategies used in online-based research, as in the panel managed by the marketing company (or its local partners), participants receive an invitation to participate in the research project. Gender and age quotas, not reproduced here, guide the sampling process, which are established based on available data published by official statistical offices in 2018 –Eurostat for the three EU countries and Statistics Canada for Canada.

The **tracking** tool will collect smartphone logs of apps and websites running in the smartphone and displayed in the screen while the screen is on, together with the time and length of these activities during the four week period. This information is often used to calculate an indicator of use of the smartphone [48, 59, 64]. Participants have to install software on their smartphone that tracks their digital activities during the period. There is an explicit consent form which they have to approve before installing the software, and they can turn the tracking tool off whenever they consider.

The tracking will be conducted on Android smartphones, although the marketing research company originally planned the inclusion of both Android and iOS smartphones. The company based their decision on the restrictions and special certification Apple asks of providers, which complicates the process of installation of the tracking technology. In particular, including iOS devices would create extra problems for participants, who would need to give permission and (re)configure every network with which they are usually connected. The main consequence would be a bias in the data collected on iOS phones, as there is no certainty about "what networks did they manage to configure and if it covers all the navigation (..., which) will mean having partial information in a way that we cannot control" (internal communication with the company).

The **online survey** has an estimated length of 10 minutes. Participants will be invited by e-mail by the company once the tracking period is finished. The questionnaire gathers information on the following areas: social connectedness; digital mobile practices, including time of use and place of use; perceived essentiality of the smartphone; ecology of media; and socio-economic background and household typology. Also, an instrumental block of questions looks into the smartphone characteristics and settings for a more nuanced interpretation of tracked data.

The semi-structured **qualitative interview** is designed to last 30 minutes approximately. The research will discuss with participants their media with a particular interest in the role of the smartphone in creating/maintaining social connectedness at home and elsewhere, a dimension linked to the different processes of domestication. The interview will include information based on the tracked usage; for example, figures on the number of accesses to the smartphone per day and hour, and a list of the 10 most used apps during the tracking period), all in order to better understand the meanings of the data for participants. Interviewers will be members of the research team, who will contact participants who volunteer for the interview. A video call (Skype or similar) will allow accessing a more diverse group of participants possible and conversations will be recorded. Transcriptions, once translated into English, will be available

for all the researchers on the team. For an easy sharing of any supporting visual material, the interviewer will share their screen with the participant.

Four individuals helped in the **validation of the questionnaire and the qualitative interview** in Spanish (two women -aged 59 and 68-, and two men -73 and 78). Their feedback helped to reword or delete questions. Final validation of the length of the questionnaire included, in addition to the initial feedback of the four volunteers, the experience of team members, colleagues, and relatives of different ages. The qualitative survey did not need extra length validation. After agreeing to the structure and the specific contents of the questionnaire and the interview outline, each local team adapted or translated it into English (Canada), Dutch (the Netherlands), Spanish (Spain), and Swedish (Sweden).

4.3 Ethics, a (g)local issue

Big data approaches come with questions regarding privacy and ethical protocols [98, 99], and our project had to face the concerns of the respective ethical boards in each partner institution. The deployment of the project was subject to the necessary ethical approval in the four partner institutions that lead the data collection. Ethical committees belonged to the universities in Spain and Canada, in Sweden the board is a country-wide institution, while in the Netherlands the research institution's director approved the research proposal. Reflecting differences in legislation and prevailing social values, each country had different dynamics and rules, and the research project had to adjust to them. Two main issues illustrate such differences.

On the one hand, in the Canadian context there is a particular concern about the use, storage and privacy of data where private companies are hired by publically funded research. Hence, ethical approval was of the highest importance so that equal access to participants was available under similar circumstances and with comparable data collection methods. On the other hand, the European Union is now highly concerned with the management of private, personal data while, at the same time, fosters the values of open science and open data in funded projects. As a consequence, a balance between these areas was needed in all participant countries.

5 Conclusion

The paper discusses the research design and the practicalities of an international research project about the digital practices of older adults. The research questions focus on the extent to which digital mobile practices relate to perceived social connectedness among older adults aged 55-79 years old. We conceptualize connectivity (or connectedness) as being a fundamentally social –rather than cognitive– phenomenon. Therefore, social connectedness articulates around four interrelated dimensions: individual traits, personal relationships or networks, community connections, and societal engagements.

The four selected countries, Spain, the Netherlands, Sweden, and Canada, have different systems of internet diffusion and smartphone use that shape differently the

digitization of later life. The project will theorize digitization of later life in relation to social connectedness by analyzing smartphone logs of a total sample of 600 individuals aged 55-79 years old during one month. Tracked use will be complemented with quantitative and qualitative self-reported information. The analysis allows combining reported use and tracked use. Beyond actual use, self-reported use indicates what people say they do in their everyday life, which could be different from what they actually do. In contrast, tracked use reports the smartphone activities, that can combine a mixture of human and programmed activities. The analysis will triangulate the results to counterbalance these effects and, beyond the raw data, will conduct a comparative analysis of how different groups use smartphones differently to theorize digitization in later life, which particular interest of the role of digital communication in the perception of social connectedness.

Two issues are specific to this study on tracked digital practices in later life. The first one is the age scope of the empirical study. Due to the methodology of data collection and based on online tools deployed by a marketing research company for accessing participants, the age range was defined between 55 and 79 years old. In Spain, internet use and mobile internet use at the age of 75 stays at 14% and 8% respectively in 2017 (see Table 1, above). Such proportions, which are the lowest ones in the selected countries, suggest not including individuals in the older old age group in the study. They would be comparatively less accessible through digital mediated environments. For this reason, establishing an upper boundary on age appeared to be a reasonable option to grant appropriate conditions for statistical instruments.

The second issue relates to the tracking system, which finally limits its scope of participants to those using Android devices. Different industrial sources report a recent increase in popularity of iOS devices [100]. In Canada and Sweden, one in three smartphones are Android; in The Netherlands, it is one out of two; while in Spain Android smartphones are seven out of ten [101, 102]. As discussed in section 4.2, these differences introduce a bias because only Android devices are being used because, again, the tracking iOS devices faces more challenges that make collected data less consistent. Also, given that tracked use is enriched with data from the survey, we will be able to compare the socio-demographic characteristics of the samples against the online population in each country to determine the existing biases.

By describing the practicalities and the challenges of this international comparative research project, we aim at helping (young) scholars to grasp better the number of relevant decisions that shape the deployment of any (international) research project. To our understanding, transparency in research design is essential. The assessment and discussion of the challenges and limits of data collection methods include overcoming limitations, providing accurate and appropriate interpretations of empirical results and, most importantly, of the analytical implications based on them.

Acknowledgments

The research project BConnect@Home (https://www.researchgate.net/project/BCONNECTHOME-Making-use-of-digital-devices-in-later-life) is funded by the JTP

2017 - JPI More Years, Better Lives (Grant Agreement 363850). The Netherlands: ZONMW (Project 9003037411); Spain: MINECO (ref. PCI-2017-080), Sweden: TBC; and Canada: Canadian Institutes of Health Research (201704MYB-386097). It also received partial funding from the Ageing + Communication + Technology project http://actproject.ca/ (ref. 895-2013-1018, Social Sciences and Humanities Research Council of Canada), and the Spanish Ministry of Science, Innovation, and Universities (ref: FJCI-2015-24120).

References

1. Graafmans, J.A.M., Taipale, V., Charness, N. eds: Gerontechnology: A Sustainable Investment in the Future. IOS Press, Amsterdam (1998)
2. Bouma, H., Graafmans, J.A.M.: Gerontechnology. IOS Press, Amsterdam (1992)
3. Pinch, T.J., Bijker, W.E.: The social construction of facts and artefacts: or how the sociology of science and the sociology of technology might benefit each other. Soc. Stud. Sci. 14, 399–441 (1984). doi:10.1177/030631284014003004
4. Latour, B.: Technology is society made durable. In: Law, J. (ed.) A Sociology of Monsters: Essays on Power, Technology, and Domination. pp. 103–131. MIT Press, Cambridge (1991)
5. Latour, B.: Reassembling the Social: An Introduction to Actor-Network-Theory. Oxford University Press, Oxford (2005)
6. Bijker, W.E.: Social construction of technology. In: Olsen, J.K.B., Pedersen, S.A., and Hendricks, V.F. (eds.) A Companion to the Philosophy of Technology. pp. 88–94. Wiley-Blackwell, Oxford (2009)
7. Peine, A., Faulkner, A., Jæger, B., Moors, E.: Science, technology and the "grand challenge" of ageing: understanding the socio-material constitution of later life. Technol. Forecast. Soc. Change. 93, 1–9 (2015). doi:10.1016/j.techfore.2014.11.010
8. Östlund, B., Olander, E., Jonsson, O., Frennert, S.: STS-inspired design to meet the challenges of modern aging: welfare technology as a tool to promote user driven innovations or another way to keep older users hostage? Technol. Forecast. Soc. Change. 93, 82–90 (2015). doi:10.1016/j.techfore.2014.04.012
9. Silverstone, R., Hirsch, E.: Consuming Technologies: Media and Information in Domestic Spaces. Routledge, London (1992)
10. Agar, J.: Constant Touch: A Global History of the Mobile Phone. Icon, Cambridge (2003)
11. International Telecommunication Union: World Telecommunication/ICT Indicators Database. ITU, Geneva (2017)
12. Castells, M., Fernández-Ardèvol, M., Linchuan Qiu, J., Sey, A.: Mobile Communication and Society: A Global Perspective. MIT Press, Cambridge (2006)
13. Haddon, L.: Information and Communication Technologies in Everyday Life: A Concise Introduction and Research Guide. Berg, Oxford (2004)
14. Silverstone, R., Hirsch, E., Morley, D.: Information and communication technologies and the moral economy of the household. In: Silverstone, R. and Hirsch, E. (eds.) Consuming Technologies: Media and Information in Domestic Spaces. pp. 15–31. Routledge, London (1992)
15. Loos, E., Haddon, L., Mante-Meijer, E. eds: Generational Use of New Media. Routledge, London (2012)
16. Haddon, L.: Domestication and mobile telephony. In: Katz, J.E. (ed.) Machines that Become Us: The Social Context of Personal Communication Technology. pp. 43–56.

Transaction, New Brunswick (2003)
17. Haddon, L.: Research questions for the evolving communications landscape. In: Ling, R.S. and Pedersen, P. (eds.) Mobile Communications: Renegotiation of the Social Sphere. pp. 7–22. Springer, London (2005)
18. Haddon, L.: Domestication analysis, objects of study, and the centrality of technologies in everyday life. Can. J. Commun. 36, 311–323 (2011). doi:10.22230/cjc.2011v36n2a2322
19. Hartmann, M.: From domestication to mediated mobilism. Mob. Media Commun. 1, 42–49 (2013). doi:10.1177/2050157912464487
20. Ito, M., Matsuda, M., Okabe, D. eds: Personal, Portable, Pedestrian: Mobile Phones in Japanese Life. The MIT Press, Cambridge (2005)
21. Katz, J.E., Aakhus, M.: Perpetual Contact: Mobile Communication, Private Talk, Public Performance. Cambridge University Press, Cambridge (2002)
22. Wajcman, J., Bittman, M., Brown, J.E.: Families without borders: mobile phones, connectedness and work-home divisions. Sociology. 42, 635–652 (2008). doi:10.1177/0038038508091620
23. Wherton, J., Sugarhood, P., Procter, R., Greenhalgh, T.: Designing technologies for social connection with older people. In: Prendergast, D. and Garattini, C. (eds.) Aging and the Digital Life Course. pp. 107–124. Berghahn Books, New York (2015)
24. Foth, M., Hearn, G.: Networked individualism of urban residents: discovering the communicative ecology in inner-city apartment buildings. Information, Commun. Soc. 10, 749–772 (2007). doi:10.1080/13691180701658095
25. Petrovčič, A., Fortunati, L., Vehovar, V., Kavčič, M., Dolničar, V.: Mobile phone communication in social support networks of older adults in Slovenia. Telemat. Informatics. 32, 642–655 (2015). doi:10.1016/j.tele.2015.02.005
26. Joyce, K., Mamo, L.: Graying the cyborg: new directions in feminist analyses of aging, science, and technology. In: Calasanti, T.M. and Slevin, K.F. (eds.) Age Matters: Realigning Feminist Thinking. Routledge, New York (2006)
27. Gilleard, C., Higgs, P.: Consumption and aging. In: Settersten, R.A. and Angel, J.L. (eds.) Handbook of Sociology of Aging. pp. 361–375. Springer Verlag, New York (2011)
28. Loe, M.: Comfort and medical ambivalence in old age. Technol. Forecast. Soc. Change. 93, 141–146 (2015). doi:10.1016/j.techfore.2014.04.013
29. Essén, A., Östlund, B.: Laggards as innovators? Old users as designers of new services & service systems. Int. J. Des. 5, 89–98 (2011)
30. Peine, A., Rollwagen, I., Neven, L.: The rise of the “innosumer”: rethinking older technology users. Technol. Forecast. Soc. Change. 82, 199–214 (2014). doi:10.1016/j.techfore.2013.06.013
31. Östlund, B.: Gammal är Äldst: En Studie av Teknikens Betydelse i Äldre Människors Liv [Older People are the Most Experienced: A Study of the Meaning of Technology in Older People’s Everyday Life], https://lup.lub.lu.se/search/publication/4386c568-3b99-48b5-83a7-703093bc383a, (1995)
32. Joyce, K., Loe, M.: Theorising technogenarians: a sociological approach to ageing, technology and health. In: Joyce, K. and Loe, M. (eds.) Technogenarians: Studying Health and Illness Through an Ageing, Science, and Technology Lens. pp. 1–9. Wiley-Blackwell, Oxford (2010)
33. Bailey, C., Foran, T.G., Ni Scanaill, C., Dromey, B.: Older adults, falls and technologies for independent living: a life space approach. Ageing Soc. 31, 829–848 (2011). doi:10.1017/S0144686X10001170
34. Neven, L.: “But obviously not for me”: robots, laboratories and the defiant identity of elder test users. Sociol. Health Illn. 32, 335–347 (2010). doi:10.1111/j.1467-9566.2009.01218.x

35. Mort, M., Roberts, C., Callén, B.: Ageing with telecare: care or coercion in austerity? Sociol. Health Illn. 35, 799–812 (2013). doi:10.1111/j.1467-9566.2012.01530.x
36. Waycott, J., Vetere, F., Pedell, S., Morgans, A., Ozanne, E., Kulik, L.: Not for me: older adults choosing not to participate in a social isolation intervention. In: Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems: CHI '16. pp. 745–757. ACM Press, New York (2016)
37. Greenhalgh, T., Wherton, J., Sugarhood, P., Hinder, S., Procter, R., Stones, R.: What matters to older people with assisted living needs? A phenomenological analysis of the use and non-use of telehealth and telecare. Soc. Sci. Med. 93, 86–94 (2013). doi:10.1016/j.socscimed.2013.05.036
38. Oudshoorn, N., Pinch, T.: How Users Matter: The Co-Construction of Users and Technologies. MIT Press, Cambridge (2003)
39. Selwyn, N.: Apart from technology: understanding people's non-use of information and communication technologies in everyday life. Technol. Soc. 25, 99–116 (2003). doi:10.1016/S0160-791X(02)00062-3
40. Peine, A., Neven, L.: From intervention to co-constitution: new directions in theorizing about aging and technology. Gerontologist. gny050, (2018). doi:10.1093/geront/gny050
41. Schulz, R., Wahl, H.-W., Matthews, J.T., De Vito Dabbs, A., Beach, S.R., Czaja, S.J.: Advancing the aging and technology agenda in gerontology. Gerontologist. 55, 724–734 (2015). doi:10.1093/geront/gnu071
42. Peek, S.T.M., Luijkx, K.G., Rijnaard, M.D., Nieboer, M.E., van der Voort, C.S., Aarts, S., van Hoof, J., Vrijhoef, H.J.M., Wouters, E.J.M.: Older adults' reasons for using technology while aging in place. Gerontology. 62, 226–237 (2016). doi:10.1159/000430949
43. Mitzner, T.L., Savla, J., Boot, W.R., Sharit, J., Charness, N., Czaja, S.J., Rogers, W.A.: Technology adoption by older adults: findings from the PRISM trial. Gerontologist. gny113, (2018). doi:10.1093/geront/gny113
44. Joyce, K., Peine, A., Neven, L., Kohlbacher, F.: Aging: the socio-material constitution of later life. In: Felt, U., Fouché, R., Miller, C.A., and Smith-Doerr, L. (eds.) The Handbook of Science and Technology Studies. pp. 915–942. MIT Press, Cambridge (2017)
45. Kvale, S.: InterViews: An Introduction to Qualitative Research Interviewing. Sage, Thousand Oaks (1996)
46. Loos, E., Haddon, L., Mante-Meijer, E. eds: The Social Dynamics of Information and Communication Technology. Ashgate, Aldershot (2008)
47. López Gómez, D.: Little arrangements that matter: rethinking autonomy-enabling innovations for later life. Technol. Forecast. Soc. Change. 93, 91–101 (2015). doi:10.1016/j.techfore.2014.02.015
48. Rosales, A., Fernández-Ardèvol, M.: Smartphones, apps and older people's interests: from a generational perspective. In: Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services: MobileHCI 2016. pp. 491–503. ACM, New York (2016)
49. Marshall, B.L., Katz, S.: How old am I? Digital culture and quantified ageing. Digit. Cult. Soc. 2, 145–152 (2016). doi:10.14361/dcs-2016-0110
50. Beneito-Montagut, R., Cassián-Yde, N., Begueria, A.: What do we know about the relationship between internet-mediated interaction and social isolation and loneliness in later life? Qual. Ageing Older Adults. 19, 14–30 (2018). doi:10.1108/QAOA-03-2017-0008
51. Cotterell, N., Buffel, T., Phillipson, C.: Preventing social isolation in older people. Maturitas. 113, 80–84 (2018). doi:10.1016/j.maturitas.2018.04.014
52. Cornwell, B., Laumann, E.O., Schumm, L.P.: The social connectedness of older

adults: a national profile. Am. Sociol. Rev. 73, 185–203 (2008). doi:10.1177/000312240807300201
53. Holt-Lunstad, J., Smith, T.B., Layton, J.B.: Social relationships and mortality risk: a meta-analytic review. PLoS Med. 7, e1000316 (2010). doi:10.1371/journal.pmed.1000316
54. Waycott, J., Vetere, F., Ozanne, E.: Building social connections: a framework for enriching older adults' social connectedness through emerging information and communication technologies. In: Barbosa Neves, B. and Vetere, F. (eds.) Ageing and Digital Technology: Designing and Evaluating Emerging Technologies for Older Adults. pp. 58–74. Springer, Berlin (2019)
55. van Tilburg, T., van Groenou, M.B.: Network and health changes among older Dutch adults. J. Soc. Issues. 58, 697–713 (2002). doi:10.1111/1540-4560.00041
56. Raento, M., Oulasvirta, A., Eagle, N.: Smartphones: an emerging tool for social scientists. Sociol. Methods Res. 37, 426–454 (2009). doi:10.1177/0049124108330005
57. Kitchin, R.: The Data Revolution: Big Data, Open Data, Data Infrastructures & their Consequences. Sage, London (2014)
58. Schäfer, M.T., van Es, K. eds: The Datafied Society: Studying Culture through Data. Amsterdam University Press, Amsterdam (2017)
59. Böhmer, M., Hecht, B., Schöning, J., Krüger, A., Bauer, G.: Falling asleep with Angry Birds, Facebook and Kindle: a large scale study on mobile application usage. In: Bylund, M. (ed.) Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services: MobileHCI '11. pp. 47–56. ACM Press, New York (2011)
60. Wagner, D.T., Rice, A., Beresford, A.R.: Device analyzer: understanding smartphone usage. In: Stojmenovic, I., Cheng, Z., and Guo, S. (eds.) Mobile and Ubiquitous Systems: Computing, Networking, and Services 10th International Conference: MOBIQUITOUS 2013. pp. 195–208. Springer, Cham (2014)
61. Bentley, F., Church, K., Harrison, B., Lyons, K., Rafalow, M.: Three hours a day: understanding current teen practices of smartphone application use. (2015)
62. Rosales, A., Fernández-Ardèvol, M.: Beyond WhatsApp: older people and smartphones. Rom. J. Commun. Public Relations. 18, 27 (2016). doi:10.21018/rjcpr.2016.1.200
63. Rosales, A., Fernández-Ardèvol, M.: Smartphone usage diversity among older people. In: Sayago, S. (ed.) Perspectives on Human-Computer Interaction Research with Older People. Springer, Cham (2019)
64. Ferreira, D., Goncalves, J., Kostakos, V., Barkhuus, L., Dey, A.K.: Contextual experience sampling of mobile application micro-usage. In: Proceedings of the 16th International Conference on Human-Computer Interaction with Mobile Devices & Services: MobileHCI '14. pp. 91–100. ACM Press, New York (2014)
65. Karikoski, J., Soikkeli, T.: Contextual usage patterns in smartphone communication services. Pers. Ubiquitous Comput. 17, 491–502 (2013). doi:10.1007/s00779-011-0503-0
66. Shin, C., Dey, A.K.: Automatically detecting problematic use of smartphones. In: Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing: UbiComp '13. pp. 335–344. ACM Press, New York (2013)
67. Lee, U., Song, J., Lee, J., Ko, M., Lee, C., Kim, Y., Yang, S., Yatani, K., Gweon, G., Chung, K.-M.: Hooked on smartphones. In: Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems: CHI '14. pp. 2327–2336. ACM Press, New York (2014)
68. Rahmati, A., Tossell, C., Shepard, C., Kortum, P., Zhong, L.: Exploring iPhone usage. In: Proceedings of the 14th International Conference on Human-Computer Interaction with Mobile Devices and Services: MobileHCI '12. pp. 11–20. ACM Press, New York

(2012)
69. Boyd, D., Crawford, K.: Critical questions for big data. Information, Commun. Soc. 15, 662–679 (2012). doi:10.1080/1369118X.2012.678878
70. Kiukkonen, N., Blom, J., Dousse, O., Gatica-Perez, D., Laurila, J.: Towards rich mobile phone datasets: Lausanne data collection campaign. In: Proceedings of the 7th ACM International Conference on Pervasive Services: ICPS'10. ACM Press, New York (2010)
71. Xu, R., Frey, R.M., Fleisch, E., Ilic, A.: Understanding the impact of personality traits on mobile app adoption - Insights from a large-scale field study. Comput. Human Behav. 62, 244–256 (2016). doi:10.1016/j.chb.2016.04.011
72. Böhmer, M., Krüger, A.: A study on icon arrangement by smartphone users. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: CHI '13. pp. 2137–2146. ACM Press, New York (2013)
73. Jones, S.L., Ferreira, D., Hosio, S., Goncalves, J., Kostakos, V.: Revisitation analysis of smartphone app use. In: Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing: UbiComp '15. pp. 1197–1208. ACM Press, New York (2015)
74. Carrascal, J.P., Church, K.: An in-situ study of mobile app & mobile search interactions. In: Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems: CHI '15. pp. 2739–2748. ACM Press, New York (2015)
75. Holz, C., Bentley, F., Church, K., Patel, M.: "I'm just on my phone and they're watching TV": quantifying mobile device use while watching television. In: Proceedings of the ACM International Conference on Interactive Experiences for TV and Online Video: TVX'15. pp. 93–102. ACM Press, New York (2015)
76. Ferdous, R., Osmani, V., Mayora, O.: Smartphone app usage as a predictor of perceived stress levels at workplace. In: Proceedings of the 9th International Conference on Pervasive Computing Technologies for Healthcare: PervasiveHealth. pp. 225–228. ICST, Gent (2015)
77. Alvarez-Lozano, J., Osmani, V., Mayora, O., Frost, M., Bardram, J., Faurholt-Jepsen, M., Kessing, L.V.: Tell me your apps and I will tell you your mood. In: Proceedings of the 7th International Conference on PErvasive Technologies Related to Assistive Environments - PETRA '14. pp. 1–7. ACM Press, New York (2014)
78. de Montjoye, Y.-A., Quoidbach, J., Robic, F., Pentland, A.: Predicting personality using novel mobile phone-based metrics. In: Greenberg, A.M., Kennedy, W.G., and Bos, N. (eds.) Social Computing, Behavioral-Cultural Modeling and Prediction: 6th International Conference, SBP 2013, Washington, DC, USA, April 2-5, 2013: Proceedings. pp. 48–55. Springer, Berlin (2013)
79. Ikebe, Y., Katagiri, M., Takemura, H.: Friendship prediction using semi-supervised learning of latent features in smartphone usage data. In: Proceedings of the International Conference on Knowledge Discovery and Information Retrieval. Volume 1: KDIR. pp. 199–205. SciTePress (2012)
80. Singh, V.K., Freeman, L., Lepri, B., Pentland, A.S.: Predicting spending behavior using socio-mobile features. In: International Conference on Social Computing (SocialCom): 2013 8 - 14 Sept. 2013, Washington, D.C., USA. pp. 174–179. IEEE, Piscataway (2013)
81. Rosales, A., Fernández-Ardèvol, M.: Generational comparison of simultaneous internet activities using smartphones and computers. In: Zhou, J. and Salvendy, G. (eds.) Human Aspects of IT for the Aged Population: Design for Aging: ITAP 2016. pp. 478–489. Springer, Cham (2016)
82. Götz, F.M., Stieger, S., Reips, U.-D.: Users of the main smartphone operating systems (iOS, Android) differ only little in personality. PLoS One. 12, e0176921 (2017). doi:10.1371/journal.pone.0176921

83. Ferreira, D., Dey, A.K., Kostakos, V.: Understanding human-smartphone concerns: a study of battery life. In: Lyons, K., Hightower, J., and Huang, E.M. (eds.) Pervasive Computing: 9th international conference, Pervasive 2011, San Francisco, USA, June 12-15, 2011. Proceedings. pp. 19–33. Springer, Berlin (2011)
84. Fernández-Ardèvol, M., Rosales, A.: My interests, my activities: learning from an intergenerational comparison of smartwatch use. In: Zhou, J. and Salvendy, G. (eds.) Human Aspects of IT for the Aged Population: Applications, Services and Contexts: ITAP 2017. pp. 114–129. Springer, Cham (2017)
85. Rosales, A., Fernández-Ardèvol, M., Ferran-Ferrer, N.: Long-term appropriation of smartwatches among a group of older people. In: Zhou, J. and Salvendy, G. (eds.) Human Aspects of IT for the Aged Population: Acceptance, Communication and Participation: ITAP 2018. pp. 135–148. Springer, Cham (2018)
86. Rosales, A., Fernández-Ardèvol, M., Comunello, F., Mulargia, S., Ferran-Ferrer, N.: Older people and smartwatches, initial experiences. El Prof. la Inf. 26, 457 (2017). doi:10.3145/epi.2017.may.12
87. Alwin, D.F., McCammon, R.J.: Generations, cohorts, and social change. In: Mortimer, J.T. and Shanahan, M.J. (eds.) Handbook of the Life Course. pp. 23–50. Kluwer Academic Publishers, New York (2003)
88. Bristow, J.: The Sociology of Generations: New Directions and Challenges. Palgrave Macmillan, London (2016)
89. Moen, P., Spencer, D.: Converging divergences in age, gender, health, and well-being. In: Binstock, R.H., George, L.K., Cutler, S.J., Hendricks, J., and Schulz, J.H. (eds.) Handbook of Aging and the Social Sciences. pp. 127–144. Elsevier, Amsterdam (2006)
90. Gilleard, C., Higgs, P., Hyde, M., Wiggins, R., Blane, D.: Class, cohort, and consumption: the British experience of the third age. Journals Gerontol. Ser. B. 60, S305–S310 (2005). doi:10.1093/geronb/60.6.S305
91. Anderson, M., Perrin, A.: Tech adoption climbs among older adults, http://www.pewinternet.org/2017/05/17/tech-adoption-climbs-among-older-adults/
92. Eurostat: Individuals who accessed the internet in the last 12 months (isoc_ci_ifp_iu), http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_ci_ifp_iu&lang=en
93. Statistics Canada: Life in the fast lane: how are Canadians managing?, 2016, https://www150.statcan.gc.ca/n1/daily-quotidien/171114/dq171114a-eng.htm
94. Eurostat: Individuals who used a mobile phone (or smart phone) to access the internet (isoc_ci_im_i), http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_ci_im_i&lang=en
95. Statistics Canada: Use of technology by age group and sex, Canada, provinces and regions (table 22-10-0110-01), https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2210011001
96. Lagerquist, J.: Internet usage growing fastest among older Canadians: StatsCan, https://www.ctvnews.ca/sci-tech/internet-usage-growing-fastest-among-older-canadians-statscan-1.3676986, (2017)
97. Creswell, J.W.: Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage, Los Angeles (2014)
98. Jensen, M.: Challenges of Privacy Protection in Big Data Analytics. BigData'13. 235–238 (2013). doi:10.1109/BigData.Congress.2013.39
99. Smith, M., Szongott, C., Henne, B., Voigt, G. Von: Big Data Privacy Issues in Public Social Media. Digit. Ecosyst. Technol. (DEST), 2012 6th IEEE Int. Conf. on. IEEE. 1–6 (2012). doi:10.1109/DEST.2012.6227909
100. Rody-Mantha, B.: Canada's prolific smartphone market skews to iOS: study, http://mediaincanada.com/2018/01/23/canadas-prolific-smartphone-market-skews-to-ios-study/, (2018)

101. DeviceAtlas: Android v iOS market share 2019, https://deviceatlas.com/blog/android-v-ios-market-share
102. Statcounter: Mobile operating system market share worldwide: Dec 2017 - Dec 2018, http://gs.statcounter.com/os-market-share/mobile/worldwide