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DOI: https://doi.org/10.1007/s10209-018-0617-5

Universal Access in the Information Society
https://doi.org/10.1007/s10209-018-0617-5

LONG PAPER

From internet access to internet skills: digital inequality among older adults

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Abstract
Although much research examines the factors that affect technology adoption and use, less is known about how older adults as a group differ in their ability to use the Internet. The theory of digital inequality suggests that even once people have gone online, differences among them will persist in important ways such as their online skills. We analyze survey data about older American adults' Internet skills to examine whether skills differ in this group and if they do, what explains differential online abilities. We find that there is considerable variation in Internet know-how and this relates to both socioeconomic status and autonomy of use. The results suggest that attempts to achieve a knowledgeable older adult population regarding Internet use must take into account these users' socioeconomic background and available access points.

Keywords Older adults · Internet skills · Digital inequality

1 Introduction

Worldwide, the proportion of older adults, often defined as people aged 60 and older, is growing rapidly compared to younger demographics due to declining fertility rates and people living longer [15, 75, 76]. Understanding issues of universal access to online information among the older adult population is a complex, but an increasingly important issue. Older adults are a highly heterogeneous group of technology users [68] characterized by their diverse prior employment experiences, motivations for using technology, and computing knowledge [33, 48, 66, 73]. Prior research on universal access for older individuals often examines technology adoption and initial learning [20, 49, 61, 63] as well as issues of web accessibility related to aging [4, 5, 11, 36, 60]. Much of this work focuses on bridging the so-called "digital divide" by getting older adults online so that they can connect with others, seek information, and obtain resources through the Internet (e.g., [13, 19]). While it is important to understand who among older adults is not online, digital inequality scholarship has also emphasized the need to examine differences among people even after they have become users [25]. It is this call for research that this paper addresses.

The theory of digital inequality posits that there is a spectrum of differences associated with Internet usage once people have crossed the access divide and have become users [25, 72]. A large body of literature across countries has shown that people from more advantaged societal positions are more likely to use the Internet for diverse purposes, especially the types of activities from which they may benefit [2, 50, 56, 64]. Additionally, research has shown that many uses are linked to people's Web-use skills [41, 69, 78]. Those from a more privileged background tend to have higher Internet skills, which links to more diverse uses and the potential to benefit from the Internet more. Most of this literature has not considered the Internet skills of older adults, however (see [40] for an exception). Although there are many benefits to going online in older adulthood – such as positive health outcomes associated with staying socially connected [16, 17] and opportunities for online work and

Eszter Hargittai is grateful to the April McClain-Delaney and John Delaney Research Professorship at Northwestern University for the time available to work on this project. Anne Marie Piper would like to acknowledge support for this work through National Science Foundation Grant IIS-1551574.

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Published online: 03 May 2018

learning [6, 34] – there is limited understanding of how older adults vary in their skills required to reap these benefits.

This article presents an analysis of differentiated levels of Internet skills among a national sample of online older adults (aged 60 and older) residing in the United States. While much of the digital inequality literature examines the population as a whole, the present paper contributes a more nuanced understanding of how older adults vary in their Web-use skills. Our analyses suggest that even among a group of online older adults, there is significant variation in skills, and this is linked to people's education, income, and autonomy of use, i.e., the freedom to use the technology when and where one wants. This suggests that addressing issues of universal online access must focus on user skills in addition to physical access to the infrastructure. A more nuanced understanding of how older Internet users differ in their ability to use the Internet effectively and efficiently is necessary to reach knowledgeable Internet users across the life course [37]. Furthermore, understanding differences in Internet skills among online older adults has implications for future policy, training programs, and technology design.

2 Related work

In a number of highly-developed countries, the proportion of older adults who are Internet users keeps increasing, with some countries seeing more than half of their older adult populations active online. In 2016, 64% of American adults 65 and older reported going online, up from 46% five years earlier [12]. In Switzerland, over 60% of those aged 60–69 were using the Internet several times a week in 2014 [9]. Among older individuals in the U.K. (age 75+), while 76% had never used the Internet in 2011, this decreased to 57% in 2016 [55]. Although this trend is encouraging, Internet adoption varies considerably among the older population depending on age, income, and educational level [10, 19, 31, 58, 66]. In the U.S., older adults who are younger, receive higher-income, and more highly educated are more likely to use the Internet. Internet use among U.S. older adults drops off significantly for people aged 75 and older [66]. Data on Internet adoption from the U.K. indicate a similar stratification based on an older adult's age, education, and other factors [28, 55]. Beyond age and socioeconomic factors, disability status and health issues are also related to Internet adoption rates [10, 13, 19, 26, 27, 44]. While prior work makes clear what factors matter for Internet adoption among older demographics, limited research has examined whether and how they relate to older adults' Internet skills, that is, their ability to use the Internet effectively and efficiently [40].

Digital inequality research has long suggested the importance of understanding differences among Internet users rather than simply whether certain groups are online or not [25]. Issues of a "second-level digital divide," in which individuals are differentiated by their ability to use the Internet effectively and efficiently [37] are particularly relevant to discussions of universal access and older adults. Much of the literature, however, focuses on comparing the online activities of younger and older adults. For example, early work suggests that older individuals tend not to use the more advanced tools that younger people use [8] and only engage in a subset of activities compared to their younger counterparts [51]. Although their usage of social network sites is growing, older adults are less likely than the younger ones to have accounts on social network platforms or actively share information on these sites [7, 35, 47, 70, 77]. Other studies examine the extent to which older people participate in new forms of online engagement that are common among younger demographics, such as online work [6] and online learning [34]. Among older adults, van Deursen and Helsper [71] found that adults aged 75 and older show less variety in their Internet use compared to those aged 65–75, and using the Internet for information purposes is more likely among higher-educated older users. Additionally, the authors found that older men spent more time online than older women, but gender did not influence the range of online activities older adults undertook. Few studies examine how factors beyond age and gender, such as disability, relate to differences in Internet use in this group (for a notable exception, see [27]). Cognitive ability, for example, has been associated with differential levels of Internet use among older adults [18, 30].

Prior work has focused on older adults' own self-assessment of computer skills and knowledge, noting that older adults are under-confident in their overall ability to use computers [53] as well as their ability to perform specific activities (e.g., health information seeking; [52]). Further, Mitzner et al. [54] argue that the difference between older and younger users is not about differences in actual computer knowledge, but instead concerns older adults' confidence and tendency to underestimate their computer-related abilities. Out of a need to assess differential levels of computer skill among older adults, Boot et al. [3] introduced the Computer Proficiency Questionnaire, which measures skills associated with computer basics, printing, communication, Internet use, and other computer-based tasks. Other similar scales (e.g., [1, 65]) focus on assessing older adults' general computer skills and knowledge.

Collectively, this body of research highlights the importance of understanding differences among older people's technology adoption, learning, and use. This literature demonstrates that older people experience highly diverse psycho-social factors that impact technology adoption and use, such as confidence and comfort in using technology [21, 54]. A wide range of other related factors, such

as the social context of use and availability of technical support, also affect an older individual's adoption of technology [48]. Differences in educational attainment, prior employment, and living situation further impact technology adoption and use [33, 66, 73]. Despite this known diversity among older adults' technology adoption and use, there have been few studies that systematically examine differences among older adults in terms of the skills required to make full use of the Internet.

One considerable challenge to studying potential disparities in skills among older adults is that earlier nationally representative datasets that include measures of Internet skills often treat older adults as a single category (e.g., aged 60 and older), although Internet use varies considerably based on age even among older age groups [55, 58, 66]. As an exception, based on a national survey of older adults conducted in 2009 in the United States, Hargittai and Dobransky [40] found that the "oldest old" (age 80 and older) and individuals with less than college education had lower levels of Internet skills than younger users of mature ages (55–64). The authors also found that, among these older adults, women and individuals reporting a disability had lower levels of Internet skills. While prior work demonstrates differences among younger people with disabilities [27], these studies together highlight the need for a better understanding of Internet skills as they relate to both age and disability. As an isolated example, van der Geest et al. [32] examined visually impaired older adults' use of online services (e.g., e-mail, chat, web forums) and self-reported competency in performing common online tasks compared to their actual skill levels from observed online activity. These researchers found that the Internet-related skills of visually impaired older adults fell short of what active participation in the online information society requires, especially for more complex information. Taken together, these findings further underscore the need for a nuanced understanding of differences in Internet skills among older adults.

Greater Web know-how can serve to empower older adults by helping them stay independent, socially connected, and informed about health issues [44–46]. Staying engaged and socially connected online may also promote late-life wellness [16, 17, 29, 67], though some have argued that reaping these benefits depends on proper training and having the skills needed to use computers and the Internet effectively [3]. Nevertheless, digital technology can be a source of disempowerment for older adults, who need ever-increasing levels of digital know-how to maintain their sense of inclusion [46]. Establishing a better understanding of older adults' Internet skills and variations in skills among this diverse group could help better customize training programs and computer courses for older adults [22], including those living in rural areas [62]. A more in-depth understanding of the factors that underlie differentiated levels of Internet use are needed to design and target such programs better and have the potential to shape future policy.

3 Method

3.1 Data collection

The survey respondents were 505 people from the U.S. aged 60 and older whom we reached through the Cint's OpinionHUB, an online survey panel service also used by others in the literature [24, 79]. Inclusion in the OpinionHUB panel is double opt-in. Initially, Cint contacts potential participants through telephone, face-to-face interactions, email, social media, and banner ads. After potential participants fill out a form, they receive an email. They then need to log in to their account on Cint to become part of the OpinionHUB panel.

We fielded the survey on August 12, 2013. OpinionHUB participants were sent an email requesting their participation and decided if they wanted to fill out the form. They received modest payment (a couple of dollars) for their participation. It is important to acknowledge that collecting these data online likely biased participants toward more experienced and skilled users thereby resulting in conservative estimates of skill variation among the broader older adult population [39].

3.2 Measures

3.2.1 Independent variables

We asked participants their age (open field), gender (two options), their highest level of education (six categories), and their income (nine categories). We recoded age into the following categories: 60–64, 65–69, 70–74, and 75–80 (80 was the age of the oldest participants in the study). While there is no universal agreement upon age that defines older adulthood, we used age 60 as our cutoff to parallel the World Health Organization's practices [75, 76]. We recoded education into three categories: high school graduate or lower, some college, and Bachelor's degree or higher. Income was recoded to midpoint categories to obtain a continuous measure. In binary analyses, we compare the highest and lowest quartiles of income.

3.2.2 Dependent variables

Regarding Internet experiences, we asked respondents "which of the following categories of devices you typically use to access the Internet (check all that apply)" to assess autonomy of use, i.e., the freedom to use the technology when and where one wants. We added up the seven options (e.g., "a computer in your own home", "a public computer

available at no cost (such as in a library or senior center)") to obtain the measure of user autonomy.

We used an established survey measure of Internet skills [42, 74] to gauge user know-how, and expanded on this instrument to assess social media skills. The former measure is made up of respondents' "level of understanding of the following more traditional Internet-related terms", which asked about 17 items (e.g., jpg, cache, malware, rss, bcc, phishing). The latter is made up of eight terms, namely app, hashtag, selfie, smartphone, social media, status update, tablet, tagging.

Table 1 Sample background

	Percent of sample
Age	
60–64	37
65–69	40
70–74	14
75–80	9
Gender	
Female	63
Male	37
Education	
High school or lower	21
Some college	40
Bachelor's or higher	39
Income	
Less than $35,000	35
$35,000–< $50,000	17
$50,000–< $100,000	36
$100,000 or more	12
Autonomy of Internet use	
One location	51
More than one location	49

3.3 The sample

Table 1 presents the sample background. The average age is 67, the majority of participants are in their sixties with just under a quarter (23%) in their seventies. More women (63%) than men participated, not surprisingly given women's higher life expectancy. About a fifth of respondents (21%) have no more than a high school degree, while almost equal numbers completed some college (40%) and finished college or got an advanced degree (39%). Over a third of participants (35%) report income under $35,000, while 12% live on over $100,000 a year, the rest are in between. Regarding the number of places where people use the Internet, just over half do so in only one location (51%), while the rest go online in more than one place.

3.4 Mode of analysis

We examine how each outcome variable—autonomy of use, general Internet skills, social media skills—relates to people's background characteristics in two ways. First, we look at the binary relationship of each with age, gender, education, and income. Then we use OLS regression analyses to see how the background variables explain differences in the outcomes, respectively, while holding other factors constant. Table 2 shows that there are no issues of multicollinearity in the dataset.

Table 2 Correlation matrix of independent and dependent variables

	Age	Female	Income	Education	Autonomy of use	Internet skills
Female	− 0.0006					
	0.9901					
Income	− 0.1887	− 0.1585				
	0	0.0005				
Education	− 0.1063	− 0.1893	0.3312			
	0.0169	0	0			
Autonomy of use	− 0.1901	− 0.0807	0.2521	0.2066		
	0	0.0699	0	0		
Internet skills	− 0.1972	− 0.0767	0.1842	0.1663	0.3133	
	0	0.0852	0.0001	0.0002	0	
Social media skills	− 0.2029	− 0.0026	0.1932	0.1452	0.2917	0.8189
	0	0.9541	0	0.0011	0	0

4 Findings

4.1 Autonomy of use

The first column in Table 3 presents the binary relationship of background characteristics with autonomy of use, which refers to the freedom to use the Internet where and when one wants. There are very clear differences among various groups with younger older adults, the more educated, and those with more income having much more user autonomy. For example, the age group 60–64 has an average of 1.9 locations of access to the Internet, which is a statistically significant difference compared to all other age groups that have fewer locations of access. Those with a college degree or more have, on average, 1.9 access locations compared to 1.4 among those with no more than a high school education. Those with the highest income have the highest number of access locations as a category of people with 2.1 locations on average.

The first column in Table 4 presents the results of OLS regression analyses on who has more autonomy of use. This supplements binary analyses well as it shows which factors remain significant in explaining the difference once we hold the other factors constant. Differences among age categories are no longer significant. Being in the most highly educated group and having more income are the most important factors explaining who has more freedom to use the Internet when and where they want. In other words, far from having equal opportunities with digital media, socioeconomic status plays a significant role in older adults' circumstances of Internet use.

4.2 General internet skills

The middle column in Table 3 shows how age, gender, education, and income relate to general Internet skills. The youngest in the sample are the savviest. Both education and income are positively related to general Internet skills. Measured on a 1–5-point scale, the youngest old (60–64) were significantly more savvy with an average score of 3.2 than the oldest old (75–80) with a 2.6 average score. Respondents with the highest levels of education had a skill score of 3.3 compared to 2.8 for those with the lowest levels of education. Participants in the highest income bracket have the highest skills averaging 3.5.

Turning to OLS regression results to see which of these relationships persist when the other factors are held constant, the picture is more complex (see Table 4). The youngest older adults have the highest skills as do those with the

Table 3 Binary relationship of outcome variables to background characteristics

	Autonomy of use (1–6)	General internet skills (1–5)	Social media skills (1–5)
Full sample	1.7	3.1	3.6
Age			
60–64	1.9***	3.2**	3.7*
65–69	1.7	3.1	3.7
70–74	1.4**	2.9	3.5
75–80	1.5	2.6**	3.0***
Gender			
Female	1.6	3.0	3.6
Male	1.8	3.2	3.6
Education			
High school or lower	1.4***	2.8**	3.4**
Some college	1.6	3.1	3.6
Bachelor's or higher	1.9***	3.3**	3.8**
Income			
Less than $35,000	1.4***	2.9**	3.4***
$35,000–<$50,000	1.6	3.1	3.6
$50,000–<$100,000	1.9***	3.1	3.7
$100,000 or more	2.1***	3.5***	4.0**
Autonomy of use			
One location	–	2.8***	3.3***
More than one location	–	3.4***	3.9***

$* p =< .05$; $** p =< .01$; $*** p =< .001$

Table 4 OLS regression analyses on autonomy of use, general Internet skills, and social media skills

	Autonomy of use	General Internet Skills	Social Media Skills
Age (75–80 is base)			
60–64	0.22 (0.14)	0.45 (0.16)**	0.53 (0.17)***
65–69	0.05 (0.14)	0.41 (0.16)**	0.55 (0.16)***
70–74	− 0.14 (0.16)	0.31 (0.18)	0.42 (0.19)*
Gender (male is base)			
Female	− 0.06 (0.08)	− 0.12 (0.09)	0.07 (0.09)
Education (high school or lower is base)			
Some college	0.09 (0.10)	0.20 (0.11)	0.20 (0.12)
Bachelor's or more	0.28 (0.100)*	0.25 (0.12)*	0.28 (0.13)*
Income (less than $35K is base)			
$35,000–<$50,000	0.16 (0.11)	0.09 (0.13)	0.11 (0.13)
$50,000–<$100,000	0.32 (0.10)***	− 0.11 (0.10)	0.03 (0.11)
$100,000 or more	0.43 (0.14)**	0.25 (0.15)	0.27 (0.16)
Autonomy of use	–	0.30 (0.05)***	0.27 (0.05)***
Intercept	1.30 (0.16)***	2.09 (0.18)***	2.37 (0.19)***
N	476	476	476
Adjusted R^2	0.09	0.12	0.10

* p =< .05; ** p =< .01; *** p =< .001

highest level of education. Income, however, is no longer significant. This model also includes autonomy of use as an independent variable, which is an important correlate of general Internet skills. Earlier, we noted that income is strongly related to autonomy of use. It is through this relationship that income influences skills. Running the model without the autonomy of use measure (not shown), those with higher income are the most skilled. It is through the possibility of having more freedom to use the Internet where and when one wishes that income influences Internet skills.

4.3 Social media skills

Similarly to the other two outcome variables, social media skills do not differ by gender as evidenced by the same figures for men and for women on that measure. All other background factors are related, however. Again measured on a 1–5-point scale, the youngest old (60–64) scored the highest with a 3.7 average compared to 3.0 for the oldest old (75–80). The highest income bracket group is again the savviest with a 4.0 average skill score. These relationships all hold when controlling for other factors depicted in the last column of Table 4, although income is not as significant as education and age.

5 Discussion

Analyzing Internet skill differences among older adults uncovers several important factors to consider in attempts to get this population more connected in effective and efficient ways, i.e., beyond ensuring core access. First, there is considerable variation of Internet skills by age among older adults. Second, socioeconomic status, especially income, is an important factor in explaining who has more autonomy of use when it comes to spending time online. Third, higher autonomy of use is significantly tied to both higher-level general Internet skills as well as social media skills. Fourth, those with the highest levels of education are the most skilled, reinforcing existing inequalities. Fifth, while there is no difference in user autonomy among various age groups, the oldest groups are the least savvy. Finally, and somewhat surprisingly given other literature on Internet skills [14, 43, 57], there are no significant skill differences among men and women in our sample. While prior work has established that Internet adoption varies considerably among the older population depending on age, income, and educational level [10, 19, 31, 58, 66], the findings presented here show that similar factors influence older adults' Internet skill levels. These findings, drawing on more recent data, confirm what Hargittai and Dobransky [40] found about older adults' Internet skills in 2009. The present analysis extends this earlier work by also applying the theory of digital inequality to social media skills and demonstrates that they vary by socioeconomic status, advantaging the more privileged. Taken together, these findings suggest several considerations for future research, technology design, and policy involving older adults and Internet use.

Drawing on the theory of digital inequality [38, 72], our analysis calls attention to the importance of differences in Internet skills among older adults once they have gone online. Thus far, much of the literature on this group

has focused on issues of a digital divide (e.g., [13, 19]) and initial computer adoption and learning (e.g., [20, 49, 61, 63]). Recent data suggest that the gap between older adults who are online and those who are will not continue to close [12, 55], making it increasingly important to shift from understanding whether older individuals are online to having a more complex discussion of how older adults vary in their ability to engage fully in the information society. Our analysis, along with prior work [40], demonstrates that issues of digital inequality exist among older adults who are active online, and highlights a need for future work examining differences in online participation based on age, socioeconomic status, and even disability status. Much existing theoretical work focuses on initial technology adoption (e.g., Technology Acceptance Model [23]). While this is an important part of understanding differential technology usage, contemporary theorizing of how socio-demographic factors affect longer-term technology use and the ability to make full use of the Internet can provide a more complete picture. As the present paper argues, studying initial adoption is only a limited part of understanding inequality around information access.

Prior work asserts that older adults in general need increasing levels of Internet know-how to maintain their sense of inclusion in the information society [46]. Designing new online technologies and training programs with an eye towards issues of digital inequality may help address disparities in Internet use. For instance, roughly half of the older adults in our sample access the Internet from a single location. Older adults with lower autonomy of use tend to have lower levels of Internet skills and report lower levels of income. Further, these older adults are less likely to own a smartphone or tablet computer compared to their more affluent peers [66]. Thus, technology designed to reach low-income older adults must consider the practical and logistical issues of a single Internet access point. For example, without a smart mobile device (e.g., smartphone, tablet computer), these individuals are likely to be without Internet access when traveling or hospitalized [59]. Future work should continue collecting data on both access points (e.g., device types and locations) and skills to see whether these trends are changing.

Technologies and training programs designed for addressing digital inequality should also focus on helping these older adults engage in capital-enhancing activities, such as new systems for staying socially connected without needing a home computer or smart mobile device (e.g., [5]). Researchers have explored designing technologies to promote online capital-enhancing activities such as online work and learning, however they have mainly done so for more affluent groups [6, 34]. Results of this paper show that such opportunities would be especially beneficial for lower-income older adults and thus future work should target such groups in particular.

6 Conclusion

The goals of this paper are two-fold in addressing the Internet skills of older adults. First, this paper tested whether online older adults differ when it comes to Web know-how and found that skills vary both within and across age groups, even among the oldest in society. Second, digital inequality literature suggests that people from less-privileged backgrounds have lower Internet skills than those from more advantaged backgrounds, a proposition heretofore rarely tested for lack of appropriate datasets about older adults. Consistent with prior work on other age groups, we find that education, and especially income, are both positively correlated with Internet skills. This suggests that more privileged users are more likely to derive benefits from the time they spend online. The results on the whole suggest more nuanced approaches to designing technologies for older adults taking into consideration their particular age group and socioeconomic circumstances.

References

1. Arning, K., Ziefle, M.: Development and validation of a computer expertise questionnaire for older adults. Behav. Inform. Technol. **27**(4), 325–329 (2008). https://doi.org/10.1080/01449290802127153
2. Bonfadelli, H.: The Internet and Knowledge Gaps: A Theoretical and Empirical Investigation. Eur. J. Commun. **17**(1), 65–84 (2002). http://ejc.sagepub.com/cgi/content/abstract/17/1/65
3. Boot, W.R., Charness, N., Czaja, S.J., Sharit, J., Rogers, W.A., Fisk, A.D., Mitzner, T., Lee, C.C., Nair, S.: Computer Proficiency Questionnaire: Assessing Low and High Computer Proficient Seniors. Gerontol. **55**(3), 404–411 (2015). https://doi.org/10.1093/geront/gnt117
4. Brajnik, G., Yesilada, Y., Harper, S.: Web accessibility guideline aggregation for older users and its validation. Univ. Access Inf. Soc. **10**(4), 403–423 (2011). https://doi.org/10.1007/s10209-011-0220-5
5. Brewer, R., Garcia, R.C., Schwaba, T., Gergle, D., Piper, A.M.: Exploring traditional phones as an e-mail interface for older adults. ACM Trans. Access. Comput. **8**(2), 6:1–6:20 (2016). https://doi.org/10.1145/2839303
6. Brewer, R., Morris, M.R., Piper, A.M.: Why would anybody do this?: Understanding older adults' motivations and challenges in crowd work. In: Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, CHI '16, pp. 2246–2257. ACM, New York, NY, USA (2016). https://doi.org/10.1145/2858036.2858198
7. Brewer, R., Piper, A.M.: Tell it like it really is: A case of online content creation and sharing among older adult bloggers. In: Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, CHI '16, pp. 5529–5542. ACM, New York, NY, USA (2016). https://doi.org/10.1145/2858036.2858379

8. Bucur, A., Renold, C., Henke, M.: How do older netcitizens compare with their younger counterparts? Cyberpsychol. Behav. Impact Internet, Multim. Virtual Real. Behav. Soc. **2**(6), 505–513 (1999). https://doi.org/10.1089/cpb.1999.2.505
9. Bundesamt fr Statistik: Kultur, Medien und Informationsgesellschaft: Panorama. Tech. rep. (2016). https://www.bfs.admin.ch/bfs/de/home/statistiken/kultur-medien-informationsgesellschaft-sport.assetdetail.200306.html
10. Carpenter, B., Buday, S.: Computer use among older adults in a naturally occurring retirement community. Comput. Hum. Behav. **23**(6), 3012–3024 (2007). http://www.sciencedirect.com/science/article/B6VDC-4M69JJ9-1/2/4c2c9a19a111241e9de7c155ef4b703b
11. Cavender, A.C., Bigham, J.P.: Toward web accessibility for older users. Univ. Access Inf. Soc. **10**(4), 357–358 (2011). https://doi.org/10.1007/s10209-011-0219-y
12. Center, P.R.: Internet/Broadband Fact Sheet. Tech. Rep. (2017). http://www.pewinternet.org/fact-sheet/internet-broadband/
13. Choi, N.G., Dinitto, D.M.: The digital divide among low-income homebound older adults: Internet use patterns, eHealth literacy, and attitudes toward computer/Internet use. J. Med. Internet Res. **15**(5), e93 (2013). https://doi.org/10.2196/jmir.2645
14. Correa, T.: Digital skills and social media use: how Internet skills are related to different types of Facebook use among 'digital natives'. Inform. Commun. Soc. **19**(8), 1095–1107 (2016). https://doi.org/10.1080/1369118X.2015.1084023
15. Cotten, S., Yost, E., Berkowsky, R., Winstead, V., Anderson, W.: Designing Technology Training for Older Adults in Continuing Care Retirement Communities. CRC Press, Boca Raton (2016)
16. Cotten, S.R., Anderson, W.A., McCullough, B.M.: Impact of Internet Use on Loneliness and Contact with Others Among Older Adults: Cross-Sectional Analysis. J. Med. Internet Res. **15**(2) (2013). https://doi.org/10.2196/jmir.2306. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3636305/
17. Cotten, S.R., Ford, G., Ford, S., Hale, T.M.: Internet use and depression among older adults. Comput. Hum. Behav. **28**(2), 496–499 (2012). https://doi.org/10.1016/j.chb.2011.10.021
18. Crabb, M., Hanson, V.L.: An Analysis of Age, Technology Usage, and Cognitive Characteristics Within Information Retrieval Tasks. ACM Trans. Access. Comput. **8**(3), 10:1–10:26 (2016). https://doi.org/10.1145/2856046
19. Cresci, M.K., Yarandi, H.N., Morrell, R.W.: Pro-Nets Versus no-nets: differences in urban older adults' predilections for internet use. Educ. Gerontol. **36**(6), 500–520 (2010). https://doi.org/10.1080/03601270903212476
20. Czaja, S., Charness, N., Fisk, A., Hertzog, C., Nair, S., Rogers, W., Sharit, J.: Factors predicting the use of technology: findings from the center for research and education on aging and technology enhancement (create). Psychol. Aging **21**, 333–352 (2006)
21. Czaja, S.J., Charness, N., Fisk, A.D., Hertzog, C., Nair, S.N., Rogers, W.A., Sharit, J.: Factors Predicting the Use of Technology: findings From the Center for Research and Education on Aging and Technology Enhancement (CREATE). Psychol. Aging **21**(2), 333–352 (2006). https://doi.org/10.1037/0882-7974.21.2.333. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1524856/
22. Czaja, S.J., Lee, C.C., Branham, J., Remis, P.: OASIS connections: results from an evaluation study. Gerontol. **52**(5), 712–721 (2012). https://doi.org/10.1093/geront/gns004
23. Davis, F.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. **13**, 319–339 (1989)
24. De Choudhury, M., Morris, M.R., White, R.W.: Seeking and Sharing Health Information Online: Comparing Search Engines and Social Media. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '14, pp. 1365–1376. ACM, New York, NY, USA (2014). https://doi.org/10.1145/2556288.2557214
25. DiMaggio, P., Hargittai, E., Celeste, C., Schafer, S.: Digital Inequality: From Unequal Access to Differentiated Use. In: K. Neckerman (ed.) Social Inequality, pp. 355–400. Russell Sage Foundation, New York (2004). https://www.russellsage.org/research/reports/dimaggio
26. Dobransky, K., Hargittai, E.: The disability divide in internet access and use. Inform. Commun. Soc. **9**(3), 313–334 (2006)
27. Dobransky, K., Hargittai, E.: Unrealized potential: Exploring the digital disability divide. Poetics **58**, 18–28 (2016)
28. Dutton, W.H., Helsper, E.J., Gerber, M.M.: Oxford Internet Survey 2009 Report: The Internet in Britain. Oxford Internet Institute, University of Oxford (2009). http://oxis.oii.ox.ac.uk/wpcontent/uploads/sites/43/2014/11/oxis2009-report.pdf
29. Erickson, J., Johnson, G.M.: Internet use and psychological wellness during late adulthood. Can. J. Aging = La Revue Canadienne Du Vieillissement **30**(2), 197–209 (2011). https://doi.org/10.1017/S0714980811000109
30. Freese, J., Rivas, S., Hargittai, E.: Cognitive ability and internet use among older adults. Poetics. (Journal of Empirical Research on Culture, the Media and the Arts) **34**(4), 236–249 (2006)
31. Friemel, T.N.: The digital divide has grown old: Determinants of a digital divide among seniors. New Media Soc. **18**(2), 313–331 (2016). https://doi.org/10.1177/1461444814538648. http://nms.sagepub.com/content/18/2/313
32. Geest, T., Meij, H., Puffelen, C.: Self-assessed and actual internet skills of people with visual impairments. Univers. Access Inf. Soc. **13**(2), 161–174 (2014). https://doi.org/10.1007/s10209-013-0304-5
33. Gonçalves, V.P., de Almeida Neris, V.P., Seraphini, S., Dias, T.C.M., Pessin, G., Johnson, T., Ueyama, J.: Providing adaptive smartphone interfaces targeted at elderly people: an approach that takes into account diversity among the elderly. Univ. Access Inf. Soc. **16**(1), 129–149 (2017). https://doi.org/10.1007/s10209-015-0429-9
34. Guo, P.J.: Older adults learning computer programming: motivations, frustrations, and design opportunities. In: Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, CHI '17, pp. 7070–7083. ACM, New York (2017). https://doi.org/10.1145/3025453.3025945
35. Haight, M., Quan-Haase, A., Corbett, B.: Revisiting the digital divide in canada: the impact of demographic factors on access to the internet, level of online activity, and social networking site usage. Inform. Commun. Soc. **17**, 503–519 (2014)
36. Hanson, V.: Technology skill and age: What will be the same 20 years from now? Univ. Access Inf. Soc. **10**, 443–452 (2011)
37. Hargittai, E.: Second-Level Digital Divide: Differences in People's Online Skills. First Monday **7**(4) (2002). http://firstmonday.org/ojs/index.php/fm/article/view/942
38. Hargittai, E.: The Digital Reproduction of Inequality. In: Grusky, D. (ed.) Social Stratification, pp. 939–944. Westview Press, Boulder (2008)
39. Hargittai, E.: Is Bigger Always Better? Potential Biases of Big Data Derived from Social Network Sites. ANNALS Am. Acad. Polit. Soc. Sci. **659**(1), 63–76 (2015). https://doi.org/10.1177/0002716215570866. http://ann.sagepub.com/content/659/1/63
40. Hargittai, E., Dobransky, K.: Old dogs, new clicks: Digital inequality in skills and uses among older adults. Can. J. Commun. **42**, 195–222 (2017)
41. Hargittai, E., Hinnant, A.: Digital Inequality: Differences in Young Adults? Use of the Internet. Commun. Res. **35**(5), 602–621 (2008). http://www.webuse.org/p/a24

42. Hargittai, E., Hsieh, Y.P.: Succinct Survey Measures of Web-Use Skills. Soc. Sci. Comput. Rev. **30**(1), 95–107 (2012). https://doi.org/10.1177/0894439310397146
43. Hargittai, E., Shaw, A.: Mind the skills gap: the role of internet know-how and gender in differentiated contributions to wikipedia. Inform. Commun. Soc. **18**(4), 424–442 (2015). https://doi.org/10.1080/1369118X.2014.957711
44. Heart, T., Kalderon, E.: Older adults: are they ready to adopt health-related ICT? Int. J. Med. Inform. **82**(11), e209–231 (2013). https://doi.org/10.1016/j.ijmedinf.2011.03.002
45. Henke, M.: Promoting independence in older persons through the internet. CyberPsychol. Behav. **2**(6), 521–527 (1999). https://doi.org/10.1089/cpb.1999.2.521. http://online.liebertpub.com/doi/abs/10.1089/cpb.1999.2.521
46. Hill, R., Betts, L.R., Gardner, S.E.: Older adults? experiences and perceptions of digital technology: (Dis)empowerment, wellbeing, and inclusion. Comput. Hum. Behav. **48**, 415–423 (2015). https://doi.org/10.1016/j.chb.2015.01.062
47. Hope, A., Schwaba, T., Piper, A.M.: Understanding digital and material social communications for older adults. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14), pp. 3903–3912. ACM, New York (2014). https://doi.org/10.1145/2556288.2557133
48. Lee, C., Coughlin, J.F.: PERSPECTIVE: Older adults' adoption of technology: an integrated approach to identifying determinants and barriers. J. Prod. Innov. Manag. **32**(5), 747–759 (2015). https://doi.org/10.1111/jpim.12176. http://onlinelibrary.wiley.com/doi/10.1111/jpim.12176/abstract
49. Lehtinen, V., Näsänen, J., Sarvas, R.: "A little silly and empty-headed": Older adults' understandings of social networking sites. In: Proceedings of the 23rd British HCI Group Annual Conference on People and Computers: Celebrating People and Technology (BCS-HCI '09). British Computer Society, pp. 45–54. Swinton, UK (2009). https://dl.acm.org/citation.cfm?id=1671017
50. Livingstone, S., Helsper, E.: Balancing opportunities and risks in teenagers? use of the internet: the role of online skills and internet self-efficacy. New Media Soc. **12**(2), 309–329 (2010). https://doi.org/10.1177/1461444809342697. http://nms.sagepub.com/content/12/2/309
51. Loges, W.E., Jung, J.Y.: Exploring the digital divide: internet connectedness and age. Commun. Res. **28**(4), 536–562 (2001). https://doi.org/10.1177/009365001028004007. http://crx.sagepub.com/cgi/content/abstract/28/4/536
52. Manaf, E., Wong, S.: Assessing the eHealth literacy skills of older adults: a preliminary study. J. Consumer Health Internet **16**(4), 369–381 (2012). https://doi.org/10.1080/15398285.2012.701163
53. Marqui, J.C., Jourdan-Boddaert, L., Huet, N.: Do older adults underestimate their actual computer knowledge? Behav. Inform. Technol. **21**(4), 273–280 (2002). https://doi.org/10.1080/01449290210000020998
54. Mitzner, T.L., Boron, J.B., Fausset, C.B., Adams, A.E., Charness, N., Czaja, S.J., Dijkstra, K., Fisk, A.D., Rogers, W.A., Sharit, J.: Older adults talk technology: technology usage and attitudes. Comput. Hum. Behav. **26**(6), 1710–1721 (2010). https://doi.org/10.1016/j.chb.2010.06.020
55. Office for National Statistics: Statistical bulletin: Internet users in the UK: 2016 (2016). https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/internetusers/2016
56. Ono, H., Zavodny, M.: Digital inequality: a five country comparison using microdata. Soc. Sci. Res. **36**(3), 1135–1155 (2007). https://www.sciencedirect.com/science/article/pii/S0049089X0600072X
57. Park, C.S.: Does Twitter motivate involvement in politics? Tweeting, opinion leadership, and political engagement. Comput. Hum. Behav. **29**(4), 1641 – 1648 (2013). https://doi.org/10.1016/j.chb.2013.01.044. http://www.sciencedirect.com/science/article/pii/S0747563213000472
58. Perrin, A., Duggan, M.: Americans' Internet Access: 2000-2015. Tech. rep., Pew Research Center (2015). http://www.pewinternet.org/2015/06/26/americans-internet-access-2000-2015/
59. Piper, A., Cornejo, R., Brewer, R.: Understanding the challenges and opportunities of smart mobile devices among the oldest old. Int. J. Mobile Hum Comput. Interact. **8**(2) (2016)
60. Piper, A.M., Brewer, R., Cornejo, R.: Technology learning and use among older adults with late-life vision impairments. Universal Access in the Information Society pp. 1–13 (2016). https://doi.org/10.1007/s10209-016-0500-1
61. Rogers, W.A., Cabrera, E.F., Walker, N., Gilbert, D.K., Fisk, A.D.: A survey of automatic teller machine usage across the adult life span. Hum. Factors **38**(1), 156–166 (1996). https://doi.org/10.1518/001872096778940723
62. Saunders, E.: Maximizing computer use among the elderly in rural senior centers. Educ. Gerontol. **30**(7), 573–585 (2004)
63. Selwyn, N.: The information aged: a qualitative study of older adult?s use of information and communications technology. J. Aging Studies **18**, 369–384 (2004)
64. Selwyn, N., Gorard, S., Furlong, J.: Whose Internet is it Anyway?: Exploring Adults' (Non)Use of the Internet in Everyday Life. Eur. J. Commun. **20**(1), 5–26 (2005). https://doi.org/10.1177/0267323105049631. http://ejc.sagepub.com/cgi/content/abstract/20/1/5
65. Sengpiel, M., Jochems, N.: Validation of the Computer Literacy Scale CLS. In: Zhou, J., Salvendy, G. (eds.) Proceedings, Part I, of the First International Conference on Human Aspects of IT for the Aged Population. Design for Aging, vol. 9193, pp. 365–375. Springer, New York (2015). https://doi.org/10.1007/978-3-319-20892-3_36
66. Smith, A.: Older adults and technology use: adoption is increasing but many seniors remain isolated from digital life. Pew Research Center (2014). http://www.pewinternet.org/2014/04/03/older-adults-andtechnology-use/
67. Sum, S., Mathews, R., Hughes, I., Campbell, A.: Internet use and loneliness in older adults. Cyberpsychol. Behav. **11**(2), 208–211 (2008)
68. van Boekel, L., Peek, S., Luijkx, K.: Diversity in older adults? Use of the Internet: identifying subgroups through latent class analysis. Med. Internet. Res. **19**(5), e180 (2017)
69. van Deursen, A., van Dijk, J., Peters, O.: Rethinking Internet skills: the contribution of gender, age, education, Internet experience, and hours online to medium-and content-related Internet skills. Poetics **39**(2), 125–144 (2011)
70. van Deursen, A., van Dijk, J., ten Klooster, P.: Increasing inequalities in what we do online: a longitudinal cross sectional analysis of internet activities among the dutch population (2010 to 2013) over gender, age, education, and income. Telematics Inform. **32**, 259–272 (2015)
71. van Deursen, A.J., Helsper, E.J.: A nuanced understanding of Internet use and non-use among the elderly. Eur. J. Commun. **30**(2), 171–187 (2015). https://doi.org/10.1177/0267323115578059
72. van Dijk, J.: The Deepening Divide. Sage Publications Inc, Thousand Oaks (2005)
73. Vroman, K.G., Arthanat, S., Lysack, C.: Who over 65 is Online? Older adults' dispositions toward information communication technology. Comput. Hum. Behav. **43**(C), 156–166 (2015). https://doi.org/10.1016/j.chb.2014.10.018
74. Wasserman, I., Richmond-Abbott, M.: Gender and the internet: causes of variation in access, level, and scope of use. Soc. Sci. Quart. **86**(1), 252–270 (2005)
75. World Health Organization: Ageing and Health Fact Sheet. http://www.who.int/mediacentre/factsheets/fs404/en/ (2015)

76. World Health Organization: World report on ageing and health. http://www.who.int/ageing/events/world-report-2015-launch/en/ (2015)
77. Zickuhr, K., Madden, M.: Older adults and internet use. Pew Research Center (2012). http://www.pewinternet.org/2012/06/06/older-adults-and-internet-use/
78. Zillien, N., Hargittai, E.: Digital Distinction: Status-Specific Internet Uses. Soc. Sci. Quart. **90**(2), 274–291 (2009). http://www.webuse.org/p/a26
79. Zyskowski, K., Morris, M.R., Bigham, J.P., Gray, M.L., Kane, S.K.: Accessible Crowdwork?: Understanding the Value in and Challenge of Microtask Employment for People with Disabilities. In: Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, CSCW '15, pp. 1682–1693. ACM, New York, NY, USA (2015). https://doi.org/10.1145/2675133.2675158