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RESEARCH ARTICLE

Do Age Perception and Network Externalities Help to Explain the Age-Based Digital Divide?

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Abstract

Older adults as a group, globally, have a significantly lower rate of internet use than the overall population. Concerns about this age-based digital divide have increased because of the COVID pandemic, since tele-health has been an effective method of delivering medical care to older adults. This study examines the effects of age perception and network externalities on the internet use decision of able-bodied older adults. Data were obtained by in-person interviews of older adults at senior centers. The results of logistic regressions and Chi square analysis showed that negative age perception significantly reduced the probability of internet use and that positive network externalities were associated with a higher rate of internet use. The paper also comments on whether an age-based digital divide will continue as today's digital natives become older adults.

Keywords

Age-based digital divide, Internet use, Older adults, Age perception, Ageism, Network externalities

Introduction

Older adults as a group, globally, have a significantly lower rate of internet use than the overall population [1-4]. Twenty-seven percent of U.S. adults aged 65 and older do not use the internet, v. ten percent of all U.S. adults [1]. The European Commission has identified a "grey digital gap:" 49 percent of European older adults use the internet, compared with 82 percent of the population aged 25 to 64 [3,4]. The age-based digital divide has persisted even as internet use among older adults has increased.

Concerns about this age-based digital divide have increased because of the COVID pandemic, since telehealth has been an effective method of delivering medical care to older adults. The internet has become a utility, enabling access to informational, health, financial, social, and entertainment services. Many employers post job openings and applications on the internet, and jobs often require internet skills. Some public and private services helpful to older adults have migrated entirely to online delivery modes. Older adults who are disadvantaged economically and socially are the ones who tend not to use the internet [5,6], could benefit most from online services, and are the heaviest users of offline services, especially social services [7].

Studies have shown that internet use may help older adults to age well by improving their health and well-being, reducing loneliness, depression and anxiety [8-13], and enabling older adults to stay independent longer into old age. During the COVID-19 pandemic, telehealth videoconferencing has been a safe and effective way to deliver health services to older adults, the age group most likely to suffer adverse effects from COVID-19 [14,15].

Despite the internet's many benefits, some older adults are resistant to internet use. Increasing internet use among older adults requires an understanding of the reasons for non-use. Previous studies have found that higher levels of education and income, as well as internet need and positive self-efficacy, lead to older adult internet use [16-19]. This study contributes to knowledge about the age-based digital divide by including age perception and network externalities in a model of older adult Internet use. The study is based on a survey of able-bodied older adults, older adults who are or potentially could be internet users.

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We hypothesize that negative age perception may have a negative effect on the probability of internet use. Today's older adults are digital immigrants who grew up without the internet. These older adults may be reluctant to change their ways, believing that older age gives them the freedom to avoid stressful, anxiety-provoking activities. Increased risk aversion among older adults [20,21] may lead to apprehension about internet use. Moreover, older adults may face more difficulties in learning technologies, make more errors and require additional time to accomplish tasks, resulting in anxiety, frustration, and subliminal negative reactions [22], and some internet technologies may not be user-friendly for older adults [23].

Ageism may also play a role in older adults' perception that they are too old for internet use. Social media and commercial advertisements sometimes contain ageist content messaging that older adults are less technologically competent than younger adults [24,25].

We also expect that network externalities such as the bandwagon and the social support effects may be associated with an older adult's decision to use the internet. The bandwagon effect is a psychological phenomenon in which people do something primarily because other people are doing it. The s*ocial support* effect refers to *support* through *social* ties to other individuals and the *community.* A critical mass of internet users in one's community or social group may be associated with a higher level of internet use among older adults in that community, both directly by volume of use and indirectly through perceptions of the internet's benefits [26,27]. Moreover, an older adult's internet self-efficacy, which in turn affects their decision to use the internet, may be influenced by internet usage within, and encouragement from, one's social network [2,28,29].

Material and Methods

Participants and data collection

Two-hundred-two older adults were interviewed at senior centers with free internet access in five northeastern Massachusetts municipalities. Town median household incomes ranged from $48, 002 to $129,082. Higher-education levels (bachelor's degree or higher, persons age 25+) ranged from 21.9 percent to 71.9 percent. The University of Massachusetts Lowell Institutional Review Board approved this research.

Trained students and the author conducted in-person interviews, responding to questions and encouraging detailed responses. Each of the participants was assessed to be without physical or cognitive challenges that might have limited internet use. Day-care clients were not included. To include older adults with varied interests, interviewers invited participation from older adults in the lunchroom or in a common room, not in a particular activity zone such as the computer area. Because participation was voluntary, the older adults surveyed may not have been representative of the senior center population.

Measures

Internet use: Participants were asked if they currently used the internet (users), had used the internet but no longer used (un-users) or never used the internet (never-users). Because the number of un-users was low, un-users and never-users were grouped together as nonusers for purposes of statistical analysis. Users were coded as 1 and nonusers were coded as 0.

Demographic variables: Gender, income, and education were recorded as binary variables: Male vs. Female (Male = 1); Income above or below $40,000 (above $40,000 = 1); Post-secondary education vs. High school graduate or less (post-secondary = 1). Participants were asked to identify their income and education groups. Gender was identified by interviewer observation. Ethnicity and disability were recorded with multiple values but converted to binary variables (Caucasian vs. non-Caucasian, Caucasian = 1 and Disabled vs. non-Disabled, non-Disabled = 1) because both the total non-Caucasian and Disabled subgroups were relatively small.

Motivational variables: Participants were asked if internet need, internet attitude and internet skill influenced their internet use decision. Multiple responses were allowed. If a respondent reported that perceived need, attitude or skill influenced their internet use decision, that motivational variable was coded as 1.

Older adults were asked if feeling too old to use the internet influenced their internet use decision. If a participant responded that their internet use decision was affected by age perception, the age perception variable was coded as 1.

Analytical strategy

The internet use decision was estimated using a binomial logistic regression model that included both demographic and motivational variables. The marginal effect of each binary variable was obtained by calculating the difference in predicted probability between a binary variable value of one or zero, other variables constant.

Network externalities associated with the internet use decision were investigated using Chi square analysis. Data from the two towns with the most different socioeconomic profiles were used for his analysis. One town had a high education/high income level (71.9% bachelor's degree or higher; median income $129,082) while the other town had a low education/income level (21.9% bachelor's degree or higher; median income $48,002). The combined data from these two towns were more than one-half of the total survey population. Comparing high-education internet users and non-users,

Table 1: Demographic characteristics of participants.

	TOTAL	USERS	UNUSERS	NEVER USERS
TOTAL	202	143	13	46
MALE (gender = 1)	64	45	4	15
FEMALE (gender = 0)	137	98	9	30
GENDER n.a.	1	0	0	1
CAUCASIAN (race = 1)	195	140	13	42
NON CAUCASIAN (race = 0)	5	3	0	2
RACE n.a.	2	1	0	1
LOW INCOME (income = 0)	97	57	10	30
HIGH INCOME (income = 1)	60	55	0	5
INCOME n.a.	45	29	3	13
LESS EDUCATION (educ = 0)	73	35	7	31
MORE EDUCATION (educ = 1)	121	105	5	11
EDUCATION n.a.	8	3	0	5
NOT DISABLED (disability = 1)	137	103	5	16
DISABLED (disability = 0)	50	29	8	26
DISABILITY n.a.	15	11	0	4

Demographic Characteristics of Internet Users, UnUsers, and Never Users. Unusers are older adults who had used the internet but no longer do so. Never Users are older adults who have never used the internet.

we tested whether being a high-education person living in a high income/high education town was associated with a positive internet use decision.

Education rather than income level was used because the response rate on education level was higher than the response rate on income. In the lower-education, lower-income town, 56 of the 58 respondents reported their education level while only 49 respondents reported income. In the higher-education, higher-income town, 59 of the 61 respondents reported their education level while 46 reported income.

Results

Descriptive results

Results from the full data set of 202 respondents are reported in Table 1 and discussed in the descriptive findings. However, because of missing data on multiple variables, the logistic regressions reported in the next section are based on 155 observations.

A majority of respondents (70.8%) used the internet, while 29.2% did not (6.4% un-users and 22.7% never-users.) 68% of the respondents were women. Internet use was greater among higher-income (92%) than lower-income participants (59%), and among more-educated (87%) than less-educated older adults (48%). Male and female participants reported similar rates of internet use (70% vs. 72%). Non-disabled participants had a higher rate of use (75%) than the slightly disabled (58%). Caucasians had a higher rate of internet use (72%) than non-Caucasians (60%) (Table 1).

Need was the motivational variable most frequently cited by older adults as a reason for their internet use decision. Seventy-eight percent of users cited need, and 53 percent of un-users and never-users reported no need. This result was consistent with earlier studies that identified need as a significant determinant of internet use.

Among participants who used the internet because of need, email was the functionality most often reported (81%), followed by shopping (74%) and information and news (72%). Health information, entertainment, social contacts and networking, and banking were also significant categories of internet use.

Network externalities played a role in the decision of almost one-half of older-adult users. Forty-seven percent of users reported that they used the internet because family and friends used the internet and that they did not want to be left behind. This response was greater among women (53%) then men (33%). There was also anecdotal evidence of network externalities. Although participants were interviewed in private, participants from the same social cluster tended to have similar responses about internet use.

For about one out of every three internet users, adequate internet skills were a reason for their using the internet. Perceived skill was more important to female (38 percent) than to male users (24 percent). Lack of skill was not a primary reason why some of the older adults surveyed had never used the internet. Only twenty-eight percent of never-users reported lack of internet skill as a reason for non-use. Lack of need, and negative age perception, were more important reasons for non-use among those who had never used the internet. Forty-six percent of un-users reported lack of skill as a reason for nonuse: if skills training had been available,

Table 2: Logistic regression with demographic variables.

Logistic	Regression	With	Demographic	Variables
Variable	Marginal	Std.Error	p value	
	Effect			
Gender	-0.058	0.079	0.461	
Race	0.043	0.193	0.836	
Education	0.284	0.078	0.000	**
Income	0.22	0.09	0.014	**
Disability	0.135	0.077	0.080	*

Pseudo R^2 = 0.2163; ** significant at 0.05 level; *significant at 0.10 level

The marginal effects of Gender, Race, Education, Income and Disability on the probability of internet use.

Table 3: Logistic regression with demographic, motivational and age perception variables.

Logistic Regression: Demographic, Motivational, and Age Perception Variables				
Variable	Marginal	Std.Error	p value	
	Effect			
Income	0.2073	0.0745	0.005	**
Education	0.2994	0.0891	0.001	**
Race	0.0065	0.1991	0.974	
Disability	0.1186	0.0903	0.189	
Gender	-0.0234	0.082	0.775	
Attitude	0.0534	0.0762	0.484	
Need	0.2106	0.0894	0.019	**
Skill	0.1885	0.0798	0.054	*
Age Perception	-0.1606	0.7572	0.043	**

**significant at 0.05; *significant at 0.10; Pseudo R^2 = 0.2632

The marginal effects of demographic variables, motivational variables and age perception on the probability of internet use.

about one-half of un-users may have continued to use the internet.

Feeling too old for internet use was, not surprisingly, more prevalent among never-users (48%) than un-users (8%), and minimal among users (3%). A larger percentage of male (67%) than female (37%) never-users reported feeling too old to use the internet.

Results of logistic regressions

In the first logistic regression, we verified consistency with previous research by estimating the probability that an older adult used the internet from the demographic characteristics of gender, income, education, race, and disability (Table 2).

The results (Table 2) were consistent with previous studies. Income and education had significantly positive marginal effects on internet use. Older adults in the higher income group were 22 percent more likely to use the internet, and more educated older adults were 28 percent more likely to use the internet. Disability, race and gender did not have significant marginal effects at the 0.05 level, although disability was significant at the 0.10 level.

Next, motivational variables were included in the model. Table 3 displays the logistic regression results of the model that included demographic and motivational variables. The inclusion of both demographic and motivational variables improved the model fit, increasing the Pseudo R^2 from 0.2163 to 0.2632 (Table 3).

Education and income had significant marginal effects on internet use. More-educated older adults were 29 percent more likely to use the internet than less-educated older adults. Higher income increased the likelihood of internet use by 21 percent. Gender, disability and race did not have significant marginal effects.

Consistent with previous studies, perceived need for the internet had a significant marginal effect on the internet use decision. Older adults who based their internet use decision on need were 21 percent more likely to use the internet.

Paralleling earlier studies, skill level affected the internet use decision at the 0.10 level. Older adults for whom skill level influenced their internet use decision were 19 percent more likely to use the internet.

Age perception had a significantly negative marginal effect on internet use. Older adults who thought they were too old for internet use were 16 percent less likely to use the internet than older adults who did not see age as an issue.

The impact of network externalities on the internet use decision was investigated using Chi Square analysis. The Chi square result showed a positive association between living in a higher-income, higher-education town and internet use. χ^2 (1, N = 77) = 9.6749, p = 0.001868, which is significant at $p < 0.05$.

Discussion

The older adults surveyed had internet access at their senior centers and had no apparent physical or cognitive disabilities that might have prevented their internet use. Therefore, those older adults who did not use the internet could have used the internet but chose not to. This is an important distinction from previous studies that included older adults who lacked internet access or for whom disabilities may have prevented internet use.

Parallel with previous research, higher income and education levels, as well as perceived need and internet skill, increased the probability of internet use.

A majority of non-users reported lack of need as a reason why they did not use the internet. However, forty-seven percent of non-users reported lack of skill or negative age perception, rather than lack of need, as a reason for non-use. Lack of skill was particularly prevalent among un-users (46 percent), suggesting that if skill training opportunities had been available, these older adults may not have stopped using the internet.

The results confirmed the hypothesis that age perception has a significant effect on the internet use decision of older adults. Older adults who thought they were too old for internet use were 16 percent less likely to use the internet. Thirty-nine percent of non-users felt that they were too old for internet use. Feeling too old for internet use was particularly prevalent among older adults who had never used the internet (48 percent).

Chi square analysis confirmed our expectation that network externalities such as the bandwagon and social support effects influenced older adult internet use. Among higher-education older adults, an association existed between living in a higher-income, higher-education town and a higher rate of internet use. Because internet use rates are higher in higher income/education communities, older adults living in such communities are more likely to have friends and neighbors who use the internet. There is peer pressure to jump on the internet bandwagon! Older adults residing in higher education/income towns also benefit from a supportive environment toward internet use from their social network.

Conclusion

As internet use becomes increasingly ubiquitous, older adults who do not use the internet will become increasingly isolated and disadvantaged. The level of concern about the age-based digital divide depends to some extent on whether this digital divide will continue as younger adults, who are digital natives, become older adults. Although the results presented here are preliminary, they suggest that the age-based digital divide may continue.

Internet technology is on a fast track for dynamic development. New technologies and devices continually replace existing ones, which then become unsupported or obsolete. No longer in the workplace, future older adults may lack access to training in new technologies and modalities. Moreover, the psychological “switching cost” of adopting new technologies and modalities seems to be greater for older adults. The perception of being too old to adopt new technologies, reinforced by ageist messaging, may reduce the likelihood that adults will continue to use the internet as they age. Those who do continue internet use may shrink the breadth of their internet use to basic functionalities such as email.

Network externalities may also contribute to a continuing age-based digital divide. Future older adults, particularly those in lower income/lower education communities, may lack the social support to continue internet use.

Limitations

The survey population is a convenience sample of older adults in a specific geographic area. Future research based on a larger sample from a broader geographic area could provide more conclusive evidence about the roles of age perception and network externalities on older-adult internet use.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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