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The digital divide has grown old: Determinants of a digital divide among seniors

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Abstract

The diffusion of the Internet is reaching a level between 80% and 90% in Western societies. Yet, while the digital divide is closing for young cohorts, it is still an issue when comparing various generations. This study focuses specifically on the so-called 'grey divide', a divide among seniors of age 65+ years. Based on a representative survey in Switzerland (N = 1105), it is found that Internet use is strongly skewed in this age group leading to a partial exclusion of the old seniors (70+). Logistic regression shows that gender differences in usage disappear if controlled for education, income, technical interest, pre-retirement computer use and marital status. Furthermore, the social context appears to have a manifold influence on Internet use. Encouragement by family and friends is a strong predictor for Internet use, and private learning settings are preferred over professional courses. Implications for digital inequality initiatives and further research are discussed.

Keywords

Digital divide, grey divide, Internet access, media use, seniors, social capital, social context, social network, Switzerland

Introduction

As of 2012, the diffusion of the Internet has reached a level as high as 81% in the United States, 84% in Germany and South Korea, 85% in Switzerland and up to 95% in the Scandinavian countries (ITU, 2013). However, the diffusion of new technologies is neither

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a random nor an egalitarian process. Instead, Internet access is strongly correlated with various socio-demographic dimensions such as income, education, gender and age (Helsper, 2010; Korupp and Szydlik, 2005; Zickuhr and Smith, 2012). Due to the pervasiveness of the Internet, an increasing number of public and private services are re-designed as online solutions, and new proprietary applications are emerging. The combination of this increase of online services relevant for the economic, political, cultural and private life and the disparity of their use leads to inequalities on the level of individuals, social groups and nations. This development is negatively connoted by researchers and policy makers alike (DiMaggio et al., 2001; Sourbati, 2009; Vicente and López, 2011). Negative outcomes of a so-called digital divide are predominantly discussed in relation with political information and participation (Bonfadelli, 2002; Norris, 2003; Sourbati, 2009; Wei, 2012; Wei and Hindman, 2011), health, disability and well-being (Dobransky and Hargittai, 2012; Rains, 2008; Rice, 2006; Shapira et al., 2007; Slegers et al., 2008; Vicente and López, 2010), as well as social capital, social inclusion and social support (Livingstone and Helsper, 2007; Nimrod, 2010; Pfeil et al., 2010; Richardson et al., 2005; Sum et al., 2008; Xie, 2008). Terms such as 'digital divide' and 'digital exclusion' emphasize that existing gaps of digital technology use should be bridged, aiming for social inclusion and equal distribution of resources and life chances (Van Dijk and Hacker, 2003).

Over the years, additional distinctions have been introduced in the realms of digital divide research. Foremost, this includes the differentiation of adoption, access and more specific usage patterns and skills (Pearce and Rice, 2013). Adoption is mostly measured as a binary variable (e.g. have used the Internet vs have never used the Internet), while usage taps a continuous form of Internet usage (e.g. frequency of Internet use). Both are referred to as a 'first-level' or 'first order digital divide'. Beyond this *access* gap, further differences can be found regarding Internet-related technology *use*, skills and literacy. Among others, this divide is called 'second-level digital divide' (Friemel and Signer, 2010; Hargittai, 2002), 'second order digital divide' (Dewan and Riggins, 2005) or 'skills divide' (Mossberger et al., 2003; Van Deursen and Van Dijk, 2011). This field of research gains importance where the first-level digital divide is on the verge of being overcome. For example, among young people (15–29 years), Internet access practically entirely saturated with 95% in the United States (Madden et al., 2013) and even more than 97% in Switzerland (BfS, 2014) or Germany (Van Eimeren and Frees, 2013).

This study addresses the inequalities between age groups with special attention to the oldest members of society in comparison with their younger successors, also called the 'grey divide' (Morris and Brading, 2007). This specific digital divide across age groups has been documented by various Internet studies (Demunter, 2005; Katz and Rice, 2002; Latzer et al., 2013; Loges and Jung, 2001; Smith, 2014; Wei, 2012). Based on the analysis of secondary data reported in Figure 1, it becomes obvious that the first-level digital divide between young and old is far from being closed and deserves special attention. The statistics demonstrate a widening digital divide for Switzerland in the period between 1997 and 2013 between the youngest and the oldest age groups (14–29 vs 70+ years), measured by the share of regular Internet users ('daily' or 'several times a week'). But even more interestingly, these data illustrate a substantial limitation of many statistics that do not include older age groups or report them as though it was a residual. At the beginning of the measurements in Switzerland, 'older' users are aggregated into

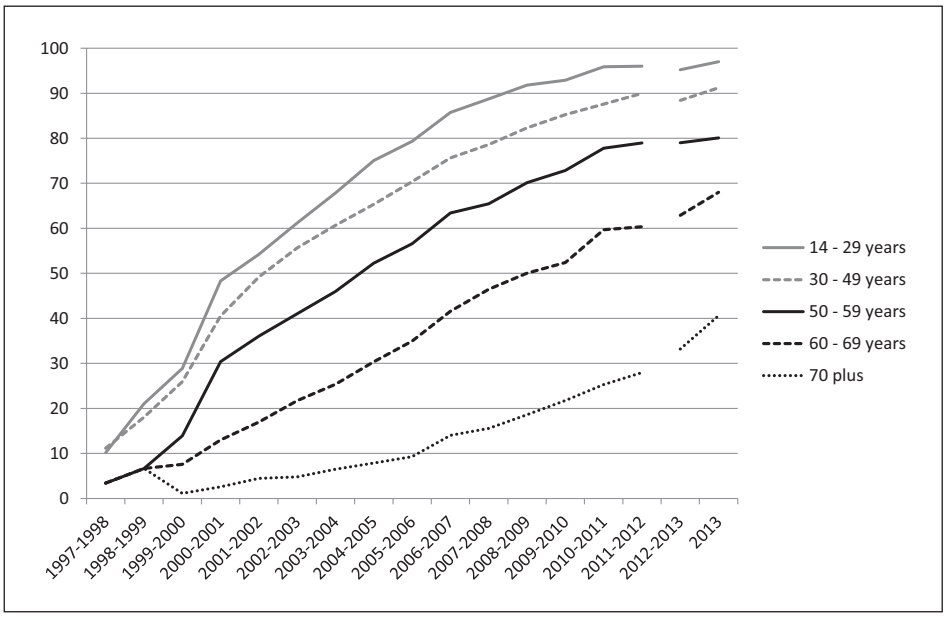

Figure 1. Internet use in Switzerland (1997–2013) by age groups. Data: percent of the Swiss population (14 years +) which uses Internet daily or several times a week. New methods starting in 2013 restrict a direct comparison with previous years.
Source: MA-Net; Net-Metrix-Base, retrieved from Swiss Federal Statistical Office (BfS, 2014).

the category '50+'. Starting only in the year 2000, more detailed statistics are reported, differentiating age groups 50–59 years, 60–69 years and 70+ years. Thus, it becomes evident that the major gap does not lie between what might be called the 'pre-seniors' (50–59 years), from those younger but rather between the 'old seniors' (70+) and the rest of the populace.

Internet use of seniors

While age is a significant explanatory variable in most digital divide studies, only few focus on seniors. Due to practical reasons concerning data collection by means of telephone surveys and low case numbers, most commercial statistics and also the majority of scientific research apply an upper age limit or report the results for a rather vaguely defined, open-ended cohort. Various bottom lines have been applied for the definition of 'seniors', 'later life' or 'older citizens', including people aged 50+ years (Gilleard and Higgs, 2008; Lee et al., 2011; Xie, 2008), 55+ years (Peacock and Künemund, 2007) or 61+ years (Selwyn et al., 2003), and it seems as though research was often times more concerned with labelling this group in a politically correct way than with the implications of treating such a diverse group as constituted of equals. Practical reasons often inhibit research on the 70+ -year-olds, for this is a cohort hard to get hold of in telephone surveys (e.g. people living in retirement homes without individual phone line). This has

led to a relatively limited knowledge of the digital divide among seniors above the age of 65 years.

Peacock and Künemund (2007) analysed socio-demographic correlates of Internet use. Compared to 'middle aged' which they define as people between 55 and 64 years of age, young seniors (65–74 years) are only 63% as likely to use the Internet, while old seniors (75+) are only 30% as likely. Additional correlates indicate that persons with a partner, higher level of education, professional occupation (vs retired or homemaker) and male seniors are more likely to engage in Internet use. Similar findings have also been reported by Selwyn et al. (2003) who found males, younger seniors (61–70 vs older), married persons with no long-term illnesses and those with higher education to be more likely to be online.

Besides the lack of technical devices to access the Internet, the main reasons for not using the Internet were found to be either motivational indifference (perceived uselessness of the information on the Internet or little relevance for one's life), or deficient knowledge (Peacock and Künemund, 2007; Schelling and Seifert, 2010; Selwyn et al., 2003; Zickuhr, 2013). Lee et al. (2011) identify four factors influencing Internet usage among seniors: (1) intrapersonal factors such as motivation and self-efficacy, (2) functional limitations such as decline of memory or spatial orientation, (3) structural limitations such as costs and (4) interpersonal limitations such as the lack of support to start using it or someone to send an email to. Their comparison of three age groups of 'pre-seniors' (50–64 years), 'young-olds' (65–74 years) and 'old-olds' (75+ years) found that the strength of influence of three of these factors differ across age groups.

The concept of *social capital* has been established as a crucial component of research on computer-mediated communication. However, most studies treat social capital as a dependent variable influenced by Internet use (Sum et al., 2008; Xie, 2008) and not as an independent variable explaining it. For example, it was found for older immigrants to Israel (aged 69–89 years) that the Internet enables seniors to maintain and extend their social network (Khvorostianov et al., 2012). Empirical studies on the reverse causal direction (social capital affecting Internet use) are limited, and results vary depending on the operationalization of social capital. Gilleard and Higgs (2008) did not find any influence of social capital when measured as the number of close relationships. Elsewhere, Korupp and Szydlik did not consider the sheer number of social ties but rather focused on family context, finding that households with children or adolescents are more likely to have computer and Internet access. Family context was even more important than economic capital (Korupp and Szydlik, 2005). With respect to socio-economically disadvantaged persons, it has been reported that support from acquaintances and their respective expectations (that the person should use the Internet) determines Internet use to a great extent (Hsieh et al., 2011). Additional support for the relevance of the social network on Internet use is provided by the finding that private support by family and friends is of higher relevance for seniors compared to professional support or online help when having problems with the computer (Selwyn et al., 2003). Furthermore, computer self-efficacy in general seems to be influenced by usage patterns within and encouragement by one's social network (Compeau and Higgins, 1995). However, as empirical studies show, older peoples discomfort with technology might not only lower but also increase the enthusiasm for technology adoption (Gilly et al., 2012).

Summarizing this body of literature, two groups of variables can be identified: individual-level factors and social-context factors. Individual factors include human capital such as education, motivation, technical interest, economic capital (income), health, age and sex. The social context encompasses marital status, social capital (support and encouragement by social network members) and Internet use within one's social network. The latter is of relevance because many Internet services provide computer-mediated interpersonal communication services for which one needs others to interact with (Rice et al., 1990).

Research questions

Based on the empirical findings cited above, it is expected to find a digital divide not only between the cohorts of the young and seniors but also within seniors as a hitherto undifferentiated cohort. Hence, the first research question looks at the proportion and frequency of Internet usage within groupings of persons 65 years and older.

RQ1. What proportions of groupings of seniors are using the Internet with which frequency?

The second research question addresses the factors accounting for Internet use or non-use. The literature suggests testing for socio-demographic variables such as sex, age, education, income, and occupational exposure to PCs. Furthermore, an increasing body of literature also suggests considering the influence of the social network. Processes of diffusion within social networks and the support provided among its members work as a kind of social capital and are likely to influence a person's adoption of Internet use. Therefore, the second research question regarding influencing factors for Internet use can be separated in two sub questions addressing individual and social aspects.

RQ2a. Which individual factors influence the likelihood of seniors' Internet use?
RQ2b. Which social factors influence the likelihood of seniors' Internet use?

With exception of age and being female, all factors are hypothesized being positive. In addition to the variables listed in Table 3, a positive effect was expected for intensity of Internet use in seniors' social network.

Many socio-economic and social factors cannot be directly influenced by digital inequality initiatives or are merely indicators of underlying hurdles for Internet use. For example, if income is found to be negatively correlated with Internet use, the financial situation of offliners cannot be improved by an initiative for this means nor are the costs necessarily the actual reason for Internet abstinence. Hence, offliners should not only be compared to onliners to identify significant correlates when trying to tap reasons for differences in their usage patterns. It is necessary to address reasons for denial of adoption independent from the individual and the social factors mentioned above. Therefore, the third research question focusses on reasons for not using the Internet as perceived by offliners.

RQ3. Which reasons keep offliners from using the Internet?

Method

A representative random sample of 1103 seniors (65 years and older) covering all three major language groups in Switzerland (German, French and Italian) was interviewed August through September 2009. In a first step, a random sample of registered households was drawn and informed about the interview by a postal letter. Next, households with a registered phone number were contacted by telephone, and a random person living in this household was interviewed by a telephone interview (computer-assisted telephone interviewing [CATI]). Households without registered phone lines and persons who were not able or willing to participate on phone received a paper and pencil version (pen and paper interviewing [PAPI]). This ensured that, persons without a direct telephone line (e.g. residents of retirement homes) were considered adequately. For the results reported here, no significant methodological influence was found. The initial sample for CATI interviews included 1544 addresses, out of which 871 interviews were completed (56%). Adjusting for neutral non-responses, the response rate is 61%. As was expected, the response rate for the PAPI interviews was lower (25%). Reasons for non-response are only known for the CATI interviews. Here, the prevailing reason is a general rejection of telephone surveys (20%). About 5% of the original sample were not able to participate in the survey due to health problems. The questionnaire and some additional details regarding the methods are documented in the project report (Schelling and Seifert, 2010).

Compared with official census statistics, males, young seniors (65–69 years) and formally higher educated individuals are over-sampled. To adjust for these biases, data were weighted by sex, age, education and language, based on probability statistics of the national census, and using a repeated weighting procedure according to Rothe and Wiedenbeck (1987). The weighting parameter ranged between 0.15 and 3.78 ($M = 1.00$, standard deviation [SD] = 0.513). Table 1 reports the sample size (n), the statistics of the national census and the share in the weighted sample.

Measures

Internet use was measured through two questions. First, it was asked whether one had *ever used* the Internet (i.e. adoption). Persons confirming to have used the Internet at least once were then asked *how often they had used the Internet during the past 6 months*. Answer categories included 'daily', 'several times a week', 'several times per month', 'fewer' and 'never'. These categories were recoded to differentiate between persons who used the Internet at least once in the past 6 months (*onliners*), and those having been online less frequent or never (*offliners*). This dichotomy matches the national statistics of Internet use reported in Figure 1. For the descriptive statistics, *age groups* span 5 years each with a last (residual) group of 85+ years. *Education* was measured as the highest degree in scholar formation. Categories were again chosen to fit the national census data to control and correct for sample bias. *Income* was measured in Swiss Francs (CHF) on household level per month before tax.

General technical interest was measured through the question whether one agreed or disagreed with the statement 'I am very interested in new technical things' (5-point scale from 1 = 'fully disagree' to 5 = 'fully agree'). The influence of the social network was measured on two dimensions. First, it was asked how intense the Internet is used by the

Table 1. Population, sample and Internet use by sex, age, language and education.

Category	Values	Population and sample			Internet use in past 6 month	
		n	Official statistic %	Weighted sample %	Onliner % (weighted)	Offliner % (weighted)
Total		1103			35.9	64.1
Sex	Male	499	42.8	42.6	47.4	52.6
	Female	604	57.2	57.4	27.4	72.6
Age (years)	65–69	401	28.5	28.5	56.6	43.4
	70–74	247	22.4	22.4	49.0	51.0
	75–79	197	19.2	19.1	28.4	71.6
	80–84	147	14.8	14.8	14.4	85.6
	85+	103	15.2	15.2	8.6	91.4
Language	German	801	71.4	72.0	35.3	64.7
	French	198	23.2	22.7	39.2	60.8
	Italian	104	5.4	5.2	30.9	69.1
Education	General education	239	37.4	38.3	15.1	84.9
	Apprenticeship	559	40.4	41.3	41.8	58.2
	Higher education	71	4.6	4.7	49.1	50.9
	University	222	15.4	15.7	69.6	30.4

respondent's social network (*Internet use by social network* [SN]). This was measured on a 5-point scale (1 = 'not at all' to 5 = 'very intense') for life partners, children, grandchildren, siblings and friends separately. Second, it was asked for each of these reference groups whether they advised the interviewed person for or against Internet use (*encouragement by SN*). This was again measured on a 5-point scale (1 = 'advice not to use the Internet' vs 5 = 'encourage using the Internet'). Arithmetic means of the two sets of variables were calculated as two indexes for further analysis (*Internet use by SN* and *encouragement by SN*). Both scales were suggested and validated by Compeau and Higgins (1995) to explain computer self-efficacy. A German version was tested in an unpublished project with 654 seniors of 50 years and older (Riesen and Hänggli, 2006).

The *reasons for not using the Internet* are listed in Table 4 and the *preferred learning settings* in Table 5. For the later, respondents had to rate the settings as being 'attractive' or 'not attractive'.

The whole questionnaire was pretested for both methods (CATI and PAPI). Based on this pretest, some question wordings were slightly adjusted to meet the special criteria of the respective survey setting.

Results

Frequency of seniors' Internet use

Table 1 reports the results for the *first research question* regarding the *frequencies of Internet use of Swiss seniors of 65 years and older (RQ1)*. In 2009, 35.9% Swiss seniors

Table 2. Descriptive statistics of independent variables.

Measure	*n*	*M*	*SD*	α
General technical interest	1071	3.11	1.66	–
Income (CHF)	872	4.982	2.691	–
Internet use by SN (mean)	1.05	3.21	0.97	.33
Life partner	685	2.07	1.49	–
Children	844	4.45	0.93	–
Grandchildren	672	3.91	1.52	–
Siblings	709	2.31	1.48	–
Friends	880	3.20	1.31	–
Encouragement by SN (mean)	1.03	3.24	0.76	.85
Life partner	653	3.12	1.15	–
Children	853	3.54	1.04	–
Grandchildren	698	3.35	0.89	–
Siblings	732	3.01	0.88	–
Friends	962	3.19	0.85	–

n: number of cases; *M*: mean value (scale from 1 to 5 for all variables except income); *SD*: standard deviation; α: Cronbach's alpha; CHF: Swiss Francs; SN: social network.

used the Internet during the past 6 months, while 64.1% are regarded as offliners. The onliners include 16.5% seniors with daily use, 11.2% use it several times a week, 4.7% several times per month and 3.5% less often. The offliners include 3.7% that have used the Internet at least once in their life but not within the last 6 months and 60.4% that have never used it before.

Individual and social factors influencing the likelihood of seniors' Internet use

Table 1 also provides results addressing the *second research question* regarding *individual factors influencing seniors' Internet use (RQ2a)*. Bivariate analysis indicate significant associations between frequency of Internet use and sex, age and education. No significant effect was found for language. The average age of onliners is 71.5 years (standard error [*SE*] = 0.29), while offliners are on average 6 years older, $M = 77.4$, $SE = 0.29$, $t(998) = -14.4$, $p < .001$. The test statistics for sex, age and education are not reported in detail at this point since they are not independent from each other and demand multivariate analysis (see below).

Table 2 reports descriptive statistics of general technical interest, income and the *social factors which might influence seniors' Internet use (RQ2b)*. As mentioned in the section above, all variables except income and education are measured on a scale from one to five. The mean general technical interest is close to the arithmetic mean of the scale and includes sufficient variance to be considered for further analysis in the regression models ($M = 3.11$, $SD = 1.66$). The mean income per household and month is 4982 CHF, which is a valid result if compared to official statistics.

In the last column, Cronbach's alpha (α) is reported for the composite measures regarding the social network (*Internet use by SN* and *encouragement by SN*) for each of

Table 3. Logistic regression analysis of Internet use.

Predictor variables	Hypothesized effect	Model 0	Model 1		Model 2		Model 3		Model 4		Model 5	
			B (*SE*)	OR	*B* (*SE*)	OR	*B* (*SE*)	OR	*B* (*SE*)	OR	*B* (*SE*)	OR
Constant			5.16 (1.07)	–	2.79 (1.19)	–	−1.43 (1.37)	–	−2.39 (1.45)	–	−3.43 (1.55)	–
Age	–		−0.12 (0.01)	0.88***	−0.09 (0.02)	0.91***	−0.09 (0.02)	0.92***	−0.09 (0.02)	0.91***	−0.08 (0.02)	0.92***
Sex (F)	–		−0.24 (0.18)	0.79	0.01 (0.20)	1.01	−0.11 (0.22)	0.90	−0.14 (0.23)	1.15	0.28 (0.24)	1.32
Education	+		0.62 (0.09)	1.85***	0.45 (0.10)	1.56***	0.39 (0.11)	1.48**	0.35 (0.12)	1.42**	0.39 (0.12)	1.48**
Income	+		0.28 (0.05)	1.33***	0.22 (0.05)	1.25***	0.19 (0.06)	1.21***	0.20 (0.06)	1.22**	0.15 (0.06)	1.16*
Pre-retirement computer use	+				2.17 (0.20)	8.76***	2.10 (0.21)	8.17***	2.11 (0.23)	8.20***	2.18 (0.23)	8.86***
Encouragement by SN	+						1.27 (0.16)	3.55***	1.19 (0.16)	3.28***	1.22 (0.17)	3.39***
General technical interest	+								0.49 (0.08)	1.64***	0.49 (0.08)	1.63***
Partnership	+										0.59 (0.27)	1.80*
Nagelkerke's R^2		.10	0.36		.52		.60		.64		.64	
Correct classification		59.3	74.5		80.7		83.0		83.9		84.2	

OR: odds ratio; SN: social network; F: female.
Significance level of OR *$p < .05$. **$p < .01$. ***$p < .001$.

Table 4. Reasons for not using the Internet (percent of consent).

	Total	65–69	70–74	75–79	80–84	85+
n	525–626	118	117	139	115	128
Use is too complicated	64.6	61	63	63	69	68
High effort to learn	60.2	54	60	55	64	68
Safety concerns	52.8	63	65	59	50	29
Concerns of technical problems	50.0	53	55	48	51	44
Other person provides information and sends e-mails	44.1	50	47	46	39	37
Costs too high	32.1	31	28	30	40	32
Lack of support	30.6	37	31	27	27	32
Limited eyesight and hearing	29.9	22	18	26	33	49
Obscene content	29.6	30	39	34	27	18
Memory problems	28.6	26	21	37	26	31
Low credibility of content	25.4	25	33	21	30	19
No time	21.6	30	27	16	24	13
Dexterity	18.5	12	12	19	25	25

Table 5. Preferred settings for learning Internet use (percent of consent).

	Total	65–69	70–74	75–79	80–84	85+
n	574–590	96	94	92	72	55
Support at home by family and friends	74.0	76	74	72	71	75
Initiative with adolescents as coach	62.9	67	65	62	53	57
Peer-mentoring among seniors	57.3	62	62	55	40	53
Class	56.4	61	54	57	47	56
At home by a professional	43.9	49	41	43	42	33
Autodidactic	32.9	34	39	29	27	27

which a mean across five variables is calculated (including life partner, children, grandchildren, siblings and friends). The results indicate that the reliability of the scale to measure Internet use by the social network is insufficient ($\alpha = .33$). Put in other words, the perceived Internet use is not very consistent among seniors' social networks. In contrast, the effect of encouragement by the social network is very consistent across all five reference groups ($\alpha = .85$). For both network dimensions, perceived Internet use and encouragement are highest for children, followed by grandchildren and friends (see Table 2). Siblings and life partners, on the other hand, are less frequent users and also less encouraging. All differences among the five items in each scale are significant (pairwise t-test, $p < .05$).

In all, 57.9% of the sample are married or have a partner (42.1% are unmarried, widowed or divorced) and 57.8% have worked with a computer before retirement. The vast majority live in their own apartments, while only 7.7% live in retirement or nursing

homes. A total of 55.7% live in rural areas (places with less than 10,000 inhabitants), while the rest live in urban areas.

Logistic regression analyses were conducted to test the hypothesized influence of individual (*RQ2a*) and social factors (*RQ2b*) on the likelihood of a person to use the Internet (vs non-use). As mentioned above, *onliners* are defined as persons who have used the Internet at least once in the past 6 months. Table 3 reports the B values, their SEs and the odds ratios (ORs). In model 1, all socio-demographic factors discussed above are included. Here, significant influences are found for age (years), education and income. As in the analysis above, a negative influence of age is found, while education and income are positively correlated with Internet use. The OR indicate how the likelihood of Internet use changes if the independent variable increases by one unit. Hence, the value of 0.88 for age means that with every additional year of age the likelihood decreases by 12% (to 88% of the year of birth before). A person in the next higher education category is 1.85 times as likely to belong to the group of Internet users (increase by 85%), and income increases the likelihood by 33% per every additional income level.

Models 2–5 report a stepwise inclusion of pre-retirement computer use, encouragement by respondent's social network, his or her general technical interest and marital status (partnership). Model 2 shows that the inclusion of pre-retirement computer use has a strong impact on a senior's Internet use. Persons who have used a computer at least from time to time before their retirement are 8.76 times as likely to belong to the group of onliners. Also, *encouragement by the social network (model 3), general technical interest (model 4)* and *marital status (model 5)* are significant factors to explain a senior's Internet use.

Furthermore, a positive influence of *Internet use by one's social network is hypothesized*. However, this factor is not included in any model since the construct lacks reliability. If one disregards this limitation and forces the mean-index into the model, it reveals no additional explanatory power (i.e. not significant at the .05 level). Also including each subgroup separately (i.e. life partner, children, grandchildren, etc.) did not result in significant effects. The only effect being close to significance was found for grandchildren ($B = -0.259$, $SE = 0.136$, $p = .056$). No significant influences were found for the *housing situation* (private vs any kind of retirement or care home), *rural vs urban regions* and the three *language groups* (German, French, Italian). *Sex* was not significant in any model. However, it was included to enhance comparability with other studies.

Nagelkerke's R^2 indicates how well the models explain whether a person is an onliner or offliner. The four variables in model 1 together explain 36% of the variance (compared to 10% of model 0 which includes only the intercept but no predictors). The inclusion of *pre-retirement computer use* and the *encouragement by the social network* substantially increases the explained variance to 52% and 60%, respectively. *General technical interest (model 4)* and *marital status (model 5)* add only little and the final model explains 64% of variance.

Alternatively, the explanatory power of the model can be illustrated by the proportion of correct classification reported in the last row of Table 3. This indicates that in 59.3% of the cases the prediction of a senior's Internet use are correct in model 0 (based on the

mere frequency in the population). Taking the eight explanatory variables of model 5 into account this percentage raises substantially to 84.2%.

Factors which keep offliners from using the Internet

The *third research question* addresses *reasons why offliners are kept from using the Internet (RQ3)*. Only seniors who had never been on the Internet in their life were considered for this analysis. Table 4 reports the percentage of seniors who agree with a particular statement. The first column reports the total for all seniors and the subsequent columns the percentages per age group. Based on the total column, the items can roughly be divided in three groups. More than half of all seniors agree on the first four items making them *dominant hurdles for Internet adoption*. The first two and most important items refer to the complexity of Internet use and the effort that has to be taken at the beginning. These items are followed by concerns about security and technical problems. The second group (though consisting of a single item) refers to a kind of *pointlessness of using the Internet oneself*: 44%. The third group seems to be of *subordinate relevance* since the items apply to a third of the respondents or less. These items include lack of resources like money and time, negative evaluation of online content (improper and low credibility), lack of support and physical or mental limitations (eyesight, hearing, dexterity and memory). Comparing the results for the various age groups, only a few substantial differences can be found. For the oldest age group (85+), limited eyesight becomes a major issue while security concerns are of comparably low importance.

The question whether the cost factor is associated with limited financial resources is tested by a bivariate correlation. A small negative correlation ($r_P = -.23$, $p < .001$) between costs as a reason for not using the Internet and income is found. This indicates that non-adoption is only weakly associated with net income.

When asking offliners for preferred learning settings, it becomes apparent that professional settings are less attractive compared to private settings (see Table 5). It can be suspected that the encouragement by one's social network also has a positive influence on the evaluation of these learning settings. Therefore, bivariate correlations of these variables and the encouragement by one's social network are calculated. Weak but positive associations between .20 and .25 for all items with the exception of 'at home support by a professional' are found.

Discussion

The results show a clear picture regarding the *first research question* and the digital divide among seniors aged 65 years and older in 2009. Only about a quarter of the Swiss seniors are onliners, and it seems to be as though Internet use is an all-or-nothing issue: seniors tend to be either intense Internet users or non-users with only few in between. Furthermore, for seniors older than 70 years, the relation between age and Internet use seems not to be linear but rather exponential. Only 4.9% of the seniors in the age group of 85+ years are using the Internet regularly, and within every 5 years younger cohort, this share approximately doubles (9.4%, 19.7%, 40.0%). This pattern illustrates why it is crucial to also include old seniors above the age of 75 as well as to not treat the seniors

as a residual category encompassing all ages above 50 or 60 years to get a valid picture of today's digital divides. Also, the magnitude of the differences emphasizes that the digital divide contains a distinct *grey divide*, which is still far from being closed. Most authors conclude that the age divide is a *temporal phenomenon*. In this reading, it is rather a generation cohort effect, which will disappear once the younger generations of onliners gets older and offliners pass away. Several authors argued that the digital divide will start reversing once those retire who already used the Internet during their labour time (Gilleard and Higgs, 2008; Peacock and Künemund, 2007) and that older adults are the fastest growing group among computer and Internet users (Kim, 2008; Wagner et al., 2010). This argument is supported in this study by the strong influence of *pre-retirement computer use*. If someone has used a computer before retirement, the likelihood of being an onliner is almost nine times as high compared to those who have not used a computer. However, it can be argued that this cohort effect might hold true for the younger seniors but not for the old seniors. The findings that every second senior of age 85 years and older is not using the Internet due to limited eyesight or hearing, with one-quarter mentioning dexterity issues (see Table 4), illustrate that the grey divide is not only a cohort issue (e.g. former onliners might become offliners due to physical limitations). Hence, in addition to appropriate support settings, technological improvements are necessary to address the age-related hurdles affecting senior technology use. Up to now, this issue has been raised by various authors (Charness and Boot, 2009; Kim, 2008; Lee et al., 2011), but little empirical data are available. Furthermore, if the gap between onliners and offliners is left to be closed merely through Internet users' ageing, it will be yet several years before even only one out of two seniors is online. Considering the development of the Internet over the past 20 years and its ever-growing relevance for virtually any aspect of societal life, just hanging on does not seem to be a viable option for digital inequality initiatives.

The second research question addresses individual factors (RQ2a) and social factors (RQ2b) influencing the likelihood of seniors' Internet use. Bivariate analyses suggest a strong correlation with sex, age, and education. However, logistic regression shows that sex becomes insignificant if controlled for other individual factors like age, education and income. This holds true for all models reported in the previous section. Hence, the large gap between males and females (38.9% and 19.4% weekly users, respectively, which is comparable to the findings of Selwyn et al., 2003) is not directly confounded with sex but rather with other factors which are determined by the respondent's sex. Among this generation, the correlation of sex with education and income is stronger compared to later generations for which educational opportunities were more equal. This might also explain why this finding stands opposed to the hypothesized effect direction and other senior-focused studies like the one by Peacock and Künemund (2007). That particular study includes the age group of 55- to 64-year-olds for which a gender-determined difference was indeed found. For education and income, the hypothesized effects are confirmed. Both factors have a strong and separate influence on Internet use of seniors. The effect of general technical interest points in the hypothesized direction. Its magnitude is comparable to education, which suggests a possible starting point for digital inequality initiatives: since education levels cannot be raised in this cohort, it could be more feasible to appeal to and attempt to increase general technical interest.

Hence, campaigns should try to raise the openness for new technologies by promoting the benefits of Internet use through persuasive messages (Hsieh et al., 2011). The relevance of this argument is also supported by the finding of Melenhorst et al. (2006) who have found that technology adoption by seniors is mainly driven by perceived benefits, while limiting factors like costs are of less importance.

Besides these individual factors, this study also considered *factors of the respondent's social context* as being important. Two factors were hypothesized to have a positive *influence on the likelihood of seniors' Internet use (RQ2b)*. While encouragement by the social network has a strong positive impact on Internet use, the applied measure of how frequently the Internet was used in one's social network did not yield any kind of systematic influence. Internet use in one's social network neither has an influence in its aggregated form nor by focusing on a single subgroup of the social network nor by an interaction with encouragement. One can think of three possible explanations for why *perceived Internet use in the social network* did not show any effect. *First*, it can be argued that the perception of Internet use by one's social network might be inaccurate. This might be at random thus diluting any factual influence beyond statistical significance or even systematic as the negative effect for grandchildren suggests (offliners might overestimate Internet use by their grandchildren, while onliners know that they use it on a 'normal' level). *Second*, there is only little variance for Internet use of children which limits its explanatory potential. *Third*, Internet use by life partners and friends can have opposing effects. On one hand, it can be argued that the use by these persons obliterates the need to use the Internet oneself since they provide all information and services by a kind of a two-step flow of communication (Lazarsfeld et al., 1968 [1944]). In fact, the results reported in Table 4 support this assumption turning offliners into 'proxy users' (Dutton et al., 2013). A total of 44% of all offliners in this study do have an *indirect* access with other people looking up information on the Internet and sending e-mails for them. On the other hand, support by family and friends are considered the most attractive way of learning (see Table 5). These opposing effects might cancel out each other resulting in a non-significant parameter in the logistic regression.

Comparing the various ORs within a model, one has to be aware of the different scale ranges (binary variables vs 4-point scales, etc.). Therefore, the potential influence of some variables is a multiple of the indicated ratio. For example, the likelihood of a person with an encouragement score of 5 would be about 450 times (=3.393^5) as high to use the Internet compared to a person with an encouragement score of 1 (given all other factors being equal). It has to be noted that this rather large number has to be interpreted with some caution because the confidence interval (CI) is large as well ($CI_{min} = 88$, $CI_{max} = 2294$). However, even a multiplication by 88 (the lower end of the CI) is a very strong effect.

The strong effect of *encouragement by the social network* on respondent's Internet use is in line with findings based on the diffusion of innovations theory of Rogers (2003). It can be hypothesized that encouragement/discouragement is a function of expected benefits and risks. If benefits outweigh the risks the social network is probably more likely to encourage the seniors. Benefits might, for example, arise from new services for computer-mediated interpersonal communication (Kim et al., 2007) or health services, while risks might arise from viruses, privacy concerns and fraud (Hakkarainen, 2012;

Yao et al., 2007). Following this argument, it will be of interest to investigate these potential factors to answer the question why people encourage or discourage seniors to use the Internet. It could be worthwhile to consider possible 'third person effects' (Gunther, 1991). The third-person effect describes the finding that people assume negative media effects to be stronger on others and more so the more distant the respective reference group is from themselves. For example, negative effects are assumed to be stronger for friends than for oneself and even stronger for the general population. Analogously, this could lead to a bias between estimation of one's own benefit/risk ratio and the ratio for various reference groups, such as same-aged people and seniors. According to this argument, encouragement could be lower if age difference between the supporters and the seniors are larger.

In addition to the correlating factors of Internet use, the *third research question addresses offliners' reasons for not using the Internet (RQ3).* The ranking of the stated reasons for non-use was divided into three groups: dominant hurdles for Internet adoption relevant to more than half of all offliners, subordinate hurdles affecting only a third or less and some form of substitution by second-hand information. In fact, the dominant and minor reasons seem not only to be different by frequency but also by content. The dominant reasons refer to concerns of potentially negative outcomes which are *expected* to be related to Internet use. Hence, seniors expect the Internet to be complicated to use and difficult to understand. They also expect to face serious security threats and technical problems. In contrast to these supposed problems, all *actual* hurdles are of minor relevance, restraining merely one-third or less of all offliners. These include financial reasons, physical and mental limitations and the lack of support. The weak correlation between costs (as a reason for not using the Internet) and income illustrates that these two factors cannot be treated as equal. Hence, the finding that income is a significant correlate of Internet use does not necessarily mean that costs are a major hurdle that needs to be addressed by digital inequality initiatives. Based on the findings reported, it seems to be more relevant as well as more feasible to lower the other perceived hurdles and to increase perceived benefits. As suggested with respect to general technical interest, this could be attempted by public communication campaigns (Rice and Atkin, 2013).

The results regarding *preferred learning settings* emphasize the relevance of one's social network for Internet adoption. Seniors not yet using the Internet seem to have a clear preference for private learning settings.

Taken together, *the social context seems to influence Internet use in manifold ways. First*, encouragement by one's social network is found to be a major factor influencing the likelihood of Internet use. *Second*, for those not using the Internet, it would be most attractive to learn it from friends and family. *Third*, the positive correlation of the encouragement scale and the approval of the various learning settings suggest that one's social network is not only providing a direct support but also motivating an offliner to make use of other kinds of support. *Fourth*, the social network might not only influence and support seniors to use the Internet but also provide offliners with second-hand access. Future research should put more emphasis on a detailed analysis of the various supporting and substituting influences of the social network. Theoretical concepts and methods developed in social network analysis could make an important contribution to the analysis of the digital divide among seniors. This might range from simple ego-network data to the

latest innovations for analysing dynamics of longitudinal social networks to disentangle influence from selection processes (Friemel, 2012; Snijders et al., 2010).

As mentioned in the introduction, the 'digital divide' can be defined on various levels. The present study focusses on the perspective of Internet use and does not take into account any subsequent divides such as use of specific applications, information and communication technology (ICT)-literacy differences or the like. It can be argued that the access divide is only the first gap, and many more gaps need to be closed before we can assume an inclusion of seniors within today's new media society. However, the finding that only about a third of all seniors older than 65 are online indicates that the first and very basic digital divide is still the one that needs to be overcome first.

With the exception of gender and perceived Internet use of friends and relatives, all hypothesized influences were confirmed by this study. Above all, *age continues to have a differentiating effect*, net of all other factors. With every additional year of age, the likelihood of Internet usage decreases by 8%, though, in fact, it decreases nearly exponentially in five-year differences. When considering a range of 65–90 years or more, this leads to huge inequalities. Hence, the digital divide intensely discussed at the beginning of the new millennium is not yet close to being closed. The digital divide defined as an access gap has grown old by the means of the affected age cohort but not by the topicality of the issue.

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