Technology generations revisited: The internet generation

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R. Sackmann, O. Winkler. Technology generations revisited: The internet generation. Gerontechnology 2013;11(4):493-503; doi:10.4017/gt.2013.11.4.002.00 This article identifies the practices and formation processes of technology generations. To that end the question is examined whether a new internet generation can be identified in relation to the previous known other generations characterized by mechanical technology, household revolution, a technology spread, and computers. This study used the ICT data set from the Statistical Bureau of Germany, survey waves 2004 and 2009. Logistic regression techniques were used for the analysis. The analysis evaluated if the four existing technology generations are still marked by the 'first-level digital divide' (differences in possession) and the 'second-level digital divide' (different modes of usage). We found that in 2009 there were still significant differences between technology generations in private internet use. The emergence of a new generation, distinct from the computer generation was investigated. The evidence supports the view that a new internet generation has indeed emerged as significant differences between these generations ('computer' and 'internet') exist with regard to the two levels of digital divide.

Keywords: cohort effect, technology acceptance, internet generation, technology generation

Demographic change, especially the reality of an ageing population, is commonly recognized as an important feature of the changing social structure in industrialized and industrializing societies. One way to face this challenge is the intelligent use of technology: either by helping older people using existing technological equipment or by developing new products that better suit the needs of older citizens. When thinking about the issue of demographic ageing, the concept of technology generations is useful. On the one hand, the correspondence between changing technology and cohort replacement can be analysed by closely looking at the appropriation of technologies and the long-term practical consequences. On the other hand, empirical results of the analysis may help product developers, consumers, and life-long learners, among others, to reflect and change their habits by being more sensitive to the diversity of options[1].

The aim of this article is twofold: Firstly, to provide a review of the literature on technology generations twenty years after this concept was first developed. Secondly, to provide an empirical analysis of technology generations, with special reference to a new emerging technology generation, the so-called internet generation. This generation is often alluded to, but so far often without sound theoretical and empirical underpinning. So, is this just a media hype, or can we justifiably speak of a new technological style?

The concept 'Technology generation'

Building on theories of generation[2-4] and technology adaptation in everyday life[5-7], the concept of technology generations was developed by German sociologists in the early 1990s[8-10]. They defined a technology generation as groups of birth cohorts whose conjunctive experience with technology is differentiated by social change. Fast technological change, especially a change of basic technology, enlarges inter-cohort differences and raises the likelihood of a conscious perception and description of differences as generational difference. By their contemporary technological actions people reproduce or dissolve technology generations (technological practice=doing and undoing generation). The likelihood of the adoption of an innovative technological practice in later adult life ('undoing generation') is higher if the expected remaining years of active life increase (for instance, by postponing retirement).

The concept of technology generations encompasses technologically related cohort effects[11] (=long lasting differences between birth cohorts in a given society) by referring to cohort differentiation due to changes in the social and cultural environment. It adds a generational perspective in sensu Mannheim[2] by viewing basic technology changes as discontinuous breaks in technological evolution. Changes in basic technology causing generational differentiation usually oc-

cur when a new technology reaches a 20 percent threshold in households in the relevant formative years (ca. 15-25 years) of birth cohorts[3,12]. Most data reported in this article refer to a grouping of birth cohorts in highly industrialized European societies, and our findings would have to be adapted to local technological spread patterns for other regions of the world.

The original study on technology generations used qualitative interviews, group discussions, surveys, and secondary data analysis to develop and test the concept. In the early 1990s this empirical work resulted in a typology of contemporary technology generations: (i) a mechanical generation (born before 1939), (ii) a generation of the household revolution (born 1939-1948), (iii) a generation of technology spread (born 1949-1963), and (iv) a computer generation (born 1964-1978). In parts, these generations differ in technological habitus (possession; modes of usage) and symbolic meanings given to new technology in general and their general collective technological identity. Generational differences in technological practice are not coercive features for individual behaviour, but just probabilistic relations, open to individual and collective change of social structures.

Elaborations

As a strong institutional underpinning to the early research on technology generations was lacking, this review of elaborations on the concept will refer to four different fields of diffusion: (i) methodological approaches, their innovations and empirical limits; (ii) refinement of the concept by focussing on interaction styles with technology; (iii) the ambivalence of the eye catcher 'digital divide', and (iv) research results on a new internet generation.

Methodologies

Most research in the field is still done as either qualitative data sampling interpreting group discussions[13] and qualitative interviews[14], or by analysing secondary data sets like the Allbus 2004[15] and the Allensbach survey 2004[16]. A problem of qualitative data analysis on its own is that generational categories are rather vague, for instance, "a group of middle-aged baby boomers" and a "group whose age resembles their parents"[17]. In cross-sectional quantitative data sets the age variable is still commonly interpreted as an age effect[16], despite most research showing that quite often taken for granted 'age effects' are a result of generational inter-cohort differences[18].

Livingstone and her collaborators employed innovative methodology in their work[19-21]. They combined qualitative interviews and group discussions with quantitative surveys and secondary data analysis as in the original technology generation project, but they also added children and young people aged 9 to 20 in an international comparative project. This new research design with children shows that even in these early life stages there are hardly any perceptible age effects in internet access. This begs the question whether age effects are plausible in higher age groups in the usage of this 'easy' technology[22].

Innovative methodology for the concept of technology generations also relies on experiments either with simulated tool interfaces[23] or with real objects[24]. They enable us to investigate 'technological practice'.

The identification of technology data in existing data sets and their analysis is still limited by the non-existence of longitudinal panel data. Within existing panels like the SOEP (Socio-economic Panel) or the ELSA (English longitudinal study of ageing), technology-related questions are so rare that even researchers working with these data sets use them as waves of cross-sectional data sets[22,25]. There is both theory and anecdotal evidence for important concepts like practice forms and the formation, stability, and possible dissolution of technology generations, however, there is a shortage of systematic empirical research.

The growing privatisation of data sets, such as user tracks and market research, further limits analysis for scientific purposes; the field is left to be explored for commercial application only[26,27].

Interface knowledge formation

A major step towards refining the concept of technology generations consisted of the work of Docampo et al.[23] who differentiated technology generations by assessing the way technological interfaces between tools and users are formed. Technology generations born before 1960 are assumed to have stored declarative and procedural knowledge in their long-term memory that was shaped in young adulthood by either mechanical or electro-mechanical equipment. The study showed that these technology generations have difficulty with interface characteristics of the 'software generation' born after 1960. Persons of the mechanical (born before 1930) and electro-mechanical generations (born 1930-1960) have greater difficulty coping with multi-layered interfaces: they take more steps and they make more mistakes. Langdon et al.[28] corroborated these results with similar experiments using interfaces of microwave ovens. Further experiments by Lim[24] which used real objects (telephone, camera, radio) instead of simulated interfaces were also convincing in replicating the finding that multi-

layered interfaces (as distinct from the functioning of the objects themselves) are the source of difficulties (measured in duration and effective use) for members of the electro-mechanical generations. It should be added that birth cohorts 1950-1959, i.e. those that are on the edge of the electro-mechanical generation and the software generation, could be distinguished from other members of the electro-mechanical generation in that they made fewer errors. With the data he had at his disposal Lim could show a higher rate of use of digital telephones in the 1950-1959 cohorts but he could not effectively conclude whether this effect was due to too short an age range used for calculating the formative period of generations - which in fact may continue up to age 30 - or whether this effect is due to experience later in life with new types of equipment.

Experimental evidence[29] supports the latter hypothesis. It shows that giving a PC with high-speed internet to ex ante non-users for a year helps the group aged 64-75 perform better than a control group in the handling of new alarm clocks or simulated telephone voice menus. Similarly O'Brien et al.[30] corroborated the finding that there are strong generational differences in the use of cash dispensing machines and mp3-players[31], but less so in the use of PCs and microwave ovens. They suggest that this is not due to the degree of complexity of technology, but to individual preferences.

Summarizing these results one could say that there is a strong generational effect of multi-layered interfaces that produce barriers to generations socialized to use other technical styles[32]. However, there is also evidence that long-term commitment to processes of self-socialisation can reverse these effects of generational habitus and open up opportunities ('undoing generation').

'Digital divide'

As well as generational differences in practice, generational differences are also communicated in public discourse. Some generation theorists even argue that generations are created and reproduced primarily by using the term 'generation' in public discourse[33]. Comparing the introduction of major technological innovations in private households over the last century, the diffusion curve of technologies varies in steepness, creating stronger or weaker cohort differences in terms of possession and operative knowledge[12]. A peculiarity of PCs, and to an even higher degree of the internet, is that their spread was rather fast. Despite of this, there is a well-established discourse on the exclusion of older generations and other underprivileged groups from this technology.

Research consistently shows that differences in possession of computers and internet access, a so-called first level digital divide, are still strong[15,16,34]. Generational differences are better at predicting the degree of (non-) possession of private internet access than other variables like (in order of importance) ethnic group, digital work-experience, human capital, sharing a household with children, income, gender, single household, and region[25]. In terms of gender and human capital differences, the variation of these generational differences between countries is quite low[17]. In surveys, 87% of internet non-users indicate that the reason for this is lack of knowledge[35].

Non-academic popular books[27] prophesize how internet and the internet generation will change society. The fact that governments in most industrialised countries want to improve digital access could be a motive for scandalising the 'digital divide' more than previous generational differences such as the spread of washing machines or dishwashers. Digital connectivity is seen as a prerequisite for a competitive economy[19]. The fast provision of American schools with internet in the late 1990s[36] is just one example of this policy. Interest groups pushed the agenda. One example comes from Germany where, starting 1999, businesses and politicians initiated public-private partnerships to finance marketing and research, the so-called initiative 'D21'[37], and, a final example, the 'digital divide' initiative, also in the USA[38]. Independent of these normative undertones, social scientists are interested in the precise process of the 'domestication' of the new technology[39].

A new internet generation?

Given the fact that the formation of technology generations is discontinuous, it is important to ask whether the spread of the internet influences the current structure of technology generations: does this development initiate a new generation and how does it influence patterns of persistence of existing technology generations?

The existing literature indicates that a number of experts support the notion of an internet generation[21]. However, the cohort spread of this generation is quite controversial as most authors do not proceed from a precise theoretical and empirical starting point: early authors — on the basis of anecdotal evidence — defined the cohort by birth after 1970[18,40] or 1972[41]. Other authors used and identified a threshold between the internet generation and the computer generation[8], those born after 1964[15,38]. Recently, Schwarze[42] argued that a fifth internet generation, born after 1990, should be added to the existing technology generation typology.

Equally important is the question of how older technology generations adapt to the internet. Empirically, the fast spread of the internet (cf. comparative data of British household technologies in[19]) suggests that generational differences between age groups are disappearing rapidly. However, German data from 2010 note a 99% rate of online participation for the cohorts born between 1981 and 1996, compared to a 14% online participation rate for the cohorts born before 1940[35]. Even within only the older age groups of those born between 1910 and 1949, a British study found significant differences between older generations, even after controlling for a number of variables including age impairment indicators[22].

Does internet use have specific technological features that differentiate generations in a similar way as technology interface knowledge? Pietrass[43] argues that interactivity, hypertextuality and virtuality are key features of the internet. Recent research shows that virtuality (such as avatars, i.e. the possibility to present oneself as another person) — a core feature of the internet analysis of Turkle[44] — is rare among users[45]. Alternatively, Melenhorst et al.[46] see interactivity as a possible hurdle for older technology generations. A distinctive feature seems to be the specific hybrid interactivity with the possibility to switch between specific point-to-point communication and mass-media communication[36,47]. This aspect is especially characteristic of social networks. Social media seem to be a major innovation, despite clear limits of the cooperation in social networks compared to face to face interactions[48].

The literature on the digital divide differentiates between a first-level-divide (differences in access to the internet) and a second-level-divide (difference in the use of the internet). Some theory and data support the notion that generational differences persist on the first level divide, whereas second level differences are due to individual preferences[15,18,36]. Other research shows that there are second-level-divisions in content interests (for instance, older generations prefer local news[49,50]). Most interesting is a finding from 2008 that there are also distinct patterns in second-level-divide use: whereas three quarters of Europeans born 1984-1996 visit social websites several times a week[20,21], older technology generations rarely visit social media, even if they are online[35,51].

Research hypotheses

Our empirical research concentrates (i) on the effect of the internet on existing technology generations, and (ii) on the formation of a new internet generation. By testing the hypotheses 1 and 4 below, we follow the differentiation of first-level digital divide. These are based on the logic of innovation diffusion and generational differences. With hypotheses 2,3 and 5 the second-level digital divide is checked. Literature suggests that second-level digital divides either do or do not exist. If they show up, they will indicate patterns of basic technological differences due to technology generation formation.

As diffusion of the internet is well advanced, one could expect, in line with Rogers[12], that the generational differences of the first-level digital divide are diminishing. Or, by contrast, one could suspect that unlike gender and income differences which do decline, generational differences persist in private internet access.

Hypothesis 1: In advanced stages of innovation diffusion, there still exist significant differences between technology generations in private internet use, even after controls for gender, income and family position (persistence hypothesis).

Second-level digital divide literature is usually not based on theoretical considerations. In hypotheses 2 and 3 that follow, we test whether the divergent results on second-level digital divide (on the one hand: non-existent; on the other hand: existent) are due to different types of interaction with technological equipment. Some internet interactions resemble traditional forms of practice, for instance, email is similar to writing a letter or a search machine is similar to looking up words in a dictionary. In these cases there should be no generational differences between internet users.

Hypothesis 2: There are no distinct technology generations among internet users in the use of email and search machines (transfer hypothesis).

Hypothesis 3 is based on the assumption that the participation in social media mixing point-to-point-communication with mass communication is a distinct innovative feature of technological practice, which separates technology generations.

Hypothesis 3: There are significant differences between technology generations among internet users in the use of social media (discontinuity hypothesis).

In a second step of research we want to test whether speculations on the formation of a new internet generation can be proven. In line with established research on technology generations[8,23] we suspect that discontinuous technology will shape new technology generations at roughly age 15-25, and at the time when a new technology surpasses the 20% threshold in private households. This is what Rogers[12] calls 'successful market introduction'. In Germany, this

threshold for the internet was reached in 2000 and this means we can expect the cohorts born after 1980 to form the 'internet generation' (following the 'computer generation', i.e. those born between 1964 and 1979). As the spread of the new technology was very quick, we assume that there are no more first-level digital divides between these two generations:

Hypothesis 4: There are no significant differences between the internet generation and the computer generation in terms of private internet access, after controlling for gender, income, and family status (diffusion hypothesis).

Hypothesis 5 is based on the assumption that in the field of the new technological practice of interactivity there are new differences between users even between the two younger technology generations.

Hypothesis 5: There are significant differences between the internet generation and the computer generation in the use of social media (formation hypothesis).

Data and methods

To test our hypotheses, we used data from the 2004 and 2009 waves of the survey on private use of information and communication technologies (ICT survey) of the Statistical Bureau of Germany. Initiated by the European Commission in 2002, the ICT survey collects data on the availability and use of information, notably via computers and internet. The focus is on questions concerning the use of the internet according to type, frequency, and selected purposes. Furthermore, experiences and concerns with new technologies as well as socio-demographic features are investigated. The study aims to provide detailed information on the distribution and the different aspects of using PCs and the internet. It explores whether certain population groups have access to new technologies.

The ICT survey is an annually conducted quota sample of private households and individuals in private households. It is a postal survey consisting of both a household- and an individual questionnaire to be filled in by every household member aged ten years or older. Annually, the sample contains 23,000 individuals in 12,000 private households from the entire federal territory of Germany. The survey allows data to be analyzed at the level of individual federal states. Six successive surveys starting in 2004 are available.

The ICT survey is strictly anonymous. To avoid re-identification of individuals, data-users are only allowed to work with eight given grouped categories to denote the respondent's age. We translated the categorized age of the current survey into year of birth. Unfortunately, we had to fit our theoretical values of technology generations to the given eight-category-variable (*Table 1*).

In the 2009 survey, every generation is over- or underrepresented with an underrun or surplus of five years. In the 2004 survey wave the limits of the generation of technology spread do not fully fit to the theoretical values.

According to our research hypotheses, we analyzed three dependent variables. In the ICT survey, all respondents were asked whether their household has internet access. Later, they were asked when they had last used the internet. Private internet use is indicated by using the internet within the last three months. This serves also as a filter for subsequent questions about internet practices and activities. In this section, private internet users were asked about sending and/or receiving emails. For our third dependent variable, we used the variable 'chatting, visiting internet-forums, using blogs or instant-messaging', to be answered by a simple 'yes' or 'no'.

The ICT survey's anonymization concept requires the use of pre-aggregated socio-demographic information. Controlling for socio-economic status, we used the net household income reported in quartiles. The ISCED-level (International Standard Classification of Education) was regrouped in three classes. The lowest educational degree is indicated by ISCED 1-2, medium education by ISCED 3-4 and the highest educational level by ISCED 5-6. To further control for education, we introduced the variable 'using a PC at work' because there is evidence for a relationship between educational levels and computer use in white collar jobs[25,52]. The family context was

Table 1. Definition of technology generations according to theory and in the two ICT surveys

Generation	Years of birth		
	According to theory	In ICT-survey year	
		2004	2009
Internet	>1980	1980-1994	1985-1999
Computer	1964-1980	1960-1979	1965-1984
Technology spread	1949-1963	1950-1959	1945-1964
Household revolution	1939-1948	1940-1949	1935-1944
Mechanical	<1938	<1939	<1934

determined using information about children younger than 16 living in the household. Finally, we controlled for region (East/West Germany) and gender. The ICT surveys did not collect data about ethnic origin.

Our dependent variables all contain binary outcomes ('no'=0, 'yes'=1). To investigate the generational differences in private internet use and use of internet-related technologies, we estimated multivariate logistic regression models. This allowed us to control for probable self-selection biases and influences through confounding variables. The data showed a hierarchical or clustered order because all members of a household were surveyed. It is likely that the range of responses of the members of one household is more similar within the household than between different households. Thus, the regression assumption of independently distributed standard errors could be violated. The correlated observations in the group may lead to biased estimations of standard errors and therefore to false inferences. To avoid this problem, we calculated robust standard errors that adjust for within-cluster correlations[53].

Results

We calculated weighted frequencies for both 2004 and 2009 (*Table 2*). The total sample sizes are n=10,303 (2004) and n=23,556 (2009). We observe a quick diffusion of private internet use and information technologies. The access to internet use in private households was already high and even grew. A total of 89% of the population use email regularly, either at home or at work. This amounted to a 9% points increase over a 5-year period. Social media applications have become more popular. By 2009, almost half of the population participated in a social media network. The use of these technologies increased by 14% between 2004 and 2009.

The percentages of the technology generations in the sample older than 10 years vary between the surveys. In addition to demographic metabolism, this is due to the already mentioned compromises that had to be made: Our theoretical technology generation model of cohort grouping had to be adapted to a fixed pre-aggregated age-grouping of the data set that could not be disentangled according to our research interests. The mechanical generation represented 20% in 2004, this had decreased to 8.7% in 2009. During 2004 and 2009, the relative proportions of the generation of household revolution and the computer generation remain at similar levels. With 15.5% in 2004 and 29.7% in 2009, the generation of technology spread has doubled. Our suggested generation, the internet generation, represented 18.6% (2004) and 18.0% (2009), respectively.

Table 2. Variables and weighted frequencies (in %); ISCED=International Standard Classification of Education

Parameter	Year	
	2004	2009
Dependent variables		
Private internet use (yes)	58.0	72.8
Use of e-mail (yes)	80.5	89.4
Use of social media (yes)	32.1	46.3
Technology Generations		
Mechanical generation	20.0	8.7
Generation of household revolution	14.3	13.2
Generation of technology spread	15.5	29.7
Computer generation	31.6	30.4
Internet generation	18.6	18.0
Control variables		
ISCED (grouped)		
Education	6.0	6.3
Low: 1-2	28.3	22.8
Medium: 3-4	48.9	51.8
High: 5-6	16.8	19.1
Uses PC at work (yes)	35.0	44.0
East Germany	18.5	20.4
West Germany	81.5	79.6
Household with children <16 yrs (yes)	45.2	27.5
Net household income		
1st Quartile	16.1	12.8
2nd Quartile	22.1	20.0
3rd Quartile	29.5	28.3
4th Quartile	32.3	38.9
Women	48.8	46.8
Men	51.2	51.1
n, millions	73.9	74.3

The following results arose from the multivariate logit-models. Table 3 reports the log odds of the estimated private internet use among technology generations over time. Log odds are hard to interpret; therefore in the text description we transformed the log odds into relative probabilities, according to the following formula:

$$p=\exp(\text{log odds } X_1)/(1+\exp(\text{log odds } X_1)) \quad [54] \qquad 1]$$

These relative probabilities can be interpreted as a thought experiment. In a given population consisting of two groups, one group is characterized by the variable and the other is the reference group. Relative probabilities report the percentage shared by the variable group and the reference group as defined by the dependent variable. In interpreting the results of categorical data on a

*Table 3. Differences in private internet use between technology generations in two different years (log odds with robust standard errors); Reference group: Internet generation, in education, do not use a computer at work, living in West Germany, household with no children younger than 16, 1st income quartile, men; ISCED: International Standard Classification of Education; +p<0.10; * p<0.05; ** p<0.01;*** p < 0.001*

Parameter	Year			
	2004		2009	
	Log odds	Standard error	Log odds	Standard error
Technology Generations				
Mechanical generation	-2.903***	0.21	-3.851***	0.33
Generation of household revolution	-2.264***	0.17	-3.472***	0.28
Generation of technology spread	-1.835***	0.16	-2.748***	0.27
Computer generation	-1.049***	0.16	-1.530***	0.30
Controls				
Low: ISCED1-2	1.338***	0.16	1.892***	0.32
Medium: ISCED3-4	1.647***	0.18	2.129***	0.32
High: ISCED5-6	2.274***	0.19	2.715***	0.33
Uses PC at work	0.331**	0.09	0.458***	0.10
East Germany	-0.346***	0.10	-0.560***	0.09
Household: children <16 yrs	-0.112	0.09	0.461***	0.11
2nd Income quartile	-0.092	0.13	0.195	0.13
3rd Income quartile	-0.117	0.12	0.402**	0.12
4th Income quartile	-0.069	0.12	0.858***	0.13
Women	-0.390***	0.07	-0.246***	0.07
Constant	1.740***	0.17	2.533***	0.18
n	7878		19523	
Log-likelihood	-2821.9		-3149.0	
Chi^2	490.9		813.7	

nominal scale with more than two values (for instance, five technology generations), one group is always compared as a relative probability to just one reference group (which is the internet generation in our analysis), the two groups combined always adding to 100%.

In hypothesis 1, we assumed persistent differences in the private internet use between generations. Data from 2004 support this assumption (*Table 3*). The technology generations show significant differences in the likelihood of private internet use. Comparing the relative probabilities of the internet and computer generation, 26% of internet users would belong to the latter group, the remaining 74% would belong to the internet generation.

$$p=\exp(-1.049)/(1+\exp(-1.049)) \quad [2]$$

Estimates for 2009 indicate increasing divergence in private internet use among generations. Younger generations are more likely to use the internet. The internet generation, which is the reference group, has the highest probability of use compared to the other groups. Comparing the internet and computer generation, 18% of internet users belong to the latter group, the remaining 82% belong to the internet generation. The differences between the generations are all significant.

Concerning the use of internet communication and interactive technologies such as email and social media, we find interesting developments over time. Technology generations showed significant differences in the use of emails in 2004 (*Table 4*). In 2009, these differences have increased even further among the technology generations. With each survey wave, the log odds are quite similar among the older generations (mechanical generation, generation of household revolution and generation of technology spread). Thus, use of email services is comparably low among the older technology generations: comparing the relative probabilities to the internet generation, the share of email users originating from the mechanical generation, generation of household revolution and generation of technology spread is 33%, 25% and 26%, respectively, in 2004. In 2009, this share is even lower at 17, 20, and 16%. The difference between computer and internet generation in the use of emails is slightly smaller: in 2004 and 2009, 34% and 25% of email users, respectively, belong to the computer generation according to relative probabilities.

In contrast to email, social media applications have not been embraced by all technology generations in the same way. We observed that technology generations become less likely to use social media compared to the internet generation over time (*Table 5*). However, the internet and the computer generation are more likely to participate. The differences between these two generations also increased slightly. Most social media users belong to either the internet or the computer generation. In 2004, 20% belonged to the computer generation (80% to the internet generation);

*Table 4. Differences in e-mail use between technology generations in two different years (log odds with robust standard errors); Reference group: Internet generation, in education, do not use a computer at work, living in West Germany, household with no children younger than 16, 1st income quartile, men; ISCED: International Standard Classification of Education; + p<0.10; * p<0.05; ** p<0.01;*** p < 0.001*

Parameter	Year			
	2004		2009	
	Log odds	Standard error	Log odds	Standard error
Technology Generations				
Mechanical Generation	-0.719**	0.24	-1.565***	0.27
Generation of household revolution	-1.098***	0.15	-1.407***	0.16
Generation of technology spread	-1.065***	0.13	-1.648***	0.13
Computer generation	-0.652***	0.12	-1.089***	0.13
Controls				
Low: ISCED1-2	1.590***	0.12	1.671***	0.13
Medium: ISCED3-4	2.143***	0.13	2.187***	0.14
High: ISCED5-6	2.604***	0.15	2.821***	0.15
Uses PC at work	0.225**	0.08	0.679***	0.07
East Germany	-0.503***	0.09	-0.443***	0.07
Household: children <16 yrs	-0.0548	0.09	-0.307***	0.07
2nd Income quartile	0.120	0.12	0.245*	0.11
3rd Income quartile	0.0919	0.11	0.154	0.10
4th Income quartile	0.0881	0.11	0.456***	0.10
Women	-0.0229	0.06	0.173***	0.05
Constant	0.128	0.14	0.951***	0.11
n	6782		18607	
Log-likelihood	-3066.7		-5536.1	
Chi^2	461.6		1103.5	

in 2009, this was 11% (and 89%, respectively).

Conclusion

The aim of this paper is to provide a theoretical and methodological overview of the research on technology generations and to underpin the debate on the probable formation of an internet generation empirically.

In their formative years, technology generations are shaped by interactions with technological interfaces and purposes. This influences access to later new technologies and their usage. We developed five research hypotheses. To test these, we used data from the 2004 and 2009 ICT surveys. The persistence hypothesis stated that differences in private internet use among technology generations are stable. Our empirical findings support this. Due to a much quicker adaptation rate of young and middle-aged technology generations, non-users of private internet are more concentrated in older technology generations in advanced diffusion stages: thus generational differences increase over time.

The transfer hypothesis assumed that there are no differences between technology generations concerning communications via email. Our logit-models support this assumption for generations older than the computer generation. The probabilities of use among these groups were significantly similar. The computer generation is quite similar to the internet generation concerning email use.

By contrast, our discontinuity hypothesis assumed differences in the use of interactive technologies such as social media for technology generations. This relationship was confirmed by the data. Younger technology generations are more likely to use social media and these differences in use have become greater over time.

The last two hypotheses compared the computer generation to the internet generation in terms of their internet use in order to demonstrate whether a new internet generation has emerged. Our calculations strongly support this assertion. The diffusion hypothesis stated that there are no differences in internet use in both groups. In 2004 and 2009, however, the diffusion of internet was different for the two generations. The internet generation uses internet more than the computer generation. Therefore a first level digital divide could persist between the groups. Furthermore, the technologi-

*Table 5. Differences in the use of social media between technology generations in two different years (log odds with robust standard errors); Reference group: Internet generation, in education, do not use a computer at work, living in West Germany, household with no children younger than 16, 1st income quartile, men; ISCED: International Standard Classification of Education; + p<0.10; * p<0.05; ** p<0.01;*** p < 0.001*

Parameter	Year			
	2004		2009	
	Log odds	Standard error	Log odds	Standard error
Technology Generations				
Mechanical generation	-2.766***	0.26	-3.756***	0.24
Generation of household revolution	-2.109***	0.14	-3.620***	0.11
Generation of technology spread	-1.821***	0.11	-2.970***	0.08
Computer generation	-1.387***	0.09	-2.052***	0.08
Controls				
Low: ISCED1-2	0.634***	0.11	1.083***	0.09
Medium: ISCED3-4	0.359**	0.12	0.873***	0.09
High: ISCED5-6	0.120	0.13	0.782***	0.10
Uses PC at work	-0.0683	0.07	0.039	0.04
East Germany	-0.358***	0.09	-0.143**	0.05
Household: children <16 yrs	-0.284***	0.08	-0.313***	0.05
2nd Income quartile	0.0479	0.11	-0.196*	0.08
3rd Income quartile	0.0490	0.10	-0.444***	0.07
4th Income quartile	0.0806	0.10	-0.566***	0.07
Women	-0.262***	0.05	-0.158***	0.03
Constant	0.312*	0.14	1.641***	0.09
n	6782			18607
Log-likelihood	-3684.9			-10704.6
Chi^2	862.1			2719.3

cal practices of interactivity are shaped differently. Our formation hypothesis assumed differences in the use of social media among the generations. The data show that the internet generation is more likely to use these applications than the computer generation and also that this difference becomes more marked over time.

These results, confirmation of the emergence of a new technology generation in the form of an internet generation, have long-run relevance for gerontechnology. The existence of first and second-level digital divides of current older technology generations also has implications for current gerontechnological work. Policies for private home technology for elderly citizens have to be mindful of persistent barriers to internet usage. At present, elder citizens still consist of technology generations shaped by mechanical and electro-mechanical equipment. However, if these generations are persuaded to go online, applications that are similar to older forms like email (letter) and search machines (encyclopaedias) are adopted quickly. Current experimental and survey research on older and younger technology generations indicate that earlier technology generations improve their use of new technologies over time. In survey research we found that a strong and persistent second-level digital divide with respect to social media exists. This indicates a more fundamental difference in the use of the new technology, probably due to its mode and purpose. If social media are to be used more extensively by seniors – which is suggested in a number of application fields – new techno-social formats that are more neutral to generational patterns would need to be developed. Longitudinal data is needed to further clarify the relationship between the intention to use technology and actual behaviour.

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