Challenges to Modernity: The Digital Divide

Die digitale Spaltung

Habilitationsschrift

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Table of Contents

5. Digitale Spaltung in Deutschland: Geringere Bildung – Seltener am PC

Korupp, S.E., Künemund, H., Schupp, J. (2006). DIW Wochenbericht, Jg. 73 (19), pp. 289-294.

6. Causes and Trends of the Digital Divide: A European Perspective

Korupp, S.E. (2006). In: Rehberg, K.-S. Soziale Ungleichheit, Kulturelle Unterschiede. Verhandlungen des 32. Kongresses der Deutschen Gesellschaft für Soziologie, Campus: Frankfurt/ Main, pp. 3043-51.

7. Senior Citizens and Young Technologies: Reasons for Senior Citizens' Non-Access and Access of the Internet in a European Comparative Perspective

Peacock, S.E., Künemund, S. (2006). Working Paper Erfurt University / University of Vechta (submitted).

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Sylvia Peacock (nee Korupp)

I dedicate my work to Ylly, who will smile at all the primitive technology we use today.

Preface

Whenever new technologies are introduced systematic changes in the social stratification of societies are to be expected, as theories on the relationship between social inequality and technology suggest (Rogers 1995, Webster 1997, Castells 1997). The digital divide is a model case for a systematic change; ever more information is available exclusively via the Internet and only those who are online benefit from this development. Attempting to assemble an exhaustive list on the available online information seems like a hopeless task: Daily politics, online education, health news, technical ideas, job ads or applications, dangerous consumer products, opinions, personal data, communal forms, inquiries, public policy, banking, brokerage, phone numbers, addresses – the number of informational items addressed online is growing daily. Some people swear that these changes are making their life easier while others complain about informational overcrowding, because they are no longer able to discern the important from the dispensable. Whatever stance we take in the current debate on the emerging "information society", it is here to stay and people who remain offline disqualify as full members.

What makes computers and Internet so unlike other household technology is their manifold but often complicated application in the human-computer and interpersonal interaction, regarding dyads (n=2) as well as exceptionally large groups (n → 801.4 million, total online population in 2005, CIA 2006). Issues connected to the use of the new technologies draw attention to fact that the digital divide is not only related to the inquiry into who has and who does not have access. Very often we fail to notice whether people are able to adequately apply the technology, i.e. feel competent enough to search the Internet and get the results they were looking for in the first place. To date, no internationally comparative study has been carried out comparing the average level of versatility, skills, or proficiency of computer- and Internet users in different countries. Publicly available data on average

computer or Internet skills are rare and the current study is no exception. Only in Chapter 6 are aspects of qualitative computer and Internet use presented – a comparison of computer and Internet activities between different social groups.[1]

I hope the results of my current studies will strengthen the conviction that it is time to gather additional publicly available data on the quality of Internet and computer use. For several years, however, the most pressing issue has been access rather than proficiency, as diffusion rates in most countries stopped increasing at a 50 to 60% household level. Thus, the "why" of computer und Internet access is what most of the chapters deal with. The results in several of the following chapters show that the use of new technologies is by no means status "neutral" as it appears to be at first glance; the research problem is multi-dimensional.

The interdependence of social structure and computer and Internet use sparked my curiosity back in the year of 2000, when I prepared the first drafts of my current project. In various places of this compendium I discuss the effects of the digital divide on gaining socio-economic advantages, and they are manifold. This compilation – to quote Hannah Arendt – "obviously could contain more or fewer chapters without for that reason changing its character " (1961: 15). Article upon article could have been stacked, but the gist of it is contained in the current selection. Therefore, a decision was made to draw the line at some point and present my results. The reader will find a structured overview on what causes the digital divide and what consequences to expect from this newly emerging division.

[1] I remain indebted to Jürgen Schupp from the DIW in Berlin for supporting my requests from within the institute to get more information on the second digital divide. To my knowledge the GSOEP special survey 2005 has remained the only publicly available set of data on contextual computer and Internet use thus far.

1. Introduction

Never before in history has it been possible to exchange such quantities of man made information in such little time at such short notice. Today we are living in a society where information technology has fundamentally transformed the flow of knowledge, global economy, social interaction, and information networks – we have entered a "network age" (Servon 2002). The questions that arise while observing these changes are how they affect existing power relations and patterns of social inequality. At the end of 2003, a declaration of the UN at the world summit in Geneva contained a statement "[…] to build a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge […]" (source: www.itu.int/wsis). This is an official recognition at an international level of how important the participation of common people is for developing informational skills. Since then an annual world summit on the information society has been hosted by the UN (on May, 15th).

In Germany, indications exist that the transmission of messages via electronic media has reached the status of fulfilling a basic need in view of the proportion of income allotted to communication (Noll & Weick 2005). But the chances of people in society to access and use computers and the Internet are heavily biased indicating a newly emerging pattern of social inequality. When we study trends and reasons for the number of people who access and use computers and Internet within and across societies we are analysing the *digital divide*.

What is meant by this abstract terminology is the division between individuals and households at different socio-economic levels, regarding their likelihood to access and use computers and Internet. The scientific relevance of the digital divide involves the introduction of a new perspective in studies on social stratification. Important questions cover aspects of model optimization, the identification of new crucial variables for studies in social inequality, and the introduction of external innovation effects on modern social settings. Socially relevant

topics involve studying trends in social inequality, the identification of endangered groups, and mapping prospective future developments.

1.1. Technology and Socioeconomic Inequality

First studies on this topic began to appear during the 1980s, coinciding with the increased use of computers at home and in companies. In 1986, Hammond questioned Daniel Bell's (1973) notion of knowledge becoming an "axial principle" in modern societies. Recent results regarding the interrelationship between the digital divide and social inequality, though, are putting more emphasis on this principle. Of course, rarely ever does the reality of innovation adoption follow a smooth, well-behaved, linear process as outlined in Rogers' diffusion theory (1995, see Chapter 1.2.1, below). Frequently, innovations happen to emerge in a rather complex, uncertain, or disorderly fashion (Kline & Rosenberg 1986). After the success of a new technology has been positively identified, the number of people who access and use it is supposed to increase. This assumption has lead researchers to believe that in the long run the digital divide might dissolve just like a *fata morgana*, i.e. time would take care of the problem (e.g. Compaine 2001).

However, such an assumption has to be hedged with caveats. Since 1996, more than 500 studies have appeared underlining the intense and solid relation between the digital divide and social stratification. Until today computers have not yet reached the developmental stage of a "push-and-go" application like telephones or mobile phones. Computer and Internet are complex multi-tasked technologies where people need specific skills to launch applications and efficiently use the devices for their daily routines. What is more, although the overall use of computers (but not the Internet) has gone beyond the 60% margin these days (Chapter 5), considering the socioeconomic background of the users we observe a heavily lop-sided profile: native young males with a high education are much more likely to belong to the group

of computer literates than, e.g., elderly foreign females with a low educational background (Chapter 3). As computer literacy is linked to issues like formal education, labour market chances, public policy, social networks, life satisfaction, or political influence unequal distribution already increasingly influence current social settings (e.g., Statistisches Bundesamt 2006, pp. 524).

1.2 Theoretical Background

Although the study of the digital divide is relatively new to the agenda of research on social inequality, several theoretical streams may be discerned discussed in detail below. The order of their presentation is according to the extent to which they entail technical details on the one side of the scale and social interaction on the other side of the scale. Neither of the theoretical approaches presented here can do without these two ingredients, because studying the digital divide covers issues on technology implementations as well as social behaviour.

Theoretical notions picturing the outcomes of social relations can serve a number of issues. In the next paragraph Everett Rogers' (1995) diffusion theory is addressed which infuses several theoretical ideas derived from the natural sciences and underlines that the digital divide is a temporary phenomenon. On the contrary, critical theory (mainly by Herbert Schiller) upholds that the introduction of new technologies reinforces traditional lines of social inequality, deepening the gap between the informational "haves" and the "have-nots". Schiller, for example, looks intensely at the quality of information. He coined the term "garbage information" that diverts, amuses, or gossips but offers little value and insinuates that the people at the bottom of the class system are swamped by this sort of information. On the other hand, privileged people are "[…] able to extend their advantages by access to sophisticated information resources" (Webster 1997, p. 91). The third general theoretical stance presented here, covered by the micro, meso, and macro level model, is designed to

facilitate empirical comparisons and track down current societal developments with regard to the digital divide (Korupp 2006, Korupp & Szydlik 2005).

1.2.1 Diffusion Theory

The diffusion theory methodically maps out the way how new technologies enter modern societies and how their use inter-depends on social interaction and human network ecology (Rogers 1995). Diffusion theory is lop-sided towards technical details. Two fundamental frameworks need to be understood in order to grasp the outline of diffusion theory and its application to research on the digital divide.

Firstly, a sigmoid curve depicts the time and shape of the process through which new technologies diffuse into a modern society. Secondly, user typologies (in the sense of Max Weber's ideal types) are normally distributed in society. These two basic abstract traits are best detailed using graphical displays of how this terminology may be understood. The basic model of diffusion dynamics slowly slopes upward until a so-called "critical mass" is reached (see Figure 1). Beyond this point adoption rates increase quickly. Note, however, that a time frame for the diffusion rates is not specified in the Figure 1.

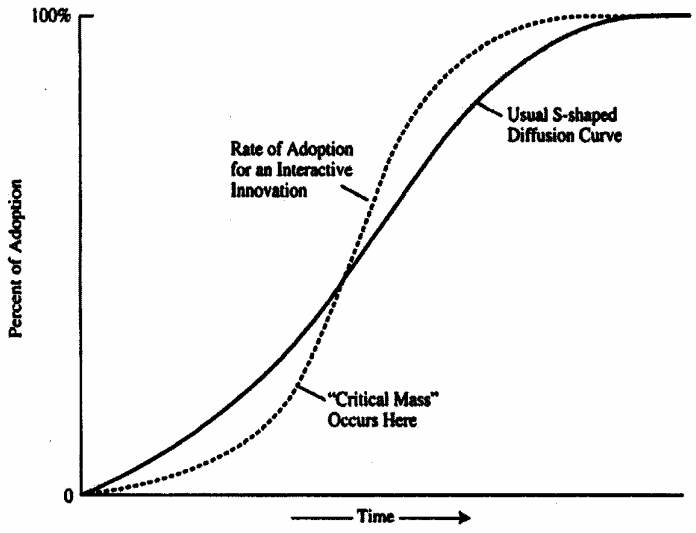

Figure 1: S-shaped Adoption Curve (Rogers 1995:314).

To explain why inequality of access occurs, Rogers created five ideal adopter categories. Figure 2 depicts the population distribution of these categories. The diffusion of innovation is assumed to run from the left category (*Innovators*) to the category on the right (*Laggards*).

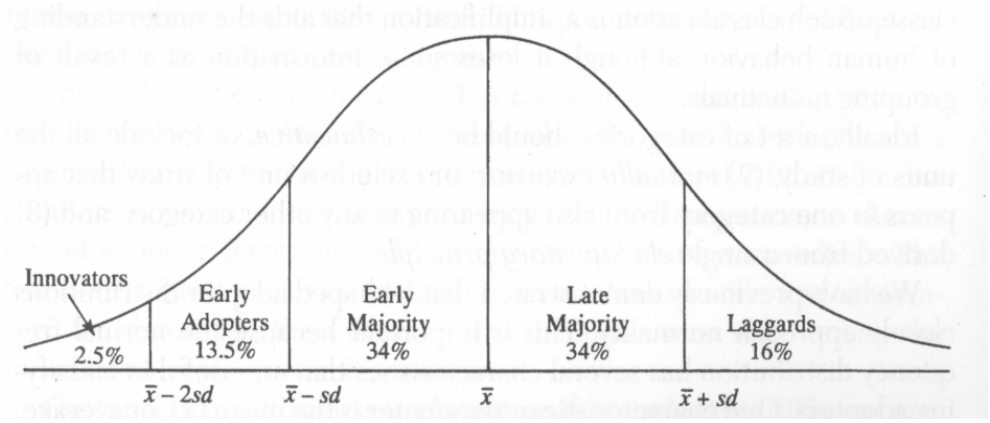

Figure 2: Adopter Categories (Rogers 1995:262).

The swiftness of technology adoption is dependent on several individual characteristics. So-called *Innovators* are the first to try out new technologies. Inventors may form a part of this group, although by no means an exclusive part. They are usually wealthy, young, and well-educated. Economic resources are needed to cut economic losses in case a new technology fails to succeed in an initial trial period (as did, for example, the invention of the visual phone). Additionally, they are young and entrepreneurial and like to try out something new. A good education is needed in order to be well-informed and have sufficient resources to handle new inventions.

Following the Innovators, *Early Adopters* start using a new technology after it has undergone a successful initial trial period. This second ideal type is supposed to have opinion leadership – today we probably would label them "trendsetters" – leading their followers (the *Early Majority*) on to try out something new. After the *Early Majority* has adopted the innovation they are followed by the *Late Majority*. The *Laggards* at the other end of the distribution are the last to adopt new technologies and some of them never do. *Laggards* are

often elderly people and to some extend socially isolated. The socio-economic status for these adopter categories is assumed to decrease, starting with the *Innovators* and ending with the *Laggards*.

Thus, according to the diffusion theory the adoption of new technologies is determined by people's age, the nature of their social networks, and their socio-economic background. These background traits, however, only influence the swiftness of adoption. Over time, successful new technologies are adopted by every individual in a society (see Figure 1).

1.2.2 Class Theory

The connection of social class and new technologies can be traced back to Herbert Irving Schiller a renowned media critic and sociologist. He critically assessed the relationship between the access to media and power, particularly with regard to information content. His main stance is that although there have been technological changes and the very infrastructure of data exchange has altered considerably, capitalism and traditional antagonistic class relations remained constant (Schiller 1981).

Among critical theorists, this notion has not gone uncontested. Although the capitalistic system has continued to stay intact, Kellner (1989), for instance, emphasizes that the contemporary economic system has evolved into something he labels "techno-capitalism", where knowledge and information equipment "[…] play increasingly important roles in the production process, the organization of society and everyday life" (p. 180). According to Webster (1997), however, the crucial focus of Marxian theory continues to rest on the role of power, control, and interest. Thus, neither of the above viewpoints invalidates the traditional theoretical terminology used by earlier generations of Marxists.

Within critical theory, information is understood as an intensely self-interest serving commodity. It is particularly important to recognize the role of power and control here.

Schiller (2004) offers myriad examples, picturing the small (and declining) number of media companies that are currently undermining the doctrine of free speech, or the increased commercialisation of the universities where ties between university researchers and private cooperation have grown quite close, or the commercialisation and privatisation of government information, often claimed by departing officials. The power of information access or selective obliteration is used to monopolize public communication, deal making or selling of scientific findings, and regarding public information as private property that may be sold as personal memories or historical studies. Schiller holds that the information society revolution has mainly served the interests of wealthy and affluent users, who to date gained easy access to a vast arena of important information. For the larger part of the population, however, "[…] the quality and the availability of information leaves a lot to be desired" (2004: 265).

The historical development is pictured in austere colours. He draws close connections between the development of the information "highways" and the steady growth of corporate powers over the last fifty years. In many post-industrial societies rudimentary commercialisation has taken over, myriad public functions have become privatised, and an increasing number economic activity is constantly being deregulated. Schiller (1989) holds that information and quality data serve mainly to meet the needs of the affluent segment of the population whilst the larger part of society is cut off from this information "revolution". For him the newly emerging technology of the Internet is no exemption to this phenomenon, as plans to commercialise the Internet are steadily progressing and may be expected to be implemented in the near future (*ibid.*). According to critical theory it cannot assumed the digital gap will close at *any time*, because political interests and traditional power relations systematically undermine progress towards more socioeconomic justice.

1.2.3 The Micro-Meso-Macro Model

In theoretical models, the use of computers resides at the highest level of a multidimensional concept of information technology access (De Haan 2004). The use of computers is based on skills, which are based on possession, in turn resting on motivation. Without having passed any of the former stages, people are unlikely to use computers for their private means. Starting from this perspective, the digital divide is incorporated into a multi-dimensional framework. Who are early adopters and why are they the first in line to use computers for their private means? Regarding the *micro-level*, one is mainly looking at effects of knowledge or human capital, that is, education and computer literacy. For the *meso-level* one can identify household settings and their influence on individual computer use. Thirdly, the *macro-level* includes domains of group membership, that is, generation, gender, ethnic background, and national differences (see Figure 3).

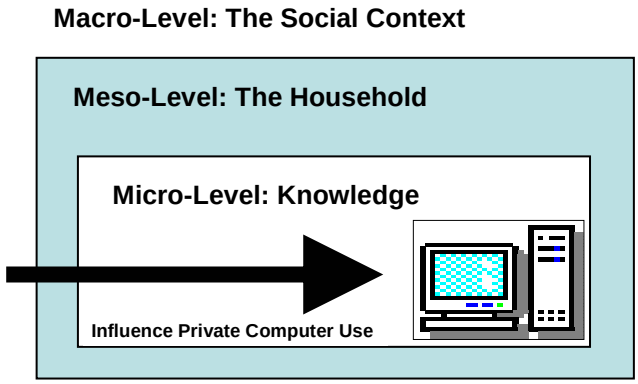

Figure 3: A Theoretical Model of the Digital Divide.

Concentrating on the *micro-level*, knowledge or human capital includes general and specific schooling and training, for example, high school diplomas or vocational training (Becker 1964). Levels of education and vocational training are positively connected to people's use of computers; computer literacy is merely an additional educational skill. Getting acquainted

with computers at work (usually in white-collar jobs) increases the likelihood that a person uses one for private purposes.

Focusing on the *meso-level*, situated between the individual and the societal level, the focus should rest on household composition and consumption restrictions, embedded within a socio-ecological framework (Watt & White 1999). The socio-ecological periphery includes habitation and technological environment. The incentives for children to deal with computers are straightforward: Computer use includes playing games interactively and facilitates doing schoolwork (Leu 1991). While catching the attention of children, teenagers, or young adults, the question remains how children induce their parents to use computers.[2] Several issues are relevant. For instance, parents want to protect their children from unwanted informational content. The best way of doing so is to know how computers work and control the content offered. At this point patterns of computer use are located in families at the level of control and regulation (Beisenherz 1988). The second issue, consumption restrictions, should mirror the structure of economic inequality (Ekdahl & Trojer 2002, Martin & Robinson 2004).

Regarding the *macro-level*, several potential determinants are identified: generation, gender, ethnicity, and regional differences. The theoretical approach including generations is derived from a concept called "technical generations" and outlines four ideal types (Sackmann and Weymann1995): The "pre-technical generation" (born before 1939) grew up in an environment bare of household technology; the "generation of the household revolution" (born between 1939 and 1948) was raised while basic kitchen technology like kettles and refrigerators diffused into private households; the third "generation of advanced household technology" (born between 1949 and 1964) grew up with inventions like the washing machine, stoves, central heating, i.e. more sophisticated technology; the following "computer generation" (born after 1964) was raised with an increasingly digitalized set of home

[2] To this day, the effects of computer use on children's social development cannot be predicted precisely (e.g. Subrahmanyam et al. 2000).

technology. Today computer chips are implemented in microwaves, washing machines, fridges, telephones, heating systems etc. According to the technological generations approach, the home environment that people are raised in determines their general habits towards new technologies later in life.

Aspects of gender are of crucial importance because sex roles are determined by a whole set of social norms and values (see Chafetz 2006). Today we still observe a troubling gender inequality when it comes to judging participation rates of women in any of the related fields of information technology (Fountain 2000, Korupp 2006, Korupp et al. 2006). Census data show that fewer women than men own a computer, particularly if they live in a single household (Statistisches Bundesamt 2003, p.24). Some researchers suggest that women are not socialized to become involved in matters of technology (Brunet & Proulx 1989, Newman et al. 1995). Regarding computers, however, both men and women are fascinated by the multitudinal applications of this new technology, but women are less emotional about computers and geared mainly towards practical applications (Löchel 1992, Fox 2006).

Ethnic differences for computer use are no longer a debated issue. Continuously disputed are the reasons for ethnic differences in the distribution of computer and Internet users. People of other than the major native ethnic group may tend to perceive a computer language to be culturally different, to belong to a so-called *outer sphere* (Nohl 2001). Most of the computer programs bought in a country use native languages or English languages for their user interfaces. These distinctions may cause delayed diffusion of computers among the different ethnic minority.

In different regions large differences continue to exist including average prosperity, labour market chances, or political influence. Regarding Germany, for instance, in 1993, the first official numbers on the distribution of home computers showed PC ownership in West Germany to be at a 22.4% level, compared to only 16.3% of the households in East Germany

(Statistisches Bundesamt 1994).[3] Unequal starting positions at the beginning of the information revolution may be responsible for regional differences and ought to be considered in studies on the digital divide. Altogether, this model forms no unilateral theoretical stance, but is meant to capture the multidimensional aspects of the digital divide.

1.3 Summary of this Study

How the digital divide is affected by and affects the fabric of social inequality is the main focus in all of the chapters of this compendium. In the second Chapter a historical account on the effect of the introduction of computer technology on income is offered capturing significant changes between 1979, 1986, 1992, and 1999. Empirical analyses are based on four large German labour market censuses with approximately 87,000 cases. Results show that in 1979, the use of a computer at work increases income levels of (male) workers, albeit for people who are working in the information segment of the labour market. Over time, advantages regarding the early adoption of this new technology slowly disappear. Effects of computer training on income levels cease to exist between the years of 1979 and 1999.

Chapter 3 offers an empirical model that shows the first attempt to test the micro, meso, macro model. The empirical findings are replicated for the years of 1997 and 2001 of the GSOEP. Large net effects are observed on the macro-level, for gender, Turkish ethnicity, and generation. On the micro- and the meso-level the net effects are substantial, too. Knowledge and household setting significantly add to explain who accesses computers and who does not. It remains an open question as to how a potential lack of primary social ties, i.e. living with children, may be compensated to help close the digital divide.

After the empirical replication a repeated attempt to empirically analyse the outcomes of the micro, meso, macro model is broadened into a social trend analysis in Chapter 4. The

[3] Before that, the statistical yearbook of the GDR offers information on radio and TV ownership only. From 1990 to 1993, the statistical yearbook for the reunited Germany contains information on PC ownership in West Germany only.

1997, 2001, and 2003 GSOEP waves contain data on private computer and internet use, as well as information on past and present socioeconomic circumstances. Results show that in 2003, membership of technical generations and ethnic background in large part determines the use of new technologies. By illustrating the importance of human capital and family context we are able to explain additional differences found for computer and internet use. Effects of income, gender, and living in a single household are significant. Our study shows that some of the long-term consequences of the 40-year German separation are diminishing with regard to computer use. We demonstrate that human and social capital are more important than economic capital to explain private computer and internet use. Indications for higher social classes to secure or even increase their favourable social positions exist. Most of the empirical work was carried out by the first author. Marc Szydlik gave ample input to help me refine the theoretical and empirical model in Chapter 4, which more than merits his inclusion as a co-author on this paper.

Research on the digital divide has been widely criticised for exclusively focussing on the first digital divide – access to computers and Internet. The results of Chapter 5 add insights on how socioeconomic background is related to the second digital divide, i.e. levels of competence for using computers and Internet. Working hypotheses are derived from diffusion theory. Gender and nationality are introduced as important characteristics. Results from the GSOEP special survey of 2005 indicate that gender, generation membership, and educational level have a double edge on the digital divide: They explain access as well as competence for using computers and Internet. Nationality and the size of the social network are significant for computer and Internet access but not for levels of competence. While the first digital divide remains substantial, the second digital divide is following in its wake. In this chapter all the empirical models and statistical calculations have been carried out by the first author. Harald Künemend and I had a number of extensive discussions about the

theoretical outline of this paper, meriting his addition as a co-author to this paper. Jürgen Schupp supported me extensively at the DIW to place some of my questions into the GSOEP questionnaire of 2005 by which, as far as I am concerned, he more than earned his place on the list of co-authors.

My central question in Chapter 6 is how differences in internet use for private ends in a European comparative perspective can be explained. A theoretical model applied to all member states of the European Union shows that tertiary education is the main indicator for internet use for private ends. But the strength of its influence varies between countries. A hypothesis is posed that over time the effect of tertiary education on internet use decreases as more users hook up to the internet. In 2002, the lowest influence is expected in countries with high diffusion rates and vice versa. The results show that momentarily this hypothesis may be maintained. Based on the empirical outcomes, an attempt is made to assort countries along cultural similarity. Three different "diffusion regions" are identified: The southern "diffusion region" consist of Greece, Italy, Portugal and Spain. Included in the eastern region are the Czech Republic, Hungary, Poland, and Slovenia. The central region includes Austria, Belgium, Germany, Denmark, France, Finland, Ireland, Luxembourg, The Netherlands, Norway, Sweden and the U.K. The most important conclusion, however, is that a country's proportion of tertiary educated adults mainly determines the speed of innovation diffusion.

In Chapter 7 the focus shifts to a special problem within the digital divide: the use of new technologies by senior citizens. As the Internet's societal pervasiveness progresses, offline senior citizens are becoming increasingly disadvantaged regarding the quality of their life. We examine reasons for non-use and the development of the frequency, intensity, and socio-demographic correlates of Internet use among senior citizens in Europe. Consequences at the individual and societal level are discussed. The Eurobarometer of 2003 offers a range of variables to explore the diffusion of Internet technology among 55+ year-old people in

Europe. Descriptive statistics, logistic regressions, and a population average model are used to identify the correlates of Internet access in four different welfare regimes. Within the population segment of the senior citizens age is a stratifying variable. Marital, occupational, and educational status have a large impact on relative chances to access the Internet. By and large, gender differences do not exist. The sizes of the coefficients differ between the four welfare regimes although most of the results can be replicated for the European region. Private access possibilities, motivational indifference, and deficient knowledge seem to be the crucial for the decision to remain offline. Financial concerns play a minor role. Except for gender differences, existing socioeconomic inequalities crystallise within the senior population as Internet access continues to be stratified along traditional lines. Social policy must keep up efforts to close the digital age gap, particularly in the Southern regions of Europe. The joint work on this paper together with Harald Künemund contains a collaborative introduction, theoretical outline, and conclusion. The empirical work and statistical models, presentation of the results have been carried out by the first author.

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No Man is an Island: The Influence of Knowledge, Household Settings, and Social Context on Private Computer Use

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Abstract: In modern societies, the digital divide indicates the emergence of a new form of social inequality. The theoretical model presented in this paper captures effects on the micro-, meso-, and macro-level. The empirical findings are replicated for the years of 1997 and 2001 of the GSOEP (the German Socio-Economic Panel). Large net effects are observed on the macro-level, for gender, Turkish ethnicity, and generation. On the micro- and the meso-level the net effects are substantial, too. Knowledge and household setting significantly add to explain who accesses computers and who does not. It remains an open question as to how a potential lack of primary social ties, i.e. living with children, may be compensated to help close the digital divide.

Keywords: Computer, knowledge, children, generation, gender, region, ethnicity

Introduction

The digital divide presumably forms an additional source of inequality within the already established social ordering. This sort of assumption may be challenged by charges of studying a non-existent myth or a "luxury" problem (Compraine, 2001). However, research results so far paint an entirely different picture. For example, computer literacy has been found to increase social activities and school performance (Wagner, Pischner, & Haisken-DeNew, 2001; Wagner, Pischner, & Haisken-DeNew, 2002), enhance mathematical and language skills (Attewell & Battle, 1999), improve successes in finding a job (Boes & Preißler, 2002), and last but not least, increase hourly wages (Kim, 2003). It is, therefore, important to find out why some people use computers while others do not.

When dealing with the digital divide, a certain lack of consistency becomes obvious as to how and for what purposes this terminology is used. It may, therefore, be helpful to start with a definition. I define the digital divide as the gap between the technological "haves" and "have-nots", particularly regarding private computer use. Sometimes a theoretical distinction is made between the "first" and the "second" digital divide (Attewell, 2001), that is, between the "access" to computers and the "purpose" of computer use (Hargittai, 2002; 2004). The former refers to research on the use of computers while the latter deals with the diversity and complexity of computer use. Before dealing with problems on user profiles, however, it should be made clear, who uses computers and who does not and why not.

The current study deals thus with the question to what extent private computer use is determined by socio-economic background. Studies that have dealt with this question so far have included the influence of social

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inequality, region, and ethnicity.[1] Beginning with the former, the digital divide is connected to socioeconomic inequality (e.g., Attewell, 2001; Bonfadelli, 2002; DiMaggio, Hargittai, Russel , & Robinson, 2001; Ekdahl & Trojer, 2002; Jung, Qiu, & Kim, 2001). Usually, "classical" attributes like education and income are introduced to explain the digital divide. A general finding is that the development of the digital divide parallels that of economic inequality (Attewell, 2001; Bucy, 2000; Ekdahl & Trojer, 2002; Luke, 2000; Martin & Robinson, 2004). A study on German teenagers from the lowest educational echelons shows that primary cultural skills, like reading and writing have to be improved before computer or Internet literacy may be acquired (Kubicek, 2004). For obvious reasons the use of new technologies like the Internet strongly depends on people's computer skills (De Haan, 2004; Raban, 2004). Thus, without a decent educational background people are unlikely to use a computer. This underlines the catalytic effects of the digital divide on social inequality as mentioned above.

Additionally, regional studies underline exclusionary trends. Dolnicar, Vukcevic, Kronegger, & Vehovar (2002), for example, shows that the use of computers in Slovenia has fallen far behind that in the EU. For the U.S., other studies forecast low income urban communities to be disqualified for further technological advancements (Servon, 2001). Other findings underline the relations between a lack of means to invest in infrastructure and the underdevelopment of rural areas (Hollifield, 2003). Others still stress that a general shortage of human capital in rural areas adds to a developmental lag (Malecki, 2003). Results from a European project indicate that the digital divide remains a pressing matter (Anderson, Brynin, & Raban, 2005). Compared to mobile technology (which has almost reached saturation level), for some time now the diffusion of the Internet has been stalling in various countries (ibidem). Using computer technology is probably more heavily linked to social structure than mobile phone technology.[2]

Research results on the influence of ethnicity cover a large range of issues. Some show that the digital divide reinforces race antagonisms between the North and the South of the world (Nelson, 2002). A study on ethnic differences between Anglo-Americans and Hispanics underscores the importance of ethnicity regarding the use of the Internet (Hacker & Steiner, 2002). Ethnic studies on small group behaviour show that race influences participation modes in seminaries on new technologies (Carstaphen & Lambiase, 1998). All these issues – social inequality, region, and ethnicity – seem to have a substantial influence on private computer use and need to be considered in a theoretical model.

Before turning to such a model, however, let us look first at the level of computer use in Germany. In 2002, only 35 out of 100 people in Germany owned a private PC, accounting for a 15% increase between 1990 and 2002 (IdW, 2003). However, two issues are evident here. First, most of the studies deal with the number of computers, hosts, Internet connections and the like without offering any explanation for the current developments (AG.MA, 2000; http://www.golem.de, 2000; http://www.heise.de, 2003; SPIEGEL, 1996; Statistisches Bundesamt, 2003; Van Eimeren, Gerhard, & Frees, 2003). This bespeaks a predominantly economistic view towards the problem, disregarding any social or cultural frameworks.

Secondly, the more recent a study, the more positive its undercurrent. In 1996, for example, concerns were voiced about the possible generation of status barriers regarding the use of new technologies (SPIEGEL, 1996). In 2003, however, a study appeared with the header: "More than half of all Germans are online!" (http://www.heise.de, 2003). International comparisons show that in Germany, however, the private use of computers is at a moderate level at best (Statistisches Bundesamt, 2003, p. 25).[3]

One area in which a theoretical explanation is sought for the digital divide is an international comparison of the number of Internet hosts. Here the diffusion rate of technology is related to general levels of trust and average material well-being in countries (Bornschier, 2001). The study shows that an early diffusion of Internet applications within a country is connected to high degrees of average trust and tolerance.

Despite numerous theoretical reflections on the matter, there is obviously a need for a more theory-driven approach to understand the development of the digital divide. Most of the work reviewed here neglects the interrelationship of different levels of social structure in their theoretical and empirical models. Studies on the digital divide often include the micro-level or perhaps the macro-level, but disregard household settings, which, because they represent people's immediate social environment obviously have a direct influence on their

[1] Another important domain of research not dealt with here connects the influence of policy or politics to the digital divide (e.g., Johnson, 2001 or Vartanova, 2002, for an overview: DiMaggio, et al., 2001).

[2] Although this division may become obsolete in the near future as computers are developing into hybrid technologies, i.e. mobile phones with integrated internet compliant computers.

[3] In 2002, 40.4% of all private households were supplied with internet access as an EU-15 average, the Netherlands leading with 65.5%, Spain and Greece at a low 29.9%, respectively, 9.2%. In comparison, Germany's level is intermediate. Seven countries have a higher and eight countries a lower level (Statistisches Bundesamt, 2003, p. 25).

behaviour. Other studies will analyse the micro-level and include household effects, but fail to consider the influence of the macro-level, although ethnic and regional studies call attention to its importance. In the next section I develop an encompassing new framework in order to build a multi-dimensional model. After discussing the theoretical model, the next section contains an overview on the data and methods used for the empirical analyses. Thereafter, the main analytic results will be presented and in the last section the most important outcomes are summarized and discussed.

The Micro-, Meso-, and the Macro-Level

The issues under investigation are reasons for people's private use of computers. In theoretical models, the use of computers resides at the highest level of a multidimensional concept of information technology access (De Haan, 2004). The use of computers is based on skills, which are based on possession, in turn resting on motivation. Without having passed any of the former stages, people are unlikely to use computers for their private means. Starting from this perspective, the digital divide is now incorporated into a multi-dimensional framework (see Figure 1).

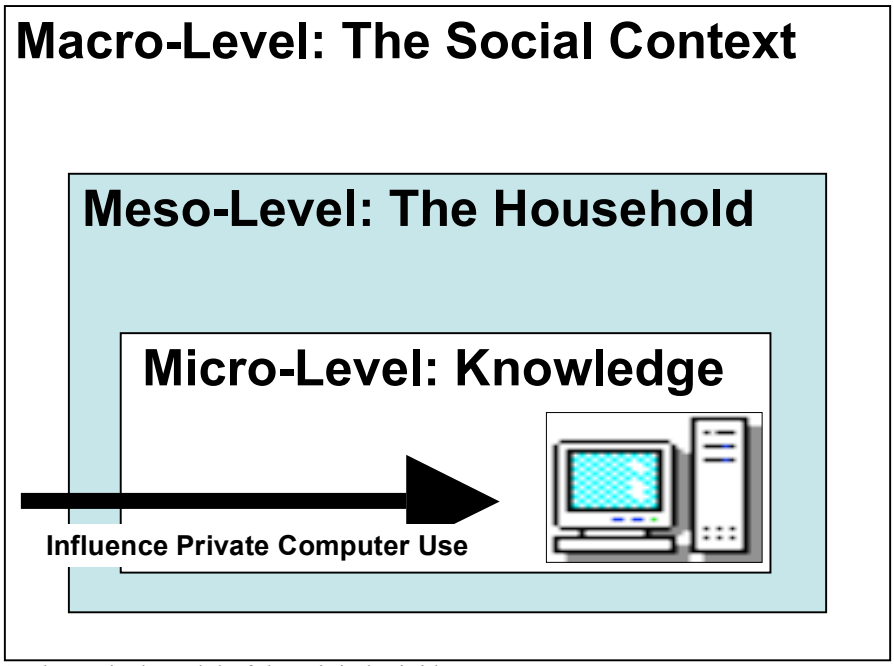

Figure 1. A Theoretical Model of the Digital Divide.

Who are early adopters and why are they the first in line to use computers for their private means? Regarding the micro-level, one is mainly looking at effects of knowledge or human capital, that is, education and computer literacy. For the meso-level one can identify household settings and their influence on individual computer use. Thirdly, the macro-level includes domains of group membership, that is, generation, gender, ethnic background, and differences between East and West Germany.

Let us first concentrate on the micro-level and how knowledge influences private computer use. Knowledge or human capital includes general and specific schooling and training, for example, high school diplomas or vocational training (Becker, 1964). I assume levels of education and vocational training to be positively connected to people's use of computers. Presumably, computer literacy is merely an additional educational skill. What is more, people with moderate levels of human capital are likely to work with computers in white collar jobs (Korupp, 2002). Getting acquainted with computers at work perhaps increases the likelihood that a person uses one for private purposes. On the micro-level, a positive relation is expected between both a person's general education and computer access at work on the one hand, and his or her private use of computers, on the other.

The household level is particularly central to this study. On the meso-level, the focus rests on household composition and consumption restrictions. Studies on computer use in families are embedded within the ecological framework of family theory (Watt & White, 1999). The ecological periphery of a family includes habitation and, more importantly, their technological environment. The incentives for children to deal with

computers are straightforward: Computer use includes playing games interactively and facilitates doing schoolwork (Leu, 1991). While catching the attention of children, teenagers, or young adults, the question remains how children induce their parents to use computers.[4] Several issues are relevant. For instance, parents may want to protect their children from unwanted informational contents. The best way of doing so is to know how computers work and control the contents offered. At this point we locate patterns of computer use in families at the level of control and regulation (Beisenherz, 1988).

Additionally, the image of the computer has developed from a distant "cold" machine into a socially "friendly" device and according to newer research, the computer has "[…] successfully connected to middle-class ideals" (Reed, 2000). So parents may simply want to adjust to middle-class ideals and ask their children to show them how to use one. Parents may also believe computer literacy to be essential for children. So to encourage them they may want to learn more about PCs together with their children.[5]

As mentioned above, household income restricts consumption patterns of household members. Therefore, a close positive connection is drawn between income and the possibilities to bridge the digital divide (Ekdahl & Trojer, 2002, Martin & Robinson, 2004). This underlies the expectation that the digital divide mirrors structures of economic inequality. In sum, on the meso-level the expectation is that both living with children and family income influence private computer use positively.

On the macro-level the influence of the wider social context is included. Several potential determinants are identified: generation, gender, ethnicity, and region. The approach for generations is derived from a concept called "technical generations" and outlines four ideal types (Sackmann & Weymann, 1995): The "pre-technical generation" (born before 1939) grew up in an environment bare of household technology; the "generation of the household revolution" (born between 1939 and 1948) was raised while basic kitchen technology like kettles and refrigerators diffused into private households; the third "generation of advanced household technology" (born between 1949 and 1964) grew up with inventions like the washing machine, stoves, central heating, i.e. more sophisticated technology; the following "computer generation" (born after 1964) was raised with an increasingly digitalized set of home technology. Today computer chips are implemented in microwaves, washing machines, fridges, telephones, heating systems etc. According to the technological generations approach, the home environment that people are raised in determines their general habits towards new technologies later in life.

The next determinant on the macro-level is gender.[6] Today we still observe a troubling gender inequality when it comes to judging participation rates of women in any of the related fields of information technology (Fountain, 2000). Census data show that fewer women than men own a computer, particularly if they live in a single household (Statistisches Bundesamt, 2003, p.24). In 1997, only approximately 30% of all Internet users were women (Suler, 1997). Research suggests that women are not socialized to become involved in matters of technology (Brunet & Proulx, 1989; Newman, Cooper, & Ruble, 1995). Regarding computers, however, both men and women are fascinated by the multitudinal applications of this new technology, but women are less emotional about computers and geared mainly towards practical applications (Löchel, 1992; Newman et al., 1995).

Let me now turn to the last two aspects, ethnicity and region. The major ethnic minority in Germany is a Turkish population of approximately two million members. Following a large immigration wave in the 1960s, a number of Turkish people have lived in Germany for more than 40 years. Still, Turkish people may tend to perceive the computer language to be culturally different, to belong to a so-called *outer sphere* (Nohl, 2001). Most of the computer programs bought in Germany use either German or English as languages for their user interfaces. These distinctions may cause delayed diffusion of computers among the Turkish ethnic minority.

Lastly, ten years after German reunification, large differences between the West and the East continue to exist including average prosperity, labour market chances, and political power (see e.g. Deutscher Bundestag, 2001; Geißler, 2002). In 1993, the first official numbers on the distribution of home computers showed PC ownership in West Germany to be at a 22.4% level compared to only 16.3% of the households in East Germany (Statistisches Bundesamt, 1994).[7] In the East, reasons such as insufficient funds or possibilities to purchase new

[4] To this day, the effects of computer use on children's social development cannot be predicted precisely (e.g. Subrahmanyam, Kraut, Greenfield, & Gross, 2000).

[5] In contrast to this, a lack of primary social ties at home should decrease people's use of computers.

[6] "Gender" is included on the macro level because sex roles are important for a whole set of social norms and values (e.g. Newman et al., 1995). Effects of ethnic background and region seem to be important according to the literature mentioned in the introduction.

[7] Before that, the statistical yearbook of the GDR offers information on radio and TV ownership only. From 1990 to 1993, the statistical yearbook for the reunited Germany contains information on PC ownership in West Germany only.

technologies before reunification explain part of their unequal starting position. The final goal is to detect long-term consequences of unequal starting positions regarding the digital divide. Thus, on the macro-level, the expectation is that being a member of an older generation, being a woman, being a member of a ethnic minority, or living in East of Germany will influence the use of computers negatively.

As new technology diffuses throughout society, one should be mindful of possible dynamic processes which exclude a static approach (see Figure 2). For the study presented here, the expected development is derived from the technology diffusion model (Rogers 1995). It states that over time, successful technology diffuses into all parts of society save into households in which people are resilient to change altogether. The main pathways run from the highest to the lowest position, concerning education and social status (see Figure 2). As diffusion continuously progresses and an increasing number of people use the new technology, computer and Internet access is less influenced by social inequality. According to the technology diffusion model, one should expect the effects discussed above to decrease (Rogers, 1995).

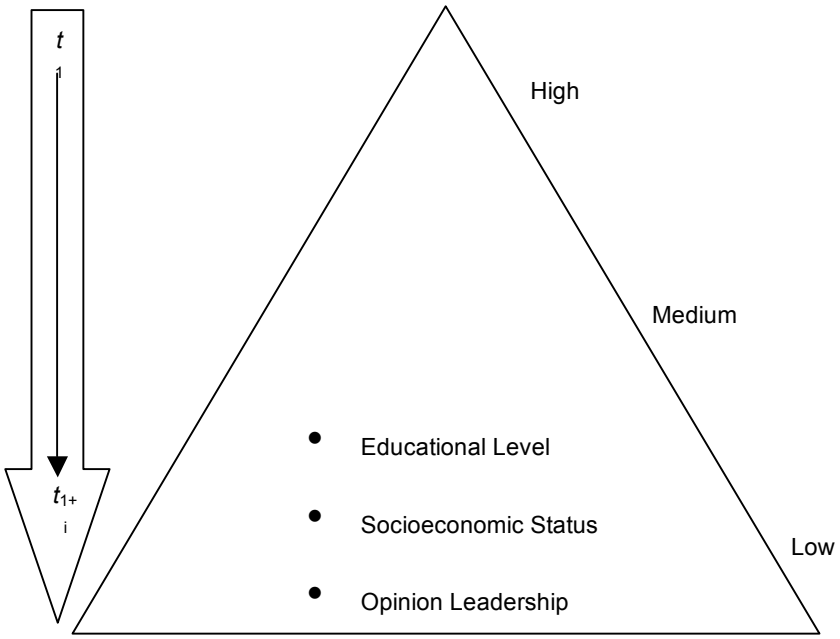

Figure 2. Diffusion Pathways of Computers in Modern Societies.

Data and Methods

The GSOEP is a representative longitudinal survey of private households in Germany (DIW, 2003). In 1997, the use of computers for private and professional means was surveyed for the first time. In 2001, these questions were posed again making an empirical replication of the model results possible for 1997 and 2001. The unweighted number of individuals in the database is 11,636 in 1997. In 2001, the unweighted number of cases increases to 20,708.[8]

Table 1 contains the cross-sectional weighted number of observations, means, standard deviations, and ranges of all the variables used in the analyses. The private use of computers is coded as a bivariate dummy variable ('yes'=1 and 'no'=0).[9] In 1997, 23% of the German population between 17 and 99 years uses a computer,

[8] Only foreigners living in Germany and not belonging to the Turkish minority were excluded from the analyses. The increase of cases between 1997 and 2001 is due to a refreshment of the sample (DIW, 2005). The GSOEP sample was refreshed in 2001 to counter problems connected to some of the anticipated future sampling biases that may have occurred due to sample attrition. It must emphasised that this wave contains a representative sample for the population living in Germany in 2001. Repeatedly testing a model is useful, because a successful empirical replication offer further evidence for precluding the presentation of chance findings. I thank the anonymous reviewers for their useful remarks on this issue.

[9] The translated question used in 1997 reads as follows: "Do you use a computer either privately, on your job, in your training/education? (by computer include the personal computer (PC) or the main-frame but not purely a game machine)." The answers are coded separately for "private" and "job, training or educational" purposes. In 2001 the question is posed: "Do you use a computer for activities not related to work?" The answer is a nominal "yes"/"no" scale. Where the computers have been accessed or used was not surveyed.

increasing to 41% in 2001. As some household members are adolescents, the GSOEP data contains a slightly higher figure of computer users than the one mentioned in the introduction (see: IdW, 2003).

Table 1
Descriptive Statistics

Contents of Variables	Range	Mean *(Std. Dev.)*	
		1997	**2001**
Privately Use Computers (No/Yes)	0/1	0.23	0.41
Knowledge			
Education (Year Proxy)	6-19	12.52 *(3.2)*	12.49 *(3.3)*
Use of a Computer at Work (No/Yes)	0/1	0.28	0.36
The Household			
No Children	0/1	0.26	0.27
Youngest Child 0-11 Years	0/1	0.18	0.17
Youngest Child 12-24 Years	0/1	0.20	0.20
Youngest Child 25+ Years	0/1	0.06	0.04
Adult Children Not Living at Home	0/1	0.30	0.32
Household Equivalent Income (D-Mark)	55-30000	2526.56 *(1248.6)*	2643.81 *(1345.4)*
Single Household	0/1	0.23	0.24
The Social Context			
Age	17-99	47.98 *(18.3)*	48.73 *(18.3)*
Pre-technical Generation	0/1	0.34	0.28
Generation of the Household Revolution	0/1	0.17	0.17
Generation of Advanced HH Technology	0/1	0.17	0.17
Computer Generation	0/1	0.32	0.38
Women	0/1	0.53	0.53
West German	0/1	0.78	0.79
Turkish	0/1	0.03	0.03
East German	0/1	0.19	0.18
Weighted Number of Cases (in Million)		47.7	50.4

Source: GSOEP, cross-section weights (DIW, 1997, 2001).

To study the effects on the micro-level (knowledge), the formal education of respondents is coded as a year-proxy for the yearly equivalent of schooling and vocational training. For instance, a university diploma equals 19 years, whereas an Abitur equals 13 years of education.[10] Calculated for the year-proxy, the formal education of the respondents ranges between six and 19 years in Table 1. On average, respondents had 12.5 years of formal education in 1997 and 2001. Of all respondents, 28% reported using a computer at work in 1997 and 36% in 2001.

To measure the effects of the meso-level, I used information on household settings (children and net equivalence household income). To indicate some social restrictions that adult persons face, only the youngest child in a household entered the equation. The age clusters for the children living at home are 0–11 years for young children, for teenagers and young adults 12–24 years, and for older adult children 25+ years. In 1997, 26% of the respondents neither lived with children in their household nor reported any adult children living away from home. Of all other people, 18% reported the youngest child in the household to be between newborn and eleven years old. About 20% reported their youngest child to be between twelve and 24 years old, and 6% lived with adult children (25 years +) at home. On average, 30% of the respondents reported having adult children living away from home. In 2001, 17% of the people lived with children from newborn to 11 years old, 20% reported living with a child between 12-24 years, only 4% were living with adult children (25+ years) at home, and 32% of the people reported having adult children no longer living at home.

Next, let us look at the household net equivalence income scaled by the OECD 2 scale. The average net household equivalence income increased from 2,526.56 DM in 1997 to 2,643.81 DM in 2001 indicating an average rise of income of about 120.- DM. This is in line with general findings (see: Deutscher Bundestag, 2001). The last variable on the household level measures whether people live in a single household (reference group: no single household). In 1997 and 2001, 23%, respectively, 24% of the people lived in single

[10] The years that are calculated according to the educational level are displayed in Appendix A.

households.[11] Approximately half of these (54% in 1997, 56% in 2001) were "genuine" single households; the others were due to what is called an "empty nest" (table not shown).

Let us now take a look at the macro-level variables within the general social context. Most of the respondents belonged to either the pre-technical generation (34% in 1997, 28% in 2001) or the computer generation (32% in 1997, 38% in 2001). The generation of the household revolution and the generation of the advanced household technology contained 17% of the population in both waves. The age of the respondents ranged between 17 and 99 years with an average of 48 years in 1997 and 49 years in 2001. The percentage of women in the data was 53% in both waves. In 1997, 78% of the population lived in West Germany and 19% in East Germany. In 2001, 80% of the people lived in the West and 18% in the East. The remaining three percent were Turkish citizens (all living in West Germany).

Results

Because the dependent variable — private computer use — is coded in a bivariate mode a logistic regression model is used to display the influence of the covariates (Andreß, Hagenaars, & Kühnel, 1997; Morgan & Teachman, 1988). In general, coefficients smaller than '1' signify a lower probability of private computer use (compared to the reference group). Parameters over '1' altogether indicate higher probabilities. The variables at interval level display marginal effects. The cluster adjusted odds ratios of the net effects of the multivariate logistic regression in 1997 and 2001 are displayed in Table 2.[12]

The results support the knowledge hypothesis that computer use is positively related to education and computer use at work. In 1997 and 2001, education has a substantial and significantly positive influence (odds ratios in Table 2 are 1.10, respectively, 1.16). The effect of the variable "Use of a Computer at Work" is large, too. People who work with computers are roughly four times more likely to use PCs for their private ends compared to those who do not (1997:3.99 and 2001:4.30).[13]

At the household level – living with children and the net equivalence income – most of the expected positive relations are detected. The variable measuring the influence of the presence of children under 11 years old in the household is non-significant in 1997, but significant in 2001. It is possible that parents of younger children increasingly use computers as a side effect of the growing market for children's software.[14] Living with children aged 12 to 25 years seems best to support the notion of the second hypothesis. The presence of teenager or young adults at home seems to make people almost twice as likely to use computers compared to people with no children (odds ratio 1.7, see Table 2). The presence of adult children (25+) does not significantly affect the private use of computers. In addition to specific generation effects (see below) in such households, we may be observing a peculiar social attitude: Perhaps because they do not feel responsible for their children's spare time activities any longer, the elderly most likely leave it up to their adult children to use new technology.

The positive household net income effect in Table 2 lends support to relations established elsewhere (Ekdahl & Trojer, 2002). We observe the marginal income effects to be 1.02 in 1997 and 2001. Compared to the influence of teenage children (e.g., 1.70 in 1997), household income has to be well above the population average to have the same influence (3,500 DM in 1997, arithmetic mean from Table 2).[15] Living in a "Single Household" has a

[11] Official statistics show percentages of single households in Germany to be around 30%. Statistical offices include all possible household affiliations of persons, whereas the GSOEP considers the composition of the current household only (personal communication DIW Jürgen Schupp, March 9, 2004). The GSOEP household weights render the correct figures, but due to the research questions I use person weights. Household weights are constructed to weight the GSOEP data on the level of the household, i.e. when using the household data. Person weights, on the other hand, are used to weight the GSOEP data that is analysed on the individual level.

[12] The significance level is chosen at $p < 0.01$ due to the large number of cases in the data. All other outcomes are rejected as chance findings. Odds ratios (or) are calculated by or=exp(log) and interpreted as relative probabilities. The net effects of Table 2 show the magnitude of the effect after controlling for all other variables in the model. Cluster adjustment takes place on the level of the household. Here the assumption of the independence of observations has to be relaxed because all members of the household have the same values for household variables (see Huber, 1967). The significance level for the changes in coefficients is not computed because the main methodical concern is to empirically replicate the results. In studies on social inequality it is difficult to extract trends within a small time frame of four years (for quasi-time dependent models, see Martin & Robinson, 2004). I thank the reviewers for pointing out this important issue.

[13] People who use computers for private ends are perhaps more likely to get a job which acquires computer expertise, too.

[14] In 2001 already, computer applications could be bought for very small children between two and three years.

[15] Note the equivalence income in Table 2 is divided by 100 to make the integers visible. The calculation is: 3,500= 70/2*100.

strong and significantly negative influence on the private use of computers underlining the importance of primary social ties for innovation diffusion into private households.

Table 2
Odds Ratios for Private PC Use in 1997 and 2001

	Cluster Adjusted Odds Ratios[a)]	
	Computer Use 1997	Computer Use 2001
Knowledge		
Education (Year-Proxy)	1.10**	1.16**
Use a PC at Work (Yes)	3.99**	4.30**
The Household Context		
No Child Reported	Reference	
Child 0-11 Years	1.01	1.33**
Child 12-24 Years	1.70**	1.65**
Child 25+ Years	1.14	0.80
Ad. Child not in HH	1.00	0.99
HH Equiv. Income /100	1.02**	1.02**
Single HH (Ref.: Shared Household)	0.70**	0.61**
The Social Context		
Pre-technical Gen.	Reference	
Gen. Of HH Rev.	3.68**	2.80**
Gen. Of Adv. HH Tec.	5.72**	4.96**
Computer Generation	9.29**	8.68**
Women (Ref.: Men)	0.49**	0.63**
West German	Reference	
Turkish	0.21**	0.30**
East German	0.72**	0.84**
Pseudo R^2	0.25	0.30
Wald χ^2	1611	4155
No. cases (unweighted)	11636	20708

Source: GSOEP (DIW, 1997, 2001).
**= *p< 0.01*
[a)] Standard errors adjusted for clustering on the household level (Huber 1967).

On the macro-level it was proposed that people belonging to the older generations, women, ethnic minorities and people living in East Germany would lag behind with respect to private computer use. These hypothesised effects seem to hold if we look at the results in Table 2. Compared to the oldest pre-technical generation (reference group), all succeeding generations display increasing odds ratios for using computer.

In 1997, men are about twice as likely as women to use computers (odds ratio in 1997 is 0.49). However, in 2001 the odds ratio has increased to 0.63. It may be indicating a slowly closing gender gap. Regarding the Turkish ethnic minority in Germany, in 1997 Turkish people are four times, and in 2001 three times less likely than West Germans to use computers. Thus, this effect remains to be substantial. Also, indications exist for a negative effect of the unequal starting position in East and West Germany after the reunification. The digital gap is still detectable roughly 10 years later, although it seems as if recently the East is catching up with the West.

With respect to the diffusion hypothesis it must be said that effects on the micro and meso-level thus far seem to be unaffected by the diffusion process. A tendency to decrease is not discernible between 1997 and 2001.[16] In a way, only the variables on the macro-level seem to offer evidence for the possible existence of a diffusion effect: By and large, they are decreasing in size between 1997 and 2001. However, one should not overlook that with an observation window of only four years (1997-2001) and two moments of observations it is still too early to judge this as conclusive support.

[16] This result implies that future studies will have to focus on significant changes in the relations between the micro- and meso-level and the first digital divide.

Discussion

Analysing what causes different levels of computer access provides valuable insights into a newly emerging issue for studies on social inequality. The general question is, to what extent is private computer use determined by socio-economic background. Empirical indications exist that socioeconomic background heavily influences computer access. As expected, the net influence of individual knowledge influences private computer use positively.[17] Early adopters are found in the upper educational echelons where people often use computers at work. It may be concluded that this new technology does not diffuse haphazardly but systematically, via the work place into higher educated people's homes.

Regarding the meso-level the main finding is that having teenage children in a household enhances people's likelihoods to use computers. The explanation is at least twofold. It may be a result of parents' efforts to increase their computer proficiency because of a sense of responsibility for their children's future skill needs or for their own need of control. Likewise, children perhaps urge their parents to invest in computers and thus create an innovation friendly atmosphere at home. The question whether we are looking at a "push" or "pull" effect has to be left to future research.

Additionally, as other studies before show, net equivalence income increases people's chances of using computers. But comparing the size of the influence of household income to that of teenagers living in the household shows that income has to be well above the arithmetic population average to match the influence of teenagers. For becoming a computer user the effect of having children, particularly teenagers, is remarkably strong. Although living with teenagers perhaps occasionally might be trying, regarding the digital divide this household constellation seems to offer a competitive edge for computer access. Of course, other forms of social capital are conceivable, like the friendship networks or the extended family. Therefore, further studies are needed to see, whether social capital is indeed more advantageous than economic capital to bridge the digital gap.

On the macro-level, the influence of belonging to a certain technical generation, or gender, or ethnic background, respectively, living in East Germany was analysed. As all the hypothesised relations are empirically supported here, several conclusions may be derived. Confrontation with computer technology at a young age seems to generate individual technological adaptability, though it is too early to proclaim a closure of the generation gap.

According to the ambivalent role model, women were expected to be less likely than men to use computers privately. Despite the empirical support for this hypothesis, conclusions should be hedged with caveats. The data of the GSOEP does not contain a measure of some of the possible motivations of women for dismissing private computer use. Due to this lack of information it remains unknown whether women try to meet some of the expectations mentioned implicitly in the theory. A follow-up study should focus on this question.

Looking at the empirical support for ethnicity, belonging to the Turkish minority seems to inhibit people from using computers. This relation persists even if we control for knowledge, household settings and the social contexts. The assumptions for the theoretical notions were that computers are perceived as cultural tools belonging to the "outer sphere" (Nohl, 2001). Due to an ongoing acculturation when living in a foreign culture over time this effect may be expected to taper off. However, the influence of belonging to the Turkish minority living in Germany is substantial. To get more insights, why this is the case one would probably need information on the duration of time spent in Turkey or Germany. More research on this topic is necessary to explain this large and persisting digital gap between the Turkish minority and the (West) German majority.

Due to the unequal starting positions after reunification in 1989, it was expected that the digital gap is still detectable between the East and the West in Germany, more than 10 years after the reunification. The empirical results show that this is the case. Tentative hints exist that the digital gap is slowly closing. However, more research is necessary to follow-up on this process and draw firm conclusions on possible trends.

Generally, a firm judgement whether the abstract notions of the diffusion theory holds would be premature in view of the time window covered by this study. A trend study at a later point in time is to be recommended. By successfully replicating the empirical results in 1997 and in 2001 the probability of chance findings has been somewhat reduced.

[17] All the empirical results discussed below are derived from so-called net effects that display the influence of a particular variable after controlling for the influence of all the other variables in the models (see footnote 12).

While substantial evidence has been produced for the emergence of the first digital divide the second digital divide may be already following in the wake. Therefore, future studies should also concentrate on probable relations between the "first" and the "second" digital divide (Attewell, 2001). These issues deal with the question how the chance of using computers and the purpose of their use may be linked to each other (Hargittai, 2001; De Haan, 2004; Korupp, 2005).

By and large, knowledge and household settings are very important for becoming a computer user. How they may influence the rise of the second digital divide is still an open question. Another worrying issue that remains is how a potential lack of social relations might be compensated to help close the digital divide.

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Appendix – Coding for the Year Proxy of Educational Level

Approximated Years of Formal Education	Graduation Level
6	Volksschule ohne Abschluß
8	Volksschule ohne Abschluß mit Lehre
9	Hauptschulabschluß ohne Lehre
10	Mittlere Reife ohne Lehre
11	Hauptschulabschluß mit Lehre
12	Mittlere Reife mit Lehre
13	Fachhochschulreife/Abitur ohne Lehre
14	Fachhochschulreife/Abitur mit Lehre
17	Fachhochschulabschluß
19	Universitätsabschluß

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Causes and Trends of the Digital Divide

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In modern societies, the digital divide indicates the emergence of a new form of social inequality. To analyse this concept we study causes of private computer and Internet access with a three-fold model including human capital, family context and social context. The 1997, 2001, and 2003 German Socio-Economic Panel waves contain data on private computer and Internet use, as well as information on past and present socio-economic circumstances. In 2003, membership of technical generations and ethnic background to a large extent determined the use of new technologies. By illustrating the importance of human capital and family context we are able to explain additional differences found for computer and Internet use. Effects of income, gender, and living in a single household are significant. Our study shows that some of the long-term consequences of the 40-year German separation are diminishing with regard to computer use. We demonstrate that human and social capital are more important than economic capital in explaining private computer and Internet use. Indications for higher social classes to secure or even increase their favourable social positions exist.

Introduction

The starting point of this research is the appearance of a new form of social inequality: the digital divide. This abstract notion is defined as a division between individuals and households at different socio-economic levels, regarding their chances to access or use information and communication technology (OECD, 2002). A theoretical distinction exists between the *first-level* and *second-level* digital divide (Attewell, 2001; DiMaggio and Hargittai, 2001; Hargittai, 2002). The first-level digital divide deals with problems of access to computers and the Internet, while the second-level focuses on the user profiles of new technologies. Before studying user profiles, however, the reasons for access versus non-access to computers and the Internet should be clarified. Therefore, we investigate the first-level digital divide. We deal with reasons for, and developments of, private computer and Internet access in Germany between 1997 and 2003. We ask who uses computers and the Internet for his or her private ends and whether we can identify possible causes and trends.

At times, research on this topic has been challenged by charges of studying a non-existent myth or 'luxury' problem (Compraine, 2001). However, empirical results paint an entirely different picture. Computer literacy is positively related to social activity and school performance (Wagner *et al.*, 2002), math and language skills (Attewell and Battle, 1999), success in finding a job (Boes and Preißler, 2002), and hourly wages (Kim, 2003). Our own research confirms these findings. Between 1979 and 1998 income levels became positively influenced by the use of computers at work (Korupp, 2001). This relationship did not weaken but slowly increased over time, remaining at a fairly stable level between the 80s and the 90s (Korupp, 2001). Given these

positive relationships we are left with the question of what influences people's access and use of computers and the Internet.

Most of the studies on this topic deal either with social inequality, regional aspects, or ethnic background.[1] If the digital gap is connected to socio-economic inequality, 'classical' attributes like education and income are introduced to help understand unequal computer access. A general finding is that the development of the digital divide parallels that of economic inequality (e.g. Bucy, 2000; Luke, 2000; Attewell, 2001; DiMaggio *et al.*, 2001; Jung *et al.*, 2001; Bonfadelli, 2002; Ekdahl and Trojer, 2002). Part of this discussion revolves around the diametric antipodes of a utopian versus dystopian view, i.e. an optimistic versus a pessimistic outlook (Ebo, 1998; Katz and Rice, 2002a,b). The question is whether the introduction of computers and the Internet to modern societies increases or decreases the general quality of life. Some authors hold that computers and the Internet will complement other media and will become as ordinary as TVs or radios (DiMaggio *et al.*, 2001; Katz and Rice, 2002b). However, rather than being an ordinary household tool a computer can be perceived as a complex, multi-tasking device. Compared to handling, for example, mobile phones, using computers and the Internet requires specific skills that go beyond mere 'push-and-go' applications.

In studies on regional aspects, authors often stress exclusionary trends. Dolnicar *et al.* (2002), for example, show that compared to the EU the use of computers in Slovenia has fallen far behind. For the US it is predicted that low income urban communities will be disqualified for further technological advancements (Servon, 2001). Results show an increasing relationship between lacking the means to invest in infrastructure and the underdevelopment of rural areas (Hollifield, 2003). Another study underlines that a general shortage of human capital in rural areas adds to a developmental lag (Malecki, 2003).

Research that connects ethnic background to the use of computers is marked by a broad variety of analytic goals and questions. By combining, for instance, the digital divide and race inequalities in a global perspective, one study shows that race antagonisms between the north and the south of the world are currently reinforced (Nelson, 2002). Research on Anglo Americans and Hispanics underscores the importance of ethnicity regarding Internet use (Hacker and Steiner, 2002). A small-scale study on an Internet seminar demonstrates that gender and race influence students' modes of participation (Carstaphen and Lambiase, 1998). Obviously, ethnic background is important for analysing the digital divide.

Let us now turn to the situation in Germany. In 2002, only 35 out of 100 people owned a private PC, accounting for a 15 per cent increase within the last 12 years (IdW, 2003). Several notions are evident when reviewing studies on the digital divide in Germany. Most of the research deals with numbers and counts of computers, hosts, and Internet connections without trying to find an explanation for the current developments (SPIEGEL, 1996; AG.MA, 2000; golem.de, 2000; heise online, 2003; Van Eimeren *et al.*, 2003; Statistisches Bundesamt, 2003). Nevertheless, the more recently a study is published, the more positive its undercurrent. For example, in 1996 concerns were voiced about the possible generation of status barriers regarding the use of new technologies (SPIEGEL, 1996). In 2003, a study appeared with the header: 'More than half of all Germans are online!' (heise online, 2003). But international comparisons show that in Germany the private use of computers is at a moderate level at best (Statistisches Bundesamt, 2003: 25).[2]

One exception is an approach explaining the number of Internet hosts in an international comparison. Here the diffusion rate of technology is related to general levels of trust and average material well-being (Bornschier, 2001). The study shows that an early diffusion of Internet applications is connected to high degrees of average trust and tolerance within countries.

To promote a more theoretically based view on the digital divide we embed our study into an individual, institutional, and social framework. We build an encompassing three-fold model based on theoretical concepts that draw on *human capital*, the *family context*, and the *social context* (see Figure 1). Regarding human capital we look at effects of education and computer use at work. Within the family context we include household settings, e.g. living with children and household income, and reflect their constraints on private computer and Internet use. Within the social context we look at domains of group membership, like technical generations, gender, ethnic background, and regional differences between East and West Germany.

Additionally, we contrast two theoretical ideas on innovation diffusion. On the one hand, a 'top down' notion exists. It indicates that people from higher socio-economic strata are the first to adopt new technologies. After a trial period in which its success is determined, the new technology 'trickles down' to people from lower socio-economic levels (Rogers, 1995). On the other hand, we see that age is determined as a key issue,

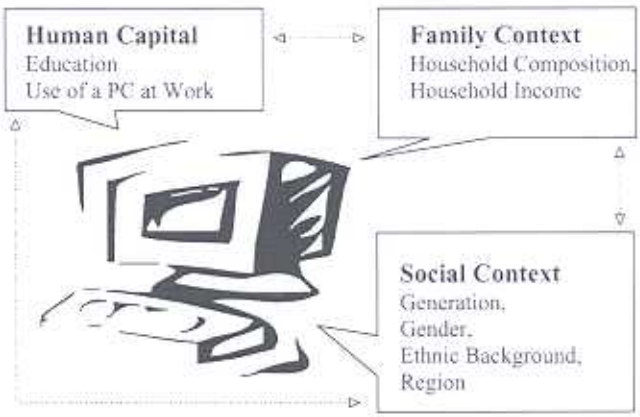

Figure 1 Three levels of explanation for privately using a computer or the Internet

assuming that youth grants a quick innovation adoption. Here innovation diffusion occurs because the adopting young generation grows older (Sackmann and Weymann, 1995; Watt and White, 1999).

Theory and Hypotheses

Let us first concentrate on the accumulation of *human capital* and how it influences private computer use. Human capital includes general and specific schooling and training, e.g. high school diplomas or vocational training (Becker, 1964). We assume levels of education and vocational training to be positively connected to people's use of computers or the Internet. In fact we presume computer literacy to be merely an additional educational skill. What is more, people with moderate levels of human capital are likely to work with computers in white collar jobs (Korupp, 2002). Getting acquainted with computers at work probably increases a person's likelihood of using one for his or her private ends. Therefore, we should find a positive relation between a person's human capital and his or her private use of computers or the Internet (hypothesis 1).

Particularly central to our study is the *family context*. Studies on computer use in families are embedded within the ecological framework of family theory (Watt and White, 1999). The ecological periphery of a family includes habitation and, more importantly, its technological environment. The incentives for children to deal with computers and the Internet are straightforward. Computer use involves playing games interactively or alone and, with respect to the Internet, searching for information (Leu, 1991).[3] Recent surveys on children's (6–13 years) user profiles show that 70 per cent play games on computers, 50 per cent use computers for their homework, 44 per cent use them for learning programs, and one-third draws and writes on the computer or surfs on the Internet (Medienpädagogischer Forschungsverbund Südwest, 2003). Hardly any of the children report programming activities. Teenagers (12–19 years) report off-line activities like listening to music (46 per cent), computer games (41 per cent), writing texts (37 per cent), or schoolwork (36 per cent) (Medienpädagogischer Forschungsverbund Südwest, 2004). They use the Internet for e-mail (44 per cent), to look for information (31 per cent), for instant messaging (26 per cent), to download news or music (23 per cent), or for educational and occupational purposes (22 per cent) (Medienpädagogischer Forschungsverbund Südwest, 2004).

Using computers and the Internet offers children an indirect participation in the adult world because most of the private and public sphere is comprehensively covered (Barthelmes and Sander, 1988).[4] The question is how children might induce their parents to use these technologies. To start with, we can locate patterns of computer use in families at the level of control and regulation (Beisenherz, 1988). This means parents may want to protect their children from unwanted informational contents. The best way of doing so is to know how the computer or Internet works and control the content offered. Additionally, though, the image of the computer has developed from being a distant 'cold' machine into a socially 'friendly' device and is, according to newer research, '[...] successfully connected to middle-class ideals' (Reed, 2000). Therefore, parents may simply want to adjust to middle-class ideals, believing computer

proficiency to be an essential future skill for their children. These assumptions lead us to expect that living together with children enhances people's likelihood of using a computer or the Internet at home (hypothesis 2). A lack of primary social ties on the other hand should decrease people's use of computers or the Internet.

In our introduction we mention a close connection between income and the possibilities of bridging the digital divide. As household income constrains purchasing power we expect family income to positively affect the private use of computers and the Internet (hypothesis 3). In the empirical section below we will follow up on the question of whether income or living with children is more essential for closing the digital divide.

The *social context* is our third level of departure. Who are the early adopters of a new technology and why are they the first to use computers and the Internet? We identify several potential determinants: generation, gender, ethnicity, and region.[5] Regarding generation, we follow an approach by Sackmann and Weymann (1995), who depict four *ideal* types.[6] The 'pre-technical generation' (born before 1939) grew up in an environment bare of household technology. The 'generation of the household revolution' (born between 1939 and 1948) was raised while basic kitchen technology diffused into private households, like water boilers and refrigerators. The third 'generation of advanced household technology' (born between 1949 and 1964) grew up with more sophisticated inventions like the washing machine, stoves, or central heating. The following 'computer generation' (born after 1964) was raised with a set of digitalized home technology. Computer chips are implemented in microwaves, washing machines, fridges, telephones, heating systems, etc. The assumption is that the home environment where people are raised determines their habits towards new technologies. Thus, for every succeeding generation we expect to find according changes in computer and Internet use (hypothesis 4).

The next determinant on the level of the social context is gender. We continue to observe a troubling gender inequality when we look at the participation rates of women in any of the related fields of information technology (Fountain, 2000). Census data show that fewer women than men own a computer, particularly if they live in a single household (Statistisches Bundesamt, 2003: 24). In 1997, only approximately 30 per cent of all Internet users were women (Suler, 1997). Research suggests that women are not socialized to become involved in matters of technology (Brunet and Proulx, 1989). On the other hand, studies show that both men and women are fascinated by the multitudinal applications of computer technology (Löchel, 1992). Nevertheless, women seem to be less emotional about computers and more interested in their practical applications (Löchel, 1992). The *ambivalent role model* poses that women face contradictory role models in technology operating fields, experiencing inconsistencies when linking their job and household obligations (Waibel, 1992; Collmer, 1995). Other than in their jobs, they are not socialized to become involved in technological issues at home. Accordingly, we expect fewer women than men to use a computer or the Internet for their private means (hypothesis 5).

At this point we are left with two more issues: ethnic background and regional aspects. Following a larger immigration wave in the 1960s, Turkish people have been settling in Germany for over 40 years. They form a major ethnic minority group with approximately two million members. As the culture of their homeland for the most part is shaped by an agrarian and patriarchal structure, many Turkish immigrants in Germany experience some distinct cultural conflicts (Geißler, 2002: 304). By and large, strong tendencies prevail towards cultural isolation resulting in a below average command of the German language (Geißler, 2002: 304). However, most of the computer programs that can be bought in Germany have either a German or English language interface. Therefore, we assume that Turkish people perceive computer systems as culturally different, belonging to a so-called *outer sphere* (Nohl, 2001). Perceived cultural differences may cause a delayed diffusion of computers and the Internet into ethnic minority groups, although this relationship probably weakens as acculturation proceeds (hypothesis 6).

As East and West Germany were separated for over 40 years, regional differences exist. In the GDR, the first 'home' computer (HC900) was manufactured in 1985. Because of supply shortages, it soon became obvious that the HC900 would not be used as a home computer. It was then labelled KC85/2. In 1989, the first computer that could be purchased in East German shops was the KC85/4. Before reunification, only 50,000 models were produced and sold (Amann, 2003). Thus, we cannot assume any noteworthy diffusion of home computer technology into the private households of the GDR. In 1993, we see that 22.4 per cent of West German households owned a PC, compared to 16.3 per cent in the East (Statistisches Bundesamt, 1994).[7] Ten years after reunification, other large differences continue to exist, including average prosperity, labour market chances, and political power (see for example Deutscher Bundestag, 2001; Geißler, 2002). Regarding our model on the digital

divide we can detect further long-term consequences of the German separation. Given the importance of initial regional settings, we expect people in East Germany to use computers and the Internet less often than people in West Germany (hypothesis 7).

How will these hypothetical relations develop over time? According to Rogers (1995), all theoretical relationships mentioned in our hypotheses should weaken over time. He assumes that after reaching 'critical mass', a self-sustaining innovation dispersion occurs.

Data and Methods

We test our hypotheses using data from the 1997, 2001, and 2003 waves of the German Socio-Economic Panel (GSOEP) (DIW, 2004). The GSOEP is a representative longitudinal survey of private households. It was first conducted in 1984 and has since been continued on a yearly basis with retrospective surveys. From the start, the panel includes information on the foreign population in Germany (DIW, 2005). In 1989, the GSOEP was expanded to East Germany. In 2001, an additional number of 4,911 households were interviewed to 'refresh' the old longitudinal sample that was suffering from sample attrition. The wave of 2001 contains more than 12,000 households and 22,000 persons. In 1997, 2001, and 2003 the use of computers for private and professional means was surveyed. Questions on Internet use were posed only in 2001 and 2003. We excluded foreigners who did not belong to the Turkish minority from our database.

Table 1 contains the cross-sectional weighted number of observations, means, standard deviations, and ranges of the variables used in the analyses. The private use of computers or the Internet is coded as a bivariate dummy

Table1 Descriptive statistics

Contents of variables	Range	Mean (Standard deviation)		
		1997	2001	2003
Privately use computers (no/yes)	0/1	0.23	0.41	0.51
Privately use the Internet (no/yes)[a]	0/1	n.a.	0.27	0.42
Human capital				
Education (year-proxy)	6–19	12.52 (3.2)	12.49 (3.3)	12.59 (3.3)
Use a computer at work (no/yes)	0/1	0.28	0.36	(0.36) [b]
Family context				
No child reported	0/1	0.26	0.27	0.27
Youngest child 0–11 years	0/1	0.18	0.17	0.16
Youngest child 12–24 years	0/1	0.20	0.20	0.20
Youngest child 25+ years	0/1	0.06	0.04	0.05
Adult children not living at home	0/1	0.30	0.32	0.32
Household equivalence income[c]	300–30,000	2421.43 (1202.3)	2658.36 (1344.0)	1433.65 (812.3)
Single household	0/1	0.23	0.24	0.23
Social context				
Age	17–99	47.98 (18.3)	48.73 (18.3)	49.49 (18.2)
Pre-technical generation	0/1	0.34	0.28	0.27
Generation of the household revolution	0/1	0.17	0.17	0.17
Generation of advanced household technology	0/1	0.17	0.17	0.17
Computer generation	0/1	0.32	0.38	0.39
Women	0/1	0.53	0.53	0.53
West German	0/1	0.78	0.79	0.79
East German	0/1	0.19	0.18	0.19
Turkish	0/1	0.03	0.03	0.02
Weighted number of cases (millions)		47.7	50.4	63.9

Source: GSOEP, weighted by person weights (DIW, 1997, 2001, 2003).

[a] *In 1997 no question is posed on private Internet use.*

[b] *In 2003 no question is posed on computer use at work. Because the value is retrieved from the 2001 wave it remains constant between 2001 and 2003.*

[c] *In 2003: Euro (€).*

variable ('yes' = 1, 'no' = 0).[8] In 1997, 23 per cent of the German population between 17 and 99 years of age uses a computer, increasing to 41 per cent in 2001 and 51 per cent in 2003. In 2001, 27 per cent and in 2003, 42 per cent of the respondents use the Internet for private means.

To study effects of human capital the formal education of respondents is coded as a year-proxy for the yearly equivalent of schooling and vocational training (table available from the first author). Formal education ranges between six and 19 years.[9] Respondents have an average formal education of 12.5 years in 1997, 2001, and 2003.[10] About 28 per cent of them report using a computer at work in 1997 and 36 per cent in 2001.[11]

To measure the effects of the *family context* we use information on household settings. Household composition hardly changes between 1997 and 2003. In 1997, 26 per cent (2001 and 2003: 27 per cent) do not live with children or report adult children living away from home. About 18 per cent report their youngest child to be between newborn and 11 years old (2001: 17 per cent; 2003: 16 per cent). Approximately 20 per cent report their youngest child to be between 12 and 24 years old and only six per cent live with adult children (25 years +) at home (2001: four per cent; 2003: five per cent). On average, 30 per cent of the respondents report adult children living away from home.

The average net household equivalence income increases from 2,421.43 DM in 1997 to 2,658.36 DM in 2001 indicating a rise of average income of about 235 DM (see also: Deutscher Bundestag, 2001). In 2003, the mean value is € 1,433.65 (= 2810 DM). We see that 23 to 24 per cent of the respondents live in a single household.[12] Approximately half of these (54 per cent in 1997, 56 per cent in 2001 and 2003) are 'genuine' single households; the others are due to what is called an 'empty nest' (table not shown).

Let us now look at the *social context*. Most of the respondents belong to either the pre-technical generation (34 per cent in 1997, 28 per cent in 2001, and 27 per cent in 2003) or the computer generation (32 per cent in 1997, 38 per cent in 2001, and 39 per cent in 2003). The generation of the household revolution and the generation of advanced household technology make up 17 per cent of our population in the three waves. The age of the respondents ranges between 17 and 99 years with an average of 48 years in 1997 and 49 years in 2001 and 2003. The percentage of women in the data is 53 per cent in all three waves. In 1997, 78 per cent of the German population lives in West Germany and 19 per cent in East Germany. In 2001, 80 per cent live in the West and 18 per cent in the East. In 2003, 79 per cent live in the West and 19 per cent live in the East. The remaining two to three per cent are Turkish citizens (all living in West Germany). Before turning to our multivariate results, it is helpful to take a closer look at the characteristics of private computer and Internet users (see Table 2).

In Table 2, we observe that approximately 60 per cent of private computer and Internet users have an education of 13 years and more. Roughly 65 per cent of them use a computer at work. They are over-represented in the category of living with children and under-represented as members of single households (15–17 per cent). This finding is a first hint towards the importance of primary social ties for private computer and Internet use. About one quarter of all computer and Internet users have families with young children under 12 years old (24–26 per cent). Approximately 28 to 29 per cent live with children between 12 and 25 years of age. Three to five percent of the respondents live with adult children (25 years and older).

In Table 2, we divided the distribution of net equivalence income into quintiles. If all income groups were evenly distributed over the quintiles, we should find 20 per cent of the population in each of these groups. However, a disproportionately low fraction of private computer and Internet users have an income in the first three quintiles (12–19 per cent). The higher income groups within the last two quintiles are over-represented (22–33 per cent). If we compare the last quintile (5th) income group of computer users in 1997, 2001, and 2003, we observe a decreasing trend of status inequality. Their fraction decreases from 30.2 per cent in 1997 to 25.4 per cent in 2003.

Furthermore, we observe large proportional differences between generations. Only four to five per cent belong to the pre-technical and 11 to 16 per cent to the generation of the household revolution. In large parts private computer and Internet users can be found in the generation of advanced household technology (21–26 per cent) and the so-called computer generation (52–64 per cent).

About 35 to 46 per cent of all private computer and Internet users are women. With respect to ethnicity and region the distribution of computer users is comparative to their proportion in the population. In sum, we see that typical computer and Internet users are male, have an above average education and use a computer at work. They share a household with children or another adult and belong to the so-called computer generation. In the following multivariate analyses we observe whether these relations hold if we control for all variables in our model simultaneously.

Table 2 The socio-economic background of private computer and Internet users

	1997	2001		2003	
	Computer user	Computer user	Internet user	Computer user	Internet user
Human capital					
Education (13+ years)	62.2	60.6	65.1	56.5	59.1
Use of a computer at work (yes)	64.7	65.6	72.4	–[a]	–[a]
Family context					
No child reported	29.1	28.9	32.7	28.8	30.3
Youngest child 0–11 years	24.8	25.0	24.6	23.9	24.4
Youngest child 12–24 years	28.9	28.6	27.5	28.3	28.9
Youngest child 25+ years	5.4	3.3	3.2	4.1	3.9
Adult children not living at home	11.8	14.2	12.0	14.9	12.5
Household equivalence income					
1st quintile	11.6	14.9	12.4	15.9	15.1
2nd quintile	18.8	16.0	14.0	16.8	15.6
3rd quintile	14.4	19.0	17.1	18.2	18.6
4th quintile	25.0	21.5	23.1	23.7	23.9
5th quintile	30.2	28.6	33.4	25.4	26.8
Single household	14.4	16.7	17.9	17.5	17.6
Social context					
Pre-technical generation	5.0	5.5	4.1	5.6	4.2
Generation of the household revolution	16.6	14.0	12.4	13.2	11.4
Generation of advanced household technology	26.5	22.1	21.8	20.8	20.4
Computer generation	51.9	58.4	61.7	60.4	64.0
Women	35.3	44.4	41.9	46.7	45.2
West German	82.7	81.2	82.8	79.6	81.1
East German	16.1	17.6	14.9	19.2	17.8
Turkish	1.2	1.2	1.0	1.2	1.1
Weighted number of cases (millions)	13.1	22.2	14.7	32.9	27.1
Percentage of all cases (see Table 1)	22.7	41.0	27.1	51.4	42.3

Source: GSOEP, weighted by person weights (DIW, 1997, 2001, 2003).

[a] In 2003, no question is posed on computer use at work. Values are retrieved from the GSOEP wave of 2001, to control for this effect.

Results

Because the dependent variables—private computer and Internet use—are coded in a bivariate mode, an appropriate statistical procedure for studying effects of the independent variables is the logistic regression model (Morgan and Teachman, 1988; Andreß *et al.*, 1997). In Table 3, the odds ratios of the cluster adjusted logistic regression models for the net effects in 1997, 2001, and 2003 are displayed.[13] Coefficients which are less than '1' signify a lower probability of private computer use compared to the reference group of the dummy variables. For variables at interval level, the coefficients display marginal effects.

The results support hypothesis 1 which states that *human capital* is positively related to the private use of computers or the Internet. In every wave, education has a substantial and significantly positive influence (odds ratios in Table 3 range from 1.11 to 1.16). Even larger is the effect for the variable 'use of a computer at work'. People who work with computers are roughly four times more likely to use PCs for their private ends compared to those who do not.[14]

Turning to the *family context*, we expect to find a positive relation between living with children and the personal odds of privately using the computers or the Internet (hypothesis 2). The variable measuring the effects of the presence of children of 11 years and younger in the household is significant only for computer use in 2001. Perhaps for a while, parents became more interested in using computers and the Internet to try out some of the new software and websites for very young children that were becoming publicly available.[15] Living with teenage children and young adults (12–24 years) seems

Table 3 Odds ratios for private computer and Internet use in 1997, 2001, and 2003

	Cluster adjusted odds ratios[a]				
	Computer use 1997	Computer use 2001	Internet use 2001	Computer use 2003	Internet use 2003
Human capital					
Education (year-proxy)	1.11**	1.16**	1.13**	1.13**	1.12**
Use a PC at work (yes)	4.04**	4.26**	3.42**	4.25**[b]	3.63**[b]
Family context					
No child reported			Reference		
Child 0–11 years	1.01	1.33**	0.97	1.16	0.95
Child 12–24 years	1.70**	1.65**	1.25**	1.63**	1.35**
Child 25+ years	1.14	0.80	0.73	0.76	0.70**
Adult child not in household	1.00	0.99	0.74**	0.95	0.82
Household equivalent income/100	1.02**	1.02**	1.02**	1.03**[c]	1.03**[c]
Single household (reference: shared household)	0.67**	0.63**	0.75**	0.75**	0.79**
Social context					
Pre-technical generation			Reference		
Generation of household revolution	3.37**	2.75**	2.74**	2.81**	2.80**
Generation of advanced household technology	5.35**	4.67**	4.27**	5.56**	5.99**
Computer generation	8.72**	8.34**	7.72**	14.70**	14.66**
Women (reference: men)	0.48**	0.62**	0.61**	0.61**	0.60**
West German			Reference		
East German	0.71**	0.83**	0.72**	0.96	0.84**
Turkish	0.20**	0.30**	0.33**	0.22**	0.27**
McFadden Pseudo R^2	0.25	0.30	0.25	0.34	0.31
Wald Chi^2	1832	4130	3218	3771	3594
Number of cases (unweighted)	11636	20708	20708	18503	18503

Source: GSOEP (DIW, 1997, 2001, 2003).

"$P < 0.01$.

[a]Standard errors adjusted for clustering on the household level (Huber, 1967).

[b]In 2003 this effect is estimated prospectively from the variable in 2001 to control for use of a computer at work. Computer use at work was not surveyed in 2003 (1348 excluded cases due to panel mortality).

[c]Coefficients for Euro (€). Coefficients for D-Mark in 2003 are 1.016 (computer) and 1.018 (Internet), respectively.

best to support the notion of our second hypothesis. The presence of teenagers and young adults is a good predictor for people's computer and Internet use. The presence of adult children (25 years +) does not significantly affect the private use of computers, apart from their negative influence on Internet use in 2003. Possibly this effect indicates a certain attitude of parents who live with adult children. Perhaps they leave it to the younger generation to 'meddle' with new technology. However, this is a singular effect for which further empirical evidence is needed.

In hypothesis 3 we draw a positive relationship between household income and computer use. The positive income effect in Table 3 supports this notion. The marginal effect of this variable is 1.02 in 1997 and 2001, and 1.03 in 2003.[16] In order to get an idea of how large the effects of teenage children are compared to net household income we calculate how high the latter has to be to match the effect of teenagers. Computing this renders a figure of 3,500 DM (€ 1,785) in 1997, 3,250 DM (€ 1,658) in 2001, and € 2,100 in 2003.[17] These numbers show that equivalence income must be well above average to match the effect of teenagers and young adults living at home. The positive and innovation friendly effects of teenage children thus seem to make up in large parts for the purchasing power measured by net equivalence income.[18] As expected, living in a 'single household' has a strong and significantly negative influence on the private use of computers and the Internet, underlining the importance of primary social ties.

Our next hypotheses are located at the level of the *social context*. The effect of generation decreases between

1997 and 2001, but no longer in 2003. This change is indicated in Table 2, where we see that an increasing number of people belong to the computer generation. The size of this change becomes clear only if we look at cross tabulations of users versus non-users of computers and the Internet in 1997, 2001, and 2003 (tables not shown). The large increase of the effect of the computer generation in 2003 is explained by the changes within the non-user group.[19] In 2001, the computer generation shows a ratio of users to non-users of roughly one out of three. In 2003, this ratio rapidly decreases to one out of four non-users to users of computers. Although not captured by any of the descriptive statistics shown above, these changes are disclosed by the multivariate models. Thus, we receive distinct support for our hypothesis that home technology equipment during childhood years determines general habits towards new technologies later in life (hypothesis 4). Compared to the pre-technical generation (reference group) all other generations successively display significantly increased odds ratios for using computers or the Internet.

We find women to be half as likely as men to use computers or the Internet in 1997 (odds ratio: 0.48), supporting hypothesis 5. This discrepancy decreases between 1997 and 2003 (in 2003 the odds ratio is 0.61). It indicates a trend towards a slowly closing gender division.

We also offered the hypothesis that ethnic background is negatively connected to the private use of computers and the Internet (hypothesis 6). This relationship is empirically supported. The strength of this effect decreases between 1997 and 2001, but this trend is discontinued in 2003. Altogether, the differences between West Germans and the Turkish minority for private computer and Internet use remain remarkable.

Additionally, we hold that the unequal starting position in East and West Germany is still detectable roughly 10 years after reunification (hypothesis 7). This relation is supported by the data. The negative influence of living in East Germany in contrast to West Germany becomes weaker between 1997 and 2001 and is non-significant in 2003 (for computer use). Although we still see a slight difference between East and West Germany regarding their private use of the Internet, we find indications for a rapidly closing technology gap between the East and the West.

Roughly ranking all the coefficients for computer use in 2003 in descending order shows that effects of generation and ethnicity have the strongest influence.[20] These are followed by 'using a computer at work', education, and living with children. Effects of income, gender, living in a single household, and region follow in their wake. Region is no longer significant for private computer use in 2003. This ranking varies little between 1997 and 2003.

Discussion

Analysing causes and trends of the digital divide provides valuable insights into newly emerging trends in social inequality. Our general questions were who uses computers or the Internet for his or her private ends and how do we explain the possible differences. The expected positive influence of *human capital* on computers and Internet use was empirically supported. Usually, early adopters are found in the upper educational echelons where people often use computers at work. We conclude that successful new technologies do not diffuse haphazardly but systematically into our society. The diffusion process appears as a vertical movement along the socio-economic strata, drifting from the highest to the lowest status position. We also observe a strong dependence between computer and Internet use at home and computer use at work. Thus, new technologies seem to push their way into private households by being used at work. This way, inequalities on the labour market are transmitted into private households and reinforce computer access disparity.

Regarding the level of *family context* we find that sharing a household with teenagers and young adults is a good predictor of whether people use a computer or the Internet for their own purposes. It may be a result of parents' efforts to increase computer proficiency because of a sense of responsibility for their children's future skill needs. Additionally, teenagers (especially) perhaps urge their parents to invest into computers creating an innovation friendly atmosphere at home. We find a positive relationship between net equivalence income and people's chances to use computers and the Internet. Still, income has to be well above average to be at the same level as household composition. People living with teenagers and young adults thus seem to have a competitive advantage to close the digital divide. Apparently, human or social capital is more important than economic capital to secure computer and Internet access.

The influence of *social context* is investigated in terms of technical generations, gender, ethnic background and regional differences between East and West Germany. We detected empirical support for the hypothesized relation between different technology generations and their use of computers and the Internet. Confrontation

with computer technology at a young age seems to make its appliance more likely. Although this relation weakened between 1997 and 2001 it is too early to proclaim a lasting closure of the generation gap. Our results indicate that this gap is opening up again. Future research should continue to focus on this issue. Another question is the relation between technology generations and ethnic background. Further research is needed to address the general applicability of the concept of technical generations to various groups of Turkish immigrants, e.g. those who grew up in rural parts of Turkey.

Turning to sex differences for computer and Internet use, it seems as if the gender divide is slowly closing up. According to the ambivalent role model, we expected women to be less likely than men to privately use computers or the Internet. Although the data supports this notion, our conclusions are hedged with caveats. The data of the GSOEP does not contain measures for some of the possible motivations of women to dismiss private computer and Internet use. A follow-up study should focus on this question. But taken together, the results indicate that the use of computers and the Internet is enforced by younger generations, initially showing a strong gender bias that is slowly tapering off.

Furthermore, we expected to find a negative relationship between ethnic background and the private use of computers and the Internet. We observe that people with a Turkish ethnic background are less likely to use computers or the Internet compared to Germans. This effect persists in spite of controlling for human capital, family context, and social contexts. Due to data limitations, however, the assumption that computers are perceived as cultural tools belonging to the *outer sphere* (Nohl, 2001) cannot be pursued. Perhaps another explanation may be useful. In Germany, immigrants are at a great risk of being overqualified for their jobs (Szydlik, 1998). Therefore, even if their job qualifications are similar to those of the German population they have less of a chance to work with computers. Ultimately, this discrimination might discourage the Turkish minority to learn how to use computers or the Internet in order to increase their job qualifications.

Regarding regional differences we showed that the digital divide between East and West Germany is narrowing down. In 2003, only insignificant differences are left between the East and the West with respect to computer use. It is probably not overoptimistic to expect the remaining gap for Internet use to close within the next few years.

We offer insights on the first-level digital divide, i.e. on different levels of access to modern computers and Internet technology. Generally, studies dealing with the second-level digital divide, that is how and for what purposes people use computers and the Internet, point out how difficult it is to study this 'technological black box' (see Attewell, 2001; DiMaggio and Hargittai, 2001; Natriello, 2001; Livingstone, 2003). Unfortunately, the GSOEP does not contain measures on user profiles either. We presume that the second-level digital divide will become a pressing future issue. Follow-up studies should focus on the quality of computer and Internet use to assess its impact on occupational skills and information access.

Obviously, the digital divide goes hand in hand with other forms of social inequality. West German males with higher education and income have much better chances of being on the favourable side of the digital divide than Turkish women with a lower education and income. Our empirical results do not indicate a decrease in other forms of social inequality due to access to computers and the Internet. On the contrary, the members of the lower social classes are not climbing the social ladder via better access to computer and Internet technology. As a more likely scenario we find indications for higher social classes to secure or even increase their favourable social positions. However, the period covered by the data (1997–2003) may be somewhat short to draw parallels between the digital divide and social status inequality. Ultimately, the question of how far social positions of people are affected by the private use of computers and the Internet needs to be followed up.

At present, our study underlines that early computer and Internet use is determined by generation and ethnic background. Furthermore, the influence of high status positions on the *individual level* and primary social relations within the *family context* determine in large parts who do and do not use computers or the Internet. A remaining question is whether a potential lack of social relations can be compensated for by means other than income to help close the digital gap. The other side of this conclusion is that, at least regarding the digital divide, it seems to pay off in more than one way to live with children.

Notes

1. Another important domain of research not dealt with here connects the influence of policy or politics to the digital divide (e.g. Johnson, 2001; Vartanova, 2002). For an overview, see DiMaggio *et al.* (2001).
2. The average supply of private households with the Internet in 2002 in the EU-15 is 40.4 per cent. The Netherlands are leading with a 65.5 per cent diffusion rate and Spain and Greece are at a low 29.9 and

9.2 per cent, respectively (Statistisches Bundesamt, 2003: 25).

3. We do not attempt to evaluate any of the impacts of computer use, because up to this point, the effects of computer use on children's social development cannot be predicted precisely (e.g. Subrahmanyam *et al.*, 2000).
4. To computer use this can be applied only to some extent, although differences should not be overestimated.
5. We include 'gender' on the macro level because sex roles are crucial for a whole set of social norms and values. Ethnic background and region summarize issues framing group behaviour and consumption patterns by membership and geographical location.
6. Here, of course, not family generations but societal generations are being depicted (see Szydlik, 2000: 19).
7. Before that, the statistical yearbook of the GDR offers information on radio and TV ownership only. From 1990 to 1993, the statistical yearbook for the reunited Germany contains information on PC ownership in West Germany only.
8. The translated question reads as follows: 'Do you use a computer [respectively, the Internet], either privately, on your job, in your training/education? (by computer include the personal computer (PC) or the main-frame but not purely a game machine).' The answers are coded separately for 'private' and 'job, training or educational' use of a computer or the Internet. In the 2003 wave of the GSOEP the bivariate (yes/no) coding of the variables for computer and Internet use are substituted by a six item scale (no comment, daily, once a week, once a month, more seldom, never). To make the results of this wave comparable to the former ones, two of these items (no comment, never) received the value '0', whereas the rest of the item scale received a '1'.
9. For example, it takes about 13 years to get an *Abitur* in Germany so the educational year-proxy is 13 here. A university degree takes on average six years and therefore a university diploma equals 19 years (13 years for the *Abitur* plus six years of studying time).
10. Usually the average educational level in Western industrialized societies increases over time. The figure found here can be explained by looking at the educational background of the Turkish population. Within our six-year time window we observe a decrease in average education for Turkish men and women. On average, a Turkish man loses an entire year and a Turkish woman more than a half of a year of schooling between 1997 and 2003 (table available from the first author).
11. In order to extend our analyses into 2003, we retrieve the variable 'computer use at work' from the 2001 wave, since it was not surveyed in 2003. Therefore, the corresponding figure in Table 1 is not interpreted.
12. Official statistics show percentages of single households in Germany to be around 30 per cent. Statistical offices include all possible household affiliations of persons, whereas the GSOEP considers the composition of the current household only (personal communication with Jürgen Schupp, DIW). The GSOEP household weights render the correct figures, but due to our research questions we use person weights.
13. The significance level is chosen at $P < 0.01$ per cent due to the large number of cases in the data. All other outcomes are rejected as chance findings. Odds ratios (or) are calculated by $or = exp^{(log)}$ and interpreted as relative probabilities (a table comparing the single and multivariate effects is available from the first author). Contrary to the conventional estimators of variance, the cluster adjusted estimator of variance corrects for the fact that on the level of the household some variables have the same value (e.g. household income). Thus, here we need to relax the assumption of independence of observations. Processing a cluster adjusted analysis requires only that the observations be independent across observations (Huber, 1967).
14. As mentioned above, in 2003 this effect is estimated prospectively. Therefore, the interpretation here is that if people use a computer at work in 2001, they are four times more likely to use a computer for private ends in 2003. Note for all three waves that people who use computers for their private ends are perhaps more likely to get a job which acquires computer expertise.
15. Computer programs can be bought for very small children between two and three years.
16. In 2003, the variable measures the effect of net equivalence income in Euros (€). Computing those effects in D-Mark (with € 1=1.96 DM) renders coefficients between 1.016 (computer use) and 1.018 (Internet use).
17. Results are taken from Table 3. Household income is measured in D-Mark in 1997 and 2001 and in € in 2003. All numbers are divided by 100. The 1997 figure, for example, is calculated as follows: 3500 = (1.7−1)/(1.02−1) × 100.
18. Note that the odds ratio does not capture effects of older siblings. What is more, additional analysis reveals tentative hints towards differences of children's effects for various status groups. Interactions between

education and living with children showed the influence of children to be more important for respondents with lower educational levels (< 13 years).

19. Additionally, note that the coding of the dependent variable changed between 2001 and 2003 (see footnote 8).
20. To rank the effects of the metric variables in Table 3 we based their scores on the averages values in Table 1.

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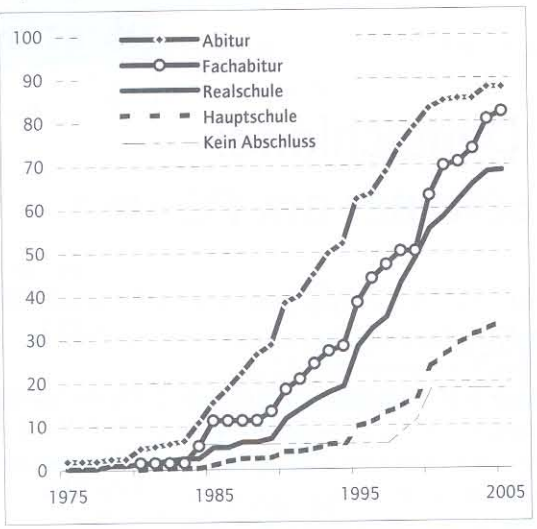
Abbildung 1

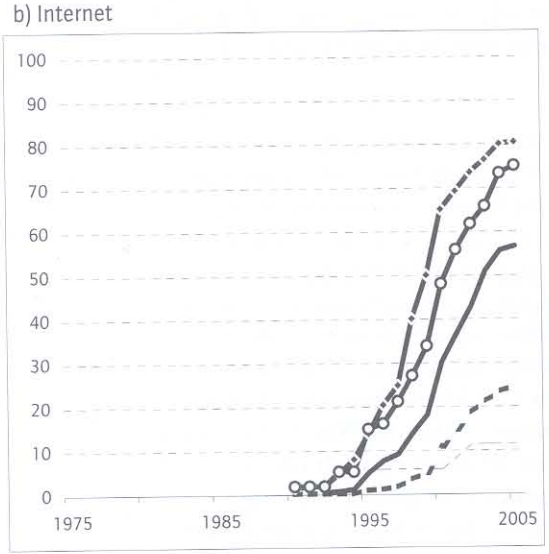
Nutzerinnen und Nutzer von Computern und Internet in Deutschland von 1975 bis 2005 nach Schulabschluss

Anteil an der Bevölkerung über 16 Jahre in %

a) Computer



b) Internet



Quellen: SOEP Sondererhebung 2005; Berechnungen des DIW Berlin.

DIW Berlin 2006

Um in Deutschland den Gefahren einer forcierten digitalen Spaltung sinnvoll entgegenzuwirken, ist es notwendig, sozio-ökonomische Merkmale, die den Zugang zu Computern und zum Internet strukturieren, zu kennen. Die vorliegende Untersuchung stützt sich auf Daten einer Sondererhebung des Sozio-oekonomischen Panel (SOEP). Diese Querschnittbefragung wurde im Sommer 2005 von TNS-Infratest Sozialforschung, München im Auftrag des DIW Berlin durchgeführt. Die Daten sind repräsentativ für die in Deutschland wohnende Bevölkerung über 16 Jahre.[6]

Computer- und Internetnutzung in Deutschland

Im Jahre 2005 nutzten in Deutschland 62 % der über 16-Jährigen einen Computer und 53 % das Internet. Die Nutzerzahlen haben seit Mitte der 80er Jahre deutlich zugenommen (Abbildung 1). Auch zeigt sich, dass die Verbreitung neuer Technologien eng mit der Schulbildung zusammenhängt: Personen mit Abitur sind überproportional häufig unter den Pionieren zu finden, die neue Technologien anwenden. Innerhalb dieser Gruppe kommt es zu einer rascheren Adaption neuer Techniken als bei Personen mit einem niedrigeren Schulabschluss. Schon in der Gruppe der Fachabiturienten und Personen mit einem Realschulabschluss werden vergleichbare Nutzeranteile deutlich später erreicht. Die Personengruppe ohne Schulabschluss oder mit Hauptschulabschluss benötigt einen noch längeren Zeithorizont. Das Abflachen der Kurven am aktuellen Rand ist möglicherweise als Indiz für eine dauerhafte Verfestigung der digitalen Spaltung zu verstehen.

Tabelle 1 weist die Nutzeranteile in verschiedenen Geburtsjahrgängen aus. Die älteste Generation, die in einer überwiegend mechanisch geprägten Haushaltsumgebung aufgewachsen ist, weist erwartungsgemäß den geringsten Anteil von PC- und Internetnutzern auf.[7] In jeder der folgenden Generationen lassen sich höhere Nutzeranteile beobachten – sowohl im privaten als auch im beruflichen Bereich. Lediglich bei der jüngsten Generation liegt die berufliche Nutzung unter jener der beiden vorhergehenden Generationen. Dies dürfte im Wesentlichen auf den hohen Anteil in dieser Gruppe zurückzuführen sein, der sich noch in der Ausbildung befindet.

6 Die Erhebung wurde im Zeitraum von Anfang Juni bis Anfang Juli 2005 im Random-Route-Verfahren anhand eines computergestützten persönlichen Interviews (CAPI) durchgeführt. Für die Analysen stehen 1012 Interviews zur Verfügung (Ausschöpfung: 50,8 %), die für die deskriptiven Auswertungen nach regionalen (Bundesland) und demographischen (Alter und Geschlecht) Merkmalen gewichtet werden. Vgl. zur methodischen Anlage der Erhebung TNS Infratest: Testerhebung zum SOEP 2006: Persönlichkeit und Alltag, Verhaltensexperimente, Retest-Studie (mimeo). München 2005.

7 Gemäß Reinhold Sackmann und Ansgar Weymann: Die Technisierung des Alltags – Generationen und technische Innovationen, Frankfurt/Main, 1994, ist diese „vortechnische" Generation in Haushalten aufgewachsen, die noch mehr oder weniger bar jeder Haushaltstechnologie waren (bis 1939 geborene Personen). Die nachfolgende Technikgeneration ist bereits in Haushalten mit elementaren Haushaltstechnologien aufgewachsen, z. B. elektrische Kühlschränke oder -herde (zwischen 1939 und 1948 geborene Personen). Die Generation der „zunehmenden Haushaltstechnisierung" wurde mit weiterentwickelter Haushaltstechnologie konfrontiert, so z. B. mit der Waschmaschine (zwischen 1949 und 1963 Geborene), die darauf folgende „Computergeneration" (1964 bis 1980 Geborene) dann mit einer größeren Anzahl computerisierter Haushaltstechnologie wie z. B. der Mikrowelle. Die von uns an dieser Stelle hinzugefügte „Internetgeneration" (nach 1980 geborene Personen) wächst bereits mit dem PC auf und lernt in der Jugendphase das Internet kennen.

Tabelle 1

Computer- und Internetnutzer nach sozio-demographischen Merkmalen

Angaben in %

	Computer			Internet		
	Insgesamt	Privat[1]	Beruflich	Insgesamt	Privat[1]	Beruflich
Generationszusammenhänge						
Geboren vor 1939 (Prätechnische Generation)	15	14	1	7	7	1
Geboren von 1939 bis 1948 (Generation erster Haushaltsgeräte)	44	27	17	36	24	13
Geboren von 1949 bis 1964 (Generation fortgeschrittener Geräte)	75	33	42	62	32	30
Geboren von 1965 bis 1980 (Computergeneration)	83	35	48	73	36	37
Geboren nach 1980 (Internetgeneration)	92	62	30	83	58	25
Anzahl guter Freunde						
Keine	28	23	5	14	11	3
1–2 Freunde	64	35	29	52	34	18
3–4 Freunde	64	34	30	56	35	21
5–7 Freunde	72	30	42	63	30	33
8 und mehr Freunde	62	31	31	58	30	28
Region						
Ostdeutschland	59	29	30	46	26	20
Westdeutschland	63	33	30	54	31	23
Nationalität						
Deutsch	62	32	30	53	30	23
Nicht deutsch	61	37	25	38	19	19
Geschlecht						
Männlich	69	34	34	60	31	29
Weiblich	57	30	26	46	29	17
Gesamtanteil	62	32	30	53	30	23

1 Ausschließlich private Nutzung.

Quellen: SOEP Sondererhebung 2005; Berechnungen des DIW Berlin.

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Zur Messung der Einbindung in soziale Netzwerke wurde darüber hinaus der Indikator „Anzahl der guten Freunde bzw. Freundinnen" verwendet. Dieser Indikator steht offenbar nur in einem schwachen Zusammenhang mit der Nutzung von PC und Internet. Die populäre These, dass typische Computer- oder Internetnutzer sozial isoliert seien, lässt sich nicht erhärten.[8] Vielmehr ist in der Gruppe ohne gute Freunde ein deutlich geringerer Anteil von Computer- und Internetnutzern anzutreffen.

In der Literatur werden als weitere Determinanten der Computer- und Internetnutzung insbesondere die Nationalität und das Geschlecht in Betracht gezogen. Ob die bei Ausländern konstatierte geringere PC- und Interentnutzung wirklich mit Sprachbarrieren begründet werden kann, bleibt jedoch fragwürdig. Denn ein wesentliches Kennzeichen dieser neuen Technologien ist ihre globale Anwendungsmöglichkeit, die es möglich macht, überall auf der Welt Nachrichten in der Muttersprache zu empfangen oder zu verschicken. Auch ist die Hypothese, dass dieses Nutzerverhalten auf Brüche mit der Herkunftskultur zurückzuführen ist, noch nicht ausreichend empirisch untersucht.[9] Tatsächlich weisen die Ergebnisse darauf hin, dass in Deutschland die Nationalität lediglich hinsichtlich der privaten Internetnutzung eine Rolle spielt (Tabelle 1).

Unterschiede zwischen Männern und Frauen in der Nutzung von PC und Internet werden in der Literatur vielfach auf geschlechtsspezifische und tendenziell technikferne Sozialisationsformen oder auf fehlende Vorbildfunktionen von Frauen in technischen Berufen zurückgeführt.[10] Die vorhandenen Daten lassen erkennen, dass Männer den Computer und das Internet zu einem höheren Prozentsatz im beruflichen Bereich nutzen als Frauen. Bei der privaten Computer- und Internetnutzung jedoch lie-

8 Um hier zu belastbaren Aussagen zu kommen, müsste freilich für Bildung und Alter kontrolliert werden, da beispielsweise im höheren Alter eine Nennung von Freunden und Freundinnen seltener erfolgt.

9 Vgl. zu diesen Thesen Arnd-Michael Nohl: Bildung und Migration. In: Frank Gesemann (Hrsg.): Migration und Integration in Berlin. Opladen 2001, S. 293–312; und Rainer Geißler: Die Sozialstruktur Deutschlands. Wiesbaden 2006.

10 Vgl. dazu Jean Brunet und Serge Proulx: Formal versus Grass-Roots Training: Women, Work, and Computers. In: Journal of Communications, Vol. 39, S. 77–84; und Jane E. Fountain: Constructing the Information Society: Women, Information Technology, and Design. In: Technology in Society, Vol. 22 (1), S. 45–62.

Tabelle 2

Nutzung neuer Technologien im Jahre 2005

	Anteil[1] in %	Computer[2]	Internet[2]
Schulbildung			
Schüler	3	4,29*	7,66**
Höchstens Hauptschule (Referenz)	36		
Realschule	34	2,56**	2,88**
(Fach-)Abitur	27	12,55**	13,71**
Generation			
Geboren vor 1939 (Prätechnische Generation) (Referenz)	21		
Geboren von 1939 bis 1948 (Generation erster Haushaltsgeräte)	13	3,45**	7,12**
Geboren von 1949 bis 1964 (Generation fortgeschrittener Geräte)	27	9,49**	14,12**
Geboren von 1965 bis 1980 (Computergeneration)	25	13,85**	22,64**
Geboren nach 1980 (Internetgeneration)	14	54,29**	70,77**
Ostdeutsch (Referenz: Westdeutsch)	21	0,56*	0,42**
Nicht deutsch (Referenz: Deutsch)	5	0,27**	0,13**
Weiblich (Referenz: männlich)	52	0,60**	0,54**
Bezahlte Tätigkeit (Referenz: Keine bezahlte Tätigkeit)	45	3,35**	3,08**
Anzahl guter Freunde (Mittelwert)	4,47	1,04*	1,06**
N / Nagelkerke's R^2	1 012	0,58	0,58

1 An der Bevölkerung über 16 Jahre.
2 Ergebnisse logistischer Regressionsanalysen – vgl. Fußnote 11.
*: p<0,05; **: p<0,01

Quellen: SOEP Sondererhebung 2005; Berechnungen des DIW Berlin. **DIW** Berlin 2006

gen Männer und Frauen beinahe gleichauf. Diese Ergebnisse legen die Vermutung nahe, dass sich die geringeren Quoten der Frauen bei der beruflichen Nutzung primär durch ihre niedrigere Erwerbsquote erklären lassen.

Die vorangegangene Betrachtung basiert allein auf der Deskription der Personenmerkmale. Um die Bedeutung der einzelnen Einflussfaktoren näher bestimmen zu können, sind multivariate Analyseverfahren anzuwenden. Tabelle 2 gibt die Ergebnisse einer entsprechenden logistischen Regression der Nutzungsintensität mit sogenannten „odd ratios" wieder.[11]

Sie machen deutlich, dass Bildung einen starken Einfluss auf die Wahrscheinlichkeit hat, einen Computer oder das Internet zu nutzen. Dennoch bleibt auch bei der statistischen Bereinigung um den Effekt des Bildungsniveaus der Alterseffekt signifikant, d. h. jüngere Personen nutzen diese Technologie unabhängig von ihrer durchschnittlich höheren Bildung häufiger. Darüber hinaus erweist sich der Einfluss der Größe des Freundeskreises als signifikant positiv.

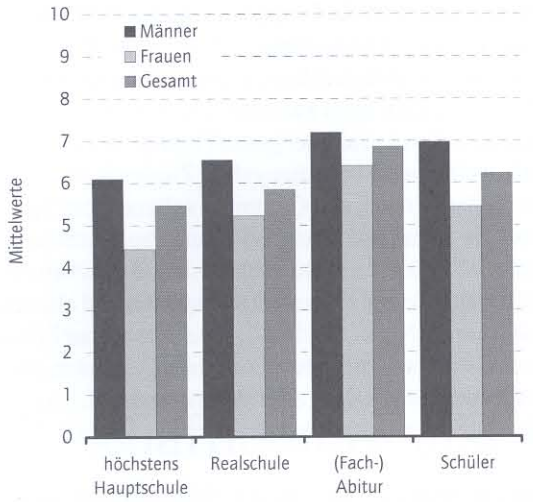
Zudem lässt sich zeigen, dass auch unter Berücksichtigung des Bildungsniveaus und der Erwerbstätigkeit bedeutsame Unterschiede zwischen Ost- und Westdeutschland, zwischen Deutschen und Nichtdeutschen sowie zwischen den Geschlechtern bestehen: In den Gruppen der Ostdeutschen, der Ausländer und der Frauen ist die Wahrscheinlichkeit geringer als in den jeweiligen Referenzgruppen, einen Computer oder das Internet zu nutzen.

Insgesamt bestätigen die SOEP-Ergebnisse die sogenannte Diffusionstheorie,[12] die in allgemeiner Form beschreibt, in welcher Weise sich die Nutzung neuer Technologien in modernen Gesellschaften verbreitet.[13] Demnach folgt die Diffusion neuer Technologien im Zeitverlauf der Form eines angeschrägten „S": Als Erstes nimmt eine kleine Anzahl von Pionieren und frühen Nutzern[14] (*innovators, early adopters*) die technologische Innovation auf, zumeist jüngere Personen mit höherer Bildung. Diesen folgt die große Gruppe der frühen and späten Mehrheit (*early / late majority*), an die sich schließlich eine kleinere Zahl von Nachzüglern (*laggards*) anschließt. Die Gruppe der Nachzügler (*laggards*) hat der Theorie zufolge den niedrigsten Bildungsgrad, ist eher älter als jünger und wenig oder gar nicht in soziale Netzwerke eingebunden. Unter der Annahme, dass (a) höchstens ein Hauptschulabschluss vorliegt, (b) dass es sich um Angehörige der prätechnischen Generation handelt und (c) dass die Personen wenige bis gar keine guten Freunde haben, ergibt sich eine rechnerische Wahrscheinlichkeit der Computernutzung von nahe null (Tabelle 2). Für die anderen Gruppen können die betreffenden Koeffizienten aus dieser Tabelle aufaddiert werden, um sie als Kontrasteffekte gegen die so definierte Gruppe der *laggards* abzusetzen. Für Personen mit mindestens einem Realschulabschluss und mindestens fünf guten Freunden, die zwischen 1949 und 1964 geboren wurden, ergibt sich eine 12mal höhere Wahrscheinlichkeit der Computernutzung. Personen mit Abitur (12,55), zwischen 1965 und 1980 geboren (13,85) und mindestens drei guten Freunden (zusammengesetzte odd ratio $3 \times (1{,}04 - 1) = 0{,}12$) weisen eine 26mal höhere Wahrscheinlichkeit auf. Es zeigt sich also, dass die von der Theorie genannten Faktoren Bildung, Alter und soziale Netzwerke in der Tat entscheidend sind für die Nutzung neuer Technologien.

11 Vgl. zur Methode z. B. David W. Hosmer Jr. und Stanley Lemeshow: Applied Logistic Regression. New York 2000 (2nd Ed.). Bis auf das Alter (siehe Tabelle 3 und 4), bei dem der Koeffizient mit dem Lebensjahr multipliziert werden muss, sind die Koeffizienten als Kontrasteffekte im Vergleich zur jeweiligen Referenzkategorie zu interpretieren. Werte kleiner als 1 indizieren eine geringere Wahrscheinlichkeit der Computer- bzw. Internetnutzung als in der Referenzgruppe; Werte größer als 1 eine vergleichsweise höhere Nutzung.
12 Everett M. Rogers: Diffusion of Innovations. New York 1995.
13 Zu einer Analyse hinsichtlich der Diffusionsprozesse von E-Business-Technologien in Unternehmen vgl. Philipp Köllinger: E-Business in europäischen Unternehmen: Wachsende Kluft zwischen Pionieren und Nachzüglern. In: Wochenbericht des DIW Berlin, Nr. 20/2004.
14 Dies wären in Deutschland die Mitglieder der Computer- bzw. Internetgeneration.

Abbildung 2

Selbsteinschätzung der Internet-Kompetenz[1]



1 Frage: Wie würden Sie auf einer Skala von 0 (ganz und gar unerfahren) bis 10 (sehr erfahren) Ihre persönliche Kompetenz im Umgang mit dem Internet einschätzen?

Quellen: SOEP Sondererhebung 2005; Berechnungen des DIW Berlin. **DIW** Berlin 2006

Nutzungsverhalten und Internetkompetenz

Abbildung 2 zeigt die Einschätzung der eigenen Kompetenz beim Umgang mit dem Internet nach Bildungsabschluss und Geschlecht. Es lässt sich erkennen, dass Unterschiede zwischen den Bildungsabschlüssen und zwischen den Geschlechtern existieren. Ähnlich wie für den Zugang zu diesen neuen Medien gibt es klare Hinweise auf einen positiven Zusammenhang zwischen dem Bildungsabschluss und der selbst attribuierten Internetkompetenz. In jeder Gruppe schätzen zudem Männer ihre eigene Internetkompetenz höher ein als Frauen. Allein in der Gruppe der (Fach-)Abiturienten zeichnet sich eine Annäherung zwischen den Geschlechtern ab.[15]

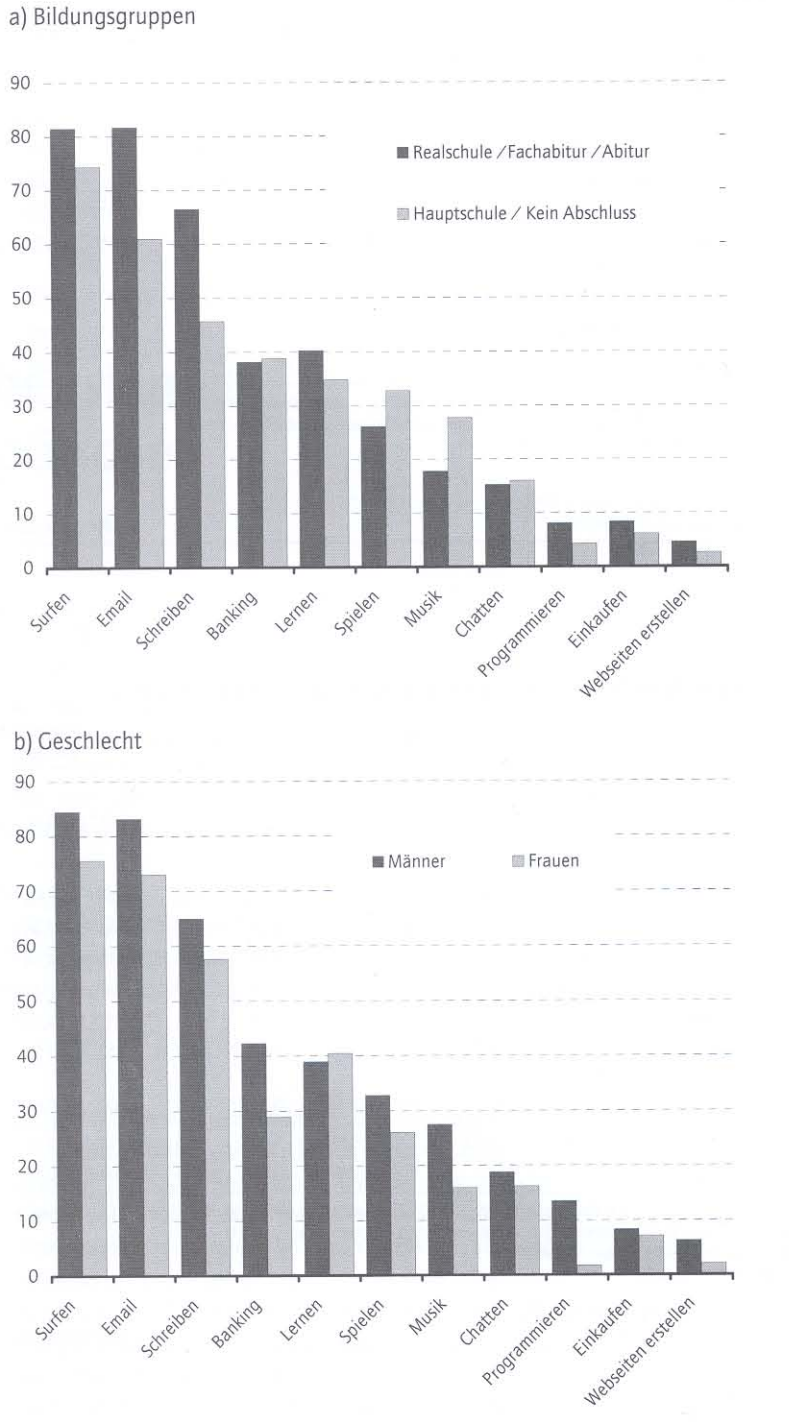
Differenziert man nach konkreten Anwendungsbereichen, so erweist sich der Einfluss der Bildung ebenfalls als bedeutsam (Abbildung 3). Die insgesamt am Häufigsten genannten Anwendungen – das Surfen im Internet, die Kommunikation per Email und die Textverarbeitung werden zumeist von Personen genannt, die mindestens einen Realschulabschluss haben. Dies gilt auch für den Bereich „Lernen am PC".[16] Personen mit höchstens einem Hauptschulabschluss nutzen den Computer dagegen häufiger zum Spielen und dem Konsum von Musik und Filmen, die also ausschließlich dem Freizeitbereich zuzuordnen sind.

Männer nutzen den Computer häufiger als Frauen im Freizeitbereich (Filme, Musik, Spiele, „onlinebanking") (Abbildung 3). Auch Programmieren ist

Abbildung 3

Ausgewählte Nutzungsarten von Computer und Internet im Jahre 2005

In % (Mehrfachnennungen möglich)



Quellen: SOEP Sondererhebung 2005; Berechnungen des DIW Berlin. **DIW** Berlin 2006

15 Der Populationsmittelwert liegt bei 6,24 Punkten. In allen Bildungsgruppen unterscheiden sich die Mittelwerte der Männer und Frauen signifikant voneinander. Innerhalb der Bildungsgruppen unterscheidet sich nur die Gruppe der „Schüler" nicht signifikant vom Populationsmittelwert.

16 Anwendungen werden mindestens einmal pro Woche genutzt.

Tabelle 3

Ausgewählte Nutzungsarten des Computers im Jahre 2005[1]

	Anteil[2] in %	Schreiben, Malen	Spielen	Lernen	Filme, Musik	Programmieren
Schulbildung						
Noch in der Schule	5	1,22	1,41	0,62	0,67	4,61
Höchstens Hauptschule (Referenz)	18					
Realschule	38	1,60	0,53*	0,74	0,39**	1,06
(Fach-)Abitur	38	3,72**	0,69	1,70*	0,55	2,42
Ostdeutsch (Referenz: Westdeutsch)	20	1,29	1,31	1,50	1,02	0,74
Nicht deutsch (Referenz: Deutsch)	5	0,66	1,18	0,47	0,72	0,66
Weiblich (Referenz: männlich)	47	0,74	0,67*	1,06	0,39**	0,10**
Erwerbstätigkeit (Referenz: nicht erwerbstätig)	62	1,41	0,53**	0,78	0,31**	2,79*
Alter (Mittelwert)	48	1,00	0,96**	0,96**	0,94**	0,98
Anzahl guter Freunde (Mittelwert)	4,85	1,08**	0,98	1,02	1,02	1,03
N / Nagelkerke's R2	631	0,13	0,14	0,10	0,29	0,19

1 Ergebnisse logistischer Regressionsanalysen – Odd Ratio-Koeffizienten: Werte kleiner als 1 indizieren eine geringere, Werte größer als 1 eine höhere Wahrscheinlichkeit als die Referenz.
2 An der Bevölkerung über 16 Jahre.
*: p<0,05; **: p<0,01

Quellen: SOEP Sondererhebung 2005; Berechnungen des DIW Berlin.

DIW Berlin 2006

Tabelle 4

Ausgewählte Nutzungsarten des Internets im Jahre 2005[1]

	Anteil[2] in %	Emails	Surfen	Chatten	Einkaufen	Banking	Webseiten erstellen
Schulbildung							
Noch in der Schule	5	1,91	1,38	1,49	0,21	0,08*	2,61
Höchstens Hauptschule (Referenz)	15						
Realschule	37	2,16*	0,96	0,84	1,09	0,81	0,98
(Fach-)Abitur	41	4,26**	1,86	0,95	1,32	1,42	2,25
Ostdeutsch (Referenz: Westdeutsch)	18	0,89	1,63	0,90	1,56	1,39	0,68
Nicht deutsch (Referenz: Deutsch)	3	0,68	5,28	0,47	1,01	0,86	2,43
Weiblich (Referenz: männlich)	45	0,51**	0,62*	0,77	0,81	0,57**	0,33*
Erwerbstätigkeit (Referenz: nicht erwerbstätig)	64	1,10	1,23	0,49**	0,57	0,92	2,67
Alter (Mittelwert)	40	0,98*	0,99	0,95**	0,97*	1,00	0,99
Anzahl guter Freunde (Mittelwert)	5,03	1,01	0,99	1,03	0,96	0,98	1,01
N / Nagelkerke's R2	532	0,10	0,06	0,19	0,05	0,10	0,09

1 Ergebnisse logistischer Regressionsanalysen – Odd Ratio-Koeffizienten: Werte kleiner als 1 indizieren eine geringere, Werte größer als 1 eine höhere Wahrscheinlichkeit als die Referenz.
2 An der Bevölkerung über 16 Jahre.
*: p<0,05; **: p<0,01

Quellen: SOEP Sondererhebung 2005; Berechnungen des DIW Berlin.

DIW Berlin 2006

offenbar weitgehend „Männersache". Frauen liegen bei den Bildungsaktivitäten vorn; dass Frauen in fast allen anderen Feldern etwas geringere Anteile aufweisen, verweist zugleich auf die kleinere Anzahl von Mehrfachnennungen bei ihnen.[17]

Auch bei der multivariaten Analyse zeigt sich, dass Personen mit höherer Bildung den Computer signifikant häufiger zum Schreiben und Lernen und seltener zum Spielen und für den Medienkonsum nutzen (Tabelle 3). Das Internet benutzen sie häufiger zur Kommunikation per Email, ansonsten unterscheiden sich die Gruppen kaum hinsichtlich der spezifischen Anwendungen (Tabelle 4). Zwischen Ost- und Westdeutschland zeigen sich keinerlei Differenzen, auch nicht zwischen Deutschen und Ausländern. Die Anzahl der guten Freunde erweist sich als weitgehend bedeutungslos. Zugleich bestätigt sich, dass Frauen den Computer seltener zum Spielen, für Filme und Musik oder zum Programmieren nutzen; dies gilt ebenso auch in allen Bereichen der Internetnutzung. Erwerbstätige spielen und chatten seltener als Nichterwerbstätige, sehen seltener Filme oder hören seltener Musik mit dem Computer, nutzen ihn aber häufiger zum Programmieren – wahrscheinlich in beruflichen Kontexten.

Auch unter Berücksichtigung der Bildung bleibt der Alterseffekt bei einer Reihe von Nutzungsmöglichkeiten bestehen. Ältere Personen spielen, lernen und chatten seltener als jüngere. Hinsichtlich der Nutzung von Textverarbeitung, Kommunikation per Email, dem allgemeinen „Surfen" und der Internet-Kontoführung sind dagegen keine Altersunterschiede feststellbar.

Fazit

Aktuelle Daten aus dem Jahre 2005 belegen, dass ein ausgeprägter Zusammenhang zwischen der Computer- sowie der Internetnutzung und der Bildung besteht. Personen mit höheren Bildungsabschlüssen sind zudem häufiger unter den Pionieren, die die neuen Computer- und Internettechnologien verwenden. Dass die Computer- und Internetverbreitung in Deutschland seit einigen Jahren auf demselben Niveau verharrt, verweist auf eine mögliche Verfestigung der digitalen Spaltung.

Menschen aus höheren Bildungsschichten fühlen sich kompetenter im Umgang mit dem Internet. Sie nutzen den Computer häufiger zu Bildungszwecken, Menschen aus niedrigeren Bildungsschichten häufiger zur Freizeitbeschäftigung. Auch verweisen die Zusammenhänge zwischen dem Bildungsniveau und der Computer- bzw. Internetnutzung sowie den subjektiv empfundenen Kompetenzen und den hier beschriebenen Nutzerpräferenzen auf eine Verfestigung der digitalen Spaltung. Fördernde Maßnahmen und Bildungsangebote zur Überwindung sollten vor allem auf die arbeitsmarkt- und bildungsfernen Gruppen konzentriert werden.

17 Diese Tendenzen bleiben bei zusätzlicher Berücksichtigung der Nutzungshäufigkeit weitgehend bestehen.

Causes and Trends of the Digital Divide: A European Perspective

Sylvia E. Korupp

Introduction

The abstract notion of the digital can be defined as a division between individuals and households at different socio-economic levels, regarding their chance to access or use information and communication technology (OECD 2002). A theoretical division exists between the »first« and »second« digital divide, sometimes addressed as »first-level« and »second-level« digital divide (Attewell 2001; DiMaggio/Hargittai 2001; Hargittai 2002). The »first« or »first-level« digital divide deals with the problems associated to accessing the internet, while the latter focuses on the user profiles, *id est* in which way and for what purposes the internet is used. Before studying different user profiles, however, reasons for accessing versus non-accessing the internet should be clear. Therefore, I investigate the »first« digital divide.

Starting point of the research is a theoretical view on the digital divide that is embedded into an individual, institutional, and social framework. An encompassing three-fold model is based on theoretical concepts drawn from a micro-, meso- and macro perspective. On the micro level the effect of *education* is included. On the meso level I look at the *household context*. On the macro level the *social context* is included. This model thus far has worked very well with German data sets (see Korupp 2004; Korupp/Szydlik 2005), but results vary within the European context. Parts of the variations unquestionably may be explained by cultural differences within countries.

At times, research on this topic has been challenged by charges of studying a non-existent myth or »luxury« problem (Compraine 2001). Nevertheless, empirical results paint an entirely different picture as to how innovations can affect individual lives. For example, internet literacy is positively related to social activity and school performance (Wagner et al. 2001; Wagner et al. 2002), math and language skills (Attewell/Battle 1999), or success in finding a job (Boes/Preißler 2002). In order to identify which of the influences can be attributed to which variable a multivariate analysis is carried out. In the following section I will offer a brief overview on how the theoretical model is derived.

Theory

Issues of education include general and specific schooling and training, e.g., high school diplomas or vocational training (Becker 1964). I assume levels of education and vocational training to be positively connected to an individual's use of the internet. In fact I presume internet literacy to be merely an additional educational skill.

What is more, we see that age often is determined as a key issue, *id est* youth commonly grants a quick innovation adoption. In this case innovation diffusion spreads as over time the adopting young generations grow older (Watt/White 1999; Sackmann/Weymann 1995). According to this concept, the home environment that people are raised in determines general habits towards new technologies and thus age determines technological adoption odds.

Regarding gender, I assume that women face contradictory role models in technology operating fields (see e.g., Waibel 1992). That is, they experience inconsistencies when linking their job and household obligations regarding the use of the internet (Collmer 1995). Other than in their job, for fulfilling household tasks usually they are not socialized to deal and become involved in technological issues (Collmer 1995). The above facts and assumptions lead me to expect fewer women than men to use internet.

Let us now turn to the meso level of the theoretical model. The image of the computer has developed from being a distant »cold« machine into a socially »friendly« device and is according to newer research, »(…) successfully connected to middle-class ideals« (Reed 2000). Parents may want to adjust to middle-class ideals, believing computer proficiency to be an essential future skill for children. These assumptions lead me to expect that living together with children enhances people's likelihood to use a computer at home. A lack of primary social ties at home on the other had should decrease people's use the internet.

What is more, a close positive connection is drawn between income and the possibilities to bridge the digital divide (e.g. Attewell 2001; DiMaggio et al. 2001; Jung et al. 2001; Ekdahl/Trojer 2002; Bonfadelli 2002). Generally, household income constrains purchasing power. Therefore one can expect family income to positively affect the private use of computers and internet.

Moreover, ethnic minorities may perceive computer language to be culturally different, to belong to a so-called *outer sphere* (Nohl 2001). In all countries most of the computer programs bought use either the native or English language for their user interface. These cultural differences may cause a delayed diffusion of computers and internet among the ethnic minority.

Last but not least, studies on regional aspects often stress exclusionary trends. Dolnicar et al., for example, shows that compared to the EU the use of computers

in Slovenia has fallen far behind (2002). For the U.S., other studies forecast low income urban communities to be disqualified for further technological advancements (Servon 2001). Some findings underline a relationship between lacking means to invest into infrastructure and the underdevelopment of rural areas (Hollifield 2003). Others stress that a general shortage of human capital in rural areas adds to a developmental lag (Malecki 2003). With regard to internet diffusion we can thus expect rural areas to be lagging behind compared to cities or urban areas. The entire assumed theoretical framework of the model is shown in Figure 1.

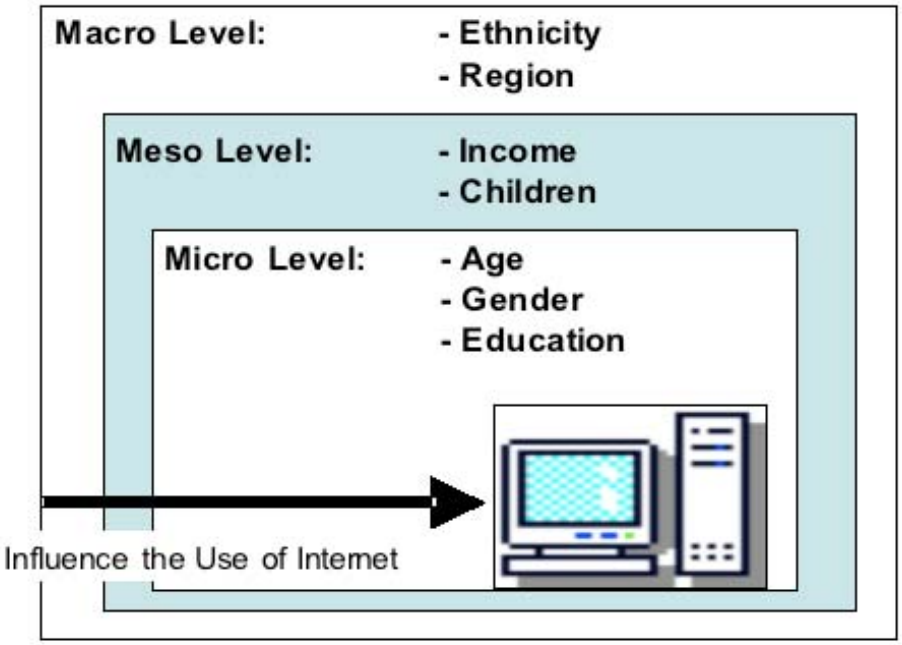


Figure 1: Theoretical ModeReferences

Data and Methods

The empirical analyses were carried out using the European Social Survey (see http://www.europeansocialsurvey.com). Within my theoretical model I consider

the main theoretical and empirical results in the literature regarding the digital divide. Mainly, I expected the model to work out well in the European context, too. However, as we will see further down the model does not fit equally well in all countries. It contains a question on internet use and the other levels of the theoretical model from 20 European countries. The data were weighted by their design and person weights to calculate the descriptive statistics (see Table 1). In Europe we observe a distinct distribution of internet use along a north-south and a west-east-axis. Most of the people that use the internet can be found in the north of Europe, *id est* in Denmark, Sweden, and Finland. Furthermore, we see that in Central Europe the countries in the West have a higher rate of internet users than in Eastern Europe.

On average, educational levels are lower in Southern and Eastern Europe, compared to their mean values in West Central Europe and Northern Europe.[1] This may be a first hint towards the fact that innovation saturation may be related to country specific levels of education. The distribution of mean age does not vary too much, except for the value in the Czech Republic, which is slightly higher than the other ones. The gender distribution is roughly at the 50 percent level in all of the countries.

Looking at the proportion of minorities in the countries we usually observe a percentage of two to three percent in the European Countries that were surveyed. The percentage of the age of the smaller children (age 0 to 14) ranges between eight percent (Czech Republic) and 18 percent (Luxembourg). The percentage of the youngest child being Teenage or young adult and living at home range between 16 percent (Belgium, Spain, Great Britain, Luxembourg) and 25 percent (France). Adult children living at home are not reported quite as often anymore and may be highly dependent on the culture of a country. Here the range lies between one percent (Sweden) and 20 percent (Slovenia). The approximated year household equivalency income ranges between a low 3.608,- Euro for Hungary and 28.486,- Euro for Norway. All currencies were computed in Euro to make international comparisons feasible.

In Table 2, the computed odds ratios for the theoretical models are shown. This time only design weights are used because this is recommended for country comparisons by the research group of the European Social Survey (see http://www.european socialsurvey.com). Coefficients which are less than »1« signify a lower probability of private internet use in comparison to the reference group in the dummy variables. Regarding our variables at interval level, they display the marginal

1 Educational level can take on the value one (primary or first stage of basic education), two (lower secondary or second stage of basic education), three (upper secondary), four (post-secondary, non tertiary education), five (first stage of tertiary education), and six (second stage of tertiary education).

effects. Parameters over »1« altogether indicate higher probabilities. If we look at the outcomes for all countries (column 1) we see that for every additional educational level the marginal effect of internet use increases by 76 percent. The effect of age is negative, indicating that the older a person is, the less likely this person becomes to be identified as an internet user. Furthermore, the effect of gender is negative, too, indicating that women in Europe are by far less likely to use the internet than men.

Living together with smaller children (up to 14 years) has a negative influence on internet use, but not living together with teenagers and young adults at home (14 to 24 years). Here we observe an on average higher significant probability to use the internet. Living with adult children (25+ years) has almost no effect on the use of the internet. It remains insignificant for the analyses. Income is significant for using the internet, but as its marginal effects are small, the here chosen cut-off value for two decimals means that the effects do not show in the table. The Cox-Snell R-square of the analysis is approximately at 33 percent indicating a fairly good model fit.

Discussion

This study deals with the question how we can explain variations on the digital divide model in a European comparative perspective. Starting point of my research is the appearance of a new form of social inequality: the digital divide. We see that the proportion of adult population in Europe has a distinct north-south and west-east divide. A three-level model is build, to explain different levels of internet use and applied to 20 different countries in the European Union. Although the theoretical notions are based on the general theoretical and empirical results of the first digital divide and works fairly well in a universal model, a large variation is found within the 20 countries. Indications were found that the speed of innovation diffusion within countries may be positively related to the country specific levels of education. Thus, the usual diffusion process seems to be a vertical movement from the highest to the lowest status positions along the socio-economic strata until most households are included.

Country	all	At	Be	cz	de	dk	es	fi	fr	gb	gr	hu	ie	it	lu	nl	no	pl	pt	se	si
WWW	0,39	0,57	0,43	0,30	0,48	0,62	0,24	0,56	0,40	0,48	0,13	0,19	0,41	0,30	0,56	0,59	0,59	0,22	0,30	0,66	0,35
EDU	2,81	3,25	3,03	3,10	3,31	3,20	2,28	2,88	3,00	2,99	2,27	2,27	2,75	2,30	2,80	2,95	3,43	2,52	1,67	3,00	3,33
AGE	46,49	44,76	45,80	50,01	47,37	47,33	46,64	46,63	45,31	47,42	47,68	47,14	44,88	46,48	41,05	46,42	47,52	43,79	46,34	47,26	45,41
SEX	0,52	0,52	0,48	0,49	0,51	0,49	0,52	0,52	0,53	0,51	0,55	0,51	0,54	0,55	0,53	0,54	0,45	0,51	0,54	0,49	0,52
MNRT	0,03	0,06	0,02	0,02	0,04	0,02	0,03	0,01	0,04	0,06	0,04	0,05	0,01	0,01	0,05	0,04	0,02	0,02	0,01	0,03	0,02
SMAL	0,12	0,11	0,11	0,08	0,11	0,14	0,10	0,11	0,15	0,13	0,10	0,11	0,13	0,10	0,18	0,16	0,14	0,12	0,11	0,12	0,09
TEEN	0,19	0,27	0,16	0,21	0,18	0,18	0,16	0,18	0,25	0,16	0,19	0,21	0,23	0,19	0,16	0,22	0,20	0,22	0,19	0,19	0,21
ADUL	0,10	0,10	0,08	0,18	0,05	0,02	0,16	0,02	0,07	0,05	0,19	0,15	0,11	0,18	0,06	0,05	0,02	0,15	0,14	0,01	0,20
OECD1	14835	15016	16727	6177	20229	24559	9089	17667	9379	25261	8601	3608	10724	12317	23149	20185	28486	3953	8142	18783	6393
NOC	36432	2257	1899	1360	2919	1506	1729	2000	1503	2052	2566	1685	2046	1207	1552	2364	2036	2110	1511	1999	1519

Table 1 Descriptive Statistics

(Source: ESS 2002/03. Data weighted by design and person weights.)

Legend: all =All Countries; at=Austria; be=Belgium; cz= Czech republic; de= Germany; dk= Denmark; es = Spain; fi= Finland; fr=France; gb= Great Britain; gr = Greece; hu=Hungary; ie=Ireland; it= Italy; lu= Luxembourg; nl= The Netherlands; no= Norway; pl= Poland; pt= Portugal; se=Sweden; si= Slovenia;

	all	at	Be	cz	de	dk	es	fi	fr	gb	gr	hu	ie	it	lu	nl	no	pl	pt	se	si
EDU	**1,76**	**1,73**	**1,89**	**2,63**	**2,02**	**1,86**	**2,41**	**1,77**	**1,70**	**1,91**	**2,56**	**2,25**	**1,80**	**2,43**	**1,59**	**1,71**	**2,10**	**2,52**	**1,54**	**1,52**	**3,05**
AGE	0,93	0,93	0,93	0,92	0,92	0,93	0,93	0,91	0,94	0,94	0,93	0,89	0,94	0,94	0,92	0,93	0,92	0,88	0,99	0,92	0,90
SEX	0,70	0,50	0,60	0,70	1,03	0,68	0,53	1,15	0,49	0,78	0,51	0,60	0,88	0,36	0,53	0,59	0,60	0,82	0,70	0,62	0,71
MNRT	0,70	1,49	0,64	0,08	0,53	0,35	0,31	0,93	0,30	0,69	0,13	0,26	1,38	0,20	1,30	0,36	0,72	1,62	0,10	0,55	1,39
SMAL	0,93	0,88	1,17	0,33	0,98	1,41	0,72	0,65	0,98	1,09	0,82	0,35	0,85	1,29	0,76	0,73	1,18	0,23	1,08	1,16	0,64
TEEN	1,54	1,64	1,45	1,26	1,61	1,65	1,58	1,19	2,40	1,34	1,01	0,72	1,76	1,42	1,95	1,24	1,69	1,33	1,29	1,68	2,09
ADUL	0,95	1,02	1,38	1,25	1,12	0,27	0,77	1,67	1,87	1,57	0,79	1,07	1,61	0,97	1,03	0,58	1,27	2,17	1,75	1,22	1,75
OECD1	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Const	1,25	5,65	1,69	0,74	1,90	3,93	0,27	6,95	0,71	1,20	0,12	2,10	0,59	0,51	5,04	9,27	2,75	1,35	0,19	14,6	0,49
CS R^2	0,33	0,28	0,34	0,25	0,31	0,31	0,32	0,39	0,33	0,34	0,24	0,29	0,30	0,27	0,34	0,27	0,36	0,33	0,08	0,37	0,40
NOC	37820	2257	1899	1360	2919	1506	1729	2000	1503	2052	2566	1685	2046	1207	1552	2364	2036	2110	1511	1999	1519

Table 2 Odds Ratios for Using the Internet in 2002 in Europe

(Source: ESS 2002/03. Data weighted by design weights, Cox-Snell R-square.)

Legend: all =All Countries; at=Austria; be=Belgium; cz= Czech republic; de= Germany; dk= Denmark; es = Spain; fi= Finland; fr=France; gb= Great Britain; gr = Greece; hu=Hungary; ie=Ireland; it= Italy; lu= Luxembourg; nl= The Netherlands; no= Norway; pl= Poland; pt= Portugal; se=Sweden; si= Slovenia;

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Senior Citizens and Internet Technology

Reasons and Correlates of Access versus Non-Access in a European Comparative Perspective

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Abstract

As the Internet's societal pervasiveness progresses, offline senior citizens are becoming increasingly disadvantaged from a socio-ecological point of view. This study looks at the reasons for non-use and the frequency, intensity, respectively socio-demographic correlates of Internet use among senior citizens in Europe. Consequences on the individual and societal level are discussed. The Eurobarometer of 2003 offers a range of variables to explore the diffusion of Internet technology among 55+ year-old people in Europe. Descriptive statistics and population average models are used to identify the correlates of Internet access in four different welfare regimes. Within the population segment of the senior citizens, age remains to be stratifying variable. Marital, occupational, and educational status have large impacts on relative chances to access the Internet. By and large, gender differences are significant. Although the size of the coefficients differs most of the results are replicated within the Euro15 region. Decisions to remain offline are based on private access possibilities, motivational indifference, and deficient knowledge; financial concerns are non-relevant. Existing socioeconomic inequalities crystallise within the senior population. Particularly in the Southern regions of Europe the digital divide is tightly intertwined with socioeconomic inequity. Social policy must keep up efforts to close the digital age gap.

1. Introduction

In the European Union, the aging of the population is one of the major challenges most of its member states have to face over the course of the next decennia. Enhanced life expectancy and decreasing fertility rates result in an increased number and proportion of older adults. This study deals with the question in how far the age of a person is related to use of Internet technology, currently understood as a characteristic of 'the making of successful aging' (e.g., Czaja & Lee 2007). Technological adoption lags are unproblematic regarding 'common' household technology; whether or not people use microwaves, motion detectors, or washing machines is up to everyone's own choice. Technology avoidance is becoming rather problematic, though, with respect to digital (communication) technology.[1] To date, more and more once personal public and private services are replaced by information technology driven devices.[2]

Helpful recent developments include chat rooms for senior citizens, a European internet portal for health information, internet newspapers, or senior citizen list-servers that keep groups up to date with relevant online activities and help to build up social networks (i.e. BAGSO 2006, European Union 2006). The Internet offers access to online information on healthcare services or professional support, providing more autonomy to people with chronic diseases or illnesses (Czaja & Lee 2007). Being a non-liner excludes senior people from knowledge of current news, medical information, and connectivity to family members, social support, interactive play, and task oriented goals (Loges & Jung 2001). So Internet technology has the potential for assisting senior citizens in a large variety of situations related to aging (Selwyn et al. 2003). What is more, the symbolic character of setting up a computer at home is often under estimated (Mollenkopf 1998a: 231).

Essentially, using a normal but 'youthful' technology like the Internet demonstrates belonging to an up-to-date group with a modern lifestyle (Mollenkopf 1998b).

Empirical studies on technology adoption confirm concise negative relationships between use of computer and Internet and the age of a person (e.g. Sackmann 1996, Korupp & Szydlik 2005). By and large, the diffusion of computers and the Internet into society has passed by older adults. In 2000, only 13% of people older than 65 years in the U.S. reported having Internet access (NTIA 2000). In 2005, 61% of the 55 to 74 year-old people in Europe reported never to have used a computer or the Internet (Demunter 2006). What explains the existence of such patterns? What sort of consequences might be expected with respect to quality of life in old age? One goal of this paper is to identify the prevalent reasons for not using the Internet; another objective is to explore empirically whether Internet access of senior citizens is determined by socioeconomic and cultural background. Before turning to empirical issues below some additional theoretical background is discussed.

2. Theoretical Background

Three different clusters exist within the domain of gerontotechnology. Firstly, a cluster called *compensation* technology, that makes up for sensory losses or functional limitations; secondly, an area of "daily life" technology covering devices for rehabilitation in order to improve a temporary or interim sensory loss or functional limitations; thirdly, and our current focus, a cluster tackling everything from "low" household to "high-tech" computers and Internet devices (Mollenkopf 2004).

Research on the latter considers two developmental lags that currently are producing an area of social tension. On the one hand, an *individual lag* occurs if social structure and the environment changes more rapidly than people's abilities. This is the case if Internet diffusion advances more swiftly than the online skills of senior citizens. Part of the *individual lag* is countered by political measures to support senior citizens' online activities (Mollenkopf 1997). Like a number of other countries, Germany has an Internet portal where training courses, online competitions, or general online information are offered to a "generation 50+" (BAGSO 2006).

On the other hand, a *structural lag* exists concerning the mismatch between the changing capabilities of older persons and the opportunity structures of modern societies. Here, social structure and institutions will fail to keep pace with changes in individual abilities (Cutler 2006). Today's *young old*, for example, do not agree with the current societal images of senior people. Therefore, it does not suffice to explain lower access rates of senior citizens merely by 'age'. Considering long past childhood environments bare of technology or stocked with rudimentary household technology only, cohort effects may offer just as much explanatory power (Sackmann 1996). Additionally, individual biographical experiences, socialisation or compositional effects may be responsible for nowadays attitudes and beliefs of older people. A number of women, for instance, lack technical experience or leave it up to the other sex to deal with technological matters. As the proportion of women increases within higher age groups, average Internet versatility may decrease. If this effect is combined with the above cohort effect, gendered and historically specific socialisation effects crystallize with respect to Internet use.

Additionally, individual characteristics like education and labour force participation may explain part of the observed correlations with age – as well as attitudinal gender

differences (Korupp et al. 2006, Dobransky & Hargittai 2006). Regarding the senior population and their use of the Internet, a connection between aging effects and compositional effects due to gender and socioeconomic status is pending explanation.[3]

In the existing literature, a number of additional socioeconomic characteristics have been identified that correlate with the propensity of Internet use. For example, research shows that Internet *laggards* often live alone (Korupp & Szydlik 2005). As the Internet intrinsically is an interactive technology – covering direct as well as lagged communication – it is important to consider existing social ties at home. If there are (at least) two people living in a home, the exchange of information on Internet technology may become more interesting and entertaining. At an advanced stage of life primary social ties may prove important for individuals to remain involved in using the Internet. Limitations to take up gainful employment may present another reason for belonging to the group of *laggards* who use new technologies late or never. In a myriad of jobs, the Internet has become a common if not essential tool, increasing employed people's likelihood to go online (Demunter 2006, Korupp & Szydlik 2005).

Another general finding is that the development of the digital divide parallels that of economic inequality (Bucy 2000, DiMaggio et al. 2001, Korupp & Szydlik 2005, Korupp 2006). In a typology of Internet users it is proposed that educational level enhances general levels of interest (Mollenkopf & Kaspar 2005). Internet skills can be assumed to be part of a general education - easier to acquire for people who already have a high level of formal schooling (Korupp 2006). Therefore, educational level probably will be positively related to the propensity of senior citizens to use the Internet. In the next section these theoretical notions will be tested with current empirical data. As the above notions are supposed to

cover general issues in the field of gerontotechnology a data base was used that would enable us to empirically replicate our model in different cultural settings.

3. Data and methods

Our analyses are based on the Eurobarometer of 2003 (no. 59.2), a large representative survey of the European population (ZA 2006).[4] Data were collected between May and June in 2003 and include completed surveys on a total of 16,161 people. The sample we analyse is restricted to the senior population aged 55 years and over (N=5091).

The two age categories we form (55-64 and 65+ years) are supposed to discern the 'young' from the 'old' senior age. Within this group of the 55 to 64 year-old we are sure to find a large enough group of actively employed people to carry out sensible comparisons to retired or house persons. In studies on the digital divide we often observe basic and crude categorizations of the senior population segment (e.g. Demunter 2006). Distinguishing "young" and "old" senior citizens may allow for a more detailed view, since large socialization variations exist between these two groups (Sackmann 1996).

The 2003 survey covered reasons for non-use and use of computer and Internet, and questions as to where, how often, and how many hours per week the Internet was used. Additionally, non-users were asked how they might be encouraged to use the Internet; and how they thought it would change their daily life if they did. All respondents were asked what kind of information they would like to find on the net, how they would use the Internet, and what sort of training they would require to use the Internet. Firstly, we proceed to outline the most immanent reasons for not using the Internet. Thereafter, we will

discuss the means and standard deviation of the variables used in the multivariate models and the results of the latter.

Within comparative European research it has become common to differentiate between various welfare regimes (e.g. Ferrera 2000, Räsänen 2006). In our current work, four types serve to distinguish different institutional settings within European countries: The Nordic, Continental, Liberal, and Mediterranean welfare regime. The Nordic regime (including Denmark, Finland, and Sweden) is exemplary for issuing extended social benefits, reinforcing gender equality, and striving for full employment. The Continental regime (including Austria, Belgium, Germany, France, Luxembourg, and The Netherlands) accentuates a conservative "breadwinner" model with high institutional benefits encouraging motherhood, while striving for full employment (of men) and offering measured social benefits. The Liberal regime (including England and Ireland) offers modest social benefits only, while encouraging full employment and gender equality. The fourth type is the Mediterranean regime (Portugal, Spain, Italy, and Greece) which incorporates a high measure of reliance on family networks and offers modest social benefits. Countries in this regime are accentuated by a traditional Catholic culture.

We expect to find older adults in the Mediterranean regime to use Internet to a lesser degree. Partly as a result of the welfare regime type, on average fewer economic resources exist in old age. What is more, countries belonging to the Mediterranean have a more agrarian structure, which, due to a more conservative outlook of the farming population, may initially counteract a swift diffusion of computer technology.

4. Results

4.1 Reasons for not using the Internet

The key reasons ticked by senior citizens for not using the Internet are shown in Table 1. Categories are sorted by their percentage in the Euro15 column.[5] In Table 1, roughly 35% ticked the category “no computer at home” or “not interested”. These sorts of motives indicate a lack of means and motivational indifference. Result underlines former findings that senior citizens prefer to have a computer at home to access the Internet (see Selwyn et al. 2003).

What is more, regional differences exist regarding these two motives. Compared to the Mediterranean regime, the Nordic, Continental, and Liberal regime have twice as many non-users at home maintaining that a missing computer at home is a key reason for not being online. Surprisingly, in-home computer access seems to be less important in the south of Europe compared to the rest of the EU15. For the option *PC is too expensive* (last row) the same regional differences exist: Only 1.5% of the senior citizens in the Mediterranean regime ticked this option while the other column percentages range between 8% and 10% (see Table 1). Lack of means seem to be less decisive for the choice of older people to remain offline in southern Europe. Perhaps this is due to a higher proportion of elders in co-residence with their adult children in the southern countries. However, the percentage of elders ticking that they “don’t know what it is” or that they are “not interested” are the highest. So, a minority of 1.5% would prefer to use the internet but cannot afford it. A majority does not invest in Internet technology, not because they think it is too expensive but because they are not interested.

- TABLE 1 HERE -

Another important category for not using the Internet is “missing skills”. Nearly 20% of the non-using senior citizens in the EURO15 region might consider going online if they were taught how to use the net. This is with regard to a growing age divide an alarming percentage. The same holds for about 13% of the senior citizens who ticked the next category “I don’t know what it is”. If these individuals received a substantial introduction to accessing the Internet they might be induced to go online.[6] The reason “too complicated” is ticked by almost 12% of the non-users within the EURO15 region. On average, about 7% of the non-users do not access the Internet because they do not believe the contents of the Web to be useful. Only a little more than 6% of the non-users maintain Internet technology to be too expensive. The latter result underline former findings that financial concerns hardly affect Internet access (Korupp 2006, Korupp & Szydlik 2005).

The descriptive results indicate that roughly 35% of the senior non-users simply lack opportunity. Between 10% and 20% of the non-users report skill related reasons, 6% think that the information on the Net is useless, and 7% report financial concerns as their main motivation for not using the Internet. Country differences indicate less familiarity with computers in the Mediterranean region.

4. 2. Descriptive Analyses

In order to examine the socio-demographic correlates of internet usage, our analytic model includes a binary dependent variable on internet use and several independent variables on socio-economic background: two age categories, marital status, educational level, occupational background, and gender. Table 2 presents the weighted cell percentages for

the variables used in the analyses according to the division of welfare regimes and for the entire EURO15 region.

- TABLE 2 HERE -

People living in a Nordic welfare regime not only have the highest number of computer and Internet users (Räsänen 2006) they also have the highest percentage of 'silver surfers' (Table 2). On average, 22.3% of the senior population in Europe are computer and 16.8% are Internet users (Euro15). Within the senior segment of the population we find about 40% of the individuals in our data to be 55 to 64 year old and approximately 60% to be more than 65 years old.[7] Between 55% and 65% of the respondents live with a partner, while 3% to 4.5% report never to have had a partner. In 2003, 33% to 41% are not living with a partner.

The next variable describes current occupational status.[8] Most of the people in our data are retired, although substantial variations exist in the four welfare regimes. The Continental regime has the highest while the Liberal regime has the lowest percentage of retirees. The Nordic and the Mediterranean Regime are situated somewhere in the middle. Similarly, large differences within the welfare regimes exist regarding the percentage of house persons. The Nordic regime reinforces gender equality, so only 1.1% (otherwise 12% to 16%) of the people report to be a house person. Self-reported unemployment rates range between 2.6% to 2.8%. In the Mediterranean regime only 0.9% identify themselves as unemployed. In the EURO15 region 6.7% are blue-collar workers, again with considerable differences between regimes. In the Nordic and Liberal regime 10.4%, respectively, 13.8% are blue-collar workers. In the Continental and Mediterranean regime we find 5.6%, respectively, 4.4% of the people in this group. Between 7% and 9% of the senior citizens are self-employed in most of Europe. Only in the Continental regime this percentage is

lower, with on average 3.6%. Between 2% and 5% of the senior population are white-collar workers. The percentage of managers varies considerable with 8.6% in the Nordic regime, 3.2% in the Continental regime, 4.5% in the Liberal regime, and 2.1% in the Mediterranean regime. The EURO15 average is 3.3%.

Educational level has a prearranged ordinal scale containing three groups.[9] Altogether, 53.8% of the respondents have up to 15 years of education, 31.6% between 16 and 19 years of formal schooling and 14.6% have 20 and more years of education. Educational level is distributed unevenly in the EURO15 region. The Nordic regimes show the highest percentage of senior citizens with 20 and more years of education, while the Continental, Liberal, and Mediterranean regime display the highest percentage of respondents with only up to 15 years of education. These results indicate that the higher expenditure of the Nordic regimes into their public educational system already is paying off through an on average higher educated population in old age.

The results for the variable *gender* indicates that we have a higher percentage of women (56.1%), compared to men (43.9%) in our set of data. This bias is found in all four regimes and in parts may be allotted to the mainly male victims of WWII and the higher life-expectancy of women.

4.3. Multivariate Results

Two groups of individuals exist – users and non-users of the Internet – who are nested in 15 European countries. In such a culturally varied region like Europe, we assume random effects to exist at country-level. Hence, a population averaged model with a method of generalized estimation equations (GEE) is used considering average random effects while

statistically computing the model coefficients (Hosmer & Lemeshow 2000). This model is well-suited for describing large groups of subjects. Accordingly, the odds ratios (e^{log}) in this table show the effect sizes for groups of subjects rather than for individuals.

As we opt to put an emphasis on regional variation, coefficients are displayed for the four welfare regimes and the generalized Euro 15 model. The Wald χ^2 test at the bottom of Table 3 indicates that the analytical models fit the data fairly well, albeit to a varying degree. We notice the best model fits are achieved for the Nordic and Continental welfare regimes and, consequently, the Euro 15 model. The lower Wald χ^2 test values for the Liberal and the Mediterranean welfare regimes indicate a lesser model fit, although their test values are still acceptable. Weighting variables used to compute the probability weights of individuals in the data are included in the model (coefficients not displayed).

- TABLE 3 HERE -

We expected to find differences in the level of Internet use within the senior population depending on their age group. In Europe (Euro 15), older senior citizens (65+) are approximately half as likely to access the Internet compared to younger senior citizens (55-64 years). In the Mediterranean regime age differences remain insignificant.

The use of Internet as an interactive technology is supposed to be enhanced by the existence of social networks. With no better alternative in the data, we use “marital status” as an indication of ongoing social interaction. In Europe (Euro 15), senior citizens without a partner are significantly less likely to access the Internet. Note, in the Mediterranean regime the coefficient “never partner” inconsistently points into the opposite direction.

Regarding occupational status it was posed that regular paid employment yields some higher odds to use the Internet, because of increasing the number of people’s secondary social ties and possibilities to interact on the Internet. What is more, many jobs

today require online skills. The results in Table 2 show that white collar workers, managers, or self-employed people have significantly higher odds to go online. Empirical evidence for unemployed and blue-collar workers is somewhat varied. In the Nordic welfare regime, retirement seems to be the cutting edge to remain offline. Even if unemployed, people in the North have significantly higher odds to access the Internet if they are part of the labour force. Within the Continental regime, significant differences exist between seniors *active* in the labour force or retired, respectively, unemployed. Findings for the Liberal and Mediterranean welfare regime are similar. Unemployed older people, blue-collar workers, and retirees have a similarly low Internet access rates, compare to all other occupational status groups.

Educational level is essential when assessing the chances of people for accessing the net. Accordingly, in all models a linearly positive connection exists regarding the effect of educational level on Internet access. The size of the coefficients varies between the four welfare regimes, and to the highest degree within the Mediterranean regime.

In the Euro 15 model, the variable 'gender' indicates significantly decreased Internet access odds for female persons. Odds are decreased in all of the welfare regimes, though a significant effect is identified only in the Nordic one. The non-significance of the "gender" effect in the other welfare regime tentatively may hint towards a decreasing importance of gender roles within the senior population segment.[10] In the next section, the above results will be discussed in detail.

5. Discussion

Computers are becoming pervasive throughout society. Since several years a trend towards an increased distribution of vital information via the Internet can be observed and this trend is unlikely to stop in the near future. With our work we want to answer what the prevailing reasons of senior citizens are for not using the Internet in a European comparative perspective. Additionally, answers are sought as to how individual socioeconomic and cultural background determines the likelihood of the Internet access of older adults.

Regarding the first issue, the core reasons for not accessing the Internet are assorted along three main categories: *lack of a device*, *motivational indifference*, and *deficient knowledge*. Financial concerns hardly play a role, probably due to today's low costs for computers and Internet and on average low poverty rates among pensioners. A *lack of device* as reason to remain disconnected might be linked to a lack of *service* for people who did not grow up with computers (Sackmann 1996). Problems may occur when choosing the computer model, hardware, software, or the appropriate installation routines. All this requires advanced knowledge about computer operating modes. Another big stumbling block might be a lack of information toward the learned decisions that have to be made long after a computer is purchased and set up at home (e.g., security issues, automatic downloads, freeware access, or malfunctions). Public access points - for example Internet cafés - cannot circumvent this problem. The cultural setting of most of these public points is unappealing to senior citizens and issues of confidentiality or security easily may alienate prospective older users. It is the device at home that facilitates access (Selwyn et al. 2003). Personal or confidential applications like email, online banking, or subscriptions to lists require positive subjective beliefs about security whenever they are carried out. In

conclusion, feigning non-interest may serve as a protection from alleged claims of - perhaps legitimate - notional inactivity.

With financial concerns no longer at stake, some findings for the USA seem replicable within a European context (Selwyn et al. 2003). Based on expected welfare and commercial effects, one might have anticipated a more thorough support to follow suit and introduce basic computer technology into senior citizens' households. Current results lead us to conclude that adequate modes lowering possible thresholds for setting up Internet connections at home are insufficient.

Turning to our second question, answers were sought as to how socioeconomic and cultural background influences Internet access at an advanced stage in people's life. Firstly, except within Mediterranean regime the empirical results show that considerable net differences exist between 'young' and 'old' senior citizens. Secondly, the existence of primary social ties in the household enhances the likelihood of older people to access the Internet. Further research will have to focus on the meaning of social ties for becoming a technology adopter. Thirdly, at an advanced age, employment and occupational status positively influence people's odds to use the Internet. As soon as older adults retire, their propensity to access the Internet is considerably reduced. Additionally, higher education levels usually imply higher odds ratios to be online. And last but not least, women are on average less likely than men to access the Internet, though gender roles do not seem as pronounced for senior citizens, compared to younger age groups (e.g. Korupp & Szydlik 2005).

Generally, the empirical models support our theoretical notions, although some findings have to be hedged with a few caveats. The results show that cultural and socioeconomic differences exist in all of the four welfare regimes, albeit to different

degrees. The digital divide is accentuated in the Mediterranean regime where strong relationships between education and Internet access can be identified. The best model fit is achieved for the Nordic regime, where most of the senior Internet users are found.

It remains undetermined how future generations of “silver surfers” will look like. Some studies rate future developments positively because coming generations will get used to new technologies throughout their lifetime (Mollenkopf 2004). Others take a rather hesitant point of view stating that today as well as in the past the pace of change through generational exchange has remained overstated. In every generation the needs and requirements of elders change as they advance into old age (Selwyn et al. 2003). Given the increasing speed of technology development, to some extent a structural lag may be a permanent characteristic of old age, at least as long as lifelong learning is not the general practice.

Literature

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Table 1: The Reasons of Senior Citizens for Not Using the Internet

	Nordic	**Continental**	**Liberal**	**Mediterranean**	**Euro15**
No computer at home	49,7%	39,2%	48,0%	23,9%	35,2%
Not interested	21,3%	35,8%	24,1%	39,6%	35,1%
Missing skills	20,1%	16,4%	26,3%	21,2%	19,5%
I don't know what it is	8,9%	8,3%	6,8%	21,7%	12,9%
Too complicated	7,7%	14,7%	10,1%	8,5%	11,7%
Contents not useful	6,5%	9,0%	7,7%	3,6%	6,8%
Internet is too expensive	8,3%	7,8%	9,0%	3,4%	6,4%
PC is too expensive	10,1%	8,3%	10,6%	1,5%	6,2%
N	169	2152	556	1591	4468

Source: Eurobarometer 59.2 (May – June 2003), weighted data.

Table 2 Cell Percentages for Senior Population in Europe (55+ Years Old)

	Nordic	Continental	Liberal	Mediterranean	Euro15
Computer Users	45,4	21,7	35,4	13,2	22,3
Internet Users	36,9	15,3	33,1	8,0	16,8
Age					
55-64 Years	41,8	41,1	40,1	38,8	40,2
65 + Years	58,2	58,9	59,9	61,2	59,8
Marital Status					
With Partner	55,6	56,1	59,3	64,1	59,1
Never Partner	4,5	3,2	4,5	2,9	3,4
No Partner	39,9	40,7	36,2	33,1	37,5
Occupation					
Retired	63,4	71,1	55,5	65,3	66,4
House Person	1,1	11,7	12,0	15,9	12,6
Unemployed	2,6	2,6	2,8	0,9	2,1
Blue collar	10,4	5,6	13,8	4,4	6,7
Self-employed	9,0	3,6	7,1	7,3	5,6
White collar	4,9	2,1	4,3	4,1	3,2
Manager	8,6	3,2	4,5	2,1	3,3
Educational Level					
Up to 15 Years	29,1	44,8	58,4	68,6	53,8
16-19 Years	21,3	40,6	32,1	19,8	31,6
+ 20 Years	49,6	14,6	9,5	11,6	14,6
Gender					
Men	44,4	43,4	44,9	44,1	43,9
Women	55,6	56,6	55,1	55,9	56,1
N	1087	2100	560	1344	5091

Source: Eurobarometer 59.2 (May – June 2003), weighted data.

Table 3 Odds Ratios for the Internet Use of Senior Citizens in Europe (Euro15)

	GEE Population Averaged Model (Z-Values)				
	Nordic	**Continental**	**Liberal**	**Mediterranean**	**Euro 15**
Number of Groups	**3**	**7** [a)]	**2**	**4**	**16** [a)]
Age					
55-64 Years (R)	1	1	1	1	1
65 + Years	0,46**	0,48**	0,58**	0,62	0,53**
	(4,3)	(4,7)	(2,5)	(1,5)	(7,0)
Marital Status					
With Partner (R)	1	1	1	1	1
Never Partner	0,49	0,52	0,37*	2,43	0,60*
	(1,8)	(1,5)	(2,1)	(1,5)	(2,4)
No Partner	0,44**	0,59	0,37**	0,74	0,54**
	(4,8)	(3,3)	(3,6)	(0,8)	(6,3)
Occupation					
Retired/Houseper. (R)	1	1	1	1	1
Unemployed	3,11**	0,78	2,59	1,95	1,62*
	(2,7)	(0,6)	(1,6)	(0,6)	(2,2)
Blue collar	1,94**	1,76*	0,6	0,40	1,46**
	(2,7)	(2,5)	(1,4)	(0,9)	(2,8)
White collar	8,06**	3,93**	4,51**	4,75**	4,52**
	(5,4)	(4,4)	(3,0)	(3,6)	(8,8)
Managers	18,29**	4,93**	2,58*	8,41**	5,96**
	(7,0)	(5,7)	(2,0)	(4,5)	(11,0)
Self-employed	2,02**	3,04**	2,20*	6,04**	2,45**
	(2,6)	(4,2)	(2,4)	(4,6)	(6,6)
Educational Level					
Up to 15 Years (R)	1	1	1	1	1
16-19 Years	2,95**	1,96**	2,90**	6,64**	2,46**
	(4,5)	(3,9)	(8,3)	(4,7)	(7,9)
+ 20 Years	4,47**	7,06**	8,35**	8,59**	5,61**
	(6,9)	(1,39)	(5,3)	(5,1)	(13,3)
Gender					
Men (R)	1	1	1	1	1
Women	0,61**	0,82	0,97	0,66	0,78**
	(3,0)	(1,4)	(0,1)	(1,5)	(3,0)
Wald χ^2	218	213	58	63	440
N	1087	2100	560	1344	5091

Source: Eurobarometer 59.2. Weighting variables are included in the model (results not shown).

* = p<0.05%; ** = p<0.01%.

[a)] Germany is included as East and West Germany.

Endnotes

[1] Although indications exist for a merging process of Internet, mobile, or organizational technology, today's Internet technology remains to have capabilities beyond those of mobile phones or personal organizers.

[2] For example, money access machines, bus and railway ticket vendors, online civil or travel agencies.

[3] Panel or life history data are needed to discern such effects. With the data used here we cannot distinguish between age and cohort effects. To our knowledge, publicly available panel information on the Internet use of older adults in Europe does not exist.

[4] Included are (in alphabetical order): Austria, Belgium, Denmark, Germany, Finland, France, Great Britain, Greece, Italy, Ireland, Luxembourg, Northern Ireland, Portugal, Spain, Sweden, and The Netherlands.

[5] We discuss items that were ticked by more than 5% of the senior population. Other items that non-users were able to choose are: 'I have no time', 'I have no computer at work', 'there is no public access point', 'the technical barriers are too high', 'the Internet is not secure enough', 'existing language barriers', 'problems with the provider', 'other reasons', respectively, 'unspecified' (question 47, 59.2 Eurobarometer survey).

[6] Percentages cannot be added because multiple answers were possible.

[7] The age of the respondents in the models ranges between 55 and 96, with a mean of 68 years and a standard deviation of eight years (Table not shown).

[8] Analysing current occupational status serves to compare effects of retirement / non-employment to paid employment without an unnecessary inflation of the model variance (e.g., using educational / occupational level *and* income). *Occupational status* serves as a rough indicator for financial resources.

[9] We excluded a small group of current students (N=12).

[10] As one replication carried out with the European Social Survey (2004) showed consistently significant gender effects at an advanced life stage this result needs some additional empirical replication.