EQUAL ACCESS FOR EVERYONE? A DIGITAL DIVIDE CASCADE FOR RETIRED SENIOR CITIZENS

Research Paper

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Abstract

Society has arrived in the digital era. The continuous transition from an analogue into a digital world provides many benefits for of our daily lives. Yet, digital access is still unevenly distributed and accompanied by unequal use of digital resources, resulting in social disparities. Especially senior citizens are lagging behind in making use of the digital media environment – despite having the necessary access to IT. To understand the causes and consequences of digital inequalities, we propose and empirically validate a digital divide cascade targeted at the retired senior audience in the context of online health information use. We analyze the role of the prior workplace experiences have on exploratory IT behavior. The results demonstrate how the digital divide ultimately leads to unequal health knowledge. We thereby contribute to the discussion of seniors' use of digital resources and derive implications for practice and policy.

Keywords: Digital Divide, Workplace, Exploratory IT Behavior, Senior Adults.

1 Introduction

The increasing ubiquity of information technology (IT), particularly the Internet, leads to a constant transition of information, as well as public and private services from the analogue to the digital environment (Friemel 2014; Wei et al. 2011). Advocated to empower citizens, to enhance social capital, and to increase 'equality of opportunity' (DiMaggio and Hargittai 2001), the Internet has already changed many aspects of the way we live and how we interact with each other. Yet the chances to participate in the digital society are not distributed equally, neither on a global, nor on an individual level (Dewan and Riggins 2005). Amongst other disadvantaged groups, especially seniors (for the context of this paper defined as retired persons) suffer from a lack of digital opportunities. In face of the demographic change many economies are confronted with (OECD 2007; 2011; 2013), an age-related divide of access to digital technology and use is a serious issue for our society's ever increasing digital advancements: those who do not take part in it are increasingly left behind and threatened by social inequalities and exclusion.

Seen as "a practical embodiment of the wider theme of social inclusion" (Selwyn 2004, p. 343), the 'digital divide' resembles these general disparities in access and use of IT (Dewan and Riggins 2005). Whilst early notions of the digital divide addressed inequalities of access to IT and particularly to the Internet (Dewan and Riggins 2005), continuous advancements and decreasing costs in IT narrowed these disparities; whilst only about 14% of adults aged 65+ in the US accessed the Internet in 2000, the number increased to 58% in 2015 (Perrin and Duggan 2015) and increased to 67% in 2017 (Anderson and Perrin 2017). Today's key issue of the digital divide is not the access but rather the unequal ways IT is used (Warschauer 2003). The notion of the 'digital divide' expanded: whilst the 'first-order divide' denotes principal access inequalities, the 'second-order divide' considers differences in digital skills, social support and the purposes IT is used for (Dewan and Riggins 2005; van Deursen and van Dijk 2015).

Yet these two levels of the digital divide are not mutually exclusive but rather are closely interdependent as they form a 'hierarchy' (Tsatsou 2011) or 'chain of effects' (Wei et al. 2011) – a so called 'digital divide cascade'. Several cascades have been proposed in the digital divide literature. Dewan and Riggins (2005) suggest that access to IT leads to IT skill development and IT use. Extending this, Wei et al. (2011) suggest that access and use of IT facilitate skill development which subsequently account for outcomes such as academic performance. Other authors suggest that access to IT is first of all preceded by motivations and later followed by skills subsequently leading to use (Van Dijk 1999; 2005; 2006; Van Dijk and Hacker 2003). Clearly, the digital divide is of a 'puzzling nature', as the cascades proposed are multifaceted and continuously evolving (Tsatsou 2011; Van Dijk and Hacker 2003). In this light, we pose that our current understanding of the digital divide cascade –especially in anticipation of the growing senior audience– has two important shortcomings:

(1) If digital skills are of importance in achieving the desired outcomes of IT use, then it is equally important to understand how seniors gained these skills. Today, policy invests in IT access and skills from early on by equipping schools with IT and teaching students digital skills. However, seniors did not receive such an early access – but some have worked with IT before retiring. A question that has been raised by Dewan and Riggins (2005, p. 313) is: "if employees are provided access within the workplace, to what extent does the support, training, and socialized context of the workplace promote home use and skill development?". This question has yet remained unanswered and little has been done to understand how access to IT before retirement has left it marks on today's IT behavior of seniors.

(2) We assume that digital skills do not automatically lead to purposeful use of technology. Though Internet penetration amongst the senior population increased, seniors still use the Internet less than any other age segment (Kim et al. 2016; Perrin and Duggan 2015). Studies indicate that many seniors despite having the necessary Internet access do not make use of the available digital offerings. For instance, whilst ~75% of Internet users aged 18-64 retrieve health information online, only 58% of the users aged 65+ do so (Fox and Duggan 2013b). Seniors are much more prone to stick with familiar media practices and seldom make intense use of the new practices of the digital environment (Nimrod 2017). Our current understanding of the digital divide cascade (access and capabilities) does not account for motivational aspects after IT has been adopted. There are specifics in the second-level divide of the senior audience (Nimrod 2017), which we suggest to be manifested in an lack of motivation –an 'engagement divide'–

that precedes actual and purposeful use. As pointed out in post-adoption literature, exploratory IT behavior acts as an important precursor for enhanced IT uses and might explain why individuals –particularly older ones– vary in their technology use. Thus, we formulate two research questions:

RQ1: *How and to what extent does prior workplace IT intensity (access divide) affect seniors' digital capabilities?*

RQ2: *To what extent does exploratory IT behavior (engagement divide) promote purposeful use of digital technologies?*

By addressing these questions, this research contributes two important 'pieces' to our understanding of the digital divide cascade. By examining the role of Workplace IT Intensity we aim to identify a distinct source of the access divide and seek to understand how experiences with IT in the workplace (before retirement) has left its marks on seniors use of digital technologies. Second, by incorporating exploratory IT behavior from post-adoption research as a type of 'engagement divide' into the digital divide cascade, we contribute to our understanding how senior citizens approach new ways to make use of their IT.

In the following section we discuss the literature and subsequently propose a digital divide cascade that incorporates Workplace IT Intensity and Exploratory IT Behavior. We then outline our methodological approach to gain evidence for the model and the results from our analysis. We discuss how our work contributes to research, practice and policy and acknowledge limitations before we conclude our paper.

2 Background

2.1 Age and Retirement

One of the challenges research faces in studying the senior population is to characterize it, as there are no agreed definitions for terms such as 'old age', 'old people' or 'the elderly' (Fox and Connolly 2018). Although chronological age indicators are frequently employed, the threshold where 'old' begins is not universally applicable since it varies contextually and culturally. The age of 60-65 and above is a frequently employed threshold but others consider the age of 50+ in defining an 'older person' (Fox and Connolly 2018; WHO 2012) whilst others employ more fine-granular age-related groups such as the 'young old', 'middle old' or the 'very old' (e.g., Forman et al. 1992). However, chronological age thresholds are criticized as having "little or no importance in the meaning of old age" (WHO 2012).

Gerontology literature considers not only the chronological, but also the biological, psychological and social dimension of age (Wattis and Curran 2006). Especially the social dimension of age is seen as important indicator as a person's role in life changes over time (Gorman 1999; Wattis and Curran 2006). Retirement –the "period of one's life after retiring from work" (Oxford Dictionary 2018)– is a major transition in life as some persons spend up to one third of their lives in retirement (WHO 2015). The transition to retirement is often associated with changes in life such as time availability, income, or social networks and such lifestyle changes may also affect peoples' health state (Behncke 2012). In retirement, work activities decline and leisure and other activities such as family- or community-related activities increase (Wang and Shi 2014).

Though retirement is often accompanied by higher age, too, people may retire at different ages; for instance when they are eligible for pension benefits, when they freely choose to or when they are forced to do so because of health conditions or due to legislation (Wang and Shi 2014). However, many retirement statistics in the U.S. and Europe center at an age threshold of 50 years (HRS 2017; SHARE 2018).

2.2 Digital Divide and Senior Citizens

Early definitions of the digital divide refer to the inequality of technological opportunities to those who are able to access information technology (IT) and those who are not (Cammaerts et al. 2003). Yet, over the years, the digital divide changed in its meaning since the sole physical access to IT is not sufficient to account for the still prevailing issue of digital inequalities (Lebens et al. 2009). Scholars suggested that the term 'digital divide' needs to be reframed in order to pay attention to social, mental and cultural factors as well as to the unequal ways IT is used (Valadez and Duran 2007; Warschauer 2002; 2003).

As a result, the ‘first-order divide’ considers the inequalities in principal access to IT whereas the ‘second-order divide’ encompasses differences in digital skills, autonomy, social support and the purposes IT is used for (Dewan and Riggins 2005; van Deursen and van Dijk 2015). As introductorily laid out, these facets are interdependent building a ‘chain of effects’ (Wei et al. 2011) or a ‘digital divide cascade’. Although several cascades have been proposed earlier, their directions and arguments are often identical (Van Dijk 1999; 2005; 2006; Van Dijk and Hacker 2003).

An early and prominent cascade has been proposed by Van Dijk (2005) who considers four divides building upon each other: motivational, material (i.e. access), skills and resulting usage divide. Although he suggests that motivation or interest to use IT is a precursor of the access to IT, he considers that these facets are not only cumulative but also recursive meaning that when reaching the usage facet, a new iteration starts again beginning with the motivational facet. Similar contentions have been made by Barzilai-Nahon (2006) as well as by Ghobadi and Ghobadi (2015) who found causal interrelations and interactions between these facets contributing to the overall theme of the digital divide.

The cascade proposed by Wei et al. (2011) considers an additional and important facet of the digital divide cascade: the outcome divide. Applied in the context of schools and students, the cascade traces how disparities in access to IT lead to differences concerning the digital skills which ultimately result in outcome inequalities in terms of academic knowledge and skills. An important finding for the context of our study is that school IT access and usage had a stronger impact on the digital skills for students without access at home than for students with computers at home (Wei et al. 2011). As such, the results indicate that institutionally supported access to IT can greatly favor digital skill development that in turn account for the outcomes gained from IT.

In the context of senior citizens and older adults, prior research stressed the important role of digital skills for this segment as well. In the study of Lam and Lee (2006), for instance, adults aged 55 and above received a three-stage behavioural modelling training to operate computers and the Internet. This intervention did not only increase their intention to use the Internet and the usefulness associated with using the Internet, but also highlighted the importance of support and encouragement. Niehaves and Plattfaut (2014) likewise highlighted the role of digital skills which appeared as the most dominant factor influencing Internet adoption decisions of respondents aged 65 and above.

Even though many senior citizens access and use the Internet (Anderson and Perrin 2017; Perrin and Duggan 2015), questions remain why this segment does not make more intense use of the digital environment. As recently pointed out by Fox and Connolly (2018), many senior users refrain from extending their IT uses. The reason behind this resistance towards new IT is largely unexplored. Hence, although access and basic digital capabilities seem to be present, senior citizens at large tend to be unwilling to extend their uses of IT and the Internet.

2.3 Post-adoption Research and Exploratory IT Behavior

Outside the digital divide literature, IS post-adoption research seeks to understand the causes and mechanisms how people interact with a particular technology after its acceptance as well as with the outcomes achieved out of its use (Jasperson et al. 2005). Post-adoptive behavior can entail a user’s decisions to adopt new features, actual feature use as well as adaptation and extension behaviors to accomplish her/his activities (Jasperson et al. 2005; Liang et al. 2015; Maruping and Magni 2015; Schmitz et al. 2016). Such behavior can result in enhanced, extended, or innovative uses reflecting using a particular IT in a more sophisticated or novel way by making more use of the functions (Bagayogo et al. 2014; Hsieh and Wang 2007; Jasperson et al. 2005; Li et al. 2013). Extended use considers “using more of the technology’s features to support an individual’s task performance” (Hsieh and Wang 2007, p. 217).

In promoting such extended IT uses, especially users’ exploratory IT behavior has been advocated that is defined as the extent to which a user actively seeks new purposes of a given technology (Ahuja and Thatcher 2005; Karahanna and Agarwal 2006; Li and Hsieh 2007; Liang et al. 2015; Nambisan et al. 1999). Hereto, Ahuja and Thatcher (2005, p. 431) proposed ‘Trying to Innovate with IT’, defined as a “user’s goal of finding new uses of existing workplace information technologies”. Trying to Innovate with IT denotes an actual behavior with goal-direction (Ahuja and Thatcher 2005). Innovative and extended IT use, as well as exploratory IT behavior are considered essentially as a self-driven behavior (Li et al. 2009) and, hence, reflects the motivations and 'engagement' with the focal technology or system.

We suggest that incorporating these advancements of post-adoption research into the digital divide cascade may help to refine our current understanding about the 'chain of effects' and to address why senior users –despite having access to IT– often leave the potentials of IT behind. However, as much of the research on post-adoptive behavior has taken place in organizational settings, the factors driving such exploratory IT behavior in private settings has not been studied yet. Moreover, despite the preliminary evidence that exploratory behavior can account for extended system use (Liang et al. 2015), Wang et al. (2013b) call for further investigations of the behavioral outcomes of innovative IT behavior.

3 Research Model Development

To answer the stated research questions, we conceptualize a digital divide cascade that denotes the sequences from disparities in access resulting in unequal outcomes – tailored to the retired audience. We build upon the digital divide cascade proposed by Wei et al. (2011) whose basic contention is that the 'access divide' results in a 'capability divide' which leads to an 'outcome divide'. We focus on 'Work IT Intensity' as a specific source of the access divide for retired senior adults and incorporate and 'engagement divide' and 'use divide' as sequences between the capability and outcome divide.

In line with Wei et al. (2011), we draw on Social Cognitive Theory (SCT) (Bandura 1986) for our argument how access, capability, and engagement divide are influenced. SCT basically posits that personal factors, environmental factors, and behavior reciprocally interact and influence each other (Bandura 1986) and, as such, resonates with the important factors affecting the digital divide at the individual level. SCT thereby allows to overcome reliance on demographic variables and lack of theory in digital divide research as frequently criticized (Tsatsou 2011; Van Dijk 2006; Van Dijk and Hacker 2003).

For the sequence between the engagement, use, and outcome divide, our reasoning is guided by recent research on post-adoptive IT behavior (Jasperson et al. 2005; Liang et al. 2015) that explains the mechanisms how individuals approach new and extended uses of IT after its initial adoption.

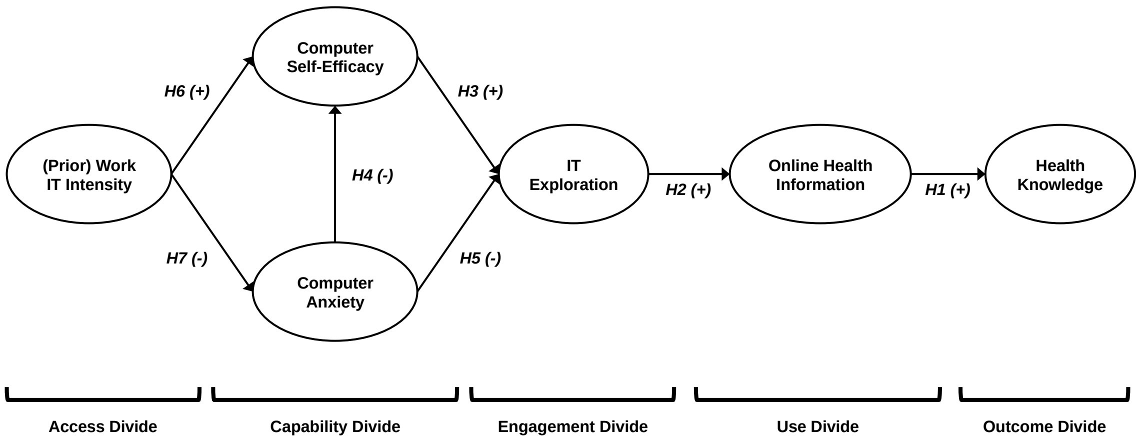

Figure 1. Conceptual Research Model of the Digital Divide Cascade

The basic contention of the proposed digital divide cascade is that inequalities in use are created by motivational differences which are, in turn, influenced by unequal digital abilities gathered through differences in access. As a consequence, unequal outcomes caused by this 'chain of effects' emerge (Wei et al. 2011). After explaining the use case for our research, we detail the proposed cascade in reverse order beginning with the outcome divide and the research context and develop according arguments.

3.1 Use Case: Online Health Information

Information became increasingly important in our society and is at the cornerstone of the digital era we are living in (Van Dijk 2006). The Internet has been advocated to empower citizens, to enhance social capital, and to increase 'equality of opportunity' (DiMaggio and Hargittai 2001). The major concern of the digital divide is the unequal access to information, knowledge and other resources and which thereby could account for social inequalities (DiMaggio and Hargittai 2001; van Deursen and van Dijk 2015).

Seniors are at higher risk to suffer from poor health (Campbell 2008) and are more likely to contribute to the increase of healthcare expenditures (Chatterjee and Price 2009; Fox and Duggan 2013a). The Internet has become an important source for health information which holds potential to increase seniors' health knowledge as it provides information in more accessible ways while allowing anonymity for sensitive topics (Keselman et al. 2008a; Keselman et al. 2008b). Consumers greatly benefit from access to health information, reporting higher participation in health-related decision making, increased understanding of and adherence to their care, and higher engagement in health improving behavior (Prey et al. 2014). However, senior citizens lag behind in making use of online health information. As introductorily stated, although using the web in general, only 58% of the senior Internet users retrieve health information from the web – in contrast to 71-76% of the younger counterparts (Fox and Duggan 2013b).

Due to the impact on society but also for the ease of communication with the target group, we chose online health information as use case to empirically test our proposed digital divide cascade.

3.2 Outcome and Use Divide

Using online health information has high potential for positive outcomes of purposeful technology use. ***Health Knowledge*** –the "extent of knowledge and understanding of personal health problems" (Wilson and Lankton 2004, p. 243)– is an important outcome for seniors and healthcare systems that can enhance their well-being. ***Online Health Information Use***, defined as the extent to which seniors obtain health-related information and support for health-related decision making with IT, reflects a purposeful use of technology and variations in its use are likely to account for variations in the benefits unfolded (DiMaggio and Hargittai 2001). We hypothesize:

H1: *Online Health Information Use is positively related to Health Knowledge.*

Whereas the Internet has become a 'normal' way of obtaining health information for younger Internet users, using the web for health purposes may be more 'novel', different, or 'innovative' for senior adults. In the following, we elaborate how the engagement divide is likely to affect the use divide subsequently.

3.3 Engagement to Use Divide: IT Exploration

Seniors rather adhere to familiar and traditional media practices than making intense use of the digital environment (Nimrod 2017). As such, we argue that there is an 'engagement divide' in seniors' overall use of technologies that leads to either increased or decreased use of digital technologies.

As outlined in the background, research on post-adoptive IT behavior considers the causal mechanisms how users engage with a given technology after its acceptance and implementation and how the focal technology is used in extended or novel ways to support one's activities (Hsieh and Wang 2007; Jasperson et al. 2005). Especially exploratory user behavior, or ***IT Exploration***, has been advocated to promote such extended uses where a user actively seeks for new purposes to use a given IT (Ahuja and Thatcher 2005; Karahanna and Agarwal 2006; Li and Hsieh 2007; Liang et al. 2015; Nambisan et al. 1999). Evidence supports the argument that the more individuals engage in such IT exploration behavior, the more new features of IT are likely to be found and applied leading to extended IT use (Liang et al. 2015). In this vein, Li et al. (2013) observed that intrinsic motivation to increase knowledge as well as motivation to experience stimulation highly accounts for exploratory IT behavior. To the extent that 'Online Health Information Use' represents a form of seniors' extended post-adoptive Internet use, then IT exploration is likely to be an antecedent. We hypothesize:

H2: *IT Exploration is positively related to Online Health Information Use.*

Given the importance IT exploration might hold to account for variations in technology use, it is equally important to understand how such attempts to find new purposes of IT is promoted. For the most part, however, IS research revolving around this concept takes place in organizational settings examining the influence of the organizational environment in supporting employees innovative and exploratory IT behavior (e.g., Ahuja and Thatcher 2005; Liang et al. 2015; Magni et al. 2011). Little is consequently known about the factors in private settings. In our proposed digital divide cascade, we suggest that differences in seniors' digital capabilities will account for differences in IT exploration.

3.4 Capability to Engagement Divide: Computer Self-efficacy and Anxiety

Some emphasis in the digital divide debate is placed on inequalities in digital skills or capabilities (DiMaggio et al. 2004; Van Deursen and Van Dijk 2016; Van Dijk 2006). Especially senior citizens need to be able to participate in digital opportunities. Lacking the necessary digital skills frequently result in avoidance (Van Deursen and Van Dijk 2016). Such skills are usually observed to be less sophisticated for senior adults: as age increases, digital skills decrease (van Deursen and van Dijk 2015).

Many theories of human behavior suggest that one's (perceived) ability to engage in a certain behavior is a direct precursor of whether one actually performs the behavior of interest (Ajzen 1985; 1991; Ajzen and Madden 1986; Bandura 1997). SCT advocates self-efficacy –the "belief in one's capability to organize and execute the courses of action required to manage prospective situations" (Bandura 1997, p. 2)– as focal determinant of human behavior (Bandura 1982; 1997).

As a consequence, IS research promoted computer self-efficacy amongst others as important variable of technology acceptance and use in general (Compeau et al. 1999; Marakas et al. 1998; Venkatesh 2000) and particularly in the realm of the digital capability divide (Wei et al. 2011). As such, ***Computer Self-Efficacy*** (CSE) denotes individuals' own judgments of being able to use a computer (Compeau et al. 1999; Compeau and Higgins 1995b). Albeit older adults generally possess less computer self-efficacy compared to younger ones (Czaja et al. 2006; Mead et al. 2000), such perceptions are of upmost importance in seniors' appropriation of the Internet (Lam and Lee 2006; Niehaves and Plattfaut 2014).

Finding new purposes of digital technologies demands higher confidence of being in control of the technology and to overcome obstacles. The more seniors perceive themselves generally as able to use computers, the more they are motivated to explore the (novel) features digital technologies offer them for various purposes (Robert and Tracy 2016). We hypothesize:

H3: *Computer Self-Efficacy positively influences IT Exploration.*

Given the importance CSE holds –especially– to senior individuals, it is necessary to dive deeper into the sources that can alter self-efficacy perceptions. Amongst others, SCT posits that self-efficacy judgments can be informed by physiological states such as fears and anxiety (Bandura 1986) lending doubts of the ability to successful execute the target behavior (Bandura 1977). In the IT context, ***Computer Anxiety*** (CA) is a feeling of discomfort, stress, or even fear when confronted with computers (Heinssen et al. 1987; Parasuraman and Igbaria 1990). In line with the arguments of SCT, mounting evidence has established a clear general, yet reversed relationship between CA and CSE (e.g., Compeau et al. 1999; Thatcher and Perrewe 2002). As this holds equally true for older adults (Lam and Lee 2006), we posit:

H4: *Computer Anxiety negatively influences Computer Self-Efficacy.*

CA acts as major barrier of computer and Internet use in the realm of the digital divide, especially among seniors where computer anxieties tend to be more pronounced (Powell 2013; Van Dijk 2006). CA inhibits individuals to make use of digital technologies, such as the Internet (Davis and Mun 2012), and renders computers more difficult to use for them (Hackbarth et al. 2003; Venkatesh 2000). Thus, seniors with higher CA tend to avoid IT exploration as they could encounter unpleasant experiences. We posit:

H5: *Computer Anxiety negatively influences IT Exploration.*

Consequently, we suggest that the 'capability divide' of the senior audience will account for the 'engagement divide'. Thus, it is important to understand the sources promoting digital capabilities.

3.5 Access to Capability Divide: Workplace IT Intensity

While the 'access divide' tends to narrow in most developed countries, the 'capability divide' tends to grow (Van Dijk 2006). Yet the existence of the access divide in the past cannot be denied. Although computers were basically available for private consumers already decades ago during the 1980s and 1990s, they were far more expensive for most people than today (Ching et al. 2005). At that time, however, firms started to equip workplaces with computers. IT access and use was much more likely at work than at home. Yet, such opportunities were unequally for todays' seniors. As a result, seniors with pre-retirement computer use are more likely to use the Internet than those who did not (Friemel 2014).

In our digital divide cascade proposed here, we devote the 'access divide' exclusively to prior ***Workplace IT Intensity*** defined as the extent to which IT was part of the previous working environment and work routine. Workplace IT intensity, as such, reflects the experiences gained via actual use of IT as well as the social environment in which these experiences took place. Inherent are, thus, inequalities with respect to physical and social access of the digital divide (DiMaggio and Hargittai 2001). In the following, we elaborate how workplace IT intensity affects digital capabilities.

SCT argues that self-efficacy judgments are prompted by psychological procedures. Individuals process and weigh information from various sources about their capability in determining their self-efficacy that, in turn, influences their behavior (Bandura 1977; 1982). Four categories of information sources are suggested (Bandura 1977; 1982): (1) enactive mastery experience or performance accomplishments with a target behavior, (2) vicarious experience or the observation of others performing the target behavior, (3) verbal persuasion or comments of others about one's ability to perform the behavior, and (4) emotional arousal or physiological states. While we discussed the latter source already above, we argue that the former sources greatly resemble with Workplace IT Intensity. There are two lines of reasoning with equal direction that explain how Workplace IT Intensity affects the capability divide.

The first aspect considers the direct hands-on experience gained through actual IT uses at the workplace. Mastery experience of a behavior is the most vital source for the formation and development of self-efficacy judgments (Bandura 1982). Digital divide research points out that people learn more digital skills in practice in a trial-and-error manner (Van Dijk 2005; 2006) and the experience with and the actual use of IT are significant predictors of one's digital abilities (Wang et al. 2013a). CSE is informed similarly by trail-and-error experiences (Agarwal et al. 2000; Robert and Tracy 2016) and direct hands-on experience with IT (e.g., Compeau and Higgins 1995a; Marakas et al. 1998).

The second aspect considers the working environment as source of vicarious experience and verbal persuasion. A major reason why people become more competent with new IT is the social environment they can draw on and the social, formal, and technical support they receive (Brandtweiner et al. 2010; DiMaggio and Hargittai 2001). In the workplace, co-workers and supervisors are highly influential in shaping IT use (Eckhardt et al. 2009; Kim et al. 2007) by helping each other to understand how IT is used and give advices to overcome difficulties (Robert and Tracy 2016). IT intense workplaces are also likely to be characterized by formal training interventions, where employees receive various forms of computer education effective to increase computer self-efficacy (Lam and Lee 2006).

Taken these lines of reasoning together, we expect that seniors having worked in a workplace with higher IT intensity had more chances to make use of various computing technologies and received more social and formal support resulting in greater accumulated digital abilities. We put forth:

> **H6:** *Work IT Intensity positively influences Computer Self-Efficacy.*
> **H7:** *Work IT Intensity negatively influences Computer Anxiety.*

Although our proposed digital divide cascade is targeted at senior citizens, we also seek to investigate –albeit in an exploratory manner– the general applicability of this cascade and to explore whether our model exhibits differences between retired and non-retired persons. To this end, we conducted a quantitative study targeted at retired senior citizens but also involving non-retired persons. We describe our research method and empirical results in the next section.

4 Research Method

4.1 Data Collection and Sample Description

To test our proposed model, we conducted a quantitative field survey in the U.S. generally targeted at the retired population of people aged at around 50 years and above (HRS 2017; SHARE 2018). In order to explore differences between retired and non-retired persons, we also aimed at collecting data from younger and employed persons. Our questionnaire was, whenever possible, based on established measures (see Table 1). Measures for Online Health Information Use and Work IT Intensity were not readily available and, thus, developed for the study. Several pre-tests with the target group led to minor adjustments of the items to improve understanding.

Construct	Items (Number and examples)	Source
Health Knowledge [2]	2 items; e.g. "I am very knowledgeable regarding care for my health problems."	Wilson and Lankton (2004)
Online Health Information Use [1]	1) "I personally use the Internet to look up information about health related topics."; 2) "I use computer-technology to research products or services before making a decision to purchase or use something."	–
IT Exploration [2]	2 items; e.g. "I try to find new uses of computer-technology for tasks important to me."	Ahuja and Thatcher (2005)
Computer Self-Efficacy [3]	10 items; e.g. "I could use an unfamiliar computer-technology if there was no one around to tell me what to do as I go."	Compeau and Higgins (1995b)
Computer Anxiety [2]	4 items; e.g. "I feel apprehensive about using computer-technologies."	Thatcher and Perrewe (2002)
Work IT Intensity [2]	1) "Using computer-technologies is/was part of my daily job routine(s)." 2) "Most of my work is or was done with computer-technology." 3) "Computer-technology use is or was important in my job(s)."	–
Scales anchored: [1]7-point (not at all – very often), [2]7-point (strongly disagree – strongly agree), [3]10-point (not at all confident – totally confident)		

Table 1. Description of Measurement Instrument

Access to the target group has been frequently shown to be difficult (e.g., Heart and Kalderon 2013) and using an online-survey might attract rather technology-savvy adults causing potentially biased results. Therefore, we employed a convenience sampling method using a paper-and-pen based field survey approach that has been shown to be successfully for gathering data from the target group (e.g., Guo et al. 2013). In order to reach retired citizens, we collected data at public places such as senior citizen centers, adult schools, and pedestrian zones in the second half of 2015. In total, we received 234 surveys and dropped those with respondents who have been never employed in their lifetime or whose data exhibited too many missing values. The remaining 219 responses constitute the basis of our analysis. Out of those, 157 belong to the retired group and 62 to the non-retired group.

As for the retired group, 62% are female and the average age is 72 years (Min: 42; Max: 101; S.D. 8.5). For the marital status, 61% are married, 18% widowed, and 12% single. Educational level is 40% post-graduate study, 36% graduated college, 16% some college, followed by 5% less than some college. Most respondents indicated an annual household income between 50k and 149k USD.

Within the non-retired group, 66% are female and the average is 56 years (Min: 21; Max: 85; S.D. 14.4). 69% are married, followed by 21% that indicated 'single' as marital status, 6% are divorced, and 2% widowed. 42% report post-graduate study as educational level, 23% graduated college, 18% some college, and 17% below some college. 32% indicated an annual household income between 100-149k USD, followed by 19% with 200k and more, 15% with 50-74k, 10% 35-49k.

We analyzed the data using Partial Least Squares (PLS) with the software SmartPLS 3.2 (Ringle et al. 2015). Analysis involved the common two-step procedure (Chin 1998) as described in the following.

4.2 Measurement Model Analysis

We first assessed the measurement model and as results in Table 2 outline, we found satisfactorily support of its quality. As all constructs are measured with reflective indicators, analysis of the measurement model focuses on reliability and validity (Chin 1998).

					Discriminant Validity					
	Construct	**CRA**	**CR**	**AVE**	1	2	3	4	5	6
1	Health Knowledge	0.832	0.922	0.855	**0.925**					
2	Online Health Info Use	0.761	0.893	0.806	0.345	**0.898**				
3	IT Exploration	0.940	0.971	0.943	0.290	0.435	**0.971**			
4	Computer Self-Efficacy	0.960	0.965	0.735	0.324	0.350	0.600	**0.857**		
5	Computer Anxiety	0.912	0.938	0.792	-0.183	-0.187	-0.468	-0.579	**0.890**	
6	Work IT Intensity	0.957	0.972	0.921	0.140	0.239	0.441	0.504	-0.304	**0.959**

Table 2. Measurement Model Results (n=216)

Indicator reliability requires items to be significant and loadings above 0.707 (Chin 1998). In our data, all items are significant with values of at least 0.815. All constructs' values for Cronbach's Alpha (CRA) and Composite Reliability (CR) exceed the threshold of 0.70 and values for Average Variance Extracted (AVE) exceed the minimum of 0.50 (Fornell and Larcker 1981) suggesting sufficient reliability. Discriminant validity was assessed by observing that each item loads highest on its designated construct (Chin 1998) and by ensuring that the square roots of AVEs are greater than the correlation (Fornell and Larcker 1981). The heterotrait-monotrait ratio with highest value of 0.631 is below the threshold of 0.850 and further supports discriminant validity (Henseler et al. 2015). The results of the measurement model analysis for the non-retired and retired sample did not substantially differ from the combined sample.

4.3 Common Method Bias Analysis

Given that we had to collect self-reported data from a single source at one point of time and place, our data might be subject to common method bias (CMB) (Podsakoff et al. 2003). During data collection, we ensured anonymity and that there are no 'wrong' or 'right' answers to the survey questions in order to mitigate threats of social-desirability biases (Podsakoff et al. 2003).

To observe the presence of CMB in our data, we employed Harman's single factor test first. Results indicate that 48% of the variance accounted to one factor, which is below the threshold of 50% (Podsakoff et al. 2003). As this test is regarded as the least favorable technique (Chang et al. 2010), we additionally performed the test of Liang et al. (2007) where an additional CMB factor containing all items is entered in the structural model and its influence on the respective single-item indicator factors is compared with the influence with the indicator's theoretical construct. In our case, the CMB factor explains an average R^2 of 0.25% and the ratio of 1:325 is smaller compared to other studies (1:42 in Liang et al. 2015; 1:154 in Maier et al. 2015). Therefore, we conclude that CMB is not a concern.

4.4 Structural Model Analysis and Results

We analyzed the results of the structural model by assessing the coefficient of determination (R^2), effect sizes (f^2), and the significance levels of the path coefficients for hypotheses testing (Chin 1998) using a bootstrapping procedure with 5000 iterations.

We analyzed the model among three groups of our sample (retired, non-retired, total) in order to compare the results. Thus, from a hypothesis testing perspective, the focus is placed on the retired group, as well as on the strengths and significance of the paths. The results of the structural model for the retired group are depicted in Figure 2. Additional results along effect sizes for comparison purposes are reported in Table 3. In total, six out of the seven hypotheses are supported for retired people. Precisely, H1, H2, H3, H5, H6, and H7 are supported whilst H4 is not. Moreover, with few exceptions, the model exhibits a better performance for the retired group than for the non-retired group underlined by higher R^2 values and greater effect sizes.

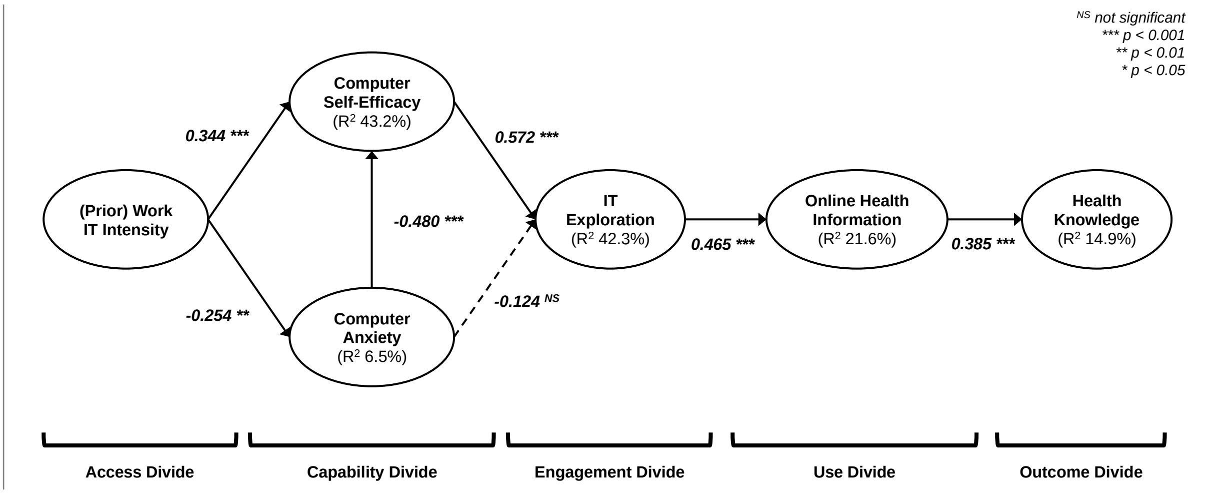

Figure 2. Structural Model Results for Retired Citizens

In order to gain deeper insights into the relationships of computer anxiety (H4), we ran additional analyses in the retired segment by analyzing direct and interaction effects of demographic variables (age, gender, education, income) on computer anxiety and IT exploration. The additional factors increased the R^2 of computer anxiety from 6.5% (as per the main model) to 22.3%. Education emerged as the only significant direct antecedent of computer anxiety (-0.193; p=0.009; f^2=0.045).

Significant interaction effects emerged with work IT intensity and gender (0.273; p=0.000; f^2=0.073; 0=male/1=female) as well as with work IT intensity and income (-0.181; p=0.029; f^2=0.042) on computer anxiety. The R^2 of IT exploration increased from 42.3% to 48.6%. Yet, only income poses a direct significant relationship (0.145; p=0.023; f^2=0.038), all other interaction effects are insignificant.

	Retired		**Non-Retired**		**Total**	
	Path	*Effect*	*Path*	*Effect*	*Path*	*Effect*
Health Knowledge *R^2 and Adjusted R^2*	**14.9%** (Adjusted 14.3%)		**6.4%** (Adjusted 4.9%)		**11.9%** (Adjusted 11.5%)	
H1: Online Health Info. Use	0.385 ***	0.174 (M)	0.254 NS	0.069 (S)	0.345 ***	0.135 (S)
Online Health Info. Use *R^2 and Adjusted R^2*	**21.6%** (Adjusted 21.1%)		**12.3%** (Adjusted 10.8%)		**18.9%** (Adjusted 18.5%)	
H2: IT Exploration	0.465 ***	0.275 (M)	0.351 **	0.140 (S)	0.435 ***	0.233 (M)
IT Exploration *R^2 and Adjusted R^2*	**42.3%** (Adjusted 41.5%)		**31.5%** (Adjusted 29.1%)		**38.2%** (Adjusted 37.6%)	
H3: Computer Self-Efficacy	0.572 ***	0.384 (L)	0.253 NS	0.055 (S)	0.496 ***	0.264 (M)
H5: Computer Anxiety	-0.124 NS	0.018	-0.363 **	0.113 (S)	-0.180 *	0.035 (S)
Computer Self-Efficacy *R^2 and Adjusted R^2*	**43.2%** (Adjusted 42.5%)		**46.5%** (Adjusted 44.7%)		**45.4%** (Adjusted 44.9%)	
H4: Computer Anxiety	-0.480 ***	0.379 (L)	-0.519 ***	0.385 (L)	-0.469 ***	0.366 (L)
H6: Work IT Intensity	0.344 ***	0.194 (M)	0.257 *	0.094 (S)	0.361 ***	0.217 (M)
Computer Anxiety *R^2 and Adjusted R^2*	**6.5%** (Adjusted 5.9%)		**23.6%** (Adjusted 22.3%)		**9.3%** (Adjusted 8.8%)	
H7: Work IT Intensity	-0.254 **	0.069 (S)	-0.486 ***	0.308 (M)	-0.304 ***	0.102 (S)
*** p < 0.001, ** p < 0.01, * p < 0.05, NS not significant Effect sizes: 0.02 (S; small), 0.15 (M; medium), and 0.35 (L; large) (Chin 1998)						

Table 3. Structural Model Results

5 Discussion and Further Research Directions

In this paper, we developed and validated a parsimonious cascade of the digital divide for retired citizens that provides insights for research, practice and policy regarding digital and social inequalities. The cascade reflects the 'chain of effects' (Wei et al. 2011): beginning with inequalities in prior workplace IT opportunities (access divide) leading to disparities in digital competencies (capability divide) that, in turn, lead to different levels of IT exploration (engagement divide) causing unequal use of digital information (use divide) that ultimately lead to unequal knowledge (outcome divide). By combining and contrasting retired with non-retired adults, we not only validated the general applicability of the cascade, but also found higher explanatory power of the model for retired citizens.

5.1 Implications and Opportunities for Research

First, and foremost, our research provided novel insights into 'retirement' as a concept to segregate age-related behavior. We focused on senior citizens, a target group that received comparatively low attention in IS research (Fox and Connolly 2018; Tams et al. 2014). Given the problems and concerns of defining this segment by chronological age (Gorman 1999; WHO 2012), we employed a more qualitative indicator: retirement. Retirement marks an important change in one's life and -as our results indicate- it serves as a suitable segmentation indicator for IT- and ageing-related research.

Second, we contribute to research on digital divide in general and on the age-related divide in particular. Prior literature already acknowledged that the digital divide is multifaceted and that the facets mutually build upon each other. Yet prior research focused primarily on the 'access divide', the 'capability divide', as well as the interrelatedness of these two divides (see e.g., Dewan and Riggins 2005). Only more recently, research took the consequences of the digital divide –the 'outcome divide'– into perspective. In that respect, Wei et al. (2011) suggest that access to and use of IT facilitate skill development that subsequently account for differences in outcomes. While our model adheres to the thought that access leads to skills, our model contrasts the one of Wei et al. (2011) with respect to achieving outcomes. More precisely, actual use precedes the outcomes gained and actual use is preceded by motivations to explore IT. As such, our 'engagement divide' is concerned with motivational differences *after* adoption and skills development. Given that the 'access divide' is narrowing in most countries, we expect that motivations as exploring IT will become more important in the future. In summary, we contribute to understand the 'puzzling' and evolving nature of the digital divide, particularly for senior citizens (Tsatsou 2011; Van Dijk and Hacker 2003).

Third, we contribute to selected aspects of the digital divide facets that we detail along the 'chain of effects' starting with the 'from access to skills' sequence. Whilst Wei et al. (2011) observed the role of school IT access versus home IT access, we observed the role of IT intensity of the (prior) workplace. Our data supports that the workplace is an important and unique root for shaping adults' digital skills. This study, hence, responds to the call of Dewan and Riggins (2005) about the extent to which the workplace promotes home IT use, as well as to Tams et al. (2014) regarding the need to uncover how computer self-efficacy among senior citizens is shaped. Further research is needed to determine the relative strength of workplace experience compared to home access and private sources of social support. In this vein, though we considered social support and educational interventions to be inherent in IT Work Intensity, further research is needed to isolate and examine the relative strengths of these factors. However, although workplace experience significantly decreases computer anxiety –particularly for women– the effect is less pronounced for the retired segment. Literature suggests that the phenomenon of computer anxiety does not "completely disappear with a rise in computer experience" (Van Dijk 2006, p. 227). As IT becomes increasingly pervasive, cyber-attacks are more than ever present, such as identity-theft or frauds etc. Thus, computer anxiety proves to be much more dynamic and malleable than computer self-efficacy and we suggest that further research is conducted to understand the dynamic nature of computer anxiety over time.

Concerning the 'capability to engagement' and 'engagement to use' sequences, we contribute to post-adoptive IT research on the antecedents and consequences of exploratory IT behavior. Prior research on this issue has largely taken place in organizational/professional settings (Ahuja and Thatcher 2005; Bagayogo et al. 2014; Liang et al. 2015; Magni et al. 2011). Our study successfully examined the applicability of these concepts within a personal/private setting. We thereby complement previous research in identifying factors that motivate individuals' innovative IT behavior and how such behavior promotes actual use. As research points out, the environment of the user can stimulate such behavior by providing autonomy. A promising direction for further research would be to examine how the environment (i.e. differences in accessing and using IT at home or in public institutions) promote such behavior for seniors (Brandtweiner et al. 2010). Likewise, the device itself could be influential as well: a tablet computer, for example, might be more encouraging for IT exploration than a traditional desktop computer.

Regarding the 'use to outcome' sequence, our research contributes to digital divide research about the consequences of digital inequalities, an important social aspect that still receives comparatively low attention (Dewan and Riggins 2005).

5.2 Implications for Practice and Policy

Understanding the causes why, where, how, and to which extent digital inequalities amongst senior citizens can affect social disparities and life chances is of high importance for our society – and a fine-grained cognizance about causes and consequences is needed. While investing in public access to IT and development of digital competencies from early on, like in schools, is clearly important and beneficial for upcoming generations, policy and practice cannot afford to forget the growing older part of the population. For those who did not have the chance to receive access and formal education in using IT from early on, workplaces play an important role in shaping digital competencies and use of IT – even after retirement. This suggests that workplaces indirectly contribute to social disparities and to important factors such as health. As such, policy should encourage firms to keep investing in IT access and education for their employees, even if they are close to retirement. As seniors rather adhere to traditional media, they need to be encouraged to 'simply try out' digital technologies. And since digital abilities matter here, those without prior work IT experiences must be encouraged and supported in gaining digital abilities, for instance through IT trainings (Chu et al. 2009; Lam and Lee 2006).

5.3 Limitations

Our study took place in a developed country and the corresponding cultural setting. Results may differ in other and/or less developed countries. The generalizability of the results is limited as data has been collected at only one point in time and self-reported measures were used. We only surveyed seniors at public places, thus we missed those who are less outgoing or bound to their home.

6 Conclusion

A frequent assertion is that the age-related divide will 'automatically' close once the generation that has grown up with IT or used IT in their labor time supersedes the current generation of seniors or those who had not the equal chance to get in touch with IT (Friemel 2014; Peacock and Künemund 2007). Our society is just at the beginning of the digital era where digital innovations are released in an ever-increasing speed. One might easily suggest that the digital innovations of today can be replaced with even more advanced ones very soon. As the digital experiences and abilities gained today can become obsolete, future seniors are likely to be in the same situation as our senior citizens today. And those that had earlier access to novel technologies than others might reap the benefits while others may be left behind (Van Dijk 2006). Therefore, monitoring social inequalities emerging from digital inequalities remains an important topic for shaping our future society.

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