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Digital inequalities: differentiated internet use and social implications

Büchi, Moritz

Abstract: Effective use of the Internet as crucial information and communication network is increasingly necessary to participate in society. This thesis analyzes differences in everyday Internet use and discusses their social implications. A sociological digital inequality perspective based on the knowledge gap hypothesis forms the main theoretical framework. It assumes that Internet use depends on and contributes to social position. Quantitative international surveys were analyzed using structural equation modeling. Network and automated content analysis were additionally used on web data. Results show that general Internet uses can be grouped into four core purposes (information seeking, social interaction, entertainment, and commercial transaction). For valid cross-country comparisons of usage types, measurement invariance testing was found critical. There are pronounced second-level digital divides with consistent age, education, and experience effects. Differences in specific online activities— privacy protection, political participation, and science participation— are mainly explained by interests and Internet skills, and these in turn depend on social position. Overall, Internet use tends to reinforce social inequalities but policies aimed at enhancing Internet skills may counter this. The consequences for individuals' subjective well-being is identified as a future avenue for empirical digital inequality research.

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DIGITAL INEQUALITIES

DIFFERENTIATED INTERNET USE AND SOCIAL IMPLICATIONS

Thesis (cumulative thesis)
presented to the Faculty of Arts and Social Sciences
of the University of Zurich
for the degree of Doctor of Philosophy

by Moritz Büchi

Accepted in the fall semester 2016
on the recommendation of the doctoral committee:

Prof. Dr. Michael Latzer (main supervisor)
Prof. Dr. Elad Segev

Zurich, 2017

Abstract

Effective use of the Internet as a crucial information and communication network is increasingly necessary to participate in society. This thesis analyzes differences in everyday Internet use and discusses their social implications. A sociological digital inequality perspective based on the knowledge gap hypothesis forms the main theoretical framework. It assumes that Internet use depends on and contributes to social position. Quantitative international surveys were analyzed using structural equation modeling. Network and automated content analysis were additionally used on web data. Results show that general Internet uses can be grouped into four core purposes (information seeking, social interaction, entertainment, and commercial transaction). For valid cross-country comparisons of usage types, measurement invariance testing was found critical. There are pronounced second-level digital divides with consistent age, education, and experience effects. Differences in specific online activities—privacy protection, political participation, and science participation—are mainly explained by interests and Internet skills, and these in turn depend on social position. Overall, Internet use tends to reinforce social inequalities but policies aimed at enhancing Internet skills may counter this. The consequences for individuals' subjective well-being is identified as a future avenue for empirical digital inequality research.

Zusammenfassung

Eine Effektive Nutzung des Internet als zentrales Informations- und Kommunikationsnetzwerk ist zunehmend notwendig für gesellschaftliche Teilhabe. In dieser Dissertation werden Internetnutzungsunterschiede im Alltag analysiert und deren sozialen Implikationen diskutiert. Dabei wird davon ausgegangen, dass die Internetnutzung von der sozialen Position abhängt und diese auch beeinflusst. Quantitative internationale Befragungsdaten wurden mit Strukturgleichungsmodellen analysiert. Netzwerk- und automatisierte Inhaltsanalyse wurden zudem auf Webdaten angewendet. Allgemeine Internetnutzung konnte in die vier Grundtypen Informationssuche, soziale Interaktion, Unterhaltung und kommerzielle Transaktion unterteilt werden. Entscheidend für valide Ländervergleiche dieser Nutzungsarten sind Messinvarianztests. Es zeigten sich erhebliche Second-Level Digital Divides mit beständigen Alters-, Bildungs- und Erfahrungseffekten. Unterschiede bei den spezifischen Onlineaktivitäten Privacy-Selbstschutz, politische Beteiligung und Wissenschaftspartizipation sind primär durch Interessen und Internetfähigkeiten zu erklären; diese wiederum werden von der sozialen Position mitbestimmt. Insgesamt verstärkt die Internetnutzung soziale Ungleichheiten eher, jedoch könnte die Förderung von Internetfähigkeiten dem entgegenwirken. Für zukünftige digitale Ungleichheitsforschung bietet sich die empirische Erfassung von Auswirkungen auf subjektives Wohlbefinden an.

Digital Inequalities

Differentiated Internet Use and Social Implications

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Preamble

This doctoral thesis comprises four articles published in refereed scholarly journals, one article currently under review, and a synopsis. [Article I \(Büchi, 2016b\)](#) details and applies the concept of measurement invariance to Internet usage within a cross-nationally comparative context. [Article II \(Büchi, Just, & Latzer, 2016b\)](#) models inequalities in Internet use with nationally representative survey data for five countries with narrowing access divides. [Article III \(Büchi, Just, & Latzer, 2016a\)](#) explains Internet users' self-help activities in protecting their privacy online by considering Internet skills as well as privacy breaches and attitudes. [Article IV \(Büchi & Vogler, 2016\)](#) analyzes the role of political interest and Internet expertise for the social structuration of online political participation. [Article V \(Büchi, 2016c\)](#) explores the online communication of science topics on the microblogging platform Twitter and the asymmetries of the resultant reference network. The present synopsis ([Büchi, 2016a](#)), finally, highlights the context and relevance of digital inequalities, presents the overarching research question along with the theoretical perspectives and methods employed, illustrates the contributions of and connections among the individual articles, synthesizes overall conclusions drawn from the empirical studies, and identifies avenues for future research.

Synopsis

1. Introduction

Not long after a sizable portion of the population began using email and the Web in their daily lives towards the end of the 1990s (at least in the United States; see [Pew Research Center, 2014](#)), social science research recognized the inequalities developing in Internet use. Although early research on the digital divide relied on its definition as «the divide between those with access to new technologies and those without» ([NTIA, 1999](#), p. xiii), scholars quickly also asked how individuals used the Internet in terms of activities and abilities once they had access (e.g., [Nie & Erbring, 2000](#); [Hargittai, 2002](#)). Today, this line of social scientific communication research generally relies on the term digital inequality. Since they influence usage practices, Internet access and access quality still remain relevant issues, even in high-diffusion countries. This is reflected, for instance, in the United States Federal Communications Commission's vote to treat fixed and mobile Internet as an essential utility rather than a luxury, with the corresponding regulatory attention (see [Kang, 2016](#)).

Early scholarship on Internet use found detrimental effects on social relationships ([Kraut, Patterson, Lundmark, Kiesler, Mukophadhyay, & Scherlis, 1998](#)) and other psychological research has also analyzed «problematic Internet use» (see [Caplan, 2003, 2010](#)). In general however, the digital divide and digital inequality literature has largely assumed an in principle positive impact of the Internet on the lives of users and considers Internet use a valuable resource. Early seminal studies with more than one thousand Google Scholar citations in this sociological tradition include [DiMaggio, Hargittai, Neuman, & Robinson \(2001\)](#), [Norris \(2001\)](#), [Warschauer \(2004\)](#), and [van Dijk \(2005\)](#). Digital inequality is a new form of social inequality in the information society that shapes life chances: «Those who function better in the digital realm and participate more fully in digitally

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mediated social life enjoy advantages» (Robinson et al., 2015, p. 570).

The overarching research question of this dissertation is formulated as «what are the inequalities in Internet use and their social implications?» The first part of this research question, the characterization and explanation of digital inequalities, means showing differences in the ways the Internet is used and identifying the most important predictors of different usage types. The focus is on countries that have high levels of Internet adoption. The second part, that of implications, deals with the social consequences that differentiated Internet use can have and discusses its policy implications in high-diffusion information societies.

To illustrate the empirical approach that this thesis applies, consider the following case. In many countries more than eight in ten adults have *access* to the Internet (see Figure 1). Some of these individuals use it extensively in their everyday lives for information seeking, checking facts, and looking up things of interest while others do not, or do so less. This *usage* divide within the connected majority of society may be explained in part by different levels of educational attainment. The strength of the relationship between education and use of the Internet for informational purposes can be tested while checking for other potential explanatory variables such as employment, skills, or interests; and it can be compared across different populations and cultures. With regards to the second part of the research question, the social implications of differentiated Internet use, the synopsis and articles below develop several propositions based on the empirical findings of the first part in conjunction with the theoretical framework.

The five articles that form the basis of the dissertation contribute different specific elements to this general research interest. The articles deal with current and sometimes very specific Internet usage patterns. However, these empirical contributions draw their significance from much broader sociotechnical developments. The Internet is an information and communication technology (ICT) that has spread in the previous decades and needs to be seen as part of the megatrend of globalization and computerization in postindustrial

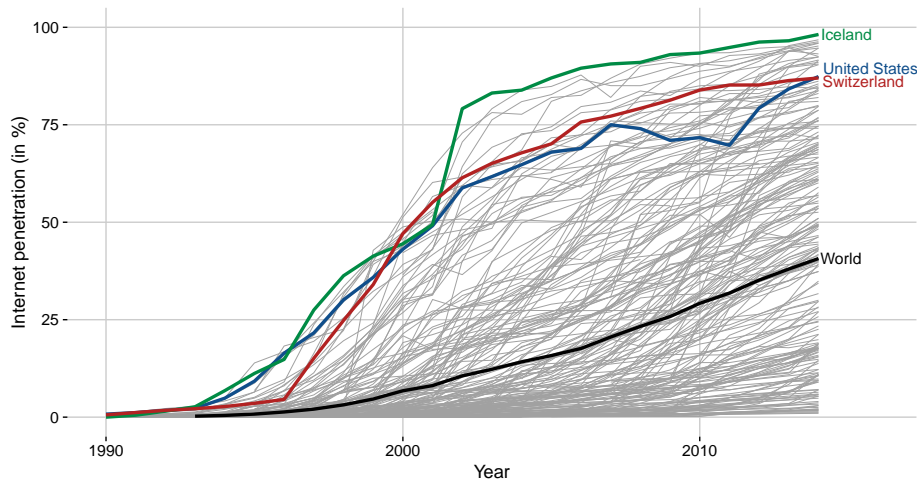


Figure 1: Internet diffusion worldwide 1990–2014. Highlighted countries include Iceland as the most connected country in 2014 (98%), the United States (87%) as the most researched country, Switzerland (87%) as the main focus of this thesis, and the world average (41%). The figure is based on World Bank data and adapted from [Kovic \(2016\)](#).

society (see [Duff, 2011](#)). Important milestones in the technical and commercial history of the Internet were J. C. R. Licklider’s call for a global network in 1960, the development of TCP/IP and an email system on ARPANET in the 1970s, public access to the World Wide Web in 1991, the founding of Google (1998), the launches of Wikipedia (2001), Facebook (2004), YouTube (2005), and Twitter (2006), and the popularizing of mobile applications starting 2007 (see [Graham & Dutton, 2014](#); [Leiner et al., 2012](#)).

This thesis makes several contributions at the intersections of Internet studies¹ with media adoption and use, media effects, media sociology, and comparative methods. It relies on a broad definition

¹ Following [Dutton \(2013\)](#), the field of Internet studies is broad in scope and difficult to define given rapid technological change and its interdisciplinary nature. Still, there is common ground in the objects of study, that is, what Internet studies seek to explain: technological design and development, patterns of use and non-use in various contexts, and policies in areas such as privacy and Internet governance. Key journals in this field are *New Media & Society* and *Information, Communication & Society* (see [Dutton, 2013](#)).

1. Introduction

of the Internet as a communication infrastructure of related social and technical innovations ([Sandvig, 2013](#)) and derives conclusions beyond currently popular devices or services. The articles below are part of the third age of Internet studies, which theorizes and empirically analyzes the links between society and the Internet, going beyond the dataless euphoria of the first and the merely descriptive documentation of the second age ([Wellman, 2004](#)).

2. Theoretical Perspectives for Digital Inequality Research

This chapter introduces the central theoretical concepts and perspectives of this thesis. Although the individual articles introduce their theoretical frameworks separately, a broader perspective and overview is offered here. The work overall is positioned in the tradition of communication science as an international social science field of study that integrates mass and interpersonal communication with an emphasis on quantitative methods (see [Rogers, 2001](#)).

2.1. Digital Divides and Inequality

Social inequalities are differences in valuable goods at one's disposal. The definition of what is valuable and how individuals achieve positions that are connected to valuable assets is a social process of stratification. Social inequality concerns the systematic distribution of valued and scarce goods across social positions; it does *not* directly concern personal, random, natural, or momentary differences. [Grusky \(2007\)](#) compiles several asset groups, such as economic, power, cultural, social, civil, and health, each of which has different subtypes. For example, a cultural asset type is knowledge, unequally distributed between the highly educated and the less-well educated or uneducated. The right to work is a type of civil asset; the advantaged are citizens, the disadvantaged illegal immigrants ([Grusky, 2007](#)). Valuable assets can also be described as capital, and [Bourdieu \(1986\)](#) prominently broadened the use of this term beyond its economic definition as assets directly convertible into money to also include social and cultural forms. Cultural capital may be institutionalized in the form of educational attainment and social capital essentially consists of connections to others ([Bourdieu, 1986](#), p. 47).

2. Theoretical Perspectives for Digital Inequality Research

These forms of capital define an individual's social position.

The critical connection between social inequality and the digital divide is that social inequalities are the cause of skills and usage differentials, and Internet use influences the attainment of the above asset types, or forms of capital, that determine social position (see [Ragnedda & Muschert, 2015](#); [Stern, 2010](#)). A lack of resources in a societal field (e.g., economic or cultural) likely leads to disadvantages in the corresponding digital field ([Helsper, 2012](#)). However, mediators between the two spheres—for example, skills for the offline-to-digital link or the relevance of online experiences for the digital-to-offline link—mean that reinforcement of social inequality is not inevitable ([Helsper, 2012](#)). The social scientific relevance of technology diffusion more generally lies in the fact that technology is always socially constructed in terms of its adoption as an act of «domestication» (see [Haddon, 2007](#)) and in its invention and development by humans in social systems. And crucially, technology also influences society as it impacts «the terms in which social, political and economic relations are played out» ([Wajcman, 2002](#), p. 360). Focusing more specifically on the convergence processes in telecommunications, [Latzner \(2013\)](#) proposes a co-evolutionary perspective to resolve the contradictions of social and technological determinism. Technologies such as the Internet are therefore drivers and simultaneously the output of societal change ([Latzner, 2013](#); [Quan-Haase, 2016](#)).

Following [Hargittai & Hsieh \(2013\)](#), further Internet diffusion has two possible long-term effects for change in social inequality. Inequality would be reduced if people of lower social status used the Internet more in beneficial ways than those of higher status. If, on the other hand, those already in higher social positions use the Internet more in beneficial ways, then inequality increases ([Hargittai & Hsieh, 2013](#)). Social inequality is a constitutive object of study for sociology as a discipline ([Bornschier, 2008](#)) and since the particular case of digital inequality centrally concerns the use of ICTs, the combination with a communication science perspective is fitting and fruitful (see [Rice & Fuller, 2013](#)).

This thesis employs the term digital divide along with digital

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inequality despite the former's evident shortcomings. It has been rightly pointed out that «divide» implies a false dichotomy, focuses mainly on access, and promotes a technologically deterministic perspective (e.g., Warschauer, 2004; van Dijk, 2005; DiMaggio & Hargittai, 2001). Nevertheless, the term has persistently proven popular and «digital divide» now refers to a field of research that analyzes the inequalities in access to the Internet, but also its uses and effects (also see *Introduction*). As a consequence, digital divide studies need to clearly states which working definition of the term is used. For example, in [Article II](#), the term is qualified with the addition of «second-level» and thus concerns Internet uses. Furthermore, «divide» is here interpreted as gradual differences which acknowledges that access, uses, or effects exist on a continuum.

The introduction presented the example of a divide in online information seeking and its dependence on education. This is essentially a variant of the seminal knowledge gap hypothesis. [Tichenor, Donohue, & Olien \(1970\)](#) hypothesized that higher socioeconomic status as marked most prominently by education is positively associated with the ability to absorb the increasing flow of information from mass media. As a consequence, in social systems where the amount of information is rapidly expanding, the *relative* differences in knowledge among socioeconomic groups tend to increase. The implication for the information age is clear: The rise of the Internet and the communicative spaces it enables, most prominently the Web, provide an abundance of digital, hyperlinked, public content that, as an unintended consequence, appears to be increasing inequality and social exclusion (see [Castells, 1997](#)).

Empirical work on Internet use from this perspective has revealed inequalities in access, usage, and skills based on education (for early results on differentiated Internet use in Switzerland, see [Bonfadelli, 2002](#)). Compared to the dominant media at the time the knowledge gap hypothesis was developed, the Internet as a technically open and multi-purpose infrastructure requires a more active user who selects from the nearly endless variety of possible online activities. This property of the Internet means that knowledge gaps

2. Theoretical Perspectives for Digital Inequality Research

may further increase because informational use of the Internet is even more strongly dependent on socioeconomic status than mere access (Wei & Hindman, 2011). Furthermore, given the nature of technological development, mastering digital skills is a moving target. What was once considered an advanced skill may now be a matter of course or obsolete. Building up digital expertise is an experiential process involving formal and informal learning, so the new and unskilled Internet user is unlikely to «catch up». If traditional socioeconomic disadvantages kept an individual from going online early on (first level) and the additional skills gap leads to ineffective use (second level), then the inequality of benefits in the form of positive online and offline outcomes of use (third level) is compounded and exacerbated.

The core mechanism of digital inequality can be expressed as follows. With relative immobility, individuals occupy different social positions that are matched to unequal valuable resources (Grusky, 2007). Attaining high-quality Internet access, autonomy of use, or support in developing digital skills depend on existing resources (see DiMaggio, Hargittai, Celeste, & Shafer, 2004). The initial differential circumstances produce unequal returns, and consequently, the types of uses that are achievable along with their beneficial outcomes lead to inequalities in life chances (Hargittai, 2008).

2.2. The Internet in Everyday Life

Why is the socioeconomic stratification of Internet use a relevant issue for social science research? The Internet is an important means to access the primary resource in the information or network society, that is, information. Societal participation and inclusion therefore necessitate Internet access, skills, and use (Witte & Mannon, 2010). The greater relevance of this thesis is thus derived from the circumstance that exclusion violates social justice norms by producing unequal opportunity and hindering effective political participation (Barry, 1998). Even if access were universal, the latter two requirements, skills and use, remain. And particularly in countries where

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diffusion is approaching saturation, social communication processes are increasingly mediated by the Internet. The Internet has become an essential part of everyday life. In fact, this exact statement is the example sentence that the Linguee online dictionary returns when querying «everyday life».¹ On a general level, ICTs have had a tethering effect by connecting individuals to devices, to others, and to usage time; and simultaneously un-tethering users from face-to-face communication and place (Schroeder, 2007; Schroeder & Ling, 2014). Schroeder & Ling (2014) draw from the sociology of Emile Durkheim to reach the conclusion that the social expectation that everyone owns and effectively uses new media technologies is increasingly universal and embedded into everyday life, leaving the digitally disengaged without viable alternatives for participation. Internet diffusion has produced network externalities—the usefulness of Internet use has increased with each new adopter to the point where it has become not just useful but necessary. The number of people excluded on the level of basic access is continually decreasing, but the remaining offline population is at an increasing disadvantage (also see Helsper & Reisdorf, 2016).

Some information is exclusively available online and certain activities are now done much more efficiently online. Virtually all domains of everyday life are affected; whether it concerns seeking political information, paying bills, buying clothes, consuming music and movies, talking to friends, or on-the-job communication, those without Internet expertise are at least partially excluded. Given that key functions of society are increasingly organized around the Internet, reduction of inequality depends crucially on skills and effective use (see Castells, 2002). Altogether, this shows how Internet use has become pervasive and crucial in modern societies. And while this routinization means that the specific affordances and constraints of this technology will be increasingly taken for granted by users, the structuring effect remains. According to van Dijk (2013a), contemporary *information* societies not only depend on information as their

¹ <http://www.linguee.com/english-german/search?query=everyday+life>

2. Theoretical Perspectives for Digital Inequality Research

central substance but are additionally characterized by the social and media networks that shape its vital structures. The increasing merging of social networks and media networks can create structural inequality (van Dijk, 2013a). Exclusion from and a lack of connectivity on the Internet means fewer connections in social networks and vice versa. Both of these networks provide access to valuable resources that increase life chances (also see Wellman, 2001). Van Alstyne & Brynjolfsson (1995) offer an economic explanation for this reinforcement mechanism. Information as a non-rival good can be shared without loss, which would support equalizing effects. However, individuals cannot communicate with everyone at once, have different pre-existing private information, and can create new information in proportion to how much they already know. Under these assumptions, individuals will try to focus their limited attention on those that have valuable information, but these target nodes will only accept connections with those offering different valuable information in exchange. Over time, mainly because not all information is public even if everyone has access to the network, this produces an information elite (van Alstyne & Brynjolfsson, 1995).

2.3. Internet Use and Social Position

Taking a relational view that recognizes both individuals' capacity to make choices as well as the importance of social structure, Pierre Bourdieu in particular offers a useful lens to analyze Internet use. Social theory of this kind aims to explain why and how people act by considering their social position and the connected opportunities and constraints. Internet use as a form of action is therefore also explainable by social position. Social structure is internalized through socialization and constitutes a set of relatively stable dispositions for actions. While this *habitus* does not exact one specific action in any given situation, it does determine how individuals interpret situations and «grasp» their reality. Because individual actions affect others, the habitus is not only an internalization of structure but also produces it.

2. Theoretical Perspectives for Digital Inequality Research

For the purposes of this thesis, the concept of habitus helps in understanding how even highly individualized attributes such as tastes and preferences relate to the social structure and conditions in which Internet users were socialized and live their everyday lives.² This perspective counters the «individual-blame bias» (Rogers, 2003, p. 118) inherent to diffusion research where the change agencies that promote innovations, rather than the potential adopters, define the social problem. Digital divide studies, as well as close adherents to the uses and gratifications paradigm, have shown a tendency to attribute the lack of online participation or other generally beneficial uses mainly to a lack of individual motivation rather than system-level deficits (see Duff, 2011; Viswanath & Finnegan, 1996). For instance, voicing one's opinion on a political issue in a Facebook group may require certain Internet skills and an interest in politics. Individuals with higher levels of skills and interest are thus more likely to contribute to this Facebook group. But Bourdieu's analytical framework also points to the circumstance that participating in online political discussion may not even be part of the habitus as a typical shared reality of low-skill users, for example poorly educated older adults, to participate in online political discussion. It is not so much a lack of skills or interest *per se* that prevents participation but a social reality that does not produce a materializing need

² Interpreted in this way, the concept of habitus is made useful for digital inequality research. Bourdieu's definition of the central concept in his social theory is, however, rather difficult to disentangle:

The structures constitutive of a particular type of environment (e.g., the material conditions of existence characteristic of a class condition) produce habitus, systems of durable, transposable dispositions, structured structures predisposed to function as structuring structures, that is, as principles of the generation and structuring of practices and representations which can be objectively 'regulated' and 'regular' without in any way being the product of obedience to rules, objectively adapted to their goals without presupposing a conscious aiming at ends or an express mastery of the operations necessary to attain them and, being all this, collectively orchestrated without being the product of the orchestrating action of a conductor (Bourdieu, 1977, 72).

2. Theoretical Perspectives for Digital Inequality Research

to participate. This perspective therefore highlights that although individual-level variables such as skills or interest are key, they are influenced by the social structure, that is, the arrangement of social positions. Status differentials connected to the social positions are attained (education, occupation, or income) as well as ascribed (gender, age, or nationality); and primarily inherited (Falcon, 2013).

The intricate relationship between structure and agency outlined above shows that explanations of the mechanisms that exacerbate digital inequality need to take into account both—structural conditions and individual choice. For example, social status constrains and permits action; individual actions are the constituents of structure, yet they cannot be aggregated in a merely additive way. Structure has emergent properties and from the perspective of the individual at any certain time point, these are relatively fixed. However, individuals with very similar backgrounds and living conditions may still vary widely in their practical use of the Internet; *choice* based on personal motivations and interests comes into play. The degree to which even these personal variables should also be treated as a result of social structure is an ongoing meta-debate in the social sciences. Markers of social status such as income and education have been widely shown to affect Internet adoption and use. Those of higher social status are more likely to have access to and effectively use the Internet (see Robinson et al., 2015; Witte & Mannon, 2010).

Digital inequality is a property of the social system, the macro level, yet its explication as an emergent outcome of individual usage patterns requires theoretical and empirical analysis at the micro level. Consequently, Internet diffusion as another macro property does not directly lead to digital inequalities; individual's actions need to be accounted for and aggregated (see Zillien, 2009). This explanatory sociological approach (Coleman, 1990) proposes that existing factors like education, interests, or social ties determine how individuals construe new technologies like the Internet (Zillien, 2009) and how they integrate them into their everyday lives. This situational mechanism reflects the opportunities and constraints for the individual as imposed by the social structure. Based on the interpre-

2. Theoretical Perspectives for Digital Inequality Research

tation of the situation, individuals then select particular actions.³ As [Article II](#), [Article III](#), and [Article IV](#) explicitly indicate, the way the Internet is interpreted and subsequently used depends on socioeconomic resources. The theory of action assumed in this thesis is based on the uses and gratifications paradigm (see [Article II](#) in particular; [Katz, Blumler, & Gurevitch, 1973a](#)), but also questions the active and rational role of the user that this approach implies (see [Ruggiero, 2000](#)).

³ This action formation mechanism of *how* individuals select actions, the micro–micro link, has been fiercely debated—perhaps the most prominent theory of action is *rational choice*. However, as [Esser \(1992\)](#) notes, for sociological analysis the psychological process of action selection is of only secondary importance because the theoretical interest lies more in the logic of aggregation.

3. World Internet Project – Preliminary Empirical Analysis

[Article II](#), [Article III](#), and [Article IV](#) employ survey data from the World Internet Project (WIP) to address their research questions¹ (see [Table 1](#)). This chapter contextualizes these articles with descriptive analyses and a general overview of Internet use in Switzerland.

The WIP is an international, collaborative research project that originated in 1999 at the University of California, Los Angeles and today consists of a network of more than 30 country partners who investigate the social, political, and economic impact of the Internet and related technologies ([WIP, 2016](#)). The empirical basis of the project's activities are national surveys on Internet use and attitudes, independently conducted by the partners. At their core, these surveys have a set of common questions that are agreed upon at annual WIP conferences.

The Media Change & Innovation Division at the Institute of Mass Communication and Media Research, University of Zurich is the Swiss country partner in the WIP (WIP-CH) and has conducted three nationally representative surveys—in 2011 (see [Latzer, Just, Metreveli, & Saurwein, 2012](#)), 2013 (see [Latzer, Just, Metreveli, & Saurwein, 2013](#)), and 2015 (see [Latzer, Büchi, & Just, 2015c](#)). The surveys used computer-assisted telephone Interviews, which also made it possible to interview non-users about their attitudes towards the Internet. Sampling quota were constructed based on age, gender, region, and employment status, to achieve nationally representative samples.

In 2015, the sampling procedure was improved to include mobile phones because the number of households without landline phones

¹ [Article I](#) also relies on World Internet Project data for illustrative purposes, but the focus is more methodological than substantive.

3. World Internet Project – Preliminary Empirical Analysis

is increasing (see [Arcos, del Mar Rueda, Trujillo, & Molina, 2014](#); [Hunsicker & Schroth, 2014](#)). With sample sizes of approximately 1100 in each of the three years, the maximum confidence interval was $\pm 2.95\%$ at the 95% confidence level. A survey research institute conducted the interviews in all three major Swiss languages, German, French, and Italian. Between 2011 and 2015, the percentage of people using the Internet in Switzerland increased from 77% to 88% (see [Appendix A](#) for an overview of the WIP–CH questionnaire).²

One of the major trends has been the rapid diffusion of *mobile* Internet use. While general access in Switzerland is approaching saturation (see [Figure 1](#)), according to the WIP–CH data the Internet was used «on the go»³ by 20% in 2011, 39% in 2013, and 63% in 2015. Within five years the figure had thus tripled—the diffusion of mobile Internet is in a phase where the cumulative distribution function is steeply sloping and the majority is adopting this technology, akin to fixed Internet around the year 2000. This means that the Internet is even more enmeshed in the daily lives of users. As anytime/anywhere use is becoming the norm, information and communication are constantly at one’s fingertips.

The WIP–CH 2015 shows that Switzerland is among the most highly connected countries—but Internet penetration of 88% also means that 12% are offline. Among adults aged 70 or over, one in two does not use the Internet, while 40% of non-users have asked others to do something like look up information or make a reservation for them online ([Latzer et al., 2015c](#)). There remain several first-level digital divides, that is, social stratification in access: women are nine points behind men, and low income, unemployment, and lower edu-

² This definition of «access» goes beyond the mere opportunity to go online; respondents were asked if they currently used the Internet in any form.

The World Bank Data in [Figure 1](#) indicates 87% Swiss Internet users in 2014, confirming the WIP–CH figures of 85% in 2013 and 88% in 2015.

³ The German survey question that measured mobile Internet use was «*Nutzen Sie das Internet auch unterwegs über mobile Geräte, zum Beispiel einem Mobiltelefon?*», which was deliberately not constrained to a single device or a mobile data plan but covered all types of en route use while excluding home-only use of a mobile device.

3. World Internet Project – Preliminary Empirical Analysis

cation are still associated with lower levels of access (Latzer et al., 2015c). Accordingly, many do not even have the basic opportunity to participate in various online activities. The WIP–CH 2015 also revealed that among the offline population, 20% felt they were missing out and 16% would like to use the Internet. Half of non-users, compared to only 12% of users, indicated that they did not feel included in the information society (Latzer et al., 2015c).

These data on Swiss Internet users also appear to confirm the privacy paradox (see Article III; Kokolakis, 2015). The concerns about companies and government violating one’s privacy showed zero correlation with personal online privacy protection (see Latzer, Büchi, & Just, 2015d). Self-help protection, for example by requesting the erasure of personal information, has risen since 2011 while the statement that the government should increase Internet regulation was only supported by 24% (Latzer et al., 2015d). Latzer, Büchi, & Just (2015b) further analyzed the connections between the Internet and politics. Seeking political information online has increased since 2011 and 42% agreed that the Internet can help them better understand political processes. Statements on other forms of digital democratization, for example that the Internet increases users’ participatory power, were less supported.

In terms of time spent online, there has been a considerable increase. Although self-reported time estimates are prone to biases, the trend is clear: since 2011 time spent using the Internet has doubled and reached 22.3 hours per week in 2015. Among Internet users, email communication is used by virtually everyone (98%), followed by information seeking activities like using search engines (98%), visiting online encyclopedias (86%), looking up word definitions (86%), or searching for news (85%) (Latzer, Büchi, & Just, 2015a). These most-used functions highlight the indispensability of the Internet for basic access to communication and information. In fact, the importance of the Internet for overall information acquisition has surpassed traditional newspapers, radio, and television in Switzerland (Latzer et al., 2015d).

The activities within the WIP, the descriptive analyses of the

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WIP–CH data, and the theoretical work on the social antecedents and effects of Internet use lead to research questions regarding digital inequalities that were addressed in the articles in this thesis and are further described in the following chapters. The common point of departure of these articles is a society where the vast majority of the population can be considered Internet users in at least a basic form. While continued research on offline populations remains important (see e.g., [Helsper & Reisdorf, 2016](#)), the principal question of this thesis is thus not if but *how* individuals use the Internet—and ultimately with what effects.

4. A Note on Methods

Overall, this thesis takes a quantitative empirical approach as it considers large-scale survey data with standardized measures and, in the case of [Article V](#), thousands of text documents and network nodes. [Article I](#), [Article II](#), [Article III](#), and [Article IV](#) rely on structural equation modeling (SEM) statistical techniques (see [Jöreskog, 1969](#)). This method is computationally relatively demanding and consequently its applied uses in social research are comparably recent. The exact model specifications on the level of equations and the details of the parameter estimations through fitting an empirical covariance matrix to the model-implied structure may be complex. However, the basic translation of a theoretical model in the sense of hypotheses about how different variables relate to each other is fairly straightforward in SEM.

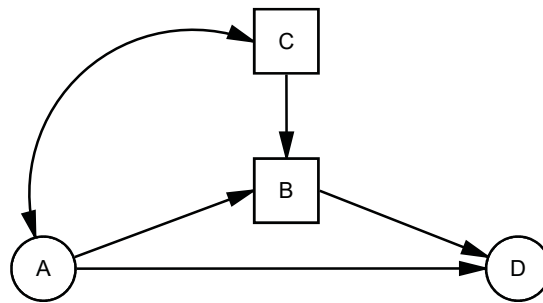


Figure 2: Example structural equation model. A and D are latent variables measured by manifest indicator variables (not shown); C and B are manifest (observed) variables. A and C are exogenous variables; B and D are endogenous variables. This is an example of a partial mediation model with the addition of C as a predictor for B.

Suppose it is hypothesized that A predicts B and D, B predicts D, C predicts B, and A and C are correlated (see [Figure 2](#)). These are assumptions about a network of variables and the nature of their

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links that can be translated into a single statistically testable model, even if some or all variables are latent. SEM combines confirmatory factor analysis, regression analysis, path modeling, and multi-group analysis (see [Article I](#)) into a single framework (and can also include multi-level and growth curve models, but these were not employed in this thesis).

Without SEM, the testing of the theoretical model in [Figure 2](#) would for example entail (a) the evaluation of the internal consistency of A and D through Cronbach's α (for a critique of this measure, see [Sijtsma, 2009](#)), (b) the calculation of mean scores for A and D which does not account for the effects of item measurement errors on structural relationships, and (c) running a sequence of regressions ($B = \beta_0 + \beta_1 A + \beta_2 C + \epsilon$ and $D = \beta_0 + \beta_1 A + \beta_2 B + \epsilon$) that does not control for all dependencies. SEM provides a generalized regression-based framework with solutions to these statistical issues by making it possible to *simultaneously* estimate multiple direct and indirect effects, test and include latent variables, and explicitly model measurement errors (see [Brown, 2015](#); [Kline, 2015](#)). In the syntax of the lavaan package ([Rosseel, 2012](#)) for the R software environment, the generic model in [Figure 2](#) would be specified as:

```
1 model <- '  
2     A =~ x1 + x2 + x3  
3     D =~ x4 + x5 + x6  
4     B ~ A + C  
5     D ~ A + B  
6     A ~~ C  
7 '
```

The above code assumes a three-item measurement for A and D. Paths that are not specified, such as between C and D, are implied to be zero. The model can then be fit, where options such as the estimator (e.g., maximum likelihood) are defined.

As [Steinmetz \(2015\)](#) argues, there has been a trend towards overcautiousness in causally interpreting structural equation models. However, the theoretical basis of SEM is causal, and accordingly,

good global fit measures (see Schermelleh-Engel, Moosbrugger, & Müller, 2003) and significant coefficients in the expected directions support the specified causal model (even if they cannot *prove* causality). Importantly, «[d]irection in the directed network models of SEM arises from presumed cause–effect assumptions made about reality» (Westland, 2015, p. 2). As such, this flexible and powerful statistical technique was chosen to address the multiple relationships between Internet uses and its predictors.

Article V relies on text mining (see Grimmer & Stewart, 2013) and network analysis (see Easley & Kleinberg, 2010). While the algorithms at the heart of these techniques, for example latent Dirichlet allocation or centrality calculation, are computational processes that use large data sets, much of the interpretation is in fact of a qualitative nature. This is due to the generative and exploratory approach (whereas SEM is mainly confirmatory), meaning that context information is crucial to make sense of the results. For instance, topic modeling discovers the latent topics in a collection of text documents, usually with a high level of interpretability (DiMaggio, Nag, & Blei, 2013), that need to be connected to the context of the texts' creation—Article V refers to this as domain knowledge. Similarly, network analysis can reveal the central nodes, but it is still the researcher's task to characterize the actors (e.g., in Article V as institutional vs. individual) and to describe why a given node is in its particular position.

The application of methods such as text mining and network analysis can be seen as part of a larger development in communication research and related fields where computing intersects with other disciplines (the most notable example being digital humanities [see Berry, 2011]). Neither content analysis nor social network analysis are new, but the Internet, in particular search engines and social media, has made vast amounts of previously unavailable or unrecorded data in principle accessible to social researchers: «The era of Big Data is underway» (boyd & Crawford, 2012, p. 663). Big data has, however, created a new data divide. boyd & Crawford (2012) note that full access is reserved for the platform owners like Facebook

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and Twitter. Their terms and conditions restrict content collection and transactional data is rarely shared. Aside from the ethical challenges of social data collection, this also means that there is a bias in the kinds of questions that are asked because few have the skills to analyze big data (boyd & Crawford, 2012).

The Internet not only produces data because users leave traces, it also offers an infrastructure that is harnessed for survey research (see Fricker, Galesic, Tourangeau, & Yan, 2005). Web-based surveys, however, are also affected by digital inequalities. The key challenge is representativeness: differences in broadband connectivity, skills, and social media use are associated with participation rates (Robinson et al., 2015). Particularly country-level surveys benefit from the established and sophisticated sampling procedures in computer-assisted telephone interviewing (see *World Internet Project – Preliminary Empirical Analysis*). Traditional survey-based analysis remains fundamental for digital inequality research and new digital methods face myriad challenges, but they nonetheless promise valuable complementary insights and are likely to be used more frequently in future studies.

5. Comparing Second-Level Digital Divides¹

The first focus of the articles in this thesis is on general Internet use inequalities ([Article I](#) and [Article II](#)). How is Internet use structured along socioeconomic and demographic indicators and what are appropriate methods to analyze second-level digital divides? How can «use» be conceptualized and subsequently measured? How can such models be used in cross-country research?

The diffusion of the Internet in different countries (see [Figure 1](#)) shows large differences by wealth (e.g., [Andrés, Cuberes, Diouf, & Serebrisky, 2010](#)), but sociocultural resources like generalized trust also influence its adoption ([Bornschier, 2001](#)). Such differences in diffusion rates across countries or regions, either descriptive or explained by other macro-level variables, are *global* digital divides. Differences within societies accordingly describe *social* digital divides. In low-diffusion countries, Internet users are usually a socioeconomic elite; for countries with very high diffusion the Internet user base is converging with the population as a whole, but the question then is what kinds of social divides still persist (see [Chen & Wellman, 2004](#))—mainly on the second and third level of digital inequality.

[Article I](#) makes a methodological contribution towards bridging research on global divides and social divides (see [Table 1](#)). The within-country social structuration of use is key, but at the same time digital inequality research is interested in drawing comparisons with other countries and in explaining the resulting similarities and differences. To this end, [Article I](#) adapts the general multi-group SEM framework

¹ Key literature in [Article I](#): [Steenkamp & Baumgartner \(1998\)](#); [Helsper & Gerber \(2012\)](#); [Davidov, Meuleman, Ciecuch, Schmidt, & Billiet \(2014\)](#); [Hasebrink \(2012\)](#).

Key literature in [Article II](#): [van Deursen & van Dijk \(2014\)](#); [Katz, Haas, & Gurevitch \(1973b\)](#); [Helsper & Gerber \(2012\)](#); [Witte & Mannon \(2010\)](#); [Zillien & Hargittai \(2009\)](#).

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to Internet use research. Basically, second-level digital divide studies link socioeconomic characteristics with Internet use variables. If the effect of the former on the latter is to be meaningfully compared across countries, it is crucial that the measures are equivalent. This requirements is statistically assessed through measurement invariance testing.

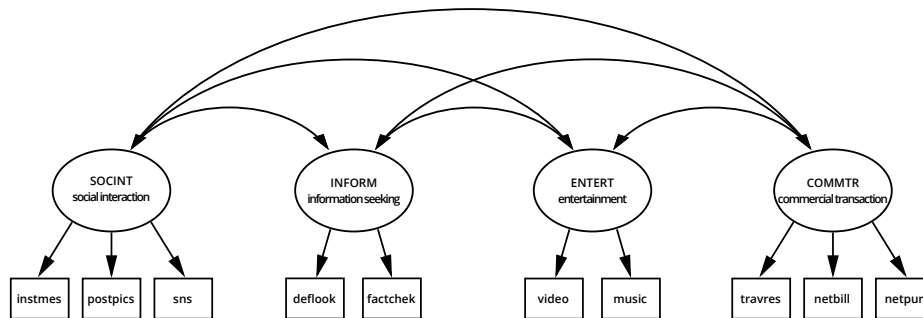


Figure 3: Measurement model of four core Internet usage types. Adapted from Büchi et al. (2016b) and Büchi (2016b). See Büchi et al. (2016b, p. 2711) for item descriptions.

Dimensions of Internet use such as types of use, skills, or privacy behavior are best measured by multiple indicators. The concept is that each indicator reflects an underlying latent factor. For example, looking up a definition on the Internet is one manifestation of the information-seeking usage type; checking a fact online is another (see Figure 3). This a priori proposition, that is, that these activities are valid indicators of informational use, needs to be empirically confirmed by salient factor loadings (Brown, 2015). Once the predictors for information seeking are added to the model, comparing their effects cross-nationally implies that information seeking does in fact mean the same in the compared countries.² Each indicator's loading therefore needs to be statistically invariant across countries for the meaningful comparison of structural relationships (Steenkamp & Baumgartner, 1998).

² Essentially, the country variable acts as a categorical moderator on the hypothesized relationships specified in the structural model. The concept of measurement invariance can be applied to comparative research with any other meaningful grouping variable.

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After detailing the concept of measurement invariance, [Article I](#) applies this to a second-level digital divide model where Internet experience and age predict four Internet usage types using WIP survey data from Switzerland, Sweden, the United States, the United Kingdom, and New Zealand. Equivalence of factor loadings is supported only for a subset of these countries. In three of the five countries the latent variables to be explained (usage types) indicate invariant measurement, so the age and experience effects are comparable. Age has strong negative effects, for example on social interaction use, indicating that younger Internet users engage in communicative online activities more frequently. Years of Internet experience, a direct consequence of first-level divides, are positively associated with use of the Internet for information seeking and transactional purposes in particular. This is the general pattern across the three countries considered in the structural model. The mere fact that there is a general pattern strengthens the finding of digital inequalities according to age and experience. Essentially, each additional country sample can be considered a replication study. At the same time, however, the model can also reveal and statistically test the significance of effect differences. For instance, the effect of age on information seeking is significant and negative in both the United States and the United Kingdom, but significantly less strong in the United Kingdom which is also shown in [Article II](#). Findings of this sort could then lead to wider conclusions regarding second-level digital divides. In countries where the amount of variance in Internet use that is explained by socioeconomic variables is comparably low, digital inequalities are less pronounced.

Together with the findings of [Article II](#) this conceptual and methodological approach could be extended to a larger number of countries or points in time. This would entail considerable variance in the Internet diffusion rate and thus statements about the dynamics between the first-level and second-level digital divide could be made. However, such a comprehensive research design would also decrease the likelihood of satisfying equivalence requirements (see [Helsper & Gerber, 2012](#)).

5. Comparing Second-Level Digital Divides

[Article II](#) is a substantive study on the second-level digital divides in the above-mentioned countries and relies on the statistical methods of [Article I](#) to map out sociodemographic differences in Internet use (see [Table 1](#)). A vital step here is the operationalization of Internet use. For what purposes do people actually use the Internet in their daily lives? At the level of individual applications or services, the variety is nearly endless. However, as [Article II](#) argues on the basis of the uses and gratifications theory, these activities reflect an underlying purpose or type of use. The core usage types developed are social interaction, information seeking, entertainment, and commercial transaction (see [Figure 3](#)). These general purposes remain stable relative to the constantly evolving individual activities, making cross-country and repeated cross-sectional analysis possible.

Studies of Internet usage divides in high-diffusion countries have shown that demographic and socioeconomic variables significantly influence for what purposes and how intensively the Internet is used (e.g., [Brandtzæg, Heim, & Karahasanović, 2011](#); [van Deursen & van Dijk, 2014](#)). One of the main results of [Article II](#) is the strong negative effect of age across all five countries. This does not mean that older adults do not use the core functionalities of the Internet ([Quan-Haase, Martin, & Schreurs, 2016](#)), but younger age is associated in particular with higher intensity of use of social interaction and entertainment. Information seeking also depends on age, and additionally on higher education and Internet experience. Commercial transaction is comparably less strongly predicted by age. It is plausible that the effect is not linear: Such advanced uses may increase slightly with age at first and then quickly decrease, producing a moderate negative linear regression coefficient. Education, and particularly Internet experience, are the key promoters of commercial transaction use. Sociodemographic variables alone explain about one third of the variation in the four usage types, which suggests pronounced structural digital inequalities and not just user differentiation according to their preferences.

The comparative perspective shows that patterns of digital inequality are similar but not the same in the five high-diffusion coun-

tries considered. From this limited sample of five countries—only three of which then demonstrated equivalence of factor loadings—it can be speculated that a smaller first-level divide, that is, a shrinking percentage of non-users, corresponds with larger second-level digital divides. On the relationship between the two predictors age and experience, [Article II](#) notes that «[t]he direct effects of experience are interesting since older people generally use the Internet less, yet experienced users do so more. Age and Internet experience are in turn positively correlated, as only older users could have gained a lot of Internet experience» ([Büchi et al., 2016b](#), p. 2716). This opposing trend appears again in [Article IV](#) and hints at the link between the first-level and the second-level digital divide. Even if the effect of experience levels off as Internet use becomes even more enmeshed in everyday life, Internet skills will likely take its place in determining advanced uses, and the contribution of education to skills appears to be relatively stable.

[Article II](#) developed a four-factor model of Internet use general enough to be applicable across countries and time, but specific enough to analyze different types that cover the core purposes of Internet use. Further research can build on this model to test second-level digital divides in other regions with different Internet diffusion trajectories (e.g., [Dodel, Büchi, & Menese, 2016](#)). [Article I](#) and [Article II](#) have stressed the importance of measurement invariance testing even for research projects such as the WIP where a comparative aim was implemented from the beginning.

This work on the general second-level digital divide has also raised the question of what other factors, besides sociodemographic variables and Internet experience, determine usage patterns. In cross-country research, macro-level variables like cultural value orientations ([Gong, Li, & Stump, 2007](#)), economic inequality and performance ([Zhang, 2013](#)), broadband infrastructure, or media system characteristics may prove relevant. For example, is informational Internet use in a country with a strong public service broadcaster lower (suppression mechanism) or higher (stimulation mechanism) than in one dominated by private broadcasters? Inclusion of further

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macro-level variables could lead to valuable results in studies with a larger number of countries using statistical multilevel models. It also remains to be empirically tested whether the hypothesis of increasing second-level digital divides developed in [Article II](#) holds. And most importantly, the consequences of the detected usage differences for social integration, life chances, and well-being need to be explored. Social differentials in the general core usage types are indicative of divides in individuals' everyday online activities, yet there are many more specific online behaviors potentially affected by digital inequalities.

Table 1: Article contributions.

Article	Focus	Research Question	Main Contributions
I	Comparing second-level digital divides: Methodology	How can different Internet uses be measured and meaningfully compared across countries?	Detailing of statistical procedures for ex post multi-group invariance testing; adaptation of these general procedures to applied cross-country Internet use research; development of recommendations for valid cross-country Internet use research
II	Comparing second-level digital divides: Concept and results	How are different uses of the Internet structured according to sociodemographic attributes in countries with high Internet penetration?	Adaptation and validation of an Internet uses typology; new multi-country evidence for distinct second-level digital divides according to age, education, and experience; support for the metric equivalence of the digital divide model for three English-speaking countries
III	Specific divides and their implications: Self-help privacy protection	What explains Internet users' varying levels of self-help privacy protection?	Generalized model for self-help privacy protection with regard to data and measures; attitudes on personal data are not strongly related to actual behavior; general Internet skills are key in enabling users to protect their privacy and benefit from their use
IV	Specific divides and their implications: Online political participation	How is online political participation structured according to sociodemographic attributes and Internet expertise?	Modeling political interest and Internet skills as mediators; general Internet skills and experience contribute significantly to explaining online political participation; support for reinforcement of democratic divides rather than mobilization
V	Specific divides and their implications: Microblogging science news	Does the microblogging platform Twitter activate new participants and perspectives in the public communication of science?	Novel methods to link old and new media and detect topic contextualizations; Twitter has a recommender role that functions "on top" of traditional sources; the network is dominated by traditional sources with conversational/community clusters at the periphery

6. Specific Divides and Their Implications

The previous chapter focused on rather general aspects of Internet use and a comparative perspective on its social structuration. This chapter examines three specific domains where digital divides can be found: privacy protection, political participation, and science communication (see [Table 1](#)).

6.1. Self-Help Privacy Protection¹

«Protecting our privacy and managing our online presentations of self are the kind of competencies that are becoming critical in the information age» ([Witte & Mannon, 2010](#), p. 152). It is clear that privacy breaches can have manifold negative consequences and the risks of experiencing privacy violations are not equally distributed. This type of inequality has been somewhat neglected in digital divide research. In recent years, however, there have been studies that explicitly connect online privacy with digital inequality, most notably by Yong Jin Park ([Park, 2013, 2015](#); [Park & Jang, 2015](#)).

Within the framework of this thesis, online privacy behavior is part of the second level of usage. However, as shown in [Article III](#), privacy protection is also a consequence of other second-level digital divides, because Internet skills determine protective actions. Self-help privacy protection measures are much more likely to be adopted by experienced and skilled users. «Not being able to put the Internet to effective and beneficial use may further the digital exclusion of certain social groups» ([Büchi et al., 2016a](#), p. 3). Some of the barriers to effective use are related to privacy: Individuals who are very concerned about privacy may abstain from Internet use altogether, and

¹ Key literature in [Article III](#): [Park \(2013\)](#); [Acquisti, Brandimarte, & Loewenstein \(2015\)](#); [Dienlin & Trepte \(2015\)](#); [Litt & Hargittai \(2014\)](#).

6. *Specific Divides and Their Implications*

those who lack the skills to counter privacy threats through self-help by blocking certain features or using fake data may not achieve beneficial outcomes and become increasingly disengaged. Unknowingly and voluntarily disclosed personal data can be used for discriminatory and surveillance practices by other users, businesses, and states, leading to personal disadvantages. Still, there is variation in the degree to which users even care who has access to their personal information (Büchi et al., 2016a, p. 10).

The idea of enabling individuals to control and selectively reveal personal information is certainly not new but its significance is growing in the information age. Since free online services are «paid for with data», and if public policies cannot ensure privacy, it is likely that some users will increasingly pay actual money for greater control over their online privacy (Rainie & Anderson, 2014). Expectations of privacy are, however, highly context-dependent and are based more on the social situation rather than the distinction between offline and online (see Nissenbaum, 2011). Savage & Waldman (2013) employ an experimental design to estimate the monetary value of online privacy in mobile app usage and find that the average consumer was willing to spend \$11 to conceal their browsing history, contacts, location, and text message contents, with more experienced users' valuation being higher. Given that users have little information about when and for what purposes their data is collected, rational decisions regarding privacy-related behavior are difficult to make (Acquisti, Taylor, & Wagman, 2016). An actual market for privacy would turn privacy into a luxury good rather than a basic right, sidelining structural explanations for low self-protection. Many social groups with higher privacy needs due to higher risks of discrimination would be further disadvantaged (Matzner, Masur, Ochs, & von Pape, 2016).

This background and the tendency to transfer responsibility for privacy protection to the user (see Matzner et al., 2016) creates a need to understand the individual factors that promote users to increase self-protective actions. The literature on the privacy paradox questions the link between privacy concerns and behavior, and the WIP-CH 2015 does in fact show that agreement with the statements

«I am concerned that governments [companies] are violating my privacy online» and «I am very vigilant about protecting my privacy online» are uncorrelated ($r = .01 [.03]$, $p = .66 [.39]$).

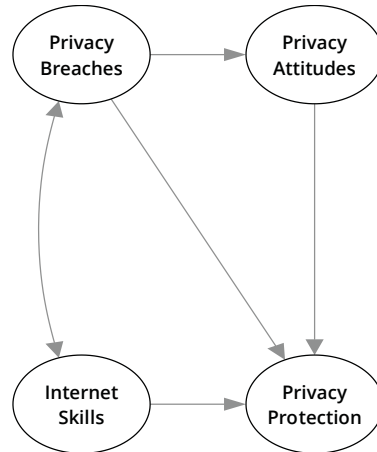


Figure 4: Online privacy model. Adapted from Büchi et al. (2016a).

Article III translates general social psychological predictors of human behavior—abilities, experiences, and attitudes—to the issue of online privacy protection. The theoretical model proposes that self-protective measures are most frequently employed by users who are highly skilled in overall Internet use, have experienced privacy violations first-hand, and place great importance on control over their personal information (see [Figure 4](#)). The study operationalizes *protection* as a multi-item factor with concrete activities as indicators, which is less prone to social desirability response bias than the protection statement above. The dimension of privacy concerned with users’ personal views focuses on *attitudes* towards personal information such as browsing history or contacts rather than on concerns. Having experienced privacy *breaches* functions as a predictor for both attitudes and protection. General Internet skills ([van Deursen, Helsper, & Eynon, 2015](#)) are added as a key variable of digital inequality research. It is assumed that the initial social position leads to skills differentials, and that these in turn structure online activities—self-help privacy protection being one important aspect that determines the benefits than can be achieved online.

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The main contribution of [Article III](#) lies in the novel combination of privacy attitudes, breaches, and protection with skills. It also increases the generalizability of previous research that has found a link between specific skills and protection as well as disclosure behaviors on Facebook by extending its scope to Internet use more generally and by analyzing representative data for a country other than the United States. There are three key findings. First, privacy attitudes are not the primary explanation for protective behavior. The effect, however, is still significant and positive. Second, there is a «learning the hard way» mechanism, meaning that experiencing privacy breaches promotes increased self-protection, also indirectly through attitudes. Third, general Internet skills are the strongest predictor of users' privacy protection measures. If age is included in this privacy model, it is revealed that older Internet users are less skilled and engage less in protective actions, making them particularly vulnerable. Given the essential role of Internet-based communication in everyday life, withdrawal from Internet use is not a viable alternative for most, making Internet skills a central asset in enabling users to mitigate the ubiquitous risk of privacy violations online and to selectively reveal and control personal information. In order to be effective, users' self-help efforts rely on accompanying collective and political efforts such as the strengthening of users' rights that take skills differentials into account ([Büchi et al., 2016a](#); [Matzner et al., 2016](#)).

6.2. Online Political Participation²

Feedback on [Article II](#) indicated that an important group of online activities—participatory use—was not explicitly covered in the four factors developed (social interaction, information seeking, entertainment, and commercial transaction). Research has shown that online participation in various forms is also affected by digital inequalities (e.g., [Hoffmann, Lutz, & Meckel, 2015](#); [Brake, 2014](#)). Consequently,

² Key literature in [Article IV](#): [Min \(2010\)](#); [De Marco, Robles, & Antino \(2014\)](#); [Theocharis, Van Deth, Obert, & Císař \(2016\)](#); [Krueger \(2002\)](#).

[Article IV](#) addresses online political participation as the prime example of this type of advanced use (see [De Marco et al., 2014](#)). If general Internet use can have a social integration function, then digital democratic participation as an evident way of taking part in the shaping of the political conditions has an even greater normative basis for equity of access and use (see [Lievrouw & Farb, 2005](#); [Duff, 2011](#)). Exercising basic citizen's rights will increasingly depend on information and organization by digital means ([Sparks, 2013](#)). Internet access, usage, and skills divides thus pose a threat to the democratic principle of equal opportunity to participate in political life.

The Internet, like other emerging ICTs in history, has continuously stirred up hopes for the flourishing of democracy. From the beginning, this has accordingly also been an important line of inquiry in digital divide research ([Sassi, 2005](#)). The basic question here is how online participation in public life and political processes is socially structured. Is the Internet a means for the disempowered to circumvent traditional barriers to participation, or do pre-existing resource differentials mean that actual use of the new communication tools will, as Pippa [Norris \(2001\)](#) puts it, «serve to reinforce the activism of the activists» (p. 238)? This tension between the mobilization hypothesis and the reinforcement hypothesis has dominated research on ICT effects and participatory divides. The literature review in [Article IV](#) reveals that there is empirical support for both in different contexts. According to the knowledge gap hypothesis ([Tichenor et al., 1970](#)), the role of education is key because it fosters literacy, communication skills, knowledge, and exposure to public affairs topics. These are essential resources for informed decision-making and political engagement, that is, fulfilling the normative role of democratic citizenship. [Wei & Hindman \(2011\)](#) assume a critical role of political knowledge for social power and inclusion, and find that differential Internet use is in fact more status-dependent than traditional media use. The social consequence is an increase in political knowledge gaps.

[Article IV](#) tests the existence and properties of socially structured

6. Specific Divides and Their Implications

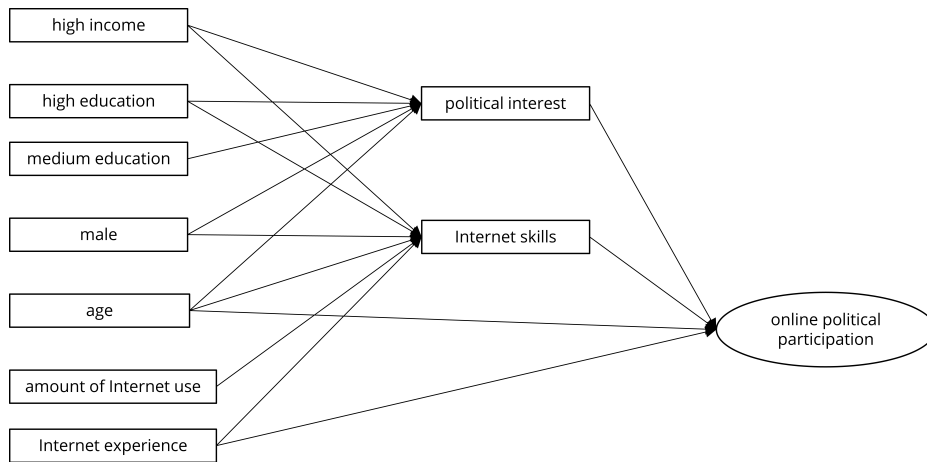


Figure 5: Explaining online political participation. Adapted from Büchi & Vogler (2016).

political participation differentials, or the «democratic divide» (Min, 2010). Its research design is unique in that it employs both political interest and Internet skills as mediators between social position and online political participation (see Figure 5). Following the theoretical perspective developed above (see *Internet Use and Social Position*), it thus assumes that while specific Internet uses can indeed be explained by users' interests and skills, these are themselves unequally distributed in ways that are better explained by social structure than individual choice.

In line with previous findings, Article IV first shows that only a small percentage of Swiss Internet users are digital political participants. Results of a cluster analysis reveal that those who do engage online by seeking political information, participating in discussions, protesting, or producing content are highly interested, have higher levels of education and income, possess high Internet skills, and are more likely to be older and male. SEM further tested the role of social position, Internet expertise variables, and political interest for online political participation across two waves of the WIP-CH survey (2011 and 2013). This repeated cross-sectional model was also subjected to invariance tests as developed in Article I: instead of grouping by country, metric invariance—and thus comparability of effects—was

supported for the two points in time.

The model shows that the variation in online political participation is to a great extent explained by political interest, Internet skills, and Internet experience ($R^2 = 43\%$; Büchi & Vogler [2016, p. 17]). The social position variables do not directly influence participation but explain the mediators, interest and skills. The strongest effects are found for education and age, with more highly educated and older users being more politically interested. Internet skills are higher for younger and more experienced users. The effect of higher education on skills is significant and positive but not very strong. In political science, a robust finding is that older adults participate more than younger people; Internet use research consistently finds that younger users are much more active online (e.g., Article II). Age thus plays an interesting role and the mechanism of its influence may be applicable to other second-level digital divide models. Younger Internet users are more skilled, but less interested, resulting in a marginal direct effect on online political participation.

In a different national context and ten years later, this study confirms the substantive findings of Min (2010), that is, the existence of a democratic divide where online political participation is associated with high political interest and Internet skills. It models and interprets the results from a digital inequality perspective and therefore further finds that social position influences political interest and Internet skills. Article IV argues that there may also be a feedback mechanism, as online political participation is likely to stimulate knowledge and interest, reinforcing the engagement of the engaged.

In conclusion, beneficial outcomes of political Internet use for society's least advantaged members will depend on education and skills development. Following Duff (2011), institutional reforms that address the real issue of unequal representation that go beyond specific fixes would need to address inequalities of information as the key resource for participation. Importantly, the «referent of distributive justice in postindustrial society» (Duff, 2011, p. 608) is not access to the infrastructure or the devices, but information itself— information that is increasingly created on and disseminated through the

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Internet, making Internet skills indispensable for social and political participation.

6.3. Microblogging Science News³

[Article IV](#) notes that «[t]he once clearly defined roles of elite senders—political actors and journalists—and the mass audience as receivers of political messages were challenged by the fundamental openness of the web» ([Büchi & Vogler, 2016](#), p. 3). The results show a clear democratic divide: online political participation depends on interest and skills, which were in turn socially structured. Analogously, in the domain of science communication, and this is the starting point for [Article V](#), traditional news sources and scientists themselves are confronted with the inputs of expert enthusiasts and the reactions of interested laypersons on social media platforms that are in principle open to anyone.

Microblogging on Twitter is one of many online modes of communication. «Tweets» are restricted to 140 characters per post and the service is used by a substantial but still small proportion of the population. In Switzerland, 17% of Internet users either read or write tweets ([Latzer et al., 2015a](#)). These are more skilled than the average user: using WIP-CH 2015 data, a logistic regression predicting the use of Twitter shows that controlling for sex, age, and education, a one-unit increase in skills (scaled 1 to 5) increases the odds of using Twitter by a factor of 1.70 ($p \leq .001$) (see p. 206). Within these limitations of short text communication and a skewed user base, however, it does «generate an additional layer of science communication with new sources, voices, and interpretations» ([Büchi, 2016c](#), p. 12) as compared to traditional news media.

The background for [Article V](#) are the larger structural changes in the way modern societies produce knowledge (see [Weinberger, 2012](#)). The Internet provides science communication with opportunities to depart from the unidirectional traditional broadcast model,

³ Key literature in [Article V](#): [Blei \(2012\)](#); [van Dijck \(2011\)](#); [Veltri & Atanasova \(2015\)](#); [Smith, Rainie, Shneiderman, & Himelboim \(2014\)](#)

to include two-way, one-to-many, and many-to-many communication (van Dijck, 2013, p. 337). Twitter has evolved from its early role as a social network site for small-group interaction to a global news and information following tool (van Dijck, 2011). The study aims to understand the role of Twitter, as one representative of new media, in public engagement with science. Are traditional news outlets' science topic selection and framing simply reproduced or do different sources get a voice? This is achieved by first collecting and comparing the communication content and then extracting and analyzing the topology of the network produced by users mentioning each other in the course of engaging with science topics. The study develops a novel method to collect a corpus of news articles and tweets on current science topics by dynamically linking the two sources. Science topics were extracted from news sources «on the fly» using topic modeling and automatically supplied to the Twitter API as search terms, resulting in corresponding tweets.

Similar to [Article IV](#), [Article V](#) finds that participation and information sharing is driven by those already interested and engaged, but not exclusively, which has been confirmed for the specific case of climate change communication (Taddicken & Reif, 2016). In [Article V](#), climate change emerged as a dominant topic, featuring prominently in both traditional news outlets as well as on Twitter. Related research shows that those convinced of anthropogenic climate change used Twitter predominantly for information sharing, that is, the redistribution of existing content (Holmberg & Hellsten, 2016). This confirms the finding of [Article V](#) that actual debate and discussion are a peripheral phenomenon.

[Article V](#) concludes that Twitter extends existing public science communication through mass media by connecting the individuals formerly known as the audience with each other and with web resources, and by producing additional interpretations of current issues. This extension of science coverage is occurring mainly in a vertical dimension, meaning that those who have the skills to participate and an interest in these issues have additional options. Twitter as a special case of an Internet-enabled social media and informa-

6. *Specific Divides and Their Implications*

tion platform does not appear to contribute much to a horizontal extension of science communication in the sense of broader participation. Despite its technically low threshold for participation, Twitter mainly features asymmetric leader–follower relationships that «are only functional where conventional institutions and media have already created a space of highly specific shared meanings, mutual understandings and structured expectations» (Geser, 2010, p. 15). Alongside a democratic divide there is thus also a science divide, illustrating another case where a technodeterministic view of ICTs as initiators of egalitarian society would produce false expectations (see Tsatsou, 2011).

As indicated, for users to participate and the technological affordances to have an equalizing and inclusive effect, certain capabilities are required. Article V found that the most active hubs in the Twitter science news network were organizations and celebrities, meaning that the mobilizing effect with regards to science participation was low. The basic mechanism of digital inequality can thus also be found at the organizational level. Here, the key competence is not general Internet skills but more of a strategic nature—The New York Times has the skills to preserve and perhaps reinforce its authoritative position. In a situation of information overload, established institutions can function as anchors and further strengthen their status. Importantly, these skills are again not randomly distributed but are to a large degree derived from the pre-existing status, that is, initial resource differentials are reproduced or even intensified on the Internet.

7. Conclusion

The concluding chapter of this thesis discusses the main results and contributions. Policy implications, directions for future research, and limitations are addressed.

7.1. Discussion and Implications

This thesis set out to explain inequalities in Internet use and describe their social consequences. Using a theoretical framework that linked social position to Internet use, chapters 5 and 6 revealed empirical usage differences and their social implications in different domains. The main contributions of the individual articles are summarized in Table 1. The most important contributions for the research on general divides include a method to bridge research on within-country and across-country usage differences as well as the development of a typology for fine-grained comparative research that covers the core purposes of Internet usage. Concerning specific divides, the key contributions lie in connecting online privacy with digital inequality, highlighting a reinforcement mechanism in online participation, and demonstrating the transfer of offline status to the online realm.

In summary and with regard to the first part of the overarching research question in this thesis—the characterization and explanation of digital inequalities—a general pattern has emerged. Broadly speaking, social status determines interest and skills, and these in turn influence online usage behavior. Article II, Article III, and Article IV, which empirically operate at the user level, provide direct evidence of this pattern. For instance, higher education is positively associated with Internet experience and with use of the Internet for informational and transactional purposes. Active personal privacy protection is highly dependent on general Internet skills. And online

7. Conclusion

political participation is predicted by political interest and Internet expertise. To varying degrees in different contexts, skills and interests as the ability and motivation for Internet use, are themselves determined by markers of social status such as gender, education, or age. The most salient finding in the articles that pertains to the second part of the research question—the social implications of digital inequalities—is that certain social groups are likely to become increasingly disconnected from the benefits attainable through Internet use. The results generally suggest reinforcement rather than equalizing effects on a societal level. The Internet as a technological innovation does not *per se* predetermine its users or uses¹—it does not favor the privileged over the disadvantaged or vice versa—but nonetheless, through its social construction and adoption, it contributes to the reinforcement of social inequalities and the production of distinctively digital inequalities (also see [Robinson et al., 2015](#); [Witte & Mannon, 2010](#); [Castells, 2002](#)). Policy directions and consequences on a societal level in light of the insights gained from the individual articles on differentiated Internet use are discussed below.

Combined with the theoretical perspectives outlined above, it becomes clear that individuals in high-diffusion countries increasingly depend on their ability to access and effectively use the Internet in their everyday activities and relationships. These mediated forms of communication crucially depend on corporations that offer services on the content/applications layer and on the physical/logical layer, with potential for vertical integration ([Bauer, 2007](#)). Accordingly, the online communication environment is to a large degree dictated by commercial actors who by definition strive to maximize profits. Companies like Google and Facebook dominate some of the most prevalent uses of the Internet and are taking the further development of the telecommunications infrastructure they so vitally depend on into

¹ Some of the pioneers involved in the development of the Internet note that «[t]he Internet is at once a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location» ([Leiner et al., 2012](#), p. 1).

their own hands, for example, by building undersea cables on which they self-allocate dedicated capacity (Finley, 2016; see Wu [2003] for the issue of network neutrality). So alongside Internet usage divides, other threats to the fair social distribution of information such as network neutrality, big data, and algorithms will also continue to challenge communication governance and regulatory regimes (e.g., Couldry et al., 2016; Saurwein, Just, & Latzer, 2015).

Article III, for example, concludes that public policy concerned with digital inclusion—in this case in the form of being able to maintain personal privacy online—needs to ensure the development of digital skills. In conjunction with the findings of Article II that education and experience influence types of uses, it seems clear that formal education provides a promising setting to improve digital skills (see van Deursen, van Dijk, & Peters, 2011). At the same time it must be acknowledged that even successful policies at this level would likely have limited effects on inequality at large; they may well ameliorate some initial divides in Internet use but a more «radical programme of economic democracy and social justice» (Sparks, 2013, p. 39) that would affect the mechanisms of inequality reproduction described in *Theoretical Perspectives* is very unlikely (also see Duff, 2011; Rogers, 2003; Eynon & Geniets, 2015; van Dijk, 2005). Furthermore, the increasing public framing of digital inequality in terms of skills and the turn away from access divides, while adequate from a purely scholarly viewpoint, runs the risk of absolving governments of their responsibility and thereby unintentionally overburdening individuals as well as educational institutions (Epstein, Nisbet, & Gillespie, 2011).

As a technical innovation, the development of the Internet was shaped by early adopters, resulting in the dominance of English and one size fits all designs and content (see Gajos, 2016). This is one area for promising policy instruments that target skills and usage divides by investing in special content for cultural minorities or otherwise disadvantaged social groups (van Dijk, 2005). The target then is not the durable offline or digital fields of exclusion, for example, low education or low online participation, but Internet skills or rele-

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vance of content as mediators between the two fields (Helsper, 2012). So although the the digital divide cannot just be «closed», policies that counter information injustice are possible (Duff, 2011; van Dijk, 2005).

7.2. Limitations and Future Research

After having outlined the contributions of the five articles in this thesis, many new possibilities for further research arise. On the one hand, specific relationships such as the link between age and types of use may be researched in more depth. On the other hand, the methods and models developed here can be tested for additional online activities, such as seeking information on health, or applied in other countries. With respect to the first focus on comparing second-level digital divides (Article I and Article II), it needs to be acknowledged that «culture» as a catch-all phrase for post hoc explanations of national differences is of limited theoretical value. Further research into second-level and third-level digital divides therefore needs to account for the trajectory of Internet diffusion, relevant regulatory regimes, the dominant Internet companies, etc., in addition to traditional cultural factors. These variables need to inform the country selection along with more practical considerations such as data availability and language skills. For example, finding equivalent measures to compare specific uses and effects of social media in South Korea and China would be challenging because dominant applications in South Korea such as Kakao Story, Twitter, and Facebook are blocked in China. Furthermore, differences in smartphone penetration rates and types of data plans mean that even access type is very different in the two populations.

Having Internet access means being able to step onto the digital playing field—but the field is not level. The burden of the access divide revealed as lack of experience and the social status of older adults and the less educated lead to lower engagement in uses such as social interaction or information seeking that are connected to social, cultural, and economic capital (see Article II). While building

knowledge and maintaining social connections can directly influence life chances, some have argued that entertainment is not a capital-enhancing use of the Internet. However, such a generalization may be problematic, because entertainment could, for example, foster social cohesion through shared cultural knowledge. In the same manner, while it is clear that gaming is not equally beneficial as finding a job online, informational or transactional use are not capital-enhancing under all circumstances either. «[T]hose who do have access but decide to use it for entertainment rather than self-improvement, can only properly be understood if they are studied as authentic human cultures rather than simply as problems to be targeted for correction» (Sparks, 2013, p. 32). This is an area where qualitative research can uncover users' integration of the Internet into their everyday lives and how they judge the utility of their specific uses.

The articles in this thesis consistently treated Internet use as a dependent variable, meaning that different online behaviors were explained by factors like socioeconomic and demographic variables, Internet skills and experience, or attitudes and interests. The further advancement of digital inequality research will require Internet use to also be treated as an independent variable (see Dodel, 2015). The sociopolitical relevance of differentiated Internet use lies in its presumed effects on its users' life chances and well-being. Accordingly, the next wave of digital inequality research is likely to focus increasingly on this third level.

Recent studies have begun to analyze, for example, tangible outcomes of Internet use (van Deursen & Helsper, 2015) or the impacts on health and social connectedness in different populations (see e.g., Yost, Winstead, Berkowsky, & Cotten, 2016; Coleman, Hale, Cotten, & Gibson, 2015). In essence, this line of research asks whether the Internet makes people happier or better off—and the answers from the still relatively small body of literature that addresses this question have primarily focused on psychological conceptions of life satisfaction (e.g., Pénard, Poussing, & Suire, 2013; Valkenburg & Peter, 2007; Trepte, Dienlin, & Reinecke, 2014). Turning to more sociologically oriented studies, Ihm & Hsieh (2015) analyzed the ef-

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fects of older adults' ICT use on their level of offline social activity and there is ample research on Internet use and social capital (e.g., Wellman, Quan-Haase, Witte, & Hampton, 2001; Ellison, Steinfield, & Lampe, 2007). There is, however, a research gap in assessing the contribution of Internet use to social well-being defined not as concrete activities or context-specific social resources but as a generalized achievement over the life course: feelings of inclusion, a sense of being part of and contributing to society, trusting other people, a belief in social progress, and an understanding of one's social environment (see Keyes, 1998; Contarello & Sarrica, 2007).

Altogether, the connection between Internet use and well-being, with great variety in either variable's operationalization, along with potential moderators like digital skills or age is a promising avenue for future research. At the macro level, Internet use can also be treated as an independent variable. While research has shown that income inequality predicts Internet diffusion negatively and economic performance is positively associated with adoption rates (Zhang, 2013), there is also a need for further research on the feedback of Internet use on the distribution of income and other valuable resources. Bauer (2016) notes that globally increasing connectivity has positive and negative effects on inequality under the influence of many economic forces and concludes that «in high-income countries ICT has contributed to increasing income inequality at stagnant median incomes» (p. 32).

The value of large-scale nationally representative data sets is undisputed, and as argued for example in Article III, indispensable when the goal is generalizability to an entire country. The quality and scope of the WIP data are thus a strength of this thesis. Useful insights in Internet use research can, however, also be obtained from the analysis of smaller and very specific populations. For instance, Robinson (2009) explored the informational habitus of economically disadvantaged youths in rural California and gained a rich understanding of usage patterns between a task-oriented, constrained stance and an exploratory, positive approach. In this vein, future research, in particular on the effects of Internet use in terms of life

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chances, may draw on marginalized groups to investigate the mechanisms that lead to digital exclusion in more depth.

Articles

ARTICLE I

Measurement Invariance in Comparative Internet Use Research

ABSTRACT

Comparative studies in communication and Internet research call for equivalent measures of key constructs that are comparable across populations. This article details and applies the concept of measurement invariance within a cross-nationally comparative context. Multi-group confirmatory factor analysis is used to test configural, metric, and scalar invariance in an empirical example and structural equation modeling introduces exogenous predictors of Internet use types. Results support metric invariance for a four-factor Internet usage model in three English-speaking countries. The significance of measurement invariance testing for unbiased comparative research is discussed.

Büchi, M. (2016). Measurement invariance in comparative Internet use research. *Studies in Communication Sciences*, 16(1), 61–69. [doi:10.1016/j.scoms.2016.03.003](https://doi.org/10.1016/j.scoms.2016.03.003)

Article II

Modeling the Second-Level Digital Divide: A Five-Country Study of Social Differences in Internet Use

ABSTRACT

Based on representative surveys on Internet use, this article advances comparative research on the second-level digital divide by modeling Internet usage disparities for five countries with narrowing access gaps. Four core Internet usage types are constructed and predicted by sociodemographic variables in a structural model. Overall, the findings confirm the recently identified shift in the digital divide from access to usage in five further countries. Results show that sociodemographics alone account for up to half of the variance in usage in these high-penetration countries, with age being the strongest predictor. Measurement invariance tests indicate that a direct comparison is only valid between three of the five countries explored. Methodologically, this points to the indispensability of such tests for unbiased comparative research.

Büchi, M., Just, N., & Latzer, M. (2016). Modeling the second-level digital divide: A five-country study of social differences in Internet use. *New Media & Society*, 18(11), 2703–2722.
[doi:10.1177/1461444815604154](https://doi.org/10.1177/1461444815604154)

Article III

Caring is not Enough: The Importance of Internet Skills for Online Privacy Protection

ABSTRACT

This article explains Internet users' self-help activities in protecting their privacy online using structural equation modeling. Based on a representative survey of Swiss Internet users, it reveals past experiences with privacy breaches as a strong predictor of current protective behavior. Further, in line with the «privacy paradox» argument, caring about privacy (privacy attitudes) alone does not necessarily result in substantial self-protection. Most strikingly, however, general Internet skills are key in explaining users' privacy behavior. These skills enable users to reduce risks of privacy loss while obtaining the benefits from online activities that increasingly depend on the revelation of personal data. Consequently, Internet skills are an essential starting point for public policies regarding users' self-help in privacy protection.

Büchi, M., Just, N., & Latzer, M. (2016). Caring is not enough: The importance of Internet skills for online privacy protection. *Information, Communication & Society*. Advance online publication. doi:10.1080/1369118X.2016.1229001

Article IV

Engaging the Engaged: Reinforcement Mechanisms in Online Political Participation

ABSTRACT

Research on the effects of the Internet on democracy has produced mixed results. The present study takes a digital inequality perspective and analyzes the role of political interest and Internet expertise for the social structuration of online political participation. Analyses are based on two-wave nationally representative survey data from Switzerland and use structural equation modeling. Results show that Internet users can be grouped into distinct categories of political and nonpolitical users. Online political participation is promoted by high political interest as well as Internet skills, and these predictors increasingly depend on social position. Implications for digital information policies are discussed.

Büchi, M., & Vogler, F. (2016). *Engaging the engaged: Reinforcement mechanisms in online political participation*. Manuscript submitted for publication.

Article V

Microblogging as an Extension of Science Reporting

ABSTRACT

Mass media have long provided general publics with science news. New media like Twitter have entered this system and provide an additional platform for the dissemination of science information. Based on automated collection and analysis of more than 900 news articles and 70,000 tweets, this study explores the online communication of current science news. Topic modeling (latent Dirichlet allocation) was used to extract five broad themes of science reporting: space missions, the US government shutdown, cancer research, Nobel Prizes and climate change. Using content and network analysis, Twitter was found to extend public science communication by providing additional voices and contextualizations of science issues. It serves a recommender role by linking to web resources, by connecting users, and by directing users' attention. The paper suggests that microblogging adds a new and relevant layer to the public communication of science.

Büchi, M. (2016). Microblogging as an extension of science reporting. *Public Understanding of Science*. Advance online publication. doi:10.1177/0963662516657794

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