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Modeling the second-level digital divide: A five-country study of social differences in Internet use

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Abstract

Based on representative surveys on Internet use this paper 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 shift in the digital divide from access to usage, recently identified for the Netherlands (Van Deursen and Van Dijk, 2014), 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.

Keywords

Internet use, representative survey, digital divide, digital inclusion, comparative cross-country research, measurement invariance, structural equation modeling

Over the past 20 years, multifaceted research has been produced concerning the digital divide, i.e. inequalities in access to (first level) and use of (second level) digital information and communication technologies (ICT; Ragnedda and Muschert, 2013; Hargittai and Hsieh, 2013). Many digital divide studies are globally comparative,

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e.g. concerning Internet diffusion (e.g. Andrés et al., 2010; Zhang, 2013). However, digital inequalities are also an intra-country issue, as certain subgroups of society may not be part of current ICT developments (Norris, 2001). In countries where most people already use the Internet in some form, the focus has shifted to a second level—to analyzing differences in how rather than if the Internet is used. Research has shown that economic and sociodemographic attributes are significant determinants of usage patterns (Teo, 2001; Peter and Valkenburg, 2006; Ortega Egea et al., 2007; Zillien and Hargittai, 2009; Van Deursen and Van Dijk, 2014). Further, differential uses in high-penetration countries are increasingly being explained by individual preferences. Low or non-use can be explained, e.g., by decisions based on a lack of utility, pleasure (Selwyn, 2006), or personality (Tan and Yang, 2014). However, social structure and individual agency are inherently entwined forces, and these forms of agency are socially structured in the sense of an informational habitus (Robinson, 2009; Zillien and Hargittai, 2009). Hence structural inequality cannot be ignored by attributing second-level differences mainly to personal choice. The fast diffusion of the Internet, its growing importance in virtually all life domains, and the fast-changing nature of online activities therefore require continued empirical examinations of the sociodemographic predictors of use.

Increased Internet penetration rates at the aggregate level do not necessarily lead to closing digital divides across social groups—in fact, it has been argued that gaps based on existing social stratifications may even be reinforced (DiMaggio and Garip, 2012; Witte and Mannon, 2010; Zillien and Hargittai, 2009; Chen and Wellman, 2004). Consequently, the variation in the purposes and implied benefits of the use of already adopted technologies needs to be further explored (DiMaggio et al., 2004). This is relevant because differences may translate into inequalities or disadvantages for certain social groups (Helsper, 2012; Witte and Mannon, 2010; Norris, 2001) who make less use of Internet services associated with social, cultural, and economic inclusion. Just like grammar or arithmetic, having online skills and knowledge is increasingly expected in all spheres of everyday networked life in more economically developed countries.

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Since various types of Internet use are associated with corresponding fields of societal participation (Helsper, 2012), Internet use is becoming imperative rather than a mere convenience (Schroeder and Ling, 2014). Consequently, this study addresses the question of how far Internet uses depend on sociodemographic attributes in countries with high Internet penetration. This analytical objective necessitates two methodological steps: establishing a model for Internet uses and confirming cross-country measurement invariance.

This paper makes three contributions to digital divide scholarship. First, it adapts and validates existing operationalizations of Internet usage types. Second, it answers calls for multiple-country studies and thereby substantially extends comparative empirical examinations of the second-level digital divide. For this it uses recent primary data on five countries collected within an international project specifically designed for the comparative study of Internet use. Finally, it rigorously enhances the quality of the comparative analysis by statistically testing the cross-country equivalence of the second-level digital divide model.

Internet activities reflect core usage types

Having Internet access means being able to use e-mail, browse the web, get information, use online banking, or download music. Of all possible Internet activities, people engage with a number of them with varying intensity. While the variety of activities is nearly endless, we suggest that most Internet uses reflect a small number of usage types. For instance, paying bills and buying products online are distinct activities but can conceptually be grouped into 'commercial transaction'. We derive these higher-order usage types by analyzing uses and gratifications theory (UGT) literature applied to the Internet. Media use reflects needs that people seek to satisfy, making UGT a suitable framework (Katz et al., 1973). The conceptual starting-point is therefore the user's perspective —for which *purposes* do people use the Internet? Because 'the Internet' is a multipurpose infrastructure (Author, 2013) without a default usage modality—unlike newspapers or broadcast media—this question is particularly relevant and answered by the resulting usage types.

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UGT has been applied to investigate usage motivations for virtually every kind of communication medium, and the emergence of the Internet has revived its significance (Ruggiero, 2000) as evidenced by various studies (e.g., Helsper and Gerber, 2012; Papacharissi and Rubin, 2000; Sundar and Limperos, 2013). LaRose and Eastin (2004) used UGT to formulate expected outcomes of Internet use: 'social outcomes' such as maintaining relationships, 'status outcomes' (finding similar people), 'novel outcomes' (finding information), 'activity outcomes' (feeling entertained), 'self-reactive outcomes' (relieving boredom), and 'monetary outcomes' (finding bargains) (LaRose and Eastin, 2004). Flanagin and Metzger (2001) developed 'needs clusters' based on UGT for different ICTs and found that the Internet served informational, leisure, relationship, and learning purposes. Although Internet-enabled applications and user demographics have since significantly evolved, generic purposes of using ICT seem relatively stable. Similar broad usage types were derived by Nie and Erbring (2000) who employed the categories of information gathering, entertainment, and commercial transaction in describing Internet activities. Peter and Valkenburg (2006) studied adolescents' use of the Internet as a social, information, and entertainment medium. Van Dijk (2005: 95) noted that the last step in the diffusion and adoption of digital media includes the intention to 'use these media for a particular purpose of information, communication, transaction, or entertainment'. Helsper and Gerber (2012) derive a very similar uses typology from 2007 data with factors for information, entertainment, communication, and finance.

Based on the UGT literature and the related Internet usage typologies we develop and adapt four factors that reflect the current understanding of Internet uses: *social interaction*, *information seeking*, *entertainment*, and *commercial transaction* (Figure 1). These usage types represent the core purposes of people's online activities.

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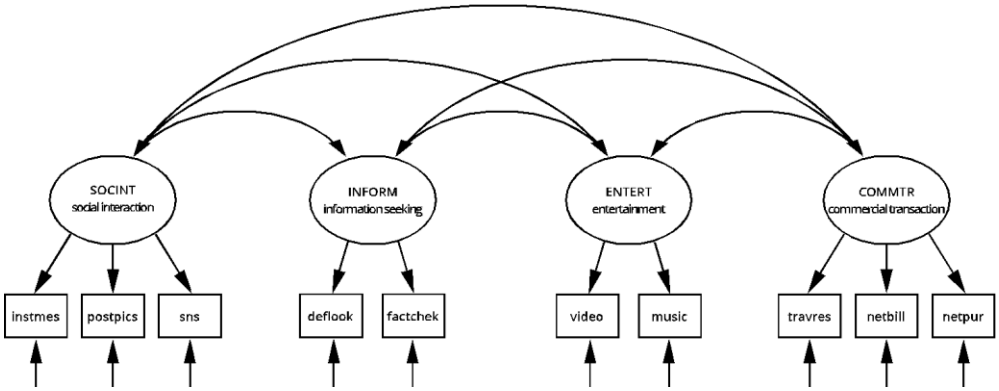
Figure 1. A four-factor model of Internet usage.



Digital divides and their sociodemographic predictors

Usage divides in high-penetration countries

Digital divides are studied from various angles, e.g. by relating the Internet user rates of different countries or regions (global divides) to measures such as income (Andrés et al., 2010) or GDP (Zhang, 2013). Our analysis instead focuses on how individuals use the Internet and a comparison of the influences of sociodemographic attributes on Internet use across countries (social divides). As early as 1999 it was noted that sociodemographic characteristics not only codetermine whether but also *how* people use the Internet (NTIA, 1999). Analogous to legacy media (e.g. Tichenor et al., 1970), Internet use and connected benefits remain stratified even when diffusion increases (DiMaggio and Hargittai, 2001; Willis and Tranter, 2006). Despite widespread access in many regions of the world, individuals' actual use practices may still reinforce inequalities along pre-existing social stratifications (Hargittai and Hsieh, 2013; Van Dijk, 2013).

While Internet access differences constitute the first-level digital divide, the second level is conceptualized using various dimensions that go beyond the binary distinction between use and non-use (e.g. DiMaggio et al., 2004; Van Dijk, 2013). Some operationalizations of the second level have highlighted differences in narrowly

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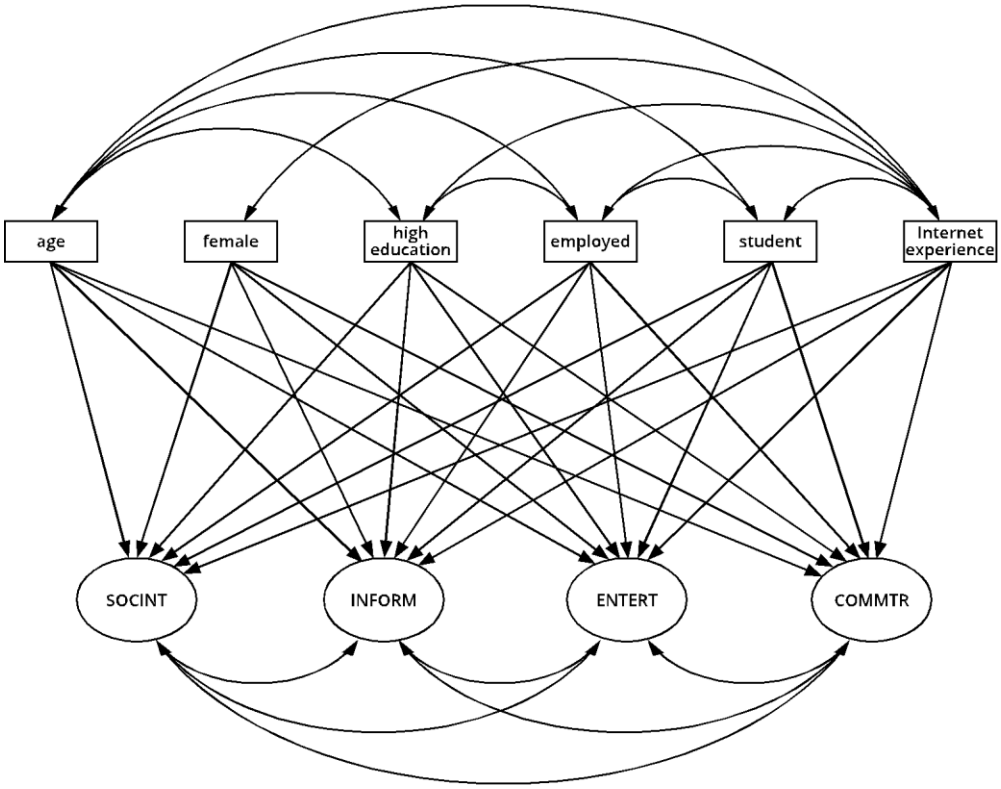
defined uses such as creating web content (Brake, 2014) or online political participation (Min, 2010).

Figure 2. Structural model of sociodemographic variables predicting Internet usage factors.



Note: For simplicity the measurement part of the usage factors, i.e. the indicator items, are omitted in the illustration.

We focus on general Internet usage types: second-level divides are revealed where exogenous sociodemographic variables predict usage although the Internet does not technologically predetermine its users or uses. Figure 2 illustrates our research model addressing the links between sociodemographic variables and Internet usage types. This model builds on previous digital divide and Internet usage research (Teo, 2001; Hargittai, 2002; Ortega Egea et al., 2007; Brandtzæg et al., 2011; Helsper and Gerber, 2012; Van Deursen and

Van Dijk, 2014). Such studies have shown that sociodemographic variables have significant effects on how the Internet is used for large European samples (Ortega Egea et al., 2007; Brandtzæg et al., 2011), the Netherlands (Van Deursen and Van Dijk, 2014), or Singapore (Teo, 2001). The present study makes an important contribution to the existing literature by using recent multi-country primary data from three continents and testing a second-level digital divide based on usage types. This means applying a factor-analytical and structural equation approach with the crucial benefit of affording cross-country invariance confirmation. Factor analysis on Internet activities was effectively used by Helsper and Gerber (2012)—we adapt these constructs to reflect current uses and relate them to exogenous sociodemographic variables. Additionally, Helsper and Gerber (2012) argue that quantitative cross-national comparisons of Internet use are more meaningful for countries with similar diffusion rates. For this reason, we focus on countries with high Internet penetration that have surpassed the 'second tipping point' of technology diffusion where saturation sets in (Van Dijk, 2013). In doing so, we address the explicit call by Van Deursen and Van Dijk (2014) to replicate Internet usage-divide findings in other countries.

Hypotheses for usage differences

At least implicitly, many investigations of the digital divide argue that Internet access is a valuable asset for users (DiMaggio et al., 2001) in finding jobs, social support, or government information. Once people have physical access, individual preferences can explain differences in Internet use within social groups (e.g. Tan and Yang, 2014; Lievrouw and Farb, 2003; Eastin and LaRose, 2000). Across general populations however, usage patterns are still tied to the structural inequalities in play when the issue was mere access. Because offline and digital fields of exclusion are connected (Helsper, 2012), usage differences cannot be dismissed by arguing that low use is solely an individual decision.

We formulate several hypotheses for personal and positional attributes that may explain differentiated Internet uses. Consistent with previous studies, we expect age to be negatively related to virtually all online activities (Teo, 2001) and consequently the usage

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factors. Recent studies have shown a strong negative effect of age on Internet use, be it time online, frequency, or variety of usage (Blank and Groselj, 2014; Pearce and Rice, 2013; Friemel, 2014; Van Deursen and Van Dijk, 2014). Although this influence is presumably not linear, the hypothesized effect is that the younger people are the more frequently they engage with all usage types. Young Internet users are well connected, generally spend more time online and have experienced Internet services as a natural extension or enabler of many aspects of life. Bonfadelli (2002) found younger Swiss users use chatting, gaming, and music services more frequently. Despite making general use of the Internet, elderly users may reject social networking sites due to a generational gap in the communicative culture, where virtual interactions are perceived as too shallow (Lüders and Brandtzæg, 2014).

H1: Social interaction, information seeking, entertainment, and commercial transaction use is higher for young Internet users.

Gender usage differences in high-diffusion countries are small when controlling for other sociodemographics and Internet experience. Findahl (2013) even showed that Swedish women spend more time than men online with their smartphone, a device particularly geared towards communication and interaction. Based on Wasserman and Richmond-Abbott (2005), higher social interaction use by women appears plausible, indicating a reversal of the traditional gender gap.

H2: Social interaction use is higher for female Internet users.

Education is generally correlated with higher levels of Internet use (Norris, 2001). Commonly, higher education is associated with informational uses, and lower education with entertainment, which generally also holds for the Internet (Author, 2013; Van Dijk, 2005). Despite this, well-educated users may use the Internet much more frequently overall for all kinds of activities, including entertainment.

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Formal education includes training and practice in integrating new information (Eveland and Scheufele, 2000) and often this is necessary for commercial and informational uses. We therefore particularly expect education to have a positive effect on information seeking and commercial transaction. For social interaction and entertainment use it remains to be explored whether the overall more frequent use of the Internet by highly educated people outweighs the fact that lower-educated users may prefer social interaction and entertainment (Van Deursen and Van Dijk, 2014).

H3: Information seeking and commercial transaction use is higher for highly educated Internet users.

Zillien and Hargittai (2009) find significant positive effects of social status on Internet usage. As both education and employment contribute to social status, we expect employment to predict usage types similarly to education. The employed are more experienced and skilled Internet users and therefore likely to use all types more frequently, particularly commercial transaction because it additionally requires socioeconomic stability. Nonetheless, the unemployed may use social interaction and entertainment more, as these are rather time-consuming activities as opposed to the goal-oriented information seeking and commercial transaction.

H4: Commercial transaction use is higher for employed Internet users.

Since students are at a stage of establishing and managing new social networks, the social interaction usage type seems particularly relevant to them. However, this may be a general age effect. Studying in higher-education, however, is clearly associated with researching, therefore we expect a positive direct effect on information seeking, beyond the indirect effect of age.

H5: Information seeking use is higher for student Internet users.

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Internet experience can 'capture the past' as it represents a consequence of the first-level access divide, and we demonstrate the effects this has on the second level. Previous research has shown that Internet experience is positively related to Internet self-efficacy judgments (Eastin and LaRose, 2000) and skills (Hargittai, 2002). These both enable and promote usage, thus we expect the effects of Internet experience to be positive in the model. We understand experience as a predictor that is particularly important for commercial transaction use because this requires increased trust and skills. For example, online credit-card use probably comes only after having gained some experience.

H6: Commercial transaction use is higher for experienced Internet users.

Data and methods

Representative survey data from five countries

Data were collected within the framework of the World Internet Project (WIP). The WIP is a major, international research project that has been investigating the social, political and economic impact of the Internet and other new technologies since 1999 and now has more than 30 partners worldwide (WIP, 2014). For this study of the second-level digital divide in high-penetration countries, the following five countries were included: New Zealand, Sweden, the United States, Switzerland, and the United Kingdom. Internet access rates in these countries, as measured by the number of current users, range from 78% to 92% (Table 1).

The sample sizes vary, since each country ensured a representative sample with regard to demographic variables such as age and gender. Based on a common questionnaire, telephone, web, and face-to-face interviews were conducted in 2012 (US) and 2013 (NZ, SE, CH, UK). Survey participants who did not use the Internet (any more) are excluded (Table 1). The mean age in the combined sample of Internet users aged 16 and over is 44.30 years (SD=17.15). Men and women are equally represented in the data (49.95% women).

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Table 1. Cross-country survey overview.

Country	Year of survey	N (total)	Max. margin of error	Internet users
New Zealand (NZ)	2013	2008	±2.19%	92%
Sweden (SE)	2013	3030	±1.78%	89%
United States (US)	2012	1351	±2.67%	85%
Switzerland (CH)	2013	1114	±2.94%	85%
United Kingdom (UK)	2013	2053	±2.16%	78%

Note: Internet users represent the percentage of people in the five countries aged 16 and over who currently use the Internet, on which subsequent analyses are based. The maximum margin of error indicates the confidence interval on the 95% confidence level. N (total) denotes the original survey size including non-users.

Internet activities and sociodemographic variables

The Internet activity items used for this analysis are shown in Table 2. These are conceptually tied to one of the usage types developed above. Frequency of use of each item was rated on a 6-point scale ranging from never to several times a day. Activities that more than half but less than nine in 10 do at least occasionally are the general target (Table 3); extremely popular or rare activities were excluded. This focuses the analysis on online activities relevant to people's everyday lives yet still exhibiting substantial variance. The other set of relevant variables concern Internet users' sociodemographic attributes. We include student status, age, gender, employment status (full-time or part-time vs. all others), level of education (high vs. medium and low), and Internet experience (years online). Age and Internet experience are measured in years and the other four variables are binary.

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From usage types to a structural model of sociodemographic usage patterns

The proposed Internet usage types are empirically tested using confirmatory factor analysis (CFA; Brown, 2006). We assign online activities to each of the four factors (Table 2)—these item assignments to higher-order factors are essentially hypotheses regarding the measurement model tested using CFA. The suitability of this analytical strategy has also been demonstrated by Helsper and Gerber (2012). One set of applications, such as listening to music and watching video online, is not independent of another set, such as using social networking sites and instant messaging. It is expected that people who use entertainment services frequently are also more likely to use communicative and interactive applications. Thus, despite the conceptually important distinction between, e.g., entertainment and social use of the Internet, our empirical validation allows for co-variances between all four usage factors and proposes an integrated structure of Internet use.

Table 2. Internet activity variables and usage factors.

Usage type factor	Variable	Item
Social interaction (SOCINT)	instmes	*do instant messaging*
	postpics	*post photos or pictures on the Internet*
	updates**	*update your status, such as what you are doing now*
	sns*	*visit social networking or video-sharing websites*
Information seeking (INFORM)	travel**	*look for travel information*
	health**	*look for health information*
	deflook	*look up a definition of a word*
	factchek*	*find or check a fact*
Entertainment (ENTERT)	games**	*play games*
	music*	*download or listen to music*
	video	*download or watch videos*

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Commercial transaction (COMMTR)	travres	*make travel reservations/bookings*
	netbill	*pay bills*
	netpur*	*buy things online*

Note: Survey question: *How often do you use the Internet for the following purposes? On average, how frequently do you [item]? Several times a day, daily, weekly, monthly, less than monthly, never.* *Marker item. **Item excluded in final model due to lack of empirical fit

Table 3. Distribution of Internet activities.

		NZ	SE	US	CH	UK	Overall
SOCINT	instmes	65.9%	29.6%	54.0%	31.7%	72.6%	50.3%
	postpics	67.1%	60.0%	67.1%	54.7%	67.0%	63.4%
	updates	62.4%	45.0%	52.8%	33.7%	81.5%	54.9%
	sns	81.8%	67.3%	65.1%	52.2%	61.1%	67.4%
INFORM	travel	85.3%	83.7%	84.2%	70.9%	80.1%	82.0%
	health	81.0%	70.4%	89.5%	63.2%	69.1%	74.4%
	deflook	85.6%	82.5%	85.3%	76.9%	73.9%	81.2%
	factchek	92.6%	89.8%	90.9%	53.8%	90.3%	86.6%
ENTERT	games	50.3%	44.7%	57.0%	30.3%	52.4%	47.6%
	music	66.9%	58.4%	65.4%	51.9%	70.1%	62.9%
	video	62.2%	43.3%	62.7%	72.4%	54.8%	56.0%
COMMTR	travres	80.3%	75.5%	75.4%	59.5%	76.0%	74.8%
	netbill	80.6%	83.2%	74.9%	64.5%	56.8%	74.0%
	netpur	85.8%	84.0%	91.9%	68.7%	86.8%	84.3%

Note: Percentage of Internet users who did not answer 'never' to an activity item, i.e. who engage in the activity at least infrequently. Cells shaded by values (<60% white, 60-79% light gray, >80% dark gray).

Subsequently, the usage types are used as endogenous variables predicted by the set of sociodemographic variables by means of structural equation modeling (SEM). Inter-factor correlations and correlations between sociodemographic variables are also specified

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where plausible. The advantages of SEM as opposed to multiple regressions include the possibility to incorporate multiple dependent (endogenous) variables and error terms in a single model. Furthermore, our approach simultaneously estimates all parameters and eliminates the need to reduce latent constructs to mean indices. Most importantly, SEM affords explicit tests of otherwise implicit assumptions in cross-country comparisons of free parameters (Davidov et al., 2014).

Measurement invariance as an indicator of cross-country comparability

In order to describe country differences regarding the influence of sociodemographic variables on Internet usage factors, the specified model needs to be comparable, i.e. 'invariant' or 'equivalent,' across countries. The measurement invariance of the initial five-country model is statistically tested on increasingly restrictive nested levels (Schermelleh-Engel et al., 2003). Two well-established levels (Vandenberg and Lance, 2000) that have also been employed in communication research (Helsper and Gerber, 2012) are relevant to this study.

The first level, *configural* invariance, requires that the proposed four-factor model fits all countries, meaning that all items load significantly and substantially on the intended factor for every country (Brown, 2006). Additionally, the overall model fit for each country is considered using the χ^2 statistic and degrees of freedom, CFI (Brown, 2006; Hu and Bentler, 1999), RMSEA (Schermelleh-Engel et al., 2003), PCLOSE, and SRMR (Hu and Bentler, 1999). Configural invariance allows the exploration of the basic usage structure cross-nationally (Steenkamp and Baumgartner, 1998).

Metric invariance is achieved if additionally constraining the factor loadings of the activity items to be equal across countries does not result in a substantial decrease of model fit. Where the conditions of metric invariance are satisfied, the structural relationships between variables may be examined. This is crucial for our research interest in the second-level digital divide—the influences of sociodemographic variables on Internet usage factors can only be meaningfully compared if the factors have invariant loadings, and thus

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mean the same in the different countries (Davidov et al., 2014). Pairwise comparisons are conducted in order to evaluate the difference between effects in different countries.

Results

Fit of the four-factor model and modifications

The first test of the Internet usage-type model includes all items listed in Table 2, where the single asterisk indicates the marker item for each factor—the item that is hypothesized to best represent the construct: using social networking sites (sns) for social interaction, checking facts (factchek) for information seeking, downloading or listening to music (music) for entertainment, and buying things online (netpur) for commercial transaction. The result is an integrated four-factor model that measures Internet usage with 14 observed variables.

However, we detected differences between the theorized structure and the empirical data: using the combined covariance matrix from all five countries, this global model yields a relatively poor fit, $\frac{\chi^2}{df} = \frac{3298}{71} = 46.46\ (p \leq .001)$, $CFI = .895$, $RMSEA = .077\ (PCLOSE = .000)$, $SRMR = .054$. The modification indices reveal an issue with the two travel items, looking for travel information and making travel reservations/bookings online, which correlate significantly. As these are items of different factors, we opted to exclude the travel information seeking variable, which had a lower factor loading. Consequently, the information seeking factor was rendered more generic—both the checking of facts and looking up of definitions are activities used in virtually any domain—thus the health information seeking item was also excluded due to its specificity and comparably low factor loading (.50 vs. >.70 for deflook and factchek). The games item of the entertainment factor showed a low factor loading of .38. Based on this and the relative rareness of online gaming among Internet users (Table 3), the item was excluded despite its conceptual fit with entertainment use. The two highest modification indices now involved the updates item, hinting at both a lack of fit with the social interaction construct it was expected to reflect and a covari-

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ance with commercial transaction. Since both freeing its path to social interaction and adding a path to commercial transaction seemed theoretically unjustifiable, excluding the updates item was the final modification to the initial model.

The loss of variety of Internet activities—and thus basing a latent higher-order construct on fewer manifest indicators—is balanced by the improved empirical fit. We opted for this simple, robust, and statistically sound model that allows for cross-national analysis and replicability in other contexts.

The final modified model on which further analyses build retains 10 items that measure the four factors (Figure 1). Using a merged data set with all five countries, the factor loadings range from .54 to .79 and are all significant at the .001 level. Inter-factor correlations vary from .45 to .72. The overall fit is very good, $\frac{\chi^2}{df} = \frac{406}{29} = 13.99$ ($p \leq .001$), $CFI = .981$, $RMSEA = .041$ ($PCLOSE = 1.000$), $SRMR = .025$. The χ^2 test remains significant, but this is not a reason to reject an otherwise fitting model (Byrne, 2010) given the large sample size.

Measurement invariance: three out of five countries comparable

Before comparing Internet usage divides in different countries it is essential to determine whether or not the model in Figure 1 makes sense in all countries. This is partly established in the global model above. The additional test of running the model with each of the single country data sets separately also confirms configural invariance based on the goodness-of-fit statistics.

Relating the measurement models of Internet usage factors to sociodemographic variables as a means to locating second-level digital divides requires metric invariance. Constraining the items to load equivalently onto their factor in all five countries produced a significantly lower model fit. As Table 3 indicates, despite similar levels of Internet penetration, the popularity of various online activities differs substantially across the five countries. Consequently, the degree to which these activity items reflect the higher-order constructs also varies. The one combination of countries that did support metric equivalence among them included NZ, the UK, and the

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US. Although the difference in χ^2 was significant between the unconstrained and the constrained model, the decrease in CFI was minor ($\Delta CFI = .003$, cutoff criterion .01; Byrne, 2010), suggesting that the factors do in fact operate comparably in these three countries. They represent the same construct and their sociodemographic determinants as well as the covariances between them can be meaningfully compared. The results for CH and SE nonetheless offer valuable findings from a single-country perspective.

Sociodemographic predictors of Internet usage types

In order to investigate social usage differences, we relate the measurement model of Internet usage to six sociodemographic measures. Figure 2 shows this path model where the integrated Internet usage factors are predicted by the set of sociodemographics. Based on the confirmatory measurement model above, we now test the hypotheses for the structural part of Figure 2. In the model, all exogenous variables predict all endogenous factors and the results then indicate where the divides are located. Generally, the predictors account for a large percentage of the variance in Internet usage factors (Table 4). The data based on 4562 Internet users from NZ, the UK, and the US fit the model in Figure 2 well, $\frac{\chi^2}{df} = \frac{1079}{210} = 5.14$ ($p \leq .001$), $CFI = .957$, $RMSEA = .030$ ($PCLOSE = 1.000$), $SRMR = .036$.

Since the sample sizes are relatively large, even small coefficients are significant. We therefore suggest interpreting significant standardized regression weights above an absolute value of about .20 as substantive effects. As shown, metric invariance is supported for the group of English-speaking countries, thus the effects are directly comparable. The coefficients for SE and CH, on the other hand, should be interpreted separately, because the four factors do not represent equivalent usage types.

Table 4. Effects of sociodemographic variables on Internet usage factors.

		social interaction	information seeking	entertainment	commercial transaction
Age	NZ	-.58***	-.27***	-.66***	-.24***

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	UK	-.57***	-.09**	-.56***	-.07*
	US	-.55***	-.41***	-.67***	-.21***
	SE	-.59***	-.31***	-.62***	-.28***
	CH	-.67***	-.14***	-.49***	-.21***
Female	NZ	.09***	-.04	-.22***	.01
	UK	.09***	-.04	-.17***	.03
	US	-.02	-.09**	-.19***	-.02
	SE	.05*	-.11***	-.21***	-.09***
	CH	-.07*	-.04	-.10**	-.00
High education	NZ	.01	.15***	.10***	.18***
	UK	.00	.17***	.06*	.18***
	US	.12***	.22***	.09**	.30***
	SE	.09***	.25***	.09***	.24***
	CH	-.04	.28***	.11**	.27***
Employed	NZ	.02	.03	-.05	.24***
	UK	.06*	.05	.04	.28***
	US	-.00	-.04	-.13***	.10**
	SE	-.06*	.10***	-.08**	.10***
	CH	-.12***	.06	.02	.16***
Student	NZ	.08**	.23***	.07*	-.08*
	UK	.01	.24***	.07**	-.03
	US	-.06	.11**	-.01	-.10*
	SE	.09**	.22***	.11***	.04
	CH	.07	.23***	.13***	.06
Internet experience	NZ	.12***	.23***	.08***	.28***
	UK	.00	.08**	.04	.22***
	US	.06	.23***	.07*	.23***
	SE	.16***	.21***	.06**	.34***

	CH	.07	.32***	.22***	.43***
R^2 (squared multiple correlations)	NZ	.37	.23	.52	.28
	UK	.35	.14	.39	.20
	US	.28	.29	.46	.24
	SE	.42	.35	.51	.32
	CH	.46	.27	.31	.36

Note: Standardized regression weights from the structural equation model using IBM SPSS Amos 21 with maximum likelihood estimation. Note that the coefficients for SE and CH are not comparable to the other countries as metric invariance was not supported for all five countries.
*p<.05. **p<.01. ***p<.001.

H1 predicted that age is negatively related to all four usage types. The model coefficients (Table 4) provide support for this. Age is by far the most important predictor of the usage frequency of different Internet services. The coefficients are all significant and negative, indicating that overall young people use the Internet for social, informational, entertainment, and transactional purposes more frequently. Age is the only predictor with significant (negative) coefficients for all factors in all five countries. Social interaction and entertainment are particularly dependent on age, with very few country differences. In the UK, the effects of age on information seeking and commercial transaction are minor.

H2 hypothesized that women make more use of social interaction applications. The results only partially confirm this. In NZ and UK the effect is significant but rather small. In the US social interaction use is independent of gender. A gender gap is, however, measured for entertainment use: women use the Internet less often for entertainment activities. Similarly, commercial transaction and information seeking are hardly gender dependent.

H3 proposed that education is a positive predictor of information seeking and commercial transaction use. The model confirms this hypothesis; the effect is less pronounced in NZ and the UK than in the US. There is no support for educational divides with regard to social interaction and entertainment use—the effects of the significant coefficients are very small.

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H4 predicted that full- or part-time employment is a positive predictor for the frequency of commercial transaction usage. This is supported for NZ and the UK; the effect in the US is also significant but small. Employment has no substantive influence on the other three usage factors. Perhaps two oppositional effects cancelled each other out—the employed tend to use the Internet more frequently overall but the jobless potentially have more time for such activities.

H5 hypothesized that students engage more in information seeking activities which is confirmed by the results. There are no other substantive effects: students do not use the Internet more or less frequently for social interaction, entertainment, or commercial transaction (once age is controlled).

H6, finally, proposed that Internet experience predicts increased commercial transaction use. The significant positive coefficients for all three countries confirm this and, additionally, experience is positively related to information seeking in NZ and the US. The 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 can have gained a lot of Internet experience. Age has its smallest effect—yet still highly significant and substantive—on information seeking and commercial transaction—the two factors predicted best by Internet experience. The results further suggest that social interaction and entertainment use of the Internet do not substantively depend on experience, and by extension perhaps on skills.

After discussing the effects of the exogenous variables individually based on the six hypotheses, we briefly shift the perspective to the endogenous factors. *Social interaction* use of the Internet is predicted primarily by age. All other sociodemographic variables have minor influences if any. *Information seeking* on the other hand depends on age, education, student status, and Internet experience. *Entertainment* usage is strongly related to age and somewhat to gender. There are no educational or employment-related divides. Of the four factors, using the Internet for *commercial transactions* is least dependent on age. A strong predictor is Internet experience along with employment, education, and age. As much as half of the total vari-

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ance of a factor is explained by the sociodemographics bundle (Table 4); for social interaction and entertainment, most of this variation is accounted for by age. For information seeking and commercial transaction, the explanatory power is distributed over almost all sociodemographic variables.

Country differences

Differences between the invariant countries in the absolute value of the significant standardized regression coefficients, i.e. differential effects of sociodemographics on Internet usage types, are as high as .31 (age on information seeking). The digital inequality patterns are not the same in the US, the UK, and NZ—they are similar however, as no significant coefficients change from positive to negative or vice versa between countries. There are instances where there is a small effect in one country but none in the others. In the US, higher education is positively associated with all usage types whereas in the UK and NZ, the frequency of social interaction use is independent of education. Further, being employed means using entertainment services less in the US but not in the other two countries. Internet experience positively predicts social interaction usage in NZ, but not in the UK or the US.

The largest difference is the effect of age on information seeking. In NZ, the regression weight is significantly larger ($p<.001$) than in the UK. The effect in the US is significantly larger than in the other two ($p<.001$). The other factor where age has differential influences is commercial transaction. NZ and the US are on a similar level (-.24 and -.21), while in the UK the effect is unsubstantial ($p<.001$ and $p<.01$). There is support for the statement that commercial transaction usage in the US depends more on higher education than in NZ and the UK ($p<.01$). For employment, the reverse is true. NZ and the UK are again similar, but in the US employment predicts commercial transaction use significantly less well ($p<.01$ and $p<.001$). The positive effect of Internet experience on the frequency of information seeking is significantly smaller in the UK than in the other two countries ($p<.001$). There are no notable cross-country differences for any other sociodemographic disparities in Internet use.

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The UK has the lowest overall second-level digital divides considering the explained variances of the Internet usage factors (squared multiple correlations, mean=27%) despite having the lowest Internet penetration rate of the three (Table 1). The US (32%), NZ (35%), CH (35%), and SE (40%) have higher average values. Aside from age, the biggest inequalities in NZ are in commercial transaction, which is used more by employed and experienced Internet users. In the UK, again not considering the dominant predictor age, the most apparent disparities concern commercial transaction usage related to employment, and information seeking related to student status. In the US, the two most manifest gaps pertain to commercial transaction as predicted by higher education and the dependency of information seeking frequency on Internet experience.

Discussion

Evidently, widespread Internet access does not correspond to equality in usage. We confirm the existence of a second-level divide in high-penetration countries and the plausibility and comparability of four usage factors in English-speaking countries. The SEM framework applied considerably extends these findings and we identify both within-country social disparities and cross-country differences, thereby providing a more comprehensive account of the second-level digital divide. The study adapts and tests an Internet-uses model, answers the calls for multiple-country studies and thus confirms and expands second-level digital divide findings. Its key strength lies in the methodologically rigorous combination of all three elements.

Usage types were constructed using CFA, making it possible to expand the model with sociodemographic predictors and to test for cross-country invariance and differences. The country comparison is based on an international collaborative project with a common questionnaire rather than relying on independent studies where measures are hardly comparable. UGT proves valuable in deriving purposes of Internet use from people's perceived needs, and we have demonstrated that the proposed four-factor usage model is robust and useful in this context. First, it permits much more detailed in-

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sights into Internet usage than could be gained from a single-variable approach. Second, the invariance across a set of countries implies some level of universality and allows cross-cultural analyses. Third, despite being more specific than usage in general, the four-factor model is generic enough to remain flexible: even if new applications emerge, they will likely be assignable to one of the latent core factors of Internet use (social interaction, information seeking, entertainment, and commercial transactions). The four factors are correlated but remain conceptually and empirically distinct meaningful dimensions of Internet use.

Some have stressed the importance of individual preferences and psychological factors in explaining the variations in Internet use (e.g. Tan and Yang, 2014; Lievrouw and Farb, 2003; Eastin and LaRose, 2000). However, the amount of variance explained by sociodemographic variables alone in this analysis (up to 52%, Table 4), which is even substantially higher than in related studies (Van Deursen and Van Dijk, 2014; Teo, 2001), suggests the persistence of actual social inequalities—and not mere user differentiation. Our finding that gaps may not decrease but even widen as technology diffuses has also been acknowledged in previous digital divide studies (Chen and Wellman, 2004; Zillien and Hargittai, 2009; Witte and Mannon, 2010). A normalization hypothesis would assume inequalities were temporary as technology diffusion progresses—our findings largely rejected this. Rather, the usage divides indicate persistent social stratifications, where it is too simple to say, for example, that older people use the Internet less because most content is for the young (Norris, 2001; Van Dijk, 2013).

Summary and implications of findings

Young Internet users make much more frequent use of all four types, a correlation that is particularly high for social interaction and entertainment. A gender gap is evident for entertainment; women use the Internet for this less. The hypothesized gender effect for social interaction is rather weak. Unsurprisingly, students seek online information more frequently. Employment, full-time or part-time, is associated with increased commercial transaction use. University education similarly predicts information seeking positively,

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and additionally commercial transaction usage. Internet experience was included as a 'composite summary' of the first-level divide that still has effects today. Those on the online side of the first-level access gap have more Internet experience and this itself is dependent on sociodemographics. Experienced users employ the Internet more frequently for informational and commercial purposes. These results imply that low-use groups such as older adults and those with lower levels of education and Internet experience—despite having physical Internet access—may become increasingly disconnected from the economic, social, cultural, and human capital attainable through Internet use.

The cross-country comparisons focused on NZ, the US, and the UK because they were found to be equivalent in the way Internet activities relate to usage types. Although the WIP survey is explicitly designed to be comparable across countries our results show that this does not relieve the researcher of ex-post invariance testing to confirm equivalence.

Limitations and future research

The statistical finding of non-equivalence for two of the five countries was methodologically crucial for unbiased comparisons but does not explain why constructs are not equivalent. Future comparative efforts should therefore additionally examine culture-specific understandings of Internet uses qualitatively. The inclusion of income as a predictor in the model was not possible, due to non-response rates for this variable of up to 40%. This study focused on core uses for a general population—perhaps digital divides pertaining to more specific uses of social subgroups could be detected in further research. Even though we were able to show considerable second-level divides, it is not yet clear which and to what extent Internet uses lead to tangible and intangible outcomes in terms of life chances, social position, and well-being. Although difficult to measure, we propose future comparative and longitudinal research that operationalizes the societal outcomes of different Internet usage types.

Within our homogenous group of high-penetration English-speaking countries, smaller first-level gaps correspond to larger sec-

ond-level divides. Future research may extend this finding with longitudinal data in order to empirically analyze the evolution of digital divides and the interrelations between the first and second level. Having scrutinized only high-diffusion countries, further insights might be gained by analyzing countries where Internet diffusion has not progressed as far, or on very different paths, such as 'leapfrogging' via mobile technologies (Drori, 2010). In any event, the fact that sociodemographic usage divides persist even when access gaps are closed calls for further theoretical and empirical inquiry into these issues.

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