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Toward a Multifaceted Model of Internet Access for Understanding Digital Divides: An Empirical Investigation

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In this investigation, a multifaceted model of Internet appropriation that encompasses four types of access—motivational, material, skills, and usage—is tested with a representative sample of the Dutch population. The analysis indicates that while the digital divide policies' focus has moved to skills and usage access, motivational and material access remain relevant since they are necessary through the entire process of Internet appropriation. Moreover, each type of access has its own ground of determination and they interact together to shape digital inequalities. Therefore, digital divide policies should address material, skills, and usage access simultaneously.

Keywords digital divide, Internet access, material access, motivation, skills, usage

Early investigations viewed the digital divide predominantly as a binary distinction—having or lacking physical access to the Internet—with the underlying assumption that provision of Internet access would ensure inclusion (Newhagen and Bucy 2005; van Dijk 2005). However, because of the widespread availability and adoption of the Internet in many developed countries, research agendas have turned to explore other types of inequities in Internet access—skills and usage (Goldfarb and Prince 2008; Hilbert 2011; Selwyn 2004; van Dijk 2005).

The new models typically include a sequence of indicators spanning awareness, attitudes, physical and material access, skills, and usage (e.g., Attewell 2001; Chen and Wellman 2004; DiMaggio et al. 2004; Katz and Rice 2002; Livingstone and Helsper 2007; Mossberger, Tolbert, and Stansbury 2003; Selwyn 2006; Ono and Zavodny 2007; van Dijk 2005; Warschauer 2003; Witte and Mannon 2009). Scholars often use one of these indicators as the dependent variable and then consider sociocultural, socioeconomic, or social indicators as determinants. This way, recent investigations have, for example, provided valuable insights into differences in Internet usage (e.g., Hargittai and Hinnant 2008; Livingstone and Helsper 2007; van Deursen and van Dijk, 2014; van Deursen, van Dijk, and Ten Klooster, 2015). However, one's attitude, skills, and materials used all might affect usage in their own way. Moreover, they all might interact with each other to shape digital inequities. Although simultaneous empirical examinations better explain how digital divide indicators behave compared with bivariate analysis (Vehovar et al. 2006), such investigations are less common (recent examples: Helsper and Eynon, 2013; Pearce and Rice 2013; Wei and Hindman 2011).

Our first objective is to devise and test a model that marks the steps to be taken by individual users in the process of appropriation of digital technology. We follow van Dijk's (2005) model, which encompasses four types of access—motivational, material, skills, and usage. In this study, the four types of Internet access are simultaneously tested to understand how they together shape the digital divide.

Our second objective is to study how important socio-demographic determinants are associated with different types of Internet access. Accounting simultaneously for a spectrum of access types provides new insights into socio-demographic divides. The analysis for example reveals that in general younger people with higher educational levels and higher income and in some areas males have better Internet access, a finding that is reinforced in every step of the Internet appropriation process. Furthermore, individuals who are motivated to use the Internet

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and who use several devices are not necessarily developing skills and improving their usage diversity.

We start by providing an overview of the literature on the four types of access—motivational, material, skills, and usage. Thereafter we present our hypotheses and the methodology for testing them. Finally, we discuss our findings and the limitations of our study.

TYPES OF INTERNET ACCESS

Motivational Internet Access

Adapting the expression of "have-nots," people who remain at the "wrong" side of the digital divide because of motivational problems are referred to as "want-nots." van Dijk's (2005) notion of motivational access is primarily shaped by attitudes toward technology. Attitudes should be considered object specific, while motivations are more goal specific (Baker 1992). The goals and reasons for Internet use are often examined with a uses and gratifications approach and bear a strong relation to types of Internet usage (e.g., Cho et al. 2003; Papacharissi and Rubin 2000). We consider motivational access as object specific with respect to the Internet. Theories of technology adoption suggest that one's attitude toward the Internet is crucial to using it (Davis 1989; Venkatesh et al. 2003). Negative attitudes toward technology such as computer anxiety have been shown to decrease access to the Internet (van Dijk 2005). Internet anxiety is characterized by avoidance, expressing negative comments about the Internet and the effects on society, and attempts to minimize the time spent using the Internet (Durndell and Haag 2002; Rockwell and Singleton 2002). In addition to dampening the extent of use, Internet anxiety negatively influences patterns of Internet use (Meuter et al. 2003), and prevents minorities from accessing it (Rojas et al. 2004).

Material Internet Access

After motivation, van Dijk (2005) frames the concept of material access. One must have the opportunity and the means to access the Internet (DiMaggio et al. 2004; Gunkel 2003). In digital divide research, attention in public opinion and policymaking long focused on this type of access (Newhagen and Bucy 2005; van Dijk 2005). Material access entails, on the one hand, physical access, or an Internet connection, whether at home or elsewhere, and on the other hand, expenses for hardware, software, and services (van Dijk 2005). Although obtaining a physical Internet connection might be an obstacle because of cost, physical access in terms of Internet connections is rising rapidly in developed countries. Differences in the types of connections and hardware employed, however, have remained stable (e.g., Davison and Cotten 2009; Pearce and Rice 2013). Material resources "keep playing their role after a physical connection is acquired" (van Dijk 2005, 117). Material divides are increasingly visible in devices used to access the Internet, including laptops, notebooks, tablet or handheld computers, smartphones, game consoles, and interactive televisions. Mobile devices provide access that, in some ways, afford greater convenience and more continuous use compared with home access (Mossberger, Tolbert, and Hamilton 2012), notably with the ever-increasing access speeds, faster processors, and high-resolution screens. Furthermore, devices such as smartphones, tablets, and also game consoles increasingly provide additional possibilities besides game playing or video streaming. They enable access to almost the entire Web. Therefore, a material access divide might emerge, regarding the differences in the number of devices used for Internet access. Instead of making the normative judgment that some devices are "better" than others, we stress that some devices are more appropriate for a particular use or application than others, making them complementary to each other (Mossberger, Tolbert, and Hamilton 2012). For example, content-rich depth searches might be better conducted on personal computers or laptops, while handheld devices might be most appropriate for using social media as a vehicle for social interaction. The underlying thought is that the more devices one has access to, the more opportunities one has, creating a material access divide that goes beyond just having a connection to the Internet or not.

Internet Skills Access

After adopting a favorable attitude toward the Internet and acquiring a physical connection, one must have the skills to use the Internet (van Dijk 2005). In recent years, the digital divide debate has centered on the acquisition of the necessary skills to use the Internet efficiently and effectively, also referred to as the second-level digital divide (Hargittai 2002). Eastin and LaRose (2000) identified self-efficacy as a crucial factor in Internet use, and self-reported skill is an important factor in explaining the types and the number of Internet activities people perform (Hargittai and Hinnant 2008; Livingstone and Helsper 2007), as well as the tangible outcomes of Internet use (Helsper, van Deursen, and Eynon, 2015). More direct evidence can be derived from digital inequality studies that measure Internet skills in actual performance tests (Hargittai 2002). van Deursen and van Dijk (2009; 2010; 2011), for example, measured a succession of medium-related and content-related skills within a large sample of the Dutch population. Medium-related skills entail operational skills, that is, basic skills required to operate Internet technology, and formal skills, that is, competencies related to navigating the Internet's hyperlinked structure. Content-related skills comprise information skills, that is, literacies to seek information, and strategic skills, which envision the attainment of goal-directed solutions in the most optimal and efficient way. The proposed distinction has been shown to be sequential and conditional. Furthermore, the tested skills were based on individual abilities, including relevant skills necessary for the general population to function adequately online. Therefore, in digital divide sequences of access, both medium- and content-related Internet skills should be considered. Both skill sets are theoretically and empirically distinct and have different determinants (van Deursen and van Dijk 2010).

Internet Usage Access

Actual usage of the Internet is the final stage of appropriation (van Dijk 2005). As a dependent factor, Internet usage is mostly defined in terms of frequency, the length of time the Internet is used, or the type of activities performed online. The latter is increasingly the focus of attention when investigating how people in different social groups use the Internet after obtaining access (Blank and Groselj 2014; Hargittai and Hinnant 2008; Livingstone and Helsper 2007; Robinson 2009; van Deursen and van Dijk 2014; van Deursen, van Dijk, and Ten Klooster, 2015; van Dijk 2005). Differences in Internet usage reveal whether differences reflect other more traditional uses in society. A recent study showed that people with lower education levels may spend more time online in their free time than those with higher education levels, but do so in different ways, for example, engaging in social interaction and gaming more often rather than for educational purposes, information seeking, or work-related reasons (van Deursen and van Dijk 2014), or what have been collectively designated as "capital enhancing activities" (Hargittai and Hinnant 2008). Therefore, frequency and time spent online should not be considered to be necessarily effective in making profitable use of the Internet. In this context, the concept of the "usage gap" is proposed. The usage gap is comparable to the knowledge gap that has been observed from the 1970s onward (Bonfadelli 2002; Cho et al. 2003; Hargittai and Hinnant 2008; van Dijk and Hacker 2003). According to the knowledge gap hypothesis, individuals with the most resources possess and gain more skills, use more and different activities, and obtain earlier and more benefits, thereby increasing (rather than reducing) resource gaps (Selwyn 2004; Tichenor, Donohue, and Olien 1970). The knowledge gap concerns the differential derivation of knowledge from the mass media. Because the difference in functionality of mass media is small compared to the Internet, the Internet may create a usage gap that is different from the knowledge gap (Bonfadelli 2002; van Deursen and van Dijk 2014). The usage gap is a thesis broader than the perception and cognition of mass media; it is potentially more relevant for society with regard to differential Internet uses and activities in all spheres of daily life (van Deursen and van Dijk 2014).

Hypotheses

Although several studies have revealed the existence of interactions between access gaps (e.g., Hoffman, Novak, and Schlosser 2000; Ghobadi and Ghobadi 2013; Wei and Hindman 2011), the current understanding of these interactions is limited. Seeking to understand how different types of access are associated with each other, we expect that besides sufficient material access, Internet attitude facilitates the acquisition of the required skills and a diverse use of the Internet (Ferro, Helbig, and Gil-Garcia 2011; Helsper 2012; Selwyn 2004). We also expect that material access, which here is defined as the number of devices people use to access the Internet, is associated not only with the levels of Internet skills (using a broader spectrum of devices might enhance someone's medium-related skills, while providing more opportunities to develop content-related Internet skills) but also, directly, with the diversity of Internet use, as every device offers different applications (Mossberger, Tolbert, and Hamilton 2012). Based upon prior research and reasoning, we derive the following hypotheses:

H1: Internet attitude (higher) is associated with material Internet access (H1a), medium-related skills (H1b), content-related skills (H1c), and usage diversity (H1d).

H2: Material Internet access (higher) is associated with medium-related skills (H2a), content-related skills (H2b), and usage diversity (H2c).

H3: Medium-related skills (higher) are associated with content-related skills (H3a) and usage diversity (H3b).

H4: Content-related skills (higher) are associated with usage diversity.

Determinants of the Digital Divide

Digital divide studies have identified many variables that account for differences in attitudes, skills, material access, and usage. We analyze weight of these variables for all four types of access. First, we consider gender. Research has long found that men have more positive attitudes toward computers and more stereotyped attitudes regarding who is capable of using them (Whitley 1997). Furthermore, women experience more computer-related anxiety than do men and generally exhibit lower levels of information technology achievement (Cooper 2006). Although the physical access gender gap has diminished in many developed countries, men use the Internet more than women do because of more prior exposure to technology and of work-related requirements (e.g., Cooper 2006; Cotten and Jelenewicz 2006; Katz and Rice 2002; Meraz 2008; Wasserman and Richmond-Abbott 2005; Zillien and Hargittai 2009). Recent studies furthermore reveal significant differences in what men and women do online (Meraz 2008; van Deursen and van Dijk 2014; van Deursen, van Dijk, and Ten Klooster, 2015; Zillien and Hargittai 2009).

Age is the second powerful predictor of Internet use. Of all age groups, older adults tend to experience the lowest Internet attitude levels (Marquié, Jourdan-Boddaert, and Huet 2002), and make the least use of digital devices (Zickhur and Madden 2012). Age also has a negative relationship with medium-related Internet skills and, due to the conditional nature of Internet skills, also with content-related Internet skills (van Deursen, van Dijk, and Peters, 2011). Because of earlier exposure and training, peer use, and greater comfort with new technology, younger people exhibit the highest frequencies of Internet use (Chen and Wellman 2004; Eynon 2009; Katz and Rice 2002; Zillien and Hargittai 2009) and the highest diversity of Internet use (van Deursen and van Dijk 2014).

The most consistent determinant in digital divide research is probably the educational level of attainment (DiMaggio et al. 2004; Katz and Rice 2002; Robinson, Dimaggio, and Hargittai 2003; van Dijk 2005). A positive relation between educational level of attainment and Internet use results from greater awareness, better training, higher capabilities, and greater abilities to evaluate content (Rice, MacCreadie, and Chang 2001). People with lower educational levels have less material access (van Dijk 2005), have lower levels of Internet skills (van Deursen and van Dijk 2011; Hargittai 2002), and use the Internet in less beneficial ways (Hargittai and Hinnant 2008; Livingstone and Helsper 2007; van Deursen and van Dijk 2014; van Deursen, van Dijk, and Ten Klooster, 2015).

Income is positively related to Internet adoption in terms of a greater capacity to afford the costs of material access (Chinn and Fairlie 2007; Goldfarb and Prince 2008; Katz and Rice 2002; Livingstone and Helsper 2007; Ono and Zavodny 2007; Rice and Haythornthwaite 2005; van Dijk 2005). Furthermore, low-income groups exhibit more negative attitudes toward the Internet (Jackson et al. 2001; Barzilai-Nahon 2006). There is also evidence that persons of higher income use the Internet more efficaciously, and employ the Internet more productively and to greater economic advantage (DiMaggio et al. 2004), while people with lower levels of income status tend to use the Internet more generally and superficially (van Deursen and van Dijk 2014; van Deursen, van Dijk, and Ten Klooster, 2015; van Dijk 2005).

Finally, we consider Internet experience, often mentioned as a direct competitor of education and consistently demonstrated to be a strong predictor of Internet usage types (Eastin and LaRose 2000; Gil-Garcia et al. 2006; Hargittai and Hinnant 2008; Howard, Rainie, and Jones 2001; Livingstone and Helsper 2007; Zillien and Hargittai 2009). Furthermore, Internet experience appears to be relevant for performing on Internet skills (Hargittai 2002), especially medium-related Internet skills (van Deursen, van Dijk, and Peters, 2011).

Since the moderating effect of most of the discussed variables has been illustrated by work on the Unified Theory of Acceptance and Use of Technology (Venkatesh et al. 2003), we predict effects of all discussed determinants on the four access types. The following hypotheses are proposed:

H5: Gender (male) is associated with Internet attitude (H5a); material Internet access (H5b); medium-related skills (H5c); content-related skills (H5d); and Internet usage diversity (H5e).

H6: Age (younger) is associated with Internet attitude (H6a); material Internet access (H6b); medium-related skills (H6c); content-related skills (H6d); and Internet usage diversity (H6e).

H7: Education (higher) is associated with Internet attitude (H7a); material Internet access (H7b); medium-related skills (H7c); content-related skills (H7d); and Internet usage diversity (H7e).

H8: Income (higher) is associated with Internet attitude (H8a); material Internet access (H8b); medium-related skills (H8c); content-related skills (H8d); and Internet usage diversity (H8e).

H9: Internet experience (higher) is associated with Internet attitude (H9a); material Internet access (H9b); medium-related skills (H9c); content-related skills (H9d); and Internet usage diversity (H9e).

CORE MODEL

The conceptual model presented in Figure 1 shows the hypothesized relationships between the access types and the explanatory variables.

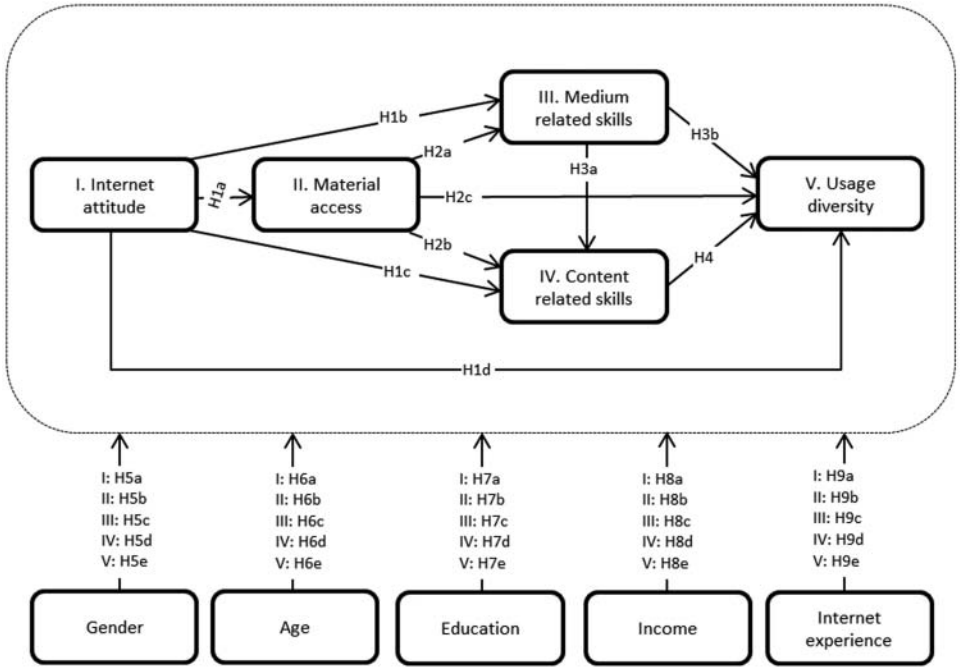

FIG. 1. Presentation of the study's hypothesized relationships.

METHOD

Sample

We relied on a data set collected in September 2012. Sampling and fieldwork were performed using PanelClix in the Netherlands. Respondents were recruited from an online panel of 108,000 people comprising a highly representative sample of the Dutch population. Members receive a small incentive of a few cents for every survey in which they participate. Panel members were e-mailed invitations to participate in the current study. The e-mail explained the survey topic and the time required to complete. In total, 2,600 people were randomly selected from the panel, with a goal of obtaining a sample of approximately 1,200 individuals. Respondents were selected in three rounds to account for gender, age, and educational level of attainment and to accurately represent the Dutch population.

Several measures were adopted to increase the survey response rate. The time required to answer survey questions was limited to approximately 15 minutes. In addition, the online survey used software that checked for missing responses. In total, 1,231 questionnaires were received, of which seven were rejected as incomplete. Thus, in total 1,224 respondents (47% response rate) were used for data analysis. In terms of education, age, and gender, our findings were consistent with the official data provided by Statistics Netherlands, though migrants were slightly underrepresented in our sample. Table 1 summarizes the respondents' demographic profile. The respondents' mean age was 48.2 years ($SD = 17.4$), ranging from 16 to 87 years. Most respondents were born in the Netherlands (95%). The average number of years of Internet experience was 11.8 ($SD = 4.6$).

Measures

In accordance with the model proposed in Figure 1, the questionnaire contained operational measures of Internet attitude, material Internet access, medium- and content-related Internet skills, Internet usage diversity, and sociodemographics.

Internet attitude was measured by the eight highest loading items of the Internet Attitude Scale (Durndell and Haag 2002). All items are balanced for the direction of response ($M = 3.44$; $SD = 0.48$; $\alpha = .69$; 5-point agreement Likert scale). Sample statements included "The Internet is dehumanizing to society", and "Life will be easier and faster with the Internet."

Material Internet access was measured using seven questions with a dichotomous answering scale. Respondents were asked which of the following seven devices they use to access the Internet: desktop PC, laptop PC, tablet PC, smartphone, game console, television, and electronic reader. All items were summed into a single scale that reflects the number of devices used to access the Internet ($M = 2.31$, $SD = 1.21$).

TABLE 1
Demographic profile

Characteristic	*N*	%
Gender		
Male	771	52.1
Female	710	47.9
Age (years)		
16–29	279	18.8
30–49	460	31.1
50–64	426	28.8
65+	316	21.3
Education		
Low	504	34.0
Medium	570	38.5
High	407	27.5
Employment status		
Employed	723	48.8
Unemployed	63	4.3
Disabled	88	5.9
Retired	371	25.1
Houseman/wife	104	7.0
Student	132	8.9

Internet skills were measured using a two-dimensional frequency-based instrument adopted from van Deursen, van Dijk, and Peters (2012; never to daily; 5-point scale). The original instrument proposed a four-dimensional inventory of operational, formal, information, and strategic Internet skills that previously demonstrated satisfactory psychometric properties. The original questionnaire was constructed using extensive, ecologically valid skill performance field tests as benchmarks, thus making the instrument more favorable than self-assessments of skills, which have significant problems of validity (Merritt, Smith, and Renzo 2005; Talja 2005). Sample items for medium-related Internet skills include "having problems with a website's layout," "downloading files," "not being able to open saved files," and "not knowing what button to push." Sample items for content-related Internet skills include "checking information on another website," "using more than one keyword," "finding information you were seeking," "use comparison websites when making a decision," and "profiting from Internet use." For the sake of parsimony and to create a two-dimensional instrument for medium- and content-related Internet skills, all correlating dimensions were again subjected to a principal component analysis, which identified two components that explained 56% of the variance. Consequently, 8 items were averaged as a measure of medium-related Internet skills ($M = 1.87$, $SD = 0.61$, $\alpha = .89$) and 10 items as a measure of content-related skills ($M = 3.54$, $SD = 0.80$, $\alpha = .90$).

Internet usage diversity was measured with several items used in the survey. Respondents were asked with what frequency they engage in 21 activities using a 5-point scale that ranged from "never" to "daily" as an ordinal-level measure in the analysis. The activities covered a broad range of activities, including "information seeking," "using online news services," "discussion groups," "training," "shopping," "social network sites," "watching videos," and "listening to music." All answers were transformed into a dichotomous answering scale, reflecting whether the Internet was used for a particular activity. Subsequently, the 21 dichotomous items were summed into a single scale that reflected the diversity of usage activities from 0 to 21 ($M = 15.03$, $SD = 4.06$).

Gender was included as a dichotomous variable. Age was computed by subtracting the reported year of birth from the survey year. Data on education were collected by degree as one of eight categories. These data were subsequently divided into three groups of low, medium, and high educational levels attained. Income was calculated as total annual family income in the last 12 months. Finally, Internet experience was captured by the number of years that people had been using the Internet.

Two rounds of survey pretesting were conducted with 10 Internet users, and amendments to the survey were made at the end of each round based on feedback. The respondents in the second round offered no major comments, at which point the survey was declared ready for posting.

DATA ANALYSIS

To test the hypothesized relationships presented in Figure 1, structural equation modeling using Amos 20.0 was applied. Structural equation modeling is a statistical methodology that adopts a confirmatory approach to the analysis of a structural theory bearing on certain phenomena (Byrne 2013). According to Byrne (2013), the term *structural equation modeling* conveys two important aspects of the procedure: (1) The causal processes under study are represented by a series of structural (i.e., regression) equations, and (2) the structural relations can be modeled pictorially to enable a clear conceptualization of the studied theory. The hypothesized model can then be tested statistically in a simultaneous analysis of all variables to determine the extent to which the model is consistent with the data. If the goodness of fit is adequate, the model argues for the plausibility of postulated relations, while if it is inadequate, the tenability of such relations is rejected (Byrne 2013). To obtain a comprehensive model fit, we included the suggested indices by

Hair et al. (2006): the χ^2 statistic, the ratio of χ^2 to its degree of freedom (χ^2/df), the standardized root mean residual (SRMR) (<.08), the Tucker–Lewis index (TLI) (>.90), and the root mean square error of approximation (RMSEA) (<.06). These fit indices are typically used to represent the three categories of model fit: absolute, parsimonious, and incremental.

RESULTS

Structural and Path Model

Statistical analyses were performed to examine basic assumptions of structural equation modeling. Normality, kurtosis, and skewness did not differ significantly from acceptable criteria, and there were no outliers, nor multicollinearity beyond what would be theoretically expected. Table 2 provides the correlations between the variables.

Figure 2 provides the path models with coefficients and variances explained. The fit results obtained from testing the validity of a causal structure of the conceptual model are good: $\chi^2(2) = 4.71$; $\chi^2/\text{df} = 2.35$; SRMR = .01; TLI = .97; RMSEA = .03 (90% confidence interval [CI] = .00, .07). The model explained 4% of the variance in Internet attitude, 25% in material Internet access, 18% in medium-related Internet skills, 40% in content-related Internet skills, and 49% in Internet use diversity.

Overview of Hypothesis

The standardized path coefficients in Figure 2 reveal several significant direct and indirect effects between the four Internet access types. A coefficient linking one construct to another in the model represents the direct effect of a determinant on an endogenous variable. An indirect effect indicates a determinant's impact on a target variable through its effect on other intervening variables in the model. A total effect on a given variable is the sum of the respective direct and indirect effects. These effects are summarized in Table 3. Hypotheses 1 through 4 are confirmed, with the exception of H1b. Overall, the sequential and successive nature of the employed model is supported.

The standardized path coefficients reveal, furthermore, significant direct and indirect effects of the five access determinants accounted for in the study. Direct, indirect, and total effects are summarized in Table 4. Most hypothesized relationships (5 through 9) are confirmed, with the exception of the contribution of gender to Internet attitude (H5a). Effects of gender on content-related Internet skills and usage diversity and of income on medium-related Internet skills and usage diversity are indirect.

Table 4 indicates that men have higher levels of material Internet access, medium- and content-related Internet skills, and usage diversity compared with women. A higher age contributes negatively to Internet attitude, material access, medium- and content-related Internet skills, and usage diversity. The indirect effect of age on content-related Internet skills is stronger than the direct effect, suggesting that the total effect of age on content-related Internet skills can be attributed largely to lower levels of medium-related Internet skills. A similar attribution is applicable for usage diversity, such that the total effect of age can be attributed largely to lower levels of medium- and content-related Internet skills. Education contributes directly to all access types. Indirect effects on content-related Internet skills and usage diversity are notable. Income directly affects material access. Some small indirect contributions to medium- and

TABLE 2
Correlation matrix

Constructs	1	2	3	4	5	6	7	8	9	10
1. Internet attitude	—	.25	*.02*	.37	.27	*−.03*	−.07	.09	.14	.17
2. Material Internet access	—	—	.27	.37	.43	−.16	−.34	.23	.31	.21
3. Medium-related Internet skills	—	—	—	.47	.55	−.19	−.38	.15	.08	*.01*
4. Content-related Internet skills	—	—	—	—	.57	−.14	−.32	.22	.21	.18
5. Internet usage	—	—	—	—	—	−.16	.44	.23	.15	.16
6. Gender	—	—	—	—	—	—	*.03*	−.12	−.22	−.12
7. Age	—	—	—	—	—	—	—	−.09	*−.01*	.06
8. Education	—	—	—	—	—	—	—	—	.36	.23
9. Income	—	—	—	—	—	—	—	—	—	.23
10. Internet experience	—	—	—	—	—	—	—	—	—	—

Note. Significant at $p < .05$; nonsignificant correlations are in italics.

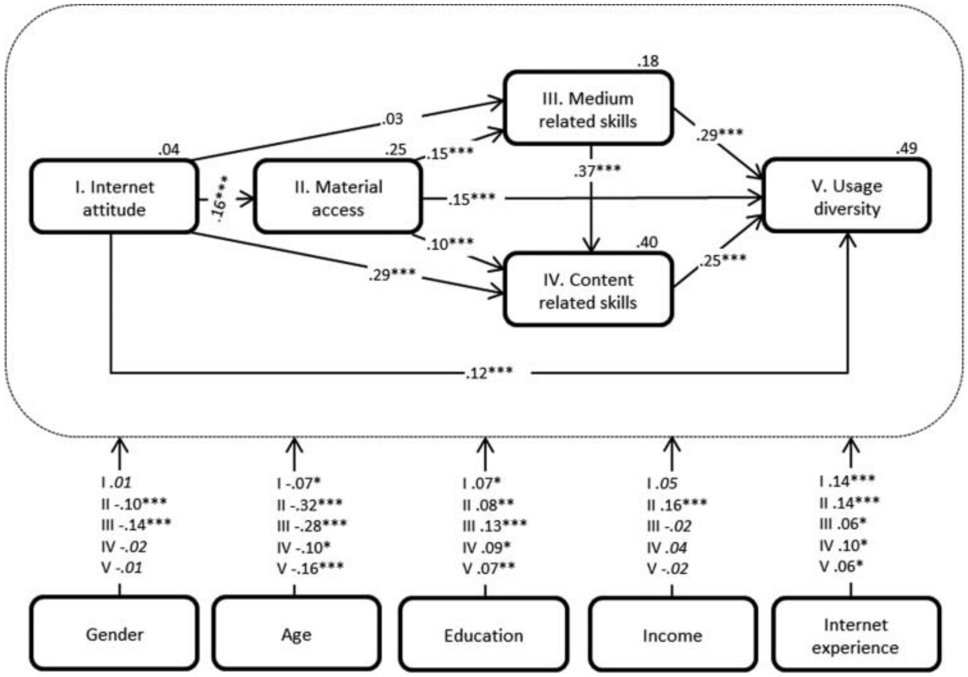

FIG. 2. Standarized path coefficients. Significance: ***$p < .001$. Squared multiple correlations are above boxes.

content-related Internet skills and usage diversity were observed. Finally, Internet experience contributes positively to all access types, directly and indirectly.

DISCUSSION

Main Findings

The current study investigated a multifaceted model of Internet access for a representative sample of the Dutch population. The model encompasses four types of access: attitude, material, skill, and usage. Although the Netherlands exhibits very high broadband household Internet penetration (96% in 2012) that facilitates participation in society online (Mossberger, Tolbert, and McNeal 2008), we find that several access divides are still present. This finding reconfirms policy initiatives that go beyond physical connectivity and address inequities in skill and usage levels (Epstein, Nisbet, and Gillespie 2011).

We have also shown that attitudinal and material access remain relevant since they are associated with all stages of appropriating digital technology. Internet attitude directly affects material access, the development of content-related Internet skills, and usage diversity. There is no direct effect on medium-related skills, suggesting that first material access is needed before these skills can develop. Attitudinal problems such as computer anxiety might be decreasing but have not disappeared. That suggests that making the Internet attractive for larger parts of the population with more relevant and user-friendly applications remains an important task. Improving one's attitude increases the likelihood of improving material access, individuals' skills in using the Internet, and a wider diversity of Internet use.

The broader property of material access remains highly relevant even though Internet penetration has reached high levels in developed countries. Material access has significant relationships with both the Internet skill type and usage diversity. Whether one has only a single access device to the Internet or more seems to be consequential, as may broadband versus narrowband access or the type of Internet subscriptions, though we did not account for these differences. Individuals with desktop computers, laptops, tablets, smartphones, and smart televisions can connect to the Internet everywhere and at all times of the day and therefore have considerably more opportunities to develop wide-ranging or varied skills and usage opportunities. Therefore, reduction in prices of devices and Internet subscriptions should be a major goal of policymakers, especially in developing countries.

The second major finding is that all four types of access to digital technology identified by van Dijk (2005) apply to Internet access. Moreover, they appear to be associated in the sequence van Dijk (2005) proposed. Although the sequence has a conditional nature in the

TABLE 3
Direct, indirect, and total effects of the Internet access sequence

Hypotheses	Direct effects β	Indirect effects β	Total effects β
H1a. Internet attitude → material access	.16	—	.16
H1b. Internet attitude → medium-related Internet skills	—	—	—
H1c. Internet attitude → content-related Internet skills	.29	.01	.30
H1d. Internet attitude → usage diversity	.12	.10	.22
H2a. Material access → medium-related Internet skills	.15	—	.15
H2b. Material access → content-related Internet skills	.10	.06	.16
H2c. Material access → usage diversity	.15	.09	.24
H3a. Medium-related → content-related Internet skills	.37	—	.37
H3b. Medium-related Internet skills → usage diversity	.29	.10	.39
H4. Content-related Internet skills → usage diversity	.25	—	.25

respect that skills, for example, will not develop without a sufficient Internet attitude or motivation and without physical and material access, all stages have their own grounds of determination and interact together to shape cumulative digital inequalities. Policies should address all access stages simultaneously. However, to enact effective policies of inclusion, it is important to understand that the number of devices used matters for medium- and content-related skills and for usage diversity. A particular minimum of medium-related Internet

TABLE 4
Significant direct, indirect, and total effects of Internet access determinants

Hypotheses	Direct effects	Indirect effects	Total effects
H5a. Gender → Internet attitude	—	—	—
H5b. Gender → material access	−.10	—	−.10
H5c. Gender → medium-related Internet skills	−.14	−.02	−.16
H5d. Gender → content-related Internet skills	—	−.07	−.07
H5e. Gender→ usage diversity	—	−.08	−.08
H6a. Age → Internet attitude	−.07	—	−.07
H6b. Age → material access	−.32	−.01	−.33
H6c. Age → medium-related Internet skills	−.28	−.05	−.33
H6d. Age → content-related Internet skills	−.10	−.18	−.28
H6e. Age → usage diversity	−.16	−.23	−.39
H7a. Education→ Internet attitude	.07	—	.07
H7b. Education→ material access	.08	.01	.09
H7c. Education→ medium-related Internet skills	.13	.01	.14
H7d. Education→ content-related Internet skills	.09	.08	.17
H7e. Education → usage diversity	.07	.11	.18
H8a. Income → Internet attitude	—	—	—
H8b. Income → material access	.16	.01	.17
H8c. Income → medium-related Internet skills	—	.02	.02
H8d. Income → content-related Internet skills	—	.03	.03
H8e. Income → usage diversity	—	.05	.05
H9a. Internet experience → Internet attitude	.14	—	.14
H9b. Internet experience → material access	.14	.02	.16
H9c. Internet experience → medium-related Internet skills	.06	.02	.08
H9d. Internet experience → Content-related Internet skills	.10	.05	.15
H9e. Internet experience → usage diversity	.06	.07	.13

skills is required for a good performance, considering content-related Internet skills. For example, the focus in improving Internet skills for older adults should be on medium-related skills because much of their content-related problems seems to originate from a lack of those skills (van Deursen and van Dijk 2009; van Deursen, van Dijk, and Peters, 2011). Finally, usage diversity is supported by all previous stages. In addition to affecting all prior access stages, usage diversity is likely to be driven by one's interests to use a particular application, interests that can be of a social, economic, cultural, or personal nature.

The third major finding is that overall younger people with higher educational levels and higher income and in some areas males have better Internet access. This has consequence since all access types are associated with each other. Internet experience also improves access in most stages. A closer examination reveals that gender most strongly affects material access, defined as having a multitude of Internet access devices and the corresponding medium-related skills. Effects of age are stronger and correspond with material access, medium-related skills, and, to a lesser extent, content-related skills and usage diversity. Indirect effects of age are significant for content-related skills and usage diversity, thus suggesting that older people must improve their medium-related skills to perform in content-related skills and to develop a diversity of Internet applications. Educational level of attainment is consequential in the same access types as is age. Income primarily affects material access, or the number of devices an individual can afford to establish an Internet connection. Internet experience has stronger direct effects on Internet attitude and material access than on skills. This suggests that individuals who have a positive attitude towards the Internet and who use several devices are not also necessarily developing skills and improving their usage diversity. More than experience is needed to fully appropriate Internet technology. Although people learn to use the Internet by trial and error in daily practice, they are not guaranteed to develop the Internet skills required to perform all tasks. Internet experience has a small direct effect on usage diversity: Users might stick to their habits and their favorite applications. To develop more skills and to enhance usage diversity, people require a particular social position that motivates or forces them to learn specific skills or to use a multitude of applications, for example, positions such as a job, a school or training membership, or a family role involving the support of school-going children. Giving people high-skilled jobs and difficult school assignments might enrich their command of Internet skills and diversity of Internet applications more than might leaving them to develop their own experience independently.

Limitations

In this study, we used van Dijk's (2005) multifaceted model of attitude, material, skills, and usage access to investigate the digital divide in the Netherlands. By studying different types of Internet access simultaneously, we revealed noteworthy associations between different types of access gaps. van Dijk's (2005) model, however, is one among several others for explaining digital divides (e.g., Attewell 2001; Chen and Wellman 2004; DiMaggio et al. 2004; Katz and Rice 2002; Livingstone and Helsper 2007; Mossberger, Tolbert, and Stansbury 2003; Selwyn 2006; Ono and Zavodny 2007; Warschauer 2004). By focusing on these models in future studies, we can enhance our understanding of the interplay between different types of access gaps. Unfortunately, compared with bivariate analyses of digital divide sources, multivariate analyses are far less common. Furthermore, future studies should focus on the mechanisms through which motivational, material, skills, and usage access gaps interact with each other in shaping the digital divide. For example, Ghobadi and Ghobadi (2013) employed a qualitative methodology that provides a theoretical grounding for future research on digital divide dynamics. This corresponds to the calls for theoretical–qualitative research studies in this area (Mason and Hacker, 2003; van Dijk, 2006).

The operationalization of the four access types under consideration in the current study has some limitations. First, attitude is posited as negative, for example, in the form of computer anxiety. Anxiety, however, might also be considered as a subjective reaction to a specific situation, an emotion (Frijda 1988; Lester, Garofalo, and Kroll 1989). Understanding attitudes and emotions as discrete entities might have implications in studying Internet use. Xie and Newhagen (2012), for example, considered anxiety as a three-level model, a line of thinking that can generate new attitudinal components, such as frustration (Bessiere et al. 2006) or efficacy (Hollander 1996).

Second, material access was measured by the number of devices used to access the Internet. Although we argued that all devices are complementary to each other, in our operationalization Internet access on one device (e.g., laptop) is considered "equal" to access on another device (e.g., game console). Although the number of devices used was indeed associated with, for example, skills and usage types, it is worthwhile in future studies to elaborate on this concept and to consider how (new or improved) devices affect the way the Internet is employed, in turn affecting Internet skills and Internet usage opportunities. Other facets of material access should also be considered in future studies—for example, the type or speed of the Internet connection.

Third, skills access is conceptualized as a distinction between medium- and content-related Internet skills, where content-related skills consist of information and strategic skills. Since the Internet evolves rapidly, recent additions to content-related skills include communication and content creation skills (van Dijk and van Deursen 2014). These skills should be added in future studies to provide an even more nuanced understanding of how Internet skills interplay with other access types.

Finally, a commensurate consideration should apply to usage diversity. Not only are more services and applications moving online, but the changing nature of the Internet, for example, also generates increasing expectations that individuals are becoming producers of Internet content (Schradie 2011), a role that would require its own particular equipment or materials and range of skills.

The current study was conducted among the Dutch population, which is characterized by high levels of Internet broadband access. In the Netherlands, Internet use is maturing and increasingly reflects known social, economic, and cultural relationships in the offline world (van Deursen and van Dijk 2014). Replication of this study in developing countries is likely to yield new insights. We expect attitude and material access to be even more important in improving skills and different types of usage. However, policies ensuring positive attitudes and required materials alone will not guarantee skilled and fruitful Internet usage. Furthermore, investigating different sources of access simultaneously in developing countries might result in different gravities of the four types of access gap, in turn demanding different policy initiatives.

In the current investigation, five important sociodemographi/ceconomic indicators and their interrelationships with different access types are explained. However, many variables are missing and need incorporation in future studies. Which factors are added depends on the context and goal of the study. The factor of race, for example, is less relevant in the Netherlands, but is an important predictor to several access types in U.S. studies (e.g., Jackson et al. 2008).

A final remark concerns the link between social exclusion and the digital divide. Although the research on the digital divide is moving beyond single outcome indicators to more refined multifaceted constructs, incorporating attitudes, access, skills, and different levels of engagement with technologies, there has been limited theoretical advancement regarding the complexities of the links between social exclusion and digital exclusion (Helsper 2012). Future work should investigate how the sources of Internet access together shape digital exclusion and subsequently relate to offline social exclusion. The explicit assumption concerning the access models, such as the one used in this investigation, is that Internet access is good. The idea is that it provides access to information, communication, knowledge, control facilities for everyday life, commodities, and opportunities to exercise civil rights (van Dijk 2005; Rice, MacCreadie, and Chang 2001). However, the link with social exclusion is complex, for example, because the perceived social value of a system differs for the phase in the diffusion curve (Newhagen 1998).

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