Individual-Multinational Study of Internet Use: The Digital Divide Explained by Displacement Hypothesis and Knowledge-gap Hypothesis

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Individual-Multinational Study of Internet Use: The Digital Divide Explained by Displacement Hypothesis and Knowledge-gap Hypothesis

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ABSTRACT

The digital divide phenomenon manifests both within and between developed and less-developed countries. The purpose of this study is to provide a theoretical foundation for digital divide research and, subsequently, to identify patterns of internet adoption and use based on individual behaviors of long-established media systems and variables traditionally employed to predict the digital divide. The knowledge gap hypothesis and the displacement hypothesis, both from the communications literature, are utilized in combination to study digital inequality and to make clearer the role of time spent with traditional media in the perpetuation of the digital divide.

Keywords

Digital divide, displacement, knowledge gap, internet, inequality.

INTRODUCTION

The inequality of information acquirement from traditional mediums such as newspapers and radio (Tichenor, Donohue, & Olien, 1970) has been replicated with the internet (Bonfadelli 2002). This phenomena is reasonable given that, compared to traditional media, the internet is a dynamic medium for information exchange, communication, and commerce. The dynamic nature of the internet requires users possess greater skill to extract information from this source, though differences in information acquirement from the internet may also be due to different rates of access and use of the internet to begin with, otherwise referred to as the digital divide.

In the European region, 58.3% of the population utilizes the internet compared to 78.3% in the North American region. The growth of internet use penetration from 2000 to 2011 has increased 353.3% in Europe and 151.7% in North America. Even while technology penetration rates have exponentially increased, there remains an evident divide between citizens who use the internet and those who do not. This digital divide, generally defined as the gap between those who can access and use digital technologies and those who cannot (e.g. Lu, 2001), is measured for internet by the inequality of internet access and internet use, classified as first-level effects and second-level effects (Hargittai, 2002 and Dewan & Riggins, 2005), respectively.

Digital divide phenomena manifest both within and between developed and less-developed countries. These divides naturally categorize citizens into either the advantaged or disadvantaged side of the divide, where those on the disadvantaged side of the digital divide are those who do not access or use the internet. These individuals tend to be those of lower socioeconomic status and, while the price of information and communications technologies (ICTs) is generally decreasing, access to certain technologies such as the internet remains non-uniform. For example, internet use (per 100 people) continues to vary widely within and between nations.

Despite the abundance of literature focused on digital divide, many studies in the research stream lack a theoretical foundation that supports the inequalities of information retrieval through ICTs. As a result, certain likely predictors of the digital divide have not been explored in the literature. It is unknown whether or not traditional information delivery sources such as newspapers, radio, and television, are being displaced by the internet or if their continued use is contributing to the internet digital divide. The purpose of the present research is to address this gap by providing a theoretical foundation for digital divide research and, subsequently, to identify patterns of internet use that are contributing to the digital divide.

http://www.internetworldstats.com/stats.htm - Internet user percentage was last updated March 2011.
adoption and use based on individual use of long-established media systems along with variables traditionally employed to predict the digital divide. The purpose is accomplished by adopting and updating a theoretical framework appropriate for the explanation of differences in ICT access and use both between and within countries. The knowledge gap hypothesis and the displacement hypothesis, both from the communications literature, are utilized in combination to study the digital divide and to make clearer the role of time spent with traditional media in the perpetuation of the digital divide. These ideas are tested in the present research that focuses on individual-level internet inequalities within and between a number of countries.

BACKGROUND AND THEORETICAL FOUNDATION

Displacement Hypothesis

Research on displacement dates back as early as the 1940’s when scholars in the communication field investigated the effect of radio on reading print media (Lazarsfeld, 1941) and books (Lazarsfeld and Kendall, 1948). Soon after, other researchers investigated the decline of newspaper purchases (Belson, 1961) and the change in the function of the radio (Parker, 1960) at the same time televisions sets were being rapidly adopted in homes. Decades later, ongoing research on displacement continues to explore new ICTs (e.g. personal computers and internet) as they are introduced. A survey of this literature is presented below.

Researchers have examined several forms of displacement. The first is time displacement, which occurs when excessive use of a specific medium or involvement in an activity advertises time spent engaged with/in alternatives (Mutz, Roberts, and van Vuuren, 1993; Robinson and Kestnabum, 1999; Cai, 2005). A second form of displacement is functional displacement. Robinson and Martin (2009) refer to functional displacement as functional equivalence and in its definition assert that “a new technology will replace those activities that most closely perform the same functions for users as did the older technologies” (p.16). Similarly, Ferguson and Perse (2000) describe functional displacement as functional alternative, as new media that can displace older media provided it can be used to achieve existing goals. Finally, Kayany and Yelsma (2000) distinguish functional displacement as the replacement of existing resources with a new resource(s) that functions as the primary means of meeting a population’s need(s). From the overlapping conceptions of the phenomena described above, functional displacement can be understood as the replacement of a technology or activity with one that is similar and, because of its superior effectiveness and efficiency, becomes the primary outlet for meeting the needs of an individual or population.

Previous research has investigated internet use and displacement effects. In comparisons by gender and generation, Kayany and Yelsma (2000) find time displacement is significantly different for adults and children (children displace more time spent viewing television and engaging in telephone and domestic conversations with internet use) but not for males and females. In relation to youth’s functional displacement of traditional media, Lee and Kuo (2002) find support with a Singaporese sample for the displacement of television with the internet but an increase in the use of radio listening and newspaper reading accompanied by internet use. Ferguson and Perse (2000), on the other hand, find the opposite effect with a sample of college students whose behavior indicated that the World Wide Web and television are functionally dissimilar and, therefore, internet use does not displace television viewing.

Other time displacement studies have evidenced an opposite (supplemental) effect with adult samples. Robinson and Kestnbaum (1999) evaluated the time displacement of personal computer users and nonusers in relation to leisure activities and participation in social events. Their results show that average users and heavy users of personal computers are more likely to participate in leisure activities or social events than nonusers, concluding that personal computer use supplements other activities rather than displaces them. A later study by Robinson, Kestnbaum, Neustadtl and Alvarez (2000) makes evident similar supplemental effects of internet use on social activities and the use of traditional media.

Knowledge Gap Hypothesis

Knowledge acquirement requires the adoption of innovations; however, the acquirement and use of such innovations are influenced by individuals’ socioeconomic status. Everett Rogers, a prominent scholar in diffusion of innovations, addresses the importance of social economic status (SES) in the adoption of innovations and states that the diffusion of innovations contributes to the gap between citizens of different socioeconomic status (Rogers, 2003). This gap exists between two segments—an advantaged group that adopts the innovation and a disadvantage group that is unable to adopt the innovation, at least not as rapidly as the former. This inequality of innovation diffusion in a social system consequent of the differences in SES is related to the diffusion of knowledge among
individuals in two ways. First, knowledge attainment stems from innovation access and, second, knowledge attainment is a function of the ability to process information; these effects are elaborated next.

Information is required for individuals to adopt innovations and the diffusion of information occurs through innovations that have been adopted (Rogers, 2003). This relationship between knowledge and individual adoption of innovations is conventionally addressed in the diffusion research, yet similar concepts are included in the mass communication literature, appearing as early as 1970. Phillip Tichenor and his associates (Tichenor et al., 1970) investigate the disparities of information attainment due to socioeconomic status. Decades later, Persaud (2001) related that, “knowledge comes from people with time and resources to discuss, think and experiment” (p.109) and found that the gap in knowledge between countries is ten times as large as the gap in income.

Tichenor, Donohue, and Olien (1970) introduce the knowledge gap hypothesis that states as information is diffused by mass media systems across groups of citizens in a social system, the acquirement of this information by these citizens will be differential or unequal based on their SES. A knowledge gap can occur whenever there is a significant difference in knowledge acquirement by individuals; therefore, knowledge gaps can manifest in greater or lesser degrees and vary across topics. This occurs because citizens with higher SES have the advantage that they acquire information at a faster rate than citizens of lower SES. This is not to say that the disadvantaged segment do not eventually acquire the information, they just may do so at a later time period.

Tichenor et al. (1970) operationalize SES as educational attainment and provide five reasons to explain why the knowledge gap can be attributed to formal education. The first contributing factor of the knowledge gap is communication skill, which provides an individual the valuable reading and comprehension skills necessary to acquire information. The second factor, stored knowledge, entails prior knowledge from previous exposure to the topic that leads to a better understanding of information in the future. The third reason is the relevant social contacts, which are interpersonal connections that represent a network of people with whom an individual can discuss information. The fourth factor, selective exposure, acceptance, and retention of information, is the idea that information being acquired is largely dependent on that which is relatively consistent with existing attitudes, beliefs, values, all of which are influenced by individuals’ education. The final contributing factor is the nature of mass media system, explained as sources of information acquirement, such as print media—often utilized by educated or “higher-status persons” (Tichenor et al., 1970).

THEORY DEVELOPMENT

The seminal research studies by Tichenor et al. (1970) and Donohue et al. (1975) address the knowledge gap that emerges from the use of traditional media systems. Tichenor et al. (1970) and Donohue et al. (1975) investigated the knowledge gap arising from information attained by reading newspapers. Although Donohue et al. (1975) operationalized mass media as newspapers, they tested the knowledge of participants by asking respondents whether they have read or heard anything about a particular topic in recent months. Therefore, by asking participants what if anything they ‘have heard’, researchers may have inadvertently generated responses based in other information delivery sources (e.g., word-of-mouth through social contacts, television, or radio).

Research conducted on the use of a single medium (like newspapers) or on traditional media alone (i.e., without inclusion of the internet), limits the generalizability of findings because the nature of mass media is one factor that contributes to the knowledge gap (Tichenor et al., 1970). By the same reasoning, studying internet use separate from the use of other media similarly limits generalizability of findings. Mass media systems, including the internet, are utilized differently by disparate status groups. As evidenced by Tichenor et al. (1970), higher status groups traditionally use print media sources more than lower status groups, an outcome that is likely owed to common use of the medium by their relevant social contacts and the level of reading and comprehension skills attained from formal education. Other information delivery sources that do not require as much skill, like television, may be utilized by lower status individuals in place of reading print media. Comparatively, the internet is a newer information source that requires technical knowledge and skills for effective utility of the medium.

Technical knowledge and skills as a contributing factor to information acquirement has rarely been incorporated into research on the knowledge gap and the digital divide even though the importance of technical knowledge and skill to communication was recognized decades ago by Katzman (1974:51) who proposed the impact of new communication technology on acquiring knowledge and stated, “A certain degree of ability to use new technology can probably be called ‘innate’ but it is important to note that much acquired knowledge and skill is directly related to the ability to acquire more information. In some cases the key is technical knowledge.” An exception to the lack of research assigning importance to technical knowledge and skill on knowledge gaps are Hargittai and Hinnant.
(2008), DiMaggio et al. (2004), Celeste and Shafer (2004). Hargittai and Hinnat (2008) claim individual skills contribute to the knowledge gap and sample individuals of high SES in an effort to understand their online skill and types of website visits. Consistent Hargittai and Hinnat’s view, DiMaggio et al. (2004), find that low technical skills contribute to individuals’ cost to use the internet compared to their cost to use traditional media. In addition, Bonfadelli (2002) attempts to integrate the knowledge gap perspective with the internet digital divide by focusing on the differences in information acquisition between traditional mediums and the internet and the impact of internet access and use on the knowledge gap. The author proposes that in order to meaningfully use the internet, individuals need to acquire the skills traditionally possessed by journalist in retrieving information. For example, internet users need to follow purposeful searching strategies and assess the credibility of sources. The internet potentially provides unlimited information and, compared to traditional media, is more widely available, better informs users of politics, and is less biased because information is not composed by journalists (Bonfadelli, 2002; Hargittai and Hinnant, 2008).

Drawing from the research of Bonfadelli (2002), and given the similarity in predictors of the knowledge gap and digital divide, we propose that the framework embodied by the knowledge gap hypothesis can be used to explain the digital divide. The knowledge gap is a phenomenon that results from varied use of multiple media systems and the digital divide results from varied adoption and use of a single technology (e.g., the internet). While the focus of digital divides has been singular technologies (either computer or the internet), we propose that internet adoption and use, and thus the digital divide, may also be a function of time and functional displacement of traditional media. Therefore, the knowledge gap hypothesis framework, which by its nature incorporates multiple media systems, can be appropriate for theoretically understanding the digital divide when it is studied in a context that incorporates traditional media alternatives. In addition, common predictors of the knowledge gap and the digital divide have been evidenced, including SES, demographics, and individuals’ skills.

An update to the knowledge gap framework that is necessary to study the digital divide is the addition of technical knowledge and skills as a contributor to the divide, the investigation of the internet as one of multiple media systems alternatives, and the incorporation of time and functional displacement effects.

Figure 1 illustrates an integration of the knowledge-gap, time displacement, and the digital divide. Individuals’ demographics, SES--inclusive of income and education--and motivation are antecedents of skills which can predict selection of the media system individuals primarily use and how much time they spend with that and other mediums. These differences between those with and without the ability and/or willingness to access or use the internet results in a digital divide. Finally, the digital divide and knowledge gap perpetuate one another since a lack of knowledge leads to slower adoption and limited use of innovations and the failure to adopt or utilize innovations, like the internet. This in turn can result in less access to and acquirement of information and, consequently, reduced knowledge.

The digital divide exists on multiples levels (Dewan and Riggins, 2005). One level is the adoption of the internet. This divide is associated with technology infrastructure and the characteristics of adopters and non-adopters. Citizens in communities that lack the physical infrastructure to support internet use are automatically on the disadvantaged side of the digital divide. Assuming the presence of internet technology infrastructure, individuals’ income largely predicts whether or not they have access to the internet. The second-level of the internet digital divide addresses a) different ways people use the internet, or the purpose(s) of use (e.g., e-commerce or gaming), and b) their frequency of internet use. Demographics, SES, and technical (computer) skills are all predictors of variations in internet use.

We incorporate a third level of the digital divide into the conceptual model--internet as the primary source of information--and suggest that this construct manifests from time and functional displacement of traditional media with use of the internet. This third level is distinct from Wei, Teo, Chan, and Tan (2011) proposed third level of the digital divide, termed the “digital outcome divide”, which is not a level of the digital divide, per se, but actually a component of the knowledge gap. The digital divide may persist as a function of media system choice and the time spent using each medium. More specifically, a gap will form between those whose primary media source is the internet and those whose primary media source is a traditional one (or several combined). Traditional media can be displaced by the internet but will remain the primary media source as long as the time spent using this media is more than the time spent using the internet. However, when the time spent using the internet becomes a majority of time spent with all media, the internet functionally displaces traditional media systems as the primary media source, and ameliorates both the digital divide and the knowledge gap. These relationships are presented in the model below and further described in the following section.
HYPOTHESES

Regardless of the environment, Katzman (1974) suggests that the ability to access information must be present to gain knowledge. This ability to access information is an antecedent to use of media sources, so that access and use of media channels are both dependent on factors of demographics, SESs, and media system choice. The following sections provide hypotheses related to these proposed relationships.

Displacement of Media Channels

The traditional sources of communication technologies such as the newspaper, radio, and television are mediums that have provided citizens with information for decades. Information and communication technologies have evolved from these one-way communication channels to two-way communication outlets (e.g., telephone and internet) and while newer ICTs contain similar functionalities of traditional mediums, the long-established information sources continue to be used. This continued use of traditional media may consequently impact the adoption and/or use of newer technologies (Cai, 2005).

New mediums or activities that are functionally similar and more effective have a greater chance of displacing mediums or activities that are traditionally used (Neuman, 1988). For example, Lee and Kuo (2002) state that internet use and watching television both provide the same gratifications and satisfactions and require a great deal of attention in their effective use. As such, the internet provides individuals with interaction and personalization opportunities, making the medium more effective and likely to displace television. This effect is evident in a preliminary study on internet and society by Nie and Ebring (2000) who find that the time individuals spend using the internet is expensed by their television time, an example of time displacement (Mutz et al., 1993). The authors also find that time spent reading newspapers is expensed less than time spent watching television and that individuals are likely displacing reading newspapers with consumption of news on the web. According to Lee and Kuo (2002), the main functions of radio and newspaper are unequivocal to the internet because newspapers function mainly as an information source and the radio acts as an entertainment source that can be used in the background, simultaneously with other activities. In contrast, other research evidences that newspaper reading increases with internet use (Robinson, Kestnabaum, Neustadtl, and Alvarez, 2000).

Consistent with the displacement hypothesis and empirical evidence, we posit that access to the internet will be associated with the amount of time watching television.

H1: The amount of time spent watching television will be negatively associated with internet use.

Research undertaken to test the knowledge gap hypothesis indicates that individuals with more education are likely to read newspapers more than those with less education because of the literacy skills necessary to understand newspaper content (Tichenor et al., 1970). Separately, Robinson, Barth, and Kohut (1997) and Robinson et al. (2000) found positive associations between newer ICTs use and newspaper reading, suggesting that individuals may verify information from one medium with another or information not found in one source may be searched for in the alternative medium. We additionally predict that newspaper reading can increase internet use because printed media
can drive users to a number of websites, including newspapers’ corresponding website, sites linked to stories appearing in the newspapers, and websites associated with newspaper advertisements. Therefore, we hypothesize that time spent reading newspapers will increase the time spent using the internet.

**H2: The amount of time spent reading the newspaper will be positively associated with internet use.**

Similar to the relationship between reading newspapers and internet use, listening to the radio can increase internet use because radio messages can drive users to a number of websites, including radio stations’ corresponding website, sites linked to stories and people featured on the radio, and websites associated with radio advertisements. Therefore, we hypothesize that time spent listening to the radio will increase the time spent using the internet.

**H3: The amount of time spent listening to the radio will be positively associated with internet use.**

**Perpetuation of the Knowledge Gap Hypothesis through Displacement**

Use of personal computers and the internet require a great deal of understanding compared to traditional media. In particular, individuals must comprehend the potential uses of computers and the internet as well as how they function. The learning process required to use a personal computer differs from that necessary to operate a television, for example. The latter involves less literacy compared to that for personal computers, which requires individuals to learn packages of software. Given the skill requirement of newer ICTs, high SES individuals are assumed to possess the ability to utilize these technologies. This contrasts to low SES individuals, who may continue to rely more on less skill-based technologies for information.

The underlying factors that account for the knowledge gap hypothesis do not focus on difference in use of various information sources. For example, that knowledge of an event can be attributed to information gained from one or more sources (e.g., radio, print, TV and/or the internet). In his study on the knowledge gap hypothesis and the internet, Bonfadelli (2002) states that the knowledge gap that results from the internet is a function of inequality of internet access, internet use, and skills. This the author contrasts to the knowledge gap that results from traditional media (television and press), which results from differences in education and motivation. This framework is a comparison of the knowledge gap within media types and does not incorporate the knowledge gap that may result from media choice, that is, the knowledge gap that results from differences in information attainment between media sources. More generally, the knowledge gap hypothesis works under the assumption that knowledge of citizens in a social system results only from varying levels of media coverage from a single source, rather than varying levels of media source access and use. The present research argues that the choice of information sources contributes to the knowledge gap to the extent that different mediums provide different levels of quality and quantity of information based on different time lines (e.g., reading news from the internet is very current compared to reading from a print source). Therefore, lower SES individuals are likely to use traditional sources whereas high SES individuals are likely to use newer mediums. In addition, since skill level is positively related to seeking and gaining information faster from media sources (Tichenor et al., 1970, Katzman, 1974), even when individuals of lower SES use newer ICTs, skill limitations may lead to less effective use of these sources. By applying the knowledge gap and displacement hypotheses to the digital divide, we posit that SES will predict a divide in the use of information media.

**H4a: Education will be positively associated with internet use.**

**H4b: Income will be positively associated with internet use.**

**H5a: Education will be negatively associated with traditional media use.**

**H5b: Income will be negatively associated with traditional media use.**

**METHODOLOGY**

**Sample and Data**

The present research will make use of the European Social Survey (ESS) which appraises a wide range of individual attitudes, beliefs, and behavioral patterns across 30 European nations. European countries were chosen to study the digital divide in internet access and use because, according to the 2011 Global IT Report, “Both in fixed and mobile

http://www.weforum.org/reports/global-information-technology-report-2010-2011-0
broadband, the European Union continues to be the largest broadband market in the world.” Given this trend, the present research will analyze member and non-member countries of the European Union to provide insight into ICT adoption and use patterns in Europe.

The ESS is a trend study that contains a total of five data collection waves where individuals surveyed varied across time periods. While this feature can create heterogeneity in the data, the issue is minimized given that the samples are generally accepted as representative of the country populations. Data was collected by survey in time periods lasting two years, starting in 2002-2003 and ending in 2010-2011. Data from each of these waves will be utilized to analyze ICT adoption and use patterns across countries over time.

**Measures**

*Internet use*

Internet use was measured by frequency. Respondents answered the question, “How often do you use the internet, the World Wide Web or e-mail – whether at home or at work.” For this variable, individuals will be categorized dichotomously as either high-intensity users or low-intensity users. High-intensity users will be coded as 1 and low intensity users will be coded as 0. No objective predetermined cut-off points for internet use have been established. The values of the ESS questionnaire item from which the dependent variable is derived consists of an 8-point scale that measures both internet access and use whether at home or at work. Since the present research focuses on internet use, we drop the internet access value. We then split the remaining values into a binary scale where high-intensity users are those who use the internet more than once weekly and low-intensity users are those who use it less frequently. We tried in this way to categorize the data more clearly than it may have been classified by the survey. For example, the two answers “Once a week” and “Several times a month” may be equivalent and were therefore both categorized as low frequency use along with “Once a month”.

*Socioeconomic Status*

Socioeconomic status is inclusive of education and income. Education was measured as formal schooling of individuals. Education will be coded using six categorical variables that represent increasing levels of educational achievement. Income is presented as a yearly measure and will be coded as a categorical variable where low income, lower middle income, upper middle income, and high income will take a value of 1, 2, 3, and 4 respectively.

*Media systems*

Media systems refer to both the choice of traditional media systems—newspapers, radio, and television—and their frequency of use. These variables were measured by the total time on an average weekday that the media were used. The frequency of use of these media will be coded continuously, ranging from 1 to 4, and where no time at all spent with a medium is coded as 0.

*Countries*

Dummy variables will be assigned to each country so that the country in which an individual resides will take a value of 1 and all other countries will take a value of 0.

**ANALYSES**

Two equations will be evaluated in this research. In the first, the outcome is binary and represents low and high frequency internet use. In the second, the outcomes are continuous and represent a frequency distribution of traditional media use in hours for TV, radio and newspapers. To test hypotheses 1, 2, and 3 that investigate internet use as a function of media choice behavior, logistic regressions will be performed for each country and all five waves. Hypotheses 4a and 4b are also tested using logistic regression where the predictor variables are those encompassed by SES, education and income, respectively, and the dependent variable is the status of individuals as either high- or low-intensity internet users. We do not assume normality in the data and thus have chosen to be more cautious in our analysis and perform logistic regressions. Hypotheses 5a, and 5b that investigate individuals’ use of traditional media will be tested using a multivariate analysis. Employment status, age and gender will be controlled for in all models and education and income will be included as controls in order to test hypotheses 1-3. Ultimately, patterns in internet and media use for samples in each country across time periods will be analyzed using t- and chi-square tests to compare proportions.

**CONCLUSION**
The present study incorporates research from communications literature to provide theoretical justification for the digital divide phenomenon. The roles of displacement and knowledge gap hypotheses are essential in understanding individual behavior of media system choice that may ultimately result in the perpetuation of the digital divide. With traditional media widely adopted and presently utilized at a decreasing cost, groups disadvantaged by their SES may be far-embedded in these systems, a condition that may prevent them from adopting or using newer ICTs.

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