GOING ONLINE WITHOUT EASY ACCESS: A TALE OF THREE CITIES

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ABSTRACT: *Building on a national study that showed that concentrated poverty matters for the "digital divide," this research compares the influence of the neighborhood-level context in three cities that vary in racial composition and income. We use a 2005 random digit-dialed survey of respondents in Northeast Ohio communities, and find unexpectedly that residents in areas of concentrated poverty demonstrate efforts to go online despite lacking home or work access. We analyze the results using regression models that include contextual "buffers" that create a unique geography for each respondent within a half-kilometer radius. Respondents who live in areas with a high percentage of African Americans or college graduates are more likely to go online even if they lack convenient Internet access, although the percentage of college graduates has a greater effect. At the neighborhood level, race and education influence the context for technology use.*

What experiences do residents of poor urban communities have with information technology? Recent national research has highlighted the role of concentrated poverty in reducing information technology access and use (Mossberger, Tolbert, & Gilbert, 2006), and this research endeavors to better understand processes at the neighborhood level. In an examination of three cities in Northeast Ohio, one high-poverty and majority African-American community was distinctive for the relatively high percentage of residents who went online even though they lacked Internet access at home or at work, and we explore individual and neighborhood factors that influence this effort to go online without convenient access.

This pattern of going online without easy access suggests complex interactions between race and concentrated poverty, as some research has shown that African Americans have more positive attitudes toward technology than similarly situated whites, and other studies have demonstrated that residence in high-poverty communities diminishes Internet access and use (Mossberger,

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JOURNAL OF URBAN AFFAIRS, Volume 30, Number 5, pages 469–488.

ISSN: 0735-2166.

Tolbert, & Stansbury, 2003; Mossberger et al., 2006). While national studies have yielded generalizable results on the importance of "place," more research is needed to understand contextual factors at the neighborhood level. This study builds on prior national research by using a random-sample telephone survey conducted in three Northeast Ohio communities in 2005: East Cleveland, which is predominantly African American and very poor; Youngstown, which is a larger, poor, and racially mixed city; and Shaker Heights, which is an affluent Cleveland suburb that is racially diverse. This sample allows us to explore race and other community characteristics for their influence on respondent experiences and behavior.

By focusing on three communities rather than a national sample, we examine these and other contextual factors in greater detail and map them more precisely. Using "buffers" to measure the unique demographic and socioeconomic environment for each individual, we find two different trends. Individuals in majority African-American neighborhoods who lack Internet access at home or at work are more likely than other respondents without access to go online in some setting. Yet, the educational attainment of a community has an even greater influence on technology use than its racial composition, and there are different patterns of Internet users who lack convenient access, with potentially different implications for future technology use.

PRIOR RESEARCH: DIGITAL INEQUALITY, RACE, AND POVERTY OF PLACE

The term "digital divide" refers to systematic disparities in information technology access and use based on age, income, education, race, and ethnicity (Norris, 2001; U.S. Department of Commerce, 2002). A number of reports using descriptive statistics have demonstrated that African Americans and Latinos have lower rates of technology access and use than white Americans (e.g., U.S. Department of Commerce, 2002, 2004), and these differences are statistically significant even when we control for income, education, and other individual-level factors (Mossberger et al., 2003; Fairlie, 2004). African Americans and Latinos are also statistically less likely than white respondents to report that they have the skills they need to use computers and the Internet, controlling for other factors (Mossberger et al., 2003).

But the effects of race and ethnicity are contradictory. African Americans, and to a lesser extent Latinos, are even *more* likely than similarly situated whites to express positive attitudes toward information technology. Despite lower rates of access and skill, African Americans are also among those who are most likely to search for a job online or to take an online class, all else equal (U.S. Department of Commerce, 2002; Mossberger et al., 2003). Finally, African Americans are more likely than similarly situated whites to report willingness to use public access for computers or the Internet, or to learn new technology skills in a variety of ways. Survey responses show the conviction among African Americans that technology is important is rooted in the belief that it is a path to economic opportunity (Mossberger et al., 2003). Among those who are currently offline, African Americans are more likely to say that they expect to use the Internet in the future (Lenhart, 2003). How, then, can these more positive attitudes be reconciled with persistently lower rates of access, use, and skill? Even as the universe of Internet users has expanded in recent years, African Americans (Madden, 2006) and Latinos (U.S. Department of Commerce, 2004) continue to lag behind in access and use.

The racial dimension of the "digital divide" is an echo of the unequal opportunities available in poor neighborhoods, especially areas characterized by concentrated poverty and racial segregation. African Americans and Latinos are more likely than whites to live in such neighborhoods. Mossberger et al. (2006) found that while residence in a poor community diminishes technology access and use for all Americans, these effects are magnified for African Americans living in high-poverty areas. Using hierarchical linear modeling to compare individual-level and community-level factors in a national random sample, they found that the median income and

educational attainment of the ZIP code had a statistically significant effect on technology access and use. Controlling for these "place" effects, race at the individual level no longer matters. Concentrated poverty does not entirely explain differences between Latinos and other Americans. Both place effects *and* ethnicity are significant predictors of lower rates of access and use for Latinos (Mossberger et al., 2006).

The cost of limited technology use and skill may be restricted mobility into well-paying jobs (Krueger, 1993; Autor, Katz, & Krueger, 1998; Goss & Phillips, 2002). Internet use encourages inclusion in the political community, including higher levels of voting (Bimber, 2003; Tolbert & McNeal, 2003; Graf & Darr, 2004). The Internet can also connect individuals to crucial services. The use of the web for health-related information has grown in recent years (Fox & Fallows, 2003). E-government is one of the fastest growing activities online, and virtually all governments at every level have some presence online (Norris, Fletcher, & Holden, 2001; Larsen & Rainie, 2002; West, 2005). As residents of poor communities are more likely to depend upon public services and to suffer from health problems, the need to find information online may be higher still in these communities.

Those who are unable to access and use the Internet regularly and effectively bear higher information costs for political participation, government services, and health, and are further disadvantaged in the labor market. Beyond these individual costs are implications for local economic development, and the human capital available to areas to attract businesses across many industries that increasingly rely upon the use of information technology (Litan & Rivlin, 2002).

THE IMPACT OF PLACE: SOCIAL NETWORKS AND INSTITUTIONS

Concentrated poverty, where 40% or more of the population live below the poverty level, is a primarily urban phenomenon and it is coupled with racial segregation. A number of scholars have argued that spatial concentration magnifies the disadvantages of poverty (Wilson, 1987; Massey & Denton, 1993; Jargowsky, 1997; Quane & Rankin, 1998; Orfield & Lee, 2005). While the 2000 census marked a modest reversal in the rapid growth of concentrated poverty, more than 8 million Americans continue to live in very poor urban neighborhoods such as the ones we examine in East Cleveland and parts of Youngstown (Pettit & Kingsley, 2003; Jargowsky, 2003). We are most interested, therefore, in further exploring the conditions in poor urban communities that might limit or enhance opportunities for learning about and using information technology.

What are the possible causes for the impact of poor communities on technology use, especially those characterized by racial segregation and concentrated poverty? Opportunities for learning about or using technology may be more constrained in poor neighborhoods, including formal and informal learning through social networks and neighborhood institutions.

Social networks may encourage technology use through peer influences, through the provision of access, and through informal learning and technical support. The potential for gaining access and knowledge through personal networks is evidenced by social use of computers and the Internet. Roughly, one-quarter of American adults report using computers or the Internet at the homes of family or friends (Mossberger et al., 2003). According to Warschauer (2003, pp. 155–157), personal relations are important for computer use because they influence norms and expectations, and offer support for making decisions and handling problems, especially for new computer users. In poor communities, where home access is more limited, social networks may be less likely to provide informal support systems.

It is also important to understand whether public institutions such as schools and libraries are filling a gap by providing access and experience with technology, especially in communities where many homes lack computers or Internet connections. Poor communities have gained

external resources to support technology use, and there have been some gains in terms of public access. The E-rate program, which was created by the passage of the Telecommunications Act of 1996, was established as a $2.25 billion annual fund to provide discounts to schools and libraries for connections to the Internet. As a result of the E-rate program, nearly all schools in the United States have Internet access (NCES, 2004). Libraries have been an important point of public access for computers and the Internet, as well as potential sources for training and assistance in locating information online. Studies show that nearly 99% of public libraries now feature free Internet access (Gates Foundation, 2004; Bertot, McClure, & Jaeger, 2005). Yet, libraries in high-poverty urban areas also report that they "cannot consistently meet the demand for public access workstations" (Bertot et al., 2005, p. 2). Surveys conducted by the University of Washington underscore the importance of libraries for maintaining access for all, as 37% of patrons in high-poverty areas have no other Internet access. About a third of library patrons use public access computers to learn or practice computer skills (Gates Foundation, 2004). What role, then, do neighborhood-level factors play in technology use?

THREE NORTHEAST OHIO COMMUNITIES

The three cities selected for comparison represent a socioeconomic continuum. East Cleveland and Shaker Heights are both inner-ring Cleveland suburbs with a similar population size (a little under 30,000), but East Cleveland is one of the poorest municipalities in the state, and Shaker Heights is one of the wealthiest. Because Youngstown is larger, it is more economically diverse than East Cleveland, and is more racially diverse as well.

East Cleveland is a majority-African-American community directly adjacent to the east side of the City of Cleveland. With a city-wide poverty rate of 32%, East Cleveland has many neighborhoods that fit the 40% threshold for concentrated poverty. Like many other communities characterized by this level of poverty, it is also highly racially segregated. The population of East Cleveland is 93.4% African American, according to the 2000 census.

Youngstown also has a high poverty rate, about 25% citywide. There are areas of concentrated poverty throughout the city, but there is more variation overall. The median household income of $24,201 is about $3,700 higher than in East Cleveland. Non-Hispanic whites comprise about 51% of the population and African Americans about 44%. Approximately 5% of Youngstown residents are Latino.

Shaker Heights is a racially diverse city, with a population that is about 60% white, 34% African American, and 3% Asian American. But Shaker Heights stands in stark contrast to the other two communities economically. The poverty rate is only 7%, and median household income is $64,000—more than three times the median income in East Cleveland and over 2.5 times the median income in Youngstown. This is also more than 50% higher than the median household income for the state of Ohio, which is about $40,000.

Because of the significance of education for technology use, it is noteworthy to compare educational attainment in the three communities. The percentage of adults age 25 and over who are high school graduates is similar for East Cleveland (69%) and Youngstown (73%). The small percentage of the population that has a bachelor's degree or more is also similar—8.5% for East Cleveland and 9.7% for Youngstown. Shaker Heights has an almost universal rate of high school graduation (95% of residents), and 62% of the population has at least a 4-year college degree.

By comparing very different communities that are all at least one-third African American, we can isolate the effects of living in impoverished, racially segregated areas of concentrated poverty from the effects of race at the individual level. This allows us to explore prior findings that African Americans in nonpoor neighborhoods are at least as likely to have home access

to technology as similarly situated whites (Mossberger et al., 2006). Unfortunately, the percentage of Latinos in these cities is too small to draw any meaningful conclusions about this group.

SURVEY DATA

The survey used in our analysis, the 2005 Internet Usage Poll, was conducted for the researchers by the Center for Policy Studies, a division of the Institute for Health and Social Policy at the University of Akron. Interviewing was conducted using computer-assisted telephone interviewing technology, which permits evaluation of the validity of incoming inputs. A quality control system, consisting of silent monitoring protocols and dedicated monitors, ensures the collection of high-quality data. Households in Youngstown, East Cleveland, and Shaker Heights comprised the sampling frame. The samples for the research were generated by a nationally known supplier: Survey Sampling, Incorporated of Fairfield, Connecticut. Using a random-digit dialing protocol, the initial sampling procedures generated a representative sample of each of the areas. In addition, further sample screening for disconnects was conducted in order to provide more accurate and efficient samples. Included in this sample were both listed and unlisted household telephone numbers. Each household was given an introduction explaining the purpose of the survey. A respondent from each household age 18 or older was chosen at random, ensuring a representative sample of the population. The survey instrument was tested prior to the interviewing phase. The interviewing process took nearly 2 months, beginning June 15, 2005 and ending August 12, 2005.

A total of 962 interviews were completed with 300 respondents in East Cleveland, 360 in Youngstown, and 302 in Shaker Heights. The cooperation rate for the survey was 28%, which approximates typical response rates for national telephone surveys.[1] Federal data show that telephone service reaches 94% of the population (U.S. Department of Commerce, 1995), so telephone surveys are a reasonable methodology for obtaining sample data even in low-income communities.

The samples for each of the three cities approximate 2000 census data. In East Cleveland, 87% of our sample is African American compared to 92% for the population 18 and older in the 2000 census. The Youngstown sample is 32% African American in comparison with 39% of adults in the census, and Shaker Heights respondents are 39% African American in contrast to 34% in the census. For gender and the proportion of the population over 65, the sample and census data are within 4 percentage points for all three cities. The East Cleveland and Shaker Heights samples are 5 and 3 percentage points higher for a 4-year college degree than the population over 25 reported in the census for those cities. For Youngstown, however, 22% of respondents have a bachelor's degree in comparison with about 10% of the city's population over age 25. Respondents generally correspond to the populations of these three cities, then, with the exception of a somewhat more educated sample in Youngstown.[2] See Table 1 for descriptive statistics on both individual- and community-level variables.

Overall, the aggregate sample is more African American and poor than the U.S. population. Because the survey targeted three cities in Northeast Ohio that are relatively dichotomous in their racial composition (white and African American), the sample included a very small proportion of any other racial and ethnic minorities. Of the respondents, 48.5% were white non-Hispanic, 51% were African American, 0.5% Asian American, and none were Latino.[3] Thus, the 51% African-American sample population is significantly greater compared to the national average of 12.3% of the U.S. population in the 2000 census. Thirty-two percent of the sample had household incomes below $18,000. Cities were selected to represent two somewhat contrasting poor areas and a comparison area that is economically more affluent, but also racially diverse.

TABLE 1

Descriptive Statistics: Individual and Community Variables

	Mean	*SD*	Min.	Max.	Definition
Individual Variables					
African American	0.51	0.50	0	1	Dummy-coded measure of race (0 = all others, 1 = African American)
Education	3.03	1.22	1	5	Index of individual educational attainment (1 = some high school or less, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = postgraduate work or degree)
Income	3.56	1.69	1	5	Index of individual annual income (1 = <$18,000, 2 = $18,001–36,000, 3 = $36,001–54,000, 4 = $54,001–$72,000, 5 = over $72,000)
Age	50	18	18	56	Measured in years
Male	0.46	0.49	0	1	Dummy-coded measure of gender (0 = female, 1 = male)
Parent	0.34	0.47	0	1	Dummy-coded measure of parenthood (0 = no children, 1 = has child(ren))
Contextual Variables					
African-American population	0.52	0.37	0.00	0.99	Percentage of population African Americans within 0.5 km radius of respondent's residence
College-educated population	0.25	0.24	0.01	0.87	Percentage of population college graduates within 0.5 km radius of respondent's residence
Household income	3.56	1.67	1	6	Average household income within 0.5 km radius of respondent's residence
Library distance ($N = 962$)	1.04	1.03	0.10	15.94	Distance to the library measured in miles

TABLE 2

Comparison of Internet Use and Home Access

	East Cleveland	Shaker Heights	Youngstown
Internet use	52%	79%	51%
Home access	39%	76%	46%

Source: 2005 Internet Usage Poll (authors).

DESCRIPTIVE STATISTICS: PATTERNS OF ACCESS AND USE

Comparing cities, there are clear differences in information technology use. When asked "Do you ever use the Internet, for any reason?," only 52% of respondents in East Cleveland and 51% in Youngstown answered yes, in comparison with 79% of the respondents in Shaker Heights. Responses for computer use were similar. This compares to national surveys conducted by the Pew Internet and American Life Project from around the same time period (Summer 2005) that reported that 68% of Americans had ever used the Internet, at least occasionally (Fox, 2005).

Even among those who did respond that they have used the Internet, there are contrasts in the places where they use computers or go online, and these differences have implications for frequency of access and opportunities to develop skills. Only 39% of East Cleveland residents had Internet access at home, compared to 46% of Youngstown residents and 76% of Shaker Heights respondents (nearly double the percentage in East Cleveland). Although only 39% of East Cleveland residents have Internet access at home, 52% of them have still gone online, indicating

TABLE 3

Place Where Respondent Uses Computers and the Internet *Most Often*

	East Cleveland		Shaker Heights		Youngstown	
	Computer	Internet	Computer	Internet	Computer	Internet
Work	22.5%	15.6%	36.7%	32.4%	20.7%	16.6%
Home	55.0%	63.0%	59.0%	62.6%	70.1%	71.3%
Library	7.0%	6.3%	2.2%	2.7%	2.4%	3.2%
School*	6.2%	3.9%	0.4%	0.0%	1.8%	1.3%
Friends/relatives	7.0%	8.6%	1.3%	1.8%	1.8%	6.4%

*All respondents are adults.

that 13% of East Cleveland residents use the Internet even though they have no home access (see Table 2). This differs markedly from the other cities. There are only 5% more Youngstown residents and 3% more Shaker Heights residents who report being online in comparison with the percentage of residents who have Internet connections at home.

Comparing Places: Internet Use

Table 3 shows a greater tendency among East Cleveland residents to rely on public access and networks of friends and relatives. We asked respondents to name the three most frequent places where they used computers in the past month, and then asked how often they had used them in that place in the past month.[4]

While home is the most frequent place of use for computers and the Internet for all cities, work is the most frequent place of use for a much higher percentage of residents in affluent Shaker Heights. Libraries (or community centers), schools, and the homes of friends or relatives are the most frequent places of use for a higher percentage of East Cleveland residents; nearly 20% of East Clevelanders who use technology access both computers and the Internet most frequently outside home or work. This compares with much smaller percentages in the other two cities.

A higher proportion of East Cleveland residents rely upon others for technology use, as well as upon public access. Nine percent of the respondents who had used the Internet in East Cleveland said that the place where they had used it most frequently in the past month was at the homes of friends or relatives, in comparison with 6% in Youngstown and 2% in Shaker Heights. Friends and relatives may play a more important role in technology use in low-income communities, according to our data. This is consistent with studies of "kinship," lending, and resource-sharing in low-income communities (Stack, 1974). Still, it is unlikely that personal networks alone can fulfill the need for technology use, and while public access has made important contributions, the limits of technology use in poor communities are apparent.

Because home and work are the most common places for frequent access, this means that East Cleveland residents are likely to use computers and the Internet much less regularly, and may not develop skills for information use as well as technical skills. In East Cleveland, 31% of Internet users went online 10 times or less in the past month in the place where they used the Internet most often, in comparison to 20% in Youngstown and 15% in Shaker Heights.

Comparison of High-Poverty Areas

Reasons for using public access technology also differed across the three cities. For East Clevelanders, the most common reason for using public access sites was the lack of a home

TABLE 4

Location Where Internet Is Used Most Often in Youngstown and East Cleveland Citywide and in High-Poverty Areas*

	Youngstown	East Cleveland	Youngstown High Poverty	East Cleveland High Poverty
Sample size	164	128	29	89
Home	71.3%	63.3%	67.9%	58.9%
Work	16.6%	15.6%	14.3%	17.8%
Other	12.1%	21.2%	17.9%	23.3%

*High-poverty areas are those census tracts with 30% or more people residing below the poverty line.

computer-–25% in East Cleveland, versus 15% in Youngstown and 11% in Shaker Heights. In the other two cities, the most common reason was convenience.

Overall, East Cleveland stands out when we compare cities. But Table 4 shows that respondents living in census tracts with poverty rates of 30% or more in Youngstown have higher rates of Internet use outside of home or work than in Youngstown as a whole. Although respondents in high-poverty areas in East Cleveland show somewhat higher rates of use outside home and work (23%) than similar neighborhoods in Youngstown (18%), the high-poverty neighborhoods outrank their cities in use outside home and work in both instances. This indicates what may be a more general trend in other very poor communities.

Because concentrated poverty has traditionally been associated with racial segregation as well, we examined the racial composition of the high-poverty areas in the study. Areas with poverty rates of 30% or more in Youngstown were 66% African American, 94% African American in East Cleveland, and 91% African American in Shaker Heights.[5] Residents of poor, predominantly African-American communities in the sample demonstrate efforts to use the Internet despite lacking a regular source of access.

Next, we turn to multivariate analysis to explore the individual and contextual factors that explain higher rates of use. Using multivariate controls, we can discover whether living in a high-poverty and predominantly African-American neighborhood is significant for predicting Internet use in places other than home or work, or whether other factors better explain these patterns.

MULTIVARIATE ANALYSIS: WHAT DETERMINES HIGH INTERNET USE OUTSIDE HOME AND WORK?

Based on the literature, we hypothesize that neighborhood characteristics matter in patterns of technology use. Three primary hypotheses structure this research: (1) We expect that individuals residing in areas with higher income and education will use the Internet more than individuals residing in areas with resource-poor socioeconomic characteristics. (2) We also hypothesize that individuals who do not have Internet access at home or work will use technology more when residing closer to a public access site. Distance to the closest public library from a respondent's home is used to measure proximity to public access. In each community in the sample, libraries are the primary and only consistent public access sites. (3) Finally, we hypothesize that individuals living in communities with a high proportion of African Americans will use technology outside home and work more than individuals residing in more heterogeneous communities. Prior research at the ZIP code level (Mossberger et al., 2006) shows that disparities among African Americans are due to place effects of segregation and concentrated poverty rather than an individual's race alone. Yet, the descriptive data here suggest a positive impact for technology use *when we are*

considering those individuals who lack regular access. Individuals who are poor and living in high-poverty areas may lack frequent access, but are making efforts to go online, nonetheless.

These hypotheses are explored by using survey data merged with data from the 2000 census. For each respondent in the survey we recorded the location of their residence, which was then used to create contextual variables for each respondent. These environmental data are used to measure socioeconomic context and distance to public libraries.

A binary dependent variable is analyzed to examine the hypotheses. In each model, the dependent variable is binary—"Do you use the Internet?"—coded 1 for yes, and 0 for no. We estimate a logistic linear regression with a binomial distribution for the entire sample using individual-level variables only. Next, we include contextual factors that control for socioeconomic characteristics of the respondent's community as well as distance to the closest technology public access site (or public library) in the three communities. Finally, we estimate the same logistic models with only individual, as well as individual and contextual variables using only the subsample of respondents who do not have access to the Internet at home or work. This subsample allows us to further probe the use of the Internet by individuals who do not possess readily available access to the Internet in their daily lives at work or home.

Buffered Contextual Variables: Creating a Unique Geography for Each Respondent

Explanatory variables measure individual-level demographic factors, as well as geographic characteristics of the respondent's community (see Table 1 for variable descriptions). Most of the contextual information that we used was available from the United States Census Bureau, Summary File 3 series.

This information is ordinarily aggregated at the block group level. According to the U.S. Census Bureau, a block group is a subdivision of a census tract. Census tracts are usually delineated by community participants, are between 1,500 and 8,000 people in size, and are constructed to be fairly homogeneous in regard to population characteristics and socioeconomic conditions. Each census tract is comprised of a number of block groups, often from three to six, with an optimal size of about 1,500 people (http://www.census.gov/geo/www/geo_defn.html, accessed 8/2/07). Block groups are the lowest scale unit that aggregates most census information.

The problem with using block group information in determining an individual's neighborhood context, however, is that it suffers from a boundary or edge effect. There is nothing intrinsically significant about a block group boundary beyond its use as a container for statistical information. Take an example where a higher-income block group abuts a lower-income block group. A respondent located on the higher-income block group boundary will experience a context that includes as many interactions with the lower-income block group as with the higher-income block group to which he or she is assigned. This respondent's context will be quite different from that experienced by a respondent located at the centroid of the higher-income block group. Because of these edge effects, it is often better to determine the characteristics of the neighborhoods within a fixed distance from the respondent, using information from all nearby block groups where appropriate. This sort of analysis was utilized by Kaplan (1999) in determining the demand and supply characteristics of neighborhood labor markets in Cleveland.

To best represent the context of each individual, we first determined the geographical location of the respondent, using an address matching procedure. From these locations, we created a series of buffers around each respondent's place of residence (see Figure 1). These buffers could be of any radius, and we developed buffers of both one kilometer and a half kilometer in radius. In the end, we decided to utilize the half kilometer buffers as a way to determine a respondent's more immediate neighborhood environment.

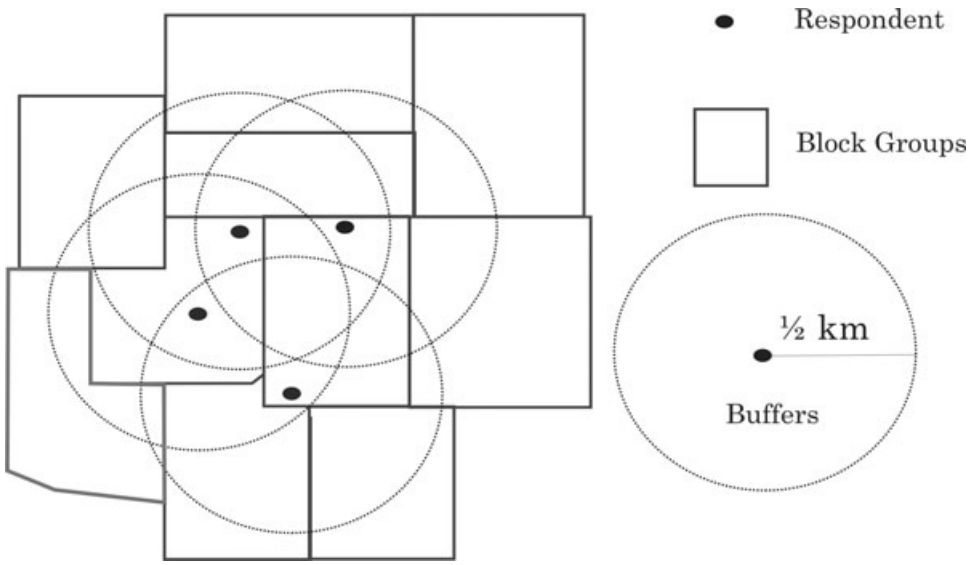

FIGURE 1

Comparison of Buffered Contextual Variables with Block Group Data

Since each buffer contained portions of several surrounding block groups, we calculated the attributes for each buffer by employing the assumption that the proportion of a particular attribute from each of the surrounding block groups was equivalent to the proportion of the block group's area contained within the buffer. For example, if a buffer covered 30% of a block group and that block group contained 40 college graduates, then we would allocate 30% of 40, or 12 graduates, to that buffer. The sum of these proportions can then be aggregated to equal the proportion of college graduates within each buffer. Because each respondent had a unique residential location, there were as many buffers as there were respondents. The buffered variables allow us to build models that take the effects of place into account even more accurately than census tracts or block groups. However, it should be noted that buffers still rely on information aggregated at the census block group level. They work by averaging out information based on what percentage of the area of a block group is found within a given buffer, but there is no way to tell whether this is the case. For instance, we do not know whether the area percentage of a block group covered by a buffer is proportional to the distribution of college-educated people, but we needed to make this assumption.

The creation of a unique geography for each respondent makes it impossible to use hierarchical linear modeling, because that method is intended to analyze *clusters* of individuals (in this case, geographic clusters such as census tracts). The buffers create a unique context for each individual (i.e., unique values for variables such as the percentage of African Americans or the educational attainment of the surrounding area), meaning that the use of multilevel analysis would be incorrect. The buffers offer more precise measurement of contextual variation, however, compared to the use of clusters and hierarchical linear modeling.

Neighborhood Factors That May Influence Technology Use

In this study, contextual variables may represent influences such as norms, resource sharing in networks, or institutional resources in the community, although these can only be suggested by the

demographic characteristics of the respondent's surroundings. We measure racial composition of the respondent's environment by the percentage of African-American population within a radius of one-half kilometer of the respondent's residence. Socioeconomic context is measured by the percentage of the population with a college degree and average household income within a radius of one-half kilometer of the respondent's residence. We utilize average household income because it provides more continuous variation than poverty rates. We use educational attainment, or the percentage of college graduates within a half-kilometer radius, as a measure of the educational climate in the respondent's neighborhood. Educational attainment and income were found to be significant contextual variables at the ZIP code level in a previous national study (Mossberger et al., 2006).

Finally, the distance to a library is included to measure convenient use of the Internet at a public site. Because the quality of public institutions may differ across cities, we ran some models that included dummy variables for cities. These were not significant in models that included the buffered variables. The buffered variables allow us to track variation within cities, such as the presence of high-poverty areas within Youngstown. We therefore chose to report the models with buffers rather than dummy variables.

Individual-Level Variables

In running our models, we used a binary dependent variable of Internet usage. Respondents to our questionnaire had simply answered "yes" or "no" to this question and we felt this gave the best results. We experimented for a while on a more nuanced dependent variable that corresponded to frequency of Internet usage (always, sometimes, sporadic, and never). In the end, though, this variable did not provide any additionally useful information and we decided that the binary variable worked best in determining access to the Internet. Control variables measure individual-level attributes of the respondents and were included to measure income, education, race, gender, and age. These are traditional demographic variables used in prior research on digital inequality, and we expect that factors other than gender will be significant. Another variable included is whether or not there are children present in the household. Some descriptive studies have shown that households with children have higher rates of home access (Lenhart, 2003). We also expect that this variable could encourage use outside the home, as parents without home access may accompany children to public access sites. Binary variables measure gender, race, and children in the household. Respondents were coded 1 for the category African American, with all others coded 0, due to the small percentages who reported being other than African American or white. For race, white non-Hispanics are the reference or left-out group; for gender, women are the reference group. Households with children are coded 1, and 0 otherwise. Education is measured on a 5-point scale with responses ranging from 1 = less than a high school degree to 5 = postgraduate work. Age is recorded in years. Income is measured on a 5-point scale with responses ranging from 1 = <$18,000 to 5 = over $72,000.

Binary logistic regression is used to explore the impact of socioeconomic characteristics on an individual's Internet use. The baseline model equation with only individual attributes is

$$Y(\textit{Internet Usage}) = \alpha + \beta_1(\textit{African American}) + \beta_2(\textit{Income}) + \beta_3(\textit{Education}) + \beta_4(\textit{Age}) + \beta_5(\textit{Male}) + \beta_6(\textit{Parent}) + \varepsilon.$$

Binary logistic regression is then utilized to examine the effect of individual and neighborhood contextual characteristics on an individual's Internet use. The model equation employed is

$$Y(\textit{Internet Usage}) = \alpha + \beta_1(\textit{African American}) + \beta_2(\textit{Income}) + \beta_3(\textit{Education}) + \beta_4(\textit{Age}) + \beta_5(\textit{Male}) + \beta_6(\textit{Parent}) + \beta_7(\textit{Percent African American}) + \beta_8(\textit{Average Household Income}) + \beta_9(\textit{Percent Population with a College Degree or More Education}) + \beta_{10}(\textit{Distance to the Closest Library}) + \varepsilon.$$

(Each model is then repeated with the subsample of respondents who do not have Internet access at home or work.)[6]

RESULTS

The first section discusses influences on technology use for all survey respondents, and the second section analyzes the subsample of respondents who did not have home or work access to the Internet. This allows us to compare Internet use for those who lack easy access to the population as a whole. The full sample also allows some comparison for the sample of three cities with previous national studies.

Baseline: What Matters for Internet Use in the Full Sample

What factors influence technology use in any setting when we examine the sample as a whole? Table 5 presents the logistic regression for Internet use for the entire sample. The first model in the left-hand column includes the variables measuring the respondent's individual characteristics as predictors for using the Internet (Table 5). We find that respondents who are

TABLE 5

Do You Use the Internet? Full Sample

Variables	Individual		Community	
Full Sample	β (*se*)	$p > \|z\|$	β (*se*)	$p > \|z\|$
Individual Level				
African American	**−0.45 (0.21)**	**0.03**	**−0.50 (0.27)**	**0.06**
Non-African American	**–**	**–**	**–**	**–**
Education	**0.89 (0.11)**	**0.00**	**0.83 (0.12)**	**0.00**
Income	**0.50 (0.08)**	**0.00**	**0.46 (0.09)**	**0.00**
Age	**−0.06 (0.01)**	**0.00**	**−0.06 (0.01)**	**0.00**
Male	0.03 (0.20)	0.88	0.02 (0.21)	0.92
Female	–	–	–	–
Parent	**0.82 (0.23)**	**0.00**	**0.83 (0.23)**	**0.00**
Nonparent	–	–	–	–
Community Level				
African-American population			0.28 (0.38)	0.46
College-educated population			1.33 (1.07)	0.21
Household income			0.00 (0.00)	0.97
Library distance			−0.12 (0.09)	0.18
Constant	0.11		0.07	
Cox & Snell R^2	0.40		0.41	
$N = 820$				

Note: Binary logistic regression coefficients with standard errors in parentheses. Parameters in bold are significant at 0.10 or better. A dash in the place of coefficients indicates the variable's reference category.

more affluent, educated, young, and parents are statistically more likely to use the Internet at home than respondents who are poor, less-educated, older, and childless. Also, African Americans are statistically less likely to use the Internet than whites. Overall, these findings are consistent with previous studies on digital inequality (Katz & Rice, 2002; U.S. Department of Commerce, 2002; Mossberger et al., 2003; Lenhart, 2003; Fairlie, 2004).

None of the contextual variables has a statistically significant relationship with Internet usage in the full sample (Table 5, column 2). This suggests, when considering all types of Internet access (at home, work, and other places), the areas in which individuals live do not significantly shape their Internet usage. Yet, prior findings at the national level have shown otherwise. One reason for these contrasting results may be the smaller amount of variation within this high-poverty, heavily African-American sample in comparison with national data. Distance to the nearest library is not significantly associated with Internet use in the full sample.

What Matters for Internet Use Among Those Who Lack Regular Access?

It is possible, however, that contextual characteristics may play a more significant role, and may be more visible, when predicting Internet use among those who lack convenient access. There may be differences between poor neighborhoods in the support that they offer for technology use for these individuals, who rely on public access or friends and relatives.

In this section, we repeat the binary logistic regression models, with and without the contextual community variables, using a subsample of the survey respondents. The subsample population is all of those respondents who do not have access to a computer at home or at work. Since home and work computer access leads to more frequent and convenient Internet use, this subsample of respondents may have different factors that influence their use of the Internet. The subsample of respondents without Internet access at home or work is composed of a greater proportion of African Americans. Also, the subsample of respondents is slightly older, with a lower mean education and income. Only one-quarter of these respondents have children, and only one-quarter have a full-time job. We expect that both individual demographic predictors and environmental predictors will be related to Internet usage. Table 6 below provides descriptive statistics of this subsample.

Table 7 reports our two models estimating Internet usage for survey respondents who do not possess access to the Internet at home or work. Largely paralleling the findings for the overall sample, in the binary logistic regression model of the subsample those who are younger, more educated, white, and parents are still significantly more likely to use the Internet. However, income is no longer a statistically significant predictor in explaining Internet usage. The subsample has a much smaller mean income than the full sample and income may not be a significant predictor because of smaller variance across the respondents included in the subsample.

There is a noticeable difference when we compare the coefficients from the full sample model with both individual and contextual variables (Table 5, column 2) with the subsample model with both individual and contextual variables (Table 7, column 2). Respondents with a greater proportion of African Americans or a college-educated population within a one-half kilometer radius from the respondent's residence are statistically more likely to use the Internet than individuals living in communities with a smaller proportion of African Americans or a smaller college-educated population. That is, when we examine only individuals who must seek out Internet access in order to use the Internet, community characteristics become a statistically significant predictor of Internet usage.

Some of these results seem contradictory, given that African Americans in the subsample individually are less likely to use the Internet, and yet living in an area with a high African-American population increases use outside home or work. This may reflect the geographic

TABLE 6

Descriptive Statistics of Subsample Without Internet Access at Home or Work: Individual and Community Variables

	Mean	*SD*	Min.	Max.	Definition
Individual Variables					
African American	0.60	0.492	0	1	Dummy-coded measure of race (0 = all others, 1 = African American)
Education	2.47	1.05	1	5	Index of individual educational attainment (1 = some high school or less, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = postgraduate work or degree)
Income	0.48	0.50	1	5	Index of individual annual income (1 = <$18,000, 2 = $18,001–36,000, 3 = $36,001–54,000, 4 = $54,001–$72,000, 5 = over $72,000)
Age	55.06	19.55	18	96	Measured in years
Male	43	0.50	0	1	Dummy-coded measure of gender (0 = female, 1 = male)
Parent	0.25	0.46	0	1	Dummy-coded measure of parenthood (0 = no children, 1 = has child(ren))
Contextual Variables					
African-American population	0.60	0.37	0.00	0.99	Percentage of population African Americans within 0.5 km radius of respondent's residence
College-educated population	0.16	0.17	0.01	0.87	Percentage of population college graduates within 0.5 km radius of respondent's residence
Household income	2.33	0.92	1	6	Index of average household income within 0.5 km radius of respondent's residence (1 = <$18,000, 2 = $18,001–36,000, 3 = $36,001–54,000, 4 = $54,001–$72,000, 5 = over $72,000)
Library distance ($N = 422$)	1.96	1.00	0.10	13.49	Distance to the library measured in miles

concentration of need in these areas. Descriptive statistics also show there are some differences visible in the population of those without easy Internet access by geographic area. In East Cleveland, for example, only 5% of those without convenient access have college degrees, whereas 37% of the subsample living in Shaker Heights have a bachelor's degree. Even within this subsample, African Americans are relatively more disadvantaged, but both heavily African-American and highly educated *areas* have residents without regular access who are more likely to go online.

Surprisingly, average household income for the buffered area surrounding respondents' residences is not statistically significant. Educational attainment of the area may be a more robust measure of socioeconomic variation within this sample. Also, although respondents without Internet access at home or work may rely on public access sites for Internet use, the distance to library variable is not statistically significant. Education and other individual-level variables may be more important for motivating information technology use at libraries than proximity and convenience.

We consider the model in Table 7, column 2 to be the fully specified model, but include the other models as a reference to the general population (full sample, Table 5) and the influence of individual characteristics (Table 7, column 1). This analysis suggests that, as hypothesized, community characteristics shape usage rates for those individuals who have obstacles in accessing technology (Internet at home and work), beyond individual-level factors.

TABLE 7

Do You Use the Internet? Subsample—Individuals Without Internet Access at Home or Work

Variables	Individual		Community	
Subsample	β (*se*)	$p > \|z\|$	β (*se*)	$p > \|z\|$
Individual Level				
African American	**−0.55 (0.27)**	**0.05**	**−0.86 (0.35)**	**0.01**
Non-African American	**–**	**–**	**–**	**–**
Education	**0.63 (0.15)**	**0.00**	**0.58 (0.15)**	**0.00**
Income	0.06 (0.12)	0.62	0.02 (0.14)	0.87
Age	**−0.06 (0.01)**	**0.00**	**−0.05 (0.01)**	**0.00**
Male	−0.29 (0.27)	0.27	−0.29 (0.28)	0.29
Female	–	–	–	–
Parent	**0.97 (0.30)**	**0.00**	**1.08 (0.31)**	**0.00**
Nonparent	–	–	–	–
Community Level				
African-American population			**0.86 (0.52)**	**0.10**
College-educated population			**3.35 (1.59)**	**0.04**
Household income			0.00 (0.00)	0.30
Library distance			0.00 (0.16)	0.99
Constant	0.53		0.13	
Cox & Snell R^2	0.23		0.24	
$N = 422$				

Note: Binary logistic regression coefficients with standard errors in parentheses. Parameters in bold are significant at 0.10 or better. A dash in the place of coefficients indicates the variable's reference category.

How Much Does Context Matter for Technology Use?

Probability simulations are used to understand the substantive magnitude of the effect of geographic factors on Internet use, while holding other explanatory variables constant at their mean or modal values. All simulations are for the subsample—that is, those lacking Internet access at home or at work. The probabilities shown in Table 8 below are reported as percentages, but are based on the logistic coefficients reported in our fully specified model (Table 7, column 2). The box presents simulations for a hypothetical respondent who is African American, male, childless, with mean education, income, and age. The respondent is assumed to reside at a location with average African-American population, household income, and educational attainment. The distance to the library variable is also set at the mean. Table 8 varies the percentage of African Americans and college graduates within one-half kilometer of the respondent's residence, holding other factors constant.

Two main findings are apparent. First, the size of the African-American population and the educational attainment of the community matter substantively and result in differences in Internet use, holding individual demographic factors constant. Second, educational attainment has a larger impact on Internet use. Respondents residing in areas with high levels of educational attainment (one standard deviation above the mean, with 33% of the population with a college degree or more education) were 8.4% more likely to use the Internet than the same respondent living an area where 16% of the population within a half-kilometer radius had a college degree (the mean for this sample). Those who live in areas where more than half the population holds a college degree (two standard deviations above the mean) are almost 20% more likely to use the Internet if they do not have easy access. Recall that many areas of Shaker Heights fit this description, as in the city overall 62% of residents over 25 are college graduates.

TABLE 8

Impact of Context on Internet Use for African Americans Lacking Internet Access at Home or Work

	African American %	Probability of Internet Use	Difference from the Mean	College Graduates %	Probability of Internet Use	Difference from the Mean
Very high (+2 *SD*)	100.0%	17.1%	+4.5	50.4%	32.5%	+19.9
High (+1 *SD*)	96.3%	16.6%	+4.0	33.2%	21.0%	+8.4
Mean	59.2%	12.6%	–	16.0%	12.6%	–
Low (−1 *SD*)	22.1%	8.6%	−4.0	0.0%	8.2%	−4.4
Very low (−2 *SD*)	0.0%	8.3%	−4.3	–	–	–

Though not as large substantively, we find that holding other factors constant, African-American respondents residing in areas with a high African-American population (96% or one standard deviation above the mean) within one-half kilometer of their home are 4% more likely to use the Internet than the same respondent living in a residence with the mean African-American population of 60%; or 8% more likely than respondents living in an area with a modest African-American population of 22% (one standard deviation below the mean) within one-half kilometer of their residence. This suggests that communities with high proportions of African Americans are slightly more likely to have information technology use outside home and work. But better-educated communities provide a much more conducive environment. This may because of the greater presence of resources in these areas—for example, friends and neighbors who have Internet access to share, or public resources such as libraries. These results are consistent with the powerful effect that education has in determining technology access and use in general, an effect that has been stable across a number of studies (Katz & Rice, 2002; Mossberger et al., 2003; Fairlie, 2004). Overall, place factors clearly matter for respondents without Internet access at home or work, although there are two patterns that are evident here.

SOME STEPS FORWARD: EFFORTS TO GO ONLINE, YET LIMITED USE

Despite greater diffusion of information technology in recent years, regular access and use are still less common in low-income communities, according to our study of three northeast Ohio cities, as well as an earlier national study. Examining patterns of access and use in more detail at the local level, we find promise in the efforts made by residents of some low-income communities, alongside a continued need for technology resources.

The most striking aspect of our survey is the extent to which residents of very poor African-American neighborhoods make an effort to compensate for a lack of home or work access. Thirteen percent of East Cleveland residents are Internet users without home access, while only 3% to 5% of Internet users in the other cities rely exclusively on access outside the home. The poorest neighborhoods in Youngstown also show higher rates of use outside of home and work in comparison with the city as a whole, suggesting possible generalizability of these findings to other areas of concentrated poverty with high populations of African Americans. This indicates variation in poor communities, and raises the question of whether those who go online without easy access differ in some way from other Internet users.

To better understand why areas of concentrated poverty stand apart even from other low-income communities, we conducted logistic regression analysis that included contextual variables measured within a half-kilometer radius for each respondent. Results for individual-level factors

were largely consistent with previous studies, for both the full sample and a subsample of those who did not have Internet access at work or home.

Only in the subsample did the contextual variables matter. The percentage of African Americans and the percentage of college graduates in a respondent's immediate environment had positive and statistically significant effects on Internet use for those who lacked home or work access, although substantively this is modest once we control for other factors at the individual and community level. The impact of the racial composition of the area is less pronounced than the effect of neighborhood educational attainment. In highly-educated communities, those who lack regular access may have other advantages in greater measure, such as friends and relatives able to share Internet access, and better opportunities for public access. Interviews we conducted indicate that East Cleveland has approximately the same number of computers per capita as Shaker Heights along with training and technical support, in part because of their aggressive pursuit of grants from public and private sources. Yet, East Cleveland residents are more likely to report in our survey that they experience long waits or insufficient time to use the Internet.

At the local level, it is also possible to test the influence of factors such as distance to the closest library. This was not significant for determining Internet use either for those who lack home or work access, or for Internet use more generally. Other variables that were significant suggest capacity or interest as determinants of technology use, rather than convenience.

We acknowledge some limitations of these data, because of trade-offs made in order to explore in greater detail the context for technology use in areas of concentrated poverty. In contrast to a prior national study, we did not find any effects for income at the neighborhood level, and race at the individual level was still a significant factor. These differences may be due to less variation in the sample, indicating that some caution may be warranted in comparing the results with nationally representative surveys. Rather, the strength of this study is that it suggests distinct patterns of effort to go online within some predominantly African-American poor communities, and certain needs that remain.

How does environment matter, especially for those in African-American neighborhoods? There is likely a greater concentration of need in these neighborhoods, but there are some other possible reasons as well. We did not measure social networks or norms in this study, but both may play some role. The modest but positive effects of living in heavily African-American areas fits with prior research showing more positive attitudes toward technology among African Americans compared to similarly situated whites (Mossberger et al., 2003). Those without regular access often depend on friends or relatives for their most important means of public access, reflecting patterns of resource sharing that Stack (1974) has described in poor African-American communities. Beyond offering access, use at the homes of friends and relatives may provide the "communities of practice" (Van Dijk, 2005, p. 91) or supportive social networks that Warschauer (2003, p. 157) has argued are important for information technology use.

Some good news for closing technology gaps is clearly evident in the tale of these three cities, as some of those who lack regular access are still willing and able to go online at times. Yet, frequent Internet users are more likely to engage in a greater range of activities online, including those that have benefits for civic engagement and economic opportunity (Mossberger, Tolbert, & McNeal, 2008). The proportion of those without home or work access is highest in areas of concentrated poverty, and these individuals have less education than those who are currently without convenient access in higher-income areas such as Shaker Heights. This indicates that lack of access may be more long term and that there may also be some skill barriers as well.

Technology use is still more limited in poor minority neighborhoods, with higher percentages of residents who are offline, and others who have only sporadic use. Real change will not be possible unless resources are available in these communities on several fronts: to maintain and

improve public access in schools and libraries, to promote the educational competencies needed for participation online, and to encourage greater home access through affordable technology.

ACKNOWLEDGMENTS: This research was supported by the Northeast Ohio Research Consortium, Ohio Urban University Program. Our thanks go to partners on the Northeast Ohio Research Consortium project from the Center for Public Administration and Public Policy at Kent State University, Center for Urban and Regional Studies at Youngstown State University, and the Center for Policy Studies at the University of Akron. We gratefully acknowledge the consortium for its support, but take responsibility for the findings and conclusions.

ENDNOTES

1 See, for example, the January 2006 report from the Pew Internet and American Life Project, "The Strength of Internet Ties" (Boase, Horrigan, Wellman, & Rainie, 2006). The response rates for the two random-digit surveys used in the report and conducted by Princeton Survey Research Associates International were 35% and 30%.

2 Income is more difficult to compare because of our categorical income data, but the samples appear representative in this respect: for example, about half of the East Cleveland sample and about 40% of the Youngstown sample have annual incomes of $18,000 or below, in comparison to median household incomes of $20,000 and $24,000 reported in the census.

3 Respondents were coded 1 in the category African American, with all others coded 0 as the reference group.

4 For frequency of use at each place, respondents were given the choices "1–10 times, 11–30 times, 31–100 times, more than 100 times."

5 While Shaker Heights is an affluent community, there are some small, poor neighborhoods on the city's boundaries.

6 We also investigated models that included dummy variables for the cities and a split sample with three models based on each city's subsample of the data; however, they did not yield results that were significantly different or more telling than the models presented here.

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