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From the 'Digital Divide' to 'Digital Inequality': Studying Internet Use as Penetration Increases*

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Abstract

We contend that as Internet penetration increases, students of inequality of access to the new information technologies should shift their attention from the "digital divide" --- inequality between "haves" and "have-nots" differentiated by dichotomous measures of access to or use of the new technologies --- to *digital inequality*, by which we refer not just to differences in access, but also to inequality *among* persons with formal access to the Internet. After reviewing data on Internet penetration, we describe five dimensions of digital inequality --- in equipment, autonomy of use, skill, social support, and the purposes for which the technology is employed -- that we believe deserve additional attention. In each case, we develop hypotheses to guide research, with the goal of developing a testable model of the relationship between individual characteristics, dimensions of inequality, and positive outcomes of technology use. Finally, because the rapidity of organizational as well as technical change means that we cannot presume that current patterns of inequality will persist into the future, we call on students of digital inequality to study institutional issues in order to understand patterns of inequality as evolving consequences of interactions among firms' strategic choices, consumers' responses, and government policies.

From the 'Digital Divide' to 'Digital Inequality': Studying Internet Use as Penetration Increases

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The Internet boosts immeasurably our collective capacity to archive information, search through large quantities of it quickly, and retrieve it rapidly. It is said that the Internet will expand access to education, good jobs, and better health; and that it will create new deliberative spaces for political discussion and provide citizens with direct access to government. In so far as such claims are plausible, Internet access is an important resource and inequality in Internet access is a significant public policy issue.

Policy makers and social scientists have worried about the distribution of Internet access since the emergence of the Internet as a mass medium in the mid-1990s. At first, observers believed that the Internet, and especially the World Wide Web, would enhance equality of access to information by reducing dramatically information's cost. As technological euphoria wore off, however, observers noted that some kinds of people were more likely to use the Internet than others --- and that, for the most part, groups with higher levels of access to the Internet were the same groups (whites, men, residents of urban areas) that had greater access to education, income, and other resources that help people get ahead (Hoffman and Novak, 1998, 1999; Benton 1998; Strover 1999). This concern about inequality, and about the possibility that the new technology might prove to exacerbate inequality rather than ameliorate it, focused on what analysts have called "the digital divide" between the online and the offline, the information "haves" and "have-nots."

Concern over this form of inequality emerged as early as 1995 (Anderson et al. 1995), when just 3 percent of Americans had ever used the World Wide Web (Pew Center 1995). Over the past five years, researchers in government and the private sector have undertaken numerous surveys that have documented persistent differences in the rates at which members of different groups use the new medium (NTIA 1995, 1998, 1999, 2000).

Although operational definitions of access have varied from study to study, most attention has been devoted to exploring the dichotomous distinction between people who use the Web and other Internet services and people who do not. In earlier work, the term "access" was used literally to refer to whether a person had the means to connect to the Internet *if she or he so chose*. More recently, "access" is sometimes used as a synonym for use. This is unfortunate, because studies that have measured both access *and* the extent of Internet use have found, first, that more people have access than use it (NTIA 1998); and, second, that whereas resources drive access, demand drives intensity of use among people who have access. Thus young adults are less likely to report having access than adults between the ages of 25 and 54 (NTIA 2000); but in homes with Internet access, teenagers spend more time online than adults (Kraut et al 1996). Similarly, using multivariate methods and multiple access measures, Bimber (2000) reported that gender differences in income and other resources account for the gap between men and women in *access* to the Internet, but that among people with access, women use the Internet less frequently than otherwise comparable men, independent of differences in income.

The dichotomous view of the "Digital Divide" as a distinction between people who do and do not have Internet access was natural and appropriate at the beginning of the diffusion process. Moreover, in the United States it was consistent with a federal-government policy paradigm dating back to the Eisenhower administration, and based on the experience of the telephone --- a paradigm that focussed exclusively on access (defined in a binary fashion) at the household level, with special concern for inequality between rural and urban areas (a distinction that was salient due both to the economics of establishing telephone networks in rural areas and to the bipartisan appeal of programs that assist rural America). This tradition is evident in the National Telecommunications and Information Administration's (NTIA) first study of the digital divide (*Falling Through the Net*, 1995). The authors of that report carefully framed attention to the Internet as continuous with existing policy, noting:

> At the core of U.S. telecommunications policy is the goal of 'universal service' – the idea that all Americans should have access to affordable telephone service. The most commonly used measure of the nation's success in achieving universal service is 'telephone penetration' – the percentage of all U.S. households that have a telephone on-premises (1).

Consistent with this tradition, that report included data only on households, emphasized a binary distinction between "haves" and "have-nots," and – most strikingly – presented all data separately for rural, urban, and central-city categories. (The latter reflected the grafting of Great Society concerns with racial inequality onto traditional concerns with rural America --- a union reflected as well in references to rural "have-nots" and "disadvantaged" central-city dwellers.) As the NTIA's research program evolved, the practice of reporting all data separately for rural and other Americans was abandoned, and separate reports for new categories of "have-nots" – based on race, income, education, age, and, most recently, disability status (NTIA 2000) have been added. Beginning in 1999, data have been reported at the individual as well as the household level.

Research on access establishes a baseline of success for a fundamental policy goal and has been valuable for both scholars and policy makers. Now, however, we believe that the time is ripe for a shift of emphasis. We agree that public policy should strive to create a society in which the benefits of the new information technologies are distributed equally, as a source of opportunity rather than as a reinforcement of privilege. But we believe that the research questions and methods appropriate for illuminating distributive issues are different now than they were at an earlier stage of the Internet's diffusion.

Specifically, we raise questions about both the beginning and the end of the phrase "access to the Internet." First, we would redefine "access": in social as well as technological terms: As the technology penetrates into every crevice of society, the pressing question will be *not* 'who can find

a network connection at home, work, or in a library or community center from which to log on?', but instead, 'what are people doing, and what are they *able* to do, when they go on-line.' Second, we would recognize that the "Internet" itself is not a fixed object, but rather a protean family of technologies and services that is being rapidly reshaped through the interacting efforts of profit-seeking corporations, government agencies and nongovernmental organizations. Patterns of inequality will reflect not just differences in individual resources, but also the way in which economic and political factors make such differences matter. We focus our empirical remarks on the United States, but believe that our perspective applies to other societies as well.

Why Rising Penetration Levels Require an Expanded Paradigm

In its rapid diffusion, the Internet is repeating in a different and somewhat compressed form a process witnessed in other communication technologies like telephones, radio, and television. At first, access to the new technology is restricted to an elite (defined either by wealth, institutional location, or both), and the great distinction is between haves and have-nots. Gradually, penetration increases, reducing the gap in access between rich and poor, urban and rural dwellers, old and young, the well educated and the unschooled. As access diffuses to parts of the public who were initially excluded, dimensions related to *quality of use* become important bases by which the benefits of the technology are stratified.

Access to and use of the Internet has spread widely and swiftly. The number of Americans online grew from 25 million in 1995 (Pew 1995) to 83 million in 1999 (IntelliQuest 1999), with 55 million Americans using the Internet on a typical day by mid-2000 (Pew 2000:5). In 1994, just 11 percent of U.S. households had on-line access (NTIA 1995). By December 1998 this figure had grown to 26.2 percent. Less than two years later it stood at 41.5 percent, and well over 50 percent of individuals between the ages of 9 and 49 reported going on-line at home, work, or some other location (NTIA 2000). A November/December 2000 survey by the Pew Internet and American Life project found 58 percent of a national sample on-line (Horrigan 2000b: 7). Other estimates

place the proportion of Americans who use the Internet at as high as 67 percent (Lebo 2000: 10). Many more have "Internet access," in the sense that term was used in the early *Digital Divide* reports (NTIA 1995, 1998): *i.e.*, they have an available on-line connection (whether or not they choose to use it) at home, work, school, library or other community access center.

Other things equal, as use of a new technology diffuses, intergroup variation in the odds of having access declines. So long as the individual characteristics and group memberships with respect to which access is unequally distributed are only moderately correlated with one another), purely structural factors account for this greater equality (this argument draws on the theoretical insights of Blau 1977). The reason is this: access to new technologies is ordinarily associated with advantaged positions with respect to a number of weakly or moderately correlated statuses or resources – for example, income, white-collar work, educational level, race, rural residence, and gender. When penetration is low, access is dominated by persons occupying privileged positions on all of these parameters. Note, however, that a much smaller proportion of the population is privileged with respect to all parameters than is privileged with respect to each. For example, there are many more white-collar employees than there are high-income, white, male, white-collar workers who are college graduates living in urban areas. As penetration grows, access overflows the most multiply privileged population groups, extending to individuals who are privileged with respect to some parameters but disadvantaged with respect to another.

This tendency is reinforced by the fact that social relations are homophilous with respect to many status characteristics at the same time (Marsden 1987). This means that new adopters who are disprivileged with respect to one or more status parameters may serve as conduits through which information about the new technology flows to others who share those disadvantaging characteristics. For example, if an Hispanic white-collar worker who lives in a rural area gains access to the Internet at her workplace, she may use the knowledge and skills she acquires to help family members who are *not* white-collar workers gain access to the Internet as well, thus tending

to reduce inequality in access between Hispanic and non-Hispanic Americans, and between urban and rural dwellers.

Consistent with this argument, as penetration has increased, inequality of access has declined. In 1998 and, again, in 2000, surveys found that new users had lower incomes and less education than Americans who had been on-line longer (Horrigan 2000a). Indeed, the most recent report from the Department of Commerce (NTIA 2000) emphasizes that groups that have been behind in achieving computer ownership and access to the Internet have made significant steps, "suggesting that digital inclusion is a realizable goal."

The proportion of Americans who go on-line is certain to continue to rise, even if the rate of growth may have moderated around mid-1999 (Robinson and Neustadtl 2001). A Spring 2000 poll by the Pew Center reported 41 percent of the 50 percent of Americans who did *not* use the Internet intended to do so (Lenhardt 2000: 2). If they did (and if those who said they probably or definitely would not go on-line did not), the proportion of Internet users would rise above 70 percent. Moreover, non-users' expectations are strongly correlated with age --- of nonusers 50 years old or younger, 65 percent expect to go on-line, compared to just 36 percent of nonusers over 50. This indicates that generational succession will send Internet usage rates even higher. Based on these cohort differences, the Pew study's author writes, "Perhaps in a generation, Internet penetration will reach the levels enjoyed by the telephone…and the television" (*ibid).*

At that point, access to the Internet could no longer contribute significantly to social inequality, simply because nearly everyone would have it. Like efforts to extend telephone service, the attempt to ensure that every American could go on-line, while important from a policy perspective, would represent a mopping-up operation.

But would this mean that the "digital divide" had been overcome, in the sense that equality of access to the benefits of the Internet would have been achieved? Some policy analysts have implied that this is the case. Drawing on the history of telephone access, Compaine (2000) argues

against legislation to ensure universal access because the combination of market forces and government programs currently in place are achieving that goal already.

We question whether the telephone is the right analogy. For one thing, the view of telephone access as a binary good – a good for which the critical distinction is simply whether one has it or not – is only appropriate to the last quarter of the 20th century. In the early and middle years of telephony, service varied in quality, some Americans connected through party lines and were thus unable to use the technology for confidential communication whereas others had individual connections, and long-distance service rates were discriminatory (Fischer 1992). In the first part of the 21st century, the rise of cell phones, palm pilots, and other devices that blur the distinction between telephones and computers are re-differentiating telephone access.

By the same token, the ability to log on to the Internet differs from the ability to pick up a receiver and find a dial tone in that the range of uses to which one can put the Internet, and the extent to which many of these uses depend on the quality of connections and equipment, user know-how, and social support, are far greater than was the case for the telephone even a decade ago. In this respect, the Internet is less similar to the late 20th-century version of telephony than to many other goods and services that are distributed unequally. And researchers can draw profitably on the histories of research in these fields, where scholars first collected and reported dichotomous measures of access to broadly defined resources and then, as access and scholarly sophistication increased, came to define their object in more differentiated terms, shifting their attention to inequality in specific features upon which the benefits of the good or service were conditioned. Studies of educational opportunity, for example, initially focused on intergroup differences in rates of high school and college attendance and graduation. As these rates increased, the focus expanded to include differences *among* high school and college students: for example, inequality in access to college-preparatory tracks and elite universities, or variations among different kinds of children in class size, school resources, or the availability of advanced placement courses (see Brint

1998 for a review). This shift in focus reflected both researchers' belief in the intrinsic importance of such factors and their interest in understanding the *social processes* that accounted for variation in achievement, educational attainment, and the effects of schooling on career and financial outcomes.

As was the case for education, we anticipate that high rates of Internet penetration will not eliminate inequality so much as increase the salience of *new kinds of inequality* --- inequality *among Internet users* in the extent to which they are able to reap benefits from their use of the technology. It is to these forms of inequality that we now turn.

Beyond the "Digital Divide": Differentiating Access, Support, and Use

Going beyond the binary view of access to a more detailed conception of inequality of technological opportunity involves four steps:

1. Identifying critical dimensions of inequality;
2. Documenting differences among groups;
3. Explaining the antecedents of inequality on these dimensions; and
4. Modeling the relationship among different forms of inequality and between these and critical outcomes.

In this section, we focus on the first of these steps: Identifying critical dimensions of inequality. We call attention to five broad forms of inequality. The first is variation in the *technical means* (hardware and connections) by which people access the Web. The second is variation in the extent to which people exercise *autonomy* in their use of the Web – for example whether they access it from work or home, whether their use is monitored or unmonitored, or whether they must compete with other users for time on-line. The third is inequality in the *skill* that people bring to their use of the Internet. The fourth is inequality in the *social support* on which Internet users can draw. The fifth is variation in the *purposes* for which people use the technology. We view each of these types of inequality as likely to shape significantly the experience that users have on-line, the uses to

which they can put the Internet and the satisfactions they draw from it, and their returns to Internet use in the form of such outcomes as human capital, social capital, earnings or political efficacy.

Inequality in technical apparatus. Kling (1998) distinguished between technological and social access, calling attention to the importance of "the physical availability of suitable equipment, including computers of adequate speed and equipped with appropriate software for a given activity." How does *inequality in the adequacy of hardware, software, and connections*, limit the ways in which different kinds of users can employ the Internet? As bandwidth increases and more and more Web sites require late-model browsers to display Java applications, sophisticated graphics, or streaming audio or video, to what extent can users without access to expensive systems access the full range of Internet content?

We hypothesize that inferior technical apparatus reduces the benefits users can gain from the Internet directly and indirectly. First, users with slow connections, older software, and old hardware are simply unable to access certain sites. Second, because their experience on the Web is less gratifying, they are likely to use the Internet less and acquire fewer of the skills that enable users to derive the full benefits that access can provide.

Inequality in autonomy of use. How much control do people exercise over their Web use? An important aspect of this dimension is the question of *where* users have access (Bimber 2000). Among persons with Internet access, are there significant intergroup differences in the extent to which that access is at home, as opposed to work, school, libraries, or other community access centers? If access is outside the home, how much flexibility does the user have in determining the hours at which she or he can access the Internet? How far does the user have to travel? To what extent is use circumscribed by regulations, time limits, filters or other technical impediments to access? If access is at work, what kinds of use are permitted (and how does this vary with organizational role), what kinds of filtering or monitoring systems are in use, and how stringently are rules enforced (O'Mahoney and Barley 1999)? If access is at home, to what extent may

autonomy be limited by the actions of other family members or the policies of the ISP (Lessig 1999)? Does in-home access have different effects on educational or occupational outcomes than access from other locations? Of people who have access at work, what predicts the degree of autonomy they possess in determining *how* they use the technology?

All studies show strong associations between educational attainment, income, race, and having Internet access at home. We further hypothesize that, where individuals have access to the Internet at work, the autonomy with which they can exercise that access is associated with their organizational rank and functional position. Finally, we hypothesize that among people with access to the Internet, the greater the autonomy of use, the greater the benefits the user derives.

Inequality in skill. Kling (1998) pointed to the importance of inequality in users' possession of "know-how, a mix of professional knowledge economic resources, and technical skills, to use technologies in ways that enhance professional practices and social life." Wilson (2000) refers to inequality in "cognitive access": the extent to which users are trained to find and evaluate the information they seek. Internet users vary in their possession of at least four kinds of relevant knowledge: recipe knowledge about how to log on, conduct searches, and download information; background knowledge (e.g., of Booleian logic for designing search algorithms) helpful to Web users but not specific to Internet use; integrative knowledge about the way the Web operates that can enable users to navigate more effectively; and technical knowledge about software, hardware, and networks necessary for troubleshooting the problems that invariably emerge, or for ensuring that one acquires the most up-to-date resources available (e.g., downloadable browser plug-ins). Taken together, these four kinds of knowledge constitute what we might (after sociolinguists' notion of "communicative competence" [Hymes 1974]) call "Internet competence": the capacity to respond pragmatically and intuitively to challenges and opportunities in a manner that exploits the Internet's potential.

We know very little about what explains inequality in the know-how or competence needed to find information on-line. While basic access to the medium is increasing, evolution in Web site construction and continual growth in the volume of information flooding the market requires more skills for efficient use of the medium. Many sites use flashy and glitzy technology without sufficient attention to human factors, rendering many sites inaccessible to all but the savviest of users with the latest hardware and software and sophisticated know-how about Web navigation. Moreover, limitations in search technology – most search engines index no more than a small percentage of all content online (Lawrence and Giles 1999) – make many sites difficult to find for the average user. In-depth studies of how people locate content online are necessary to understand how different people use the Web differently (Hargittai 2000b).

We hypothesize that Internet competence is related directly to individuals' capacity to use the Internet for the purposes they choose. A study of on-line sessions of an experimentally designed sample of new users (Neuman et al. 1996) demonstrated that the emotional impact – whether users felt frustrated or gratified at the session's end --- was a function of their success in attaining their objectives. Thus we further hypothesize that Internet competence is related to the satisfaction users derive from the experience, the extent to which they find it stressful or rewarding, and therefore, the extent to which they persist in Internet use and acquire additional skills.

Inequality in the availability of social support. Based on these observations about competence, we would expect inequality in competence to deepen inexorably, as skillful users find the Internet rewarding and acquire greater skill and users without know-how are frustrated and turn away. Yet we know that this is not the case: most new users do become more competent. We suspect that a major reason for this is that they can draw on *social support* from more experienced users when they reach the limits of their own skills.

Access to social support has become more important as the technology has penetrated new sectors of the population. Anecdotal evidence suggests that early Web users were embedded in dense

networks of technically sophisticated peers. By contrast, more recent converts to the Internet are often less sophisticated and more isolated. We would suggest the utility of exploring the distribution and impact of at least three kinds of support: formal technical assistance from persons employed to provide it (for example, office staff in workplaces, customer support staff in businesses, librarians, and teachers); technical assistance from friends and family members to whom the user can turn when he or she encounters problems; and emotional reinforcement from friends and family, in the forms of both commiseration when things go wrong and positive interest in sharing discoveries when things go right.

We hypothesize that social support of all kinds increases users' motivation to use the technology and the extent to which they develop their own digital competence. We further predict that variation in social support influences the returns to Internet access, however these are measured.

Variation in use. Finally, how do income, education, and other factors influence *the purposes for which one uses the Internet*? From the standpoint of public policy, not all uses are equal. The Internet prophets who foresaw that the Web would empower citizens, increase social capital, and enhance equality of opportunity probably did not have gambling or pornography sites in mind when they made these predictions. We place high priority on examining determinants of different kinds of use, especially distinguishing among uses that increase economic productivity (e.g., skill-enhancement, learning about employment opportunities, consumer information, or education) or political or social capital (e.g., using the Internet to follow the news, gather information relevant to electoral decision-making, learn about public issues, engage in civic dialogue, or take part in or organize social-movement activities [Norris 2001]), and those that represent consumption of entertainment.

We know relatively little about how different kinds of users vary on these dimensions. On the one hand, NTIA (1998, 2000) reports that lower-income and less-educated Internet users are

more likely than wealthy users to use the Internet to find jobs, and Spooner and Rainey (2000) found that African-American Internet users are more likely than their white counterparts to use the Web for education and job-hunting. How much using the Internet to find jobs will increase the status of individuals excluded from the informal social networks through which social scientists have found that information about the most desirable jobs is distributed (Lin 2000) is an open question. Nonetheless, egalitarians should find such results encouraging. Yet the relatively early adopters by groups that have had lower levels of adoption may be atypical in ways that make it unwise to use their behavior as a basis for predicting the behavior of later adopters from the same groups.

We hypothesize that, in the long run, education will be a strong predictor of the use of the Internet for the enhancement of human capital, the development of social capital, and political participation. We further predict that such uses of the Internet will be more strongly associated with positive life outcomes than will forms of Internet use that represent pure consumption activities.

Towards a model of technological inequality. Implicit in concern about the "digital divide" is the assumption that people who use the Internet will garner returns in the form of greater access to goods and services they value and to enhanced life chances in the form of more education, better jobs, and higher incomes. In this sense, the "Digital Divide" is related to the larger issue of inequality in access to new technologies and to the effects of such inequality on the relative life chances of members of different groups. Researchers have found some evidence that computer use enhances learning in schools and earnings in the workplace, with higher returns to some groups than to others (Krueger 1993; Attewell and Battle 1999). It is not too early to ask similar questions about access to the Internet.

If one aggregates the hypotheses set out in the previous sections, one may discern a model of the influence of technological inequality on individual life chances that may both apply to the

Internet and generalize beyond it. Briefly, we would predict that the quality of technical apparatus, autonomy of use, skill, and social support influence the efficacy with which Web users employ the technology. Skill and social support constitute a feedback loop with learning, which, along with efficacy, increases satisfaction and therefore encourages greater use. The dependent variables --- increases in human capital (including educational attainment), social capital (including political agency), and earnings --- are direct functions of the efficacy, intensity, and purposes of use, and indirect consequences (through these mediating variables) of apparatus quality, autonomy, skill, and support.

Other forms of inequality. In focusing on inequality in individuals' ability to gain effective access to the full range of content and services that the Internet provides, we have given short shrift to two other forms of inequality that warrant scholarly attention. One of these is cross-national variation in Internet access and use. Studies of the "digital divide" are invariably carried out within national societies or smaller units. Were they based on multinational samples, citizenship might well be as important a predictor as income, education, gender, or race. Norris (2001) identifies a "global divide" that separates wired countries from those with little access to the network. Hargittai (1999) documents and explains cross-national variation in connectedness to the World Wide Web among OECD countries.

Wilson (2000) has called attention to another dimension of inequality between social and linguistic groups: the availability of suitable content. This, in turn, is related to access to the skills and time required to mount a Web site and to the capital necessary to promote it and keep it current. Little empirical research bears on the question of the availability of culturally and linguistic specific Internet content of different kinds (except to document the dominant position of English as the language of the Web [OECD 1997]), but the issue has received substantial attention from policy makers and technology critics. When scholars turn to this topic, it will be important to

study not just the amount and quality of culturally and linguistically specific Web sites, but also their availability from the portals to which most Web users have ready access.

Social Organization of Technological Inequality

Our critique of the paradigm that has guided much research and policy discussion about inequality in access to and use of the Internet has thus far focused on the binary view of inequality implicit in the notion of "digital divide." In this section, we depart from a second implicit assumption in most research on the "digital divide": that to understand inequality in "access" it is sufficient to focus exclusively on individual resources and behavior.

By contrast, we believe that access to and use of the Internet is continually transformed by the interactions of corporations' strategic choices, individual users' responses to these choices, programmers' decisions about code (Lessig 1999), and government regulation (including intellectual-property legislation, privacy rulings, antitrust actions, and economic regulation). Corporate strategies, as modified by government regulation and consumer response, must be taken into systematic account because they continually alter individual-level incentives and constraints that produce inequality of access to the technology (Neuman, McKnight, & Solomon 1998).

For example, the extent to which differences in the quality of hardware, connections, or software shape one's effective access to the full range of information on the Web is in part a product of how companies decide to design their Web sites, and whether they provide "low-graphics" or "text-only" options for users with less advanced equipment. Decisions on the part of companies supplying the market with browsers and of ISPs responsible for the software people use to access the Internet also influence people's ability to navigate the Web. The importance of financial inequality in limiting Internet access depends, as well, on regulatory and legislative decisions that expand definitions of "intellectual property" (and constrict the definition of "fair use") in ways that may lead Internet firms to substitute pay-information services for free-information services. The fact that the government issues accessibility standards for electronic and

information technology by which all government Web sites have to comply (Access Board 2000) also exemplifies how institutional measures can contribute to the degree to which sites are accessible to users with different needs and resources.

Decisions about investments in network infrastructure are another example of how institutional factors shape patterns of access. For example, Internet connectivity in rural America is limited by relatively weak telecommunications infrastructure investment. As a result, there is less competition among ISPs, rates are higher, and fewer households subscribe (Strover 1999). By contrast, the superior availability of infrastructure in urban areas is responsible for relatively rapid penetration of high-speed Internet access in urban public libraries, a development that has helped to increase formal access for the low-income and minority communities that many such libraries serve (Bertot & McClure 1998).

A significant institutional change – and the one that leads us to regard differences in navigational skills as an increasingly important dimension of inequality – is the expansion of commercial content and the rise of portal sites and search-engine technologies that render some sites difficult to access and award prominent positions to others based on financial compensation or other nonrandom criteria, thus increasing the human-capital investments required for effective access to the Web as a whole. Most people "satisfice" when they gather information on the Web, trading off comprehensive coverage in favor of minimizing the costs of search. An analysis of almost one billion queries on the Altavista search engine revealed that 77 percent of sessions included but one query and 85 percent of users viewed only the first screen of search results (Silverstein et al 1998). Content creators can only reach large audiences if online gatekeepers (the term by which we refer to Web services that categorize online information and provide links and search facilities to other sites) channel users to them (Hargittai 2000b). During the late 1990s, entrepreneurs developed comprehensive and strongly branded "portals" – Web sites containing search engines, category guides, and various shopping and information services – to match users

and content. By 1999, such sites accounted for one in four of the most visited destinations of the Web (Waxman 2000b). Internet traffic is highly concentrated: 80 percent of "hits" (successful efforts to contact a site) go to just .5 percent of Web sites, and "portal sites" account for one in four of these most visited destinations (Waxman 2000a, 2000b). The search engines featured by such sites are often biased in their choice and, especially, their ranking of sites in response to user queries (Introna & Nissenbaum 2000). Web destinations that portal sites display prominently or that search engines rank high are likely to monopolize the attention of all but the most sophisticated and committed Internet users. If Castells (1996) is right in his prediction that that Internet users will soon divide into "two distinct populations, the interacting and the interacted," then understanding the economic and political economic determinants of this process will be an essential step in understanding and explaining digital inequality.

Policies of public institutions also shape patterns of inequality in effective Internet access and use. The capacity of different kinds of Americans to use the Internet to gain access to information about government and politics will depend upon the extent to which government agencies and political institutions make information available, the form in which they present the information, the strategies they use to promote their sites, and the manner in which they interact with different types of users (Fountain 2001; Norris 2001).

Policies of one level of government may be counteracted by practices at another. Federal (and corporate) policies contributed to a large jump in Internet connectivity in U.S. public schools (from 3 percent in 1994 to 63 percent in 1999 [U.S. Department of Education 2000]). But Internet *use* in schools is limited by weakness in training and support staffing, which has made it difficult for teachers to integrate the Internet effectively with other curricular materials (Bolt & Crawford 2000).

Conclusion

The "digital divide" paradigm served researchers and policy makers during the opening years of Internet diffusion. But the ongoing expansion of Internet access, along with continuing institutional change, requires that we move beyond that paradigm if we are to document and explain important dimensions of digital inequality as Internet penetration continues to increase. In particular, we call for researchers to:

1. Expand the focus of research the "Digital Divide" between "haves" and "have-nots" (or between users and non-users) to the full range of *digital inequality* in equipment, autonomy, skill, support, and scope of use among people who are already on-line.

2. Go beyond documenting inequality to developing and testing models of the processes that engender or ameliorate inequality by mediating the relationship between individuals' social identities and their access to and use of new technologies.

3. Extend such models to the relationship between the use of these technologies and valued individual-level outcomes, and investigate variations in rates-of-return to technology use for different subgroups within the population.

4. Supplement individual-level research with analysis of institutional factors that shape and modify over time the relationships between individual characteristics and individual outcomes.

Accomplishing this agenda will require an expansion of surveys of Internet users and non-users to cover an expanded menu of topics. Students of digital inequality will also need to expand their methodological armory to include observational designs, analyses of user behavior based on massive data sets in which sessions rather than persons are the unit of analysis, analyses of link patterns among Web sites, ethnographies of use, cross-national comparisons, experimental survey designs, and political-economic research on industrial organization and regulatory issues.

This is a large agenda, but not impossibly so. The digital revolution is the first major technological change that has occurred *after* the institutional development of the social sciences that accompanied the emergence of federal science funding and the expansion of research univer-

sities in the 1960s. As such, it represents a challenge to the social sciences (in collaboration with colleagues in computer science and engineering) to demonstrate their ability to help society understand and anticipate the consequences of technological change as it is taking place. Properly conducted, such work can serve as an example for social scientists concerned with the effects of biotechnology and other technological revolutions that are sure to come.

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