Assistive Technology and Information Technology Use and Need by Persons With Disabilities in the United States, 2001

August 2005

U.S. Department of Education
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Dawn Carlson
National Institute on Disability and Rehabilitation Research

Nat Ehrlich
University of Michigan, Ann Arbor

U.S. Department of Education
National Institute on Disability and Rehabilitation Research

U.S. Department of Education
Margaret Spellings
Secretary

National Institute on Disability and Rehabilitation Research
Steven James Tingus
Director

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Contents

Figures

Tables

Executive Summary

The 2001 Survey of Assistive Technology and Information Technology Use and Need by Persons With Disabilities in the United States (AT Survey), was conducted over a nine-month period from March through December 2001. Each respondent was screened in as a person with a disability based on a screening instrument developed by the National Institute on Disability and Rehabilitation Research (NIDRR), the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), and the Survey Research Center (SRC) in the Institute for Social Research at the University of Michigan. The screener used questions from the 2000 U. S. Census and the National Health Interview Survey. Respondents were asked about personal characteristics, including disability status, followed by questions about assistive technology (AT) and information technology (IT) use and need in the home, at school, at work, and in the community. Attitudes and opinions about the availability and usefulness of AT (devices, technologies and services) were explored, as well as other factors believed to affect AT use and need, such as the severity of the impairment and the need for personal assistance services.

The respondents were drawn from two sources: a targeted list of persons with disabilities and random-digit dialing. A total of 1,414 individuals were interviewed by telephone: 1,002 from the list sample and 412 from the random-digit dial sample. The overall response rate exceeded 90 percent for both samples. Analysis showed no systematic selection bias in the random-digit dial portion of the survey, but there was over-representation of respondents from states with smaller populations in the list sample. Also, a series of reliability tests was performed to test for differences in response patterns between the two samples. No statistically significant differences were detected. We believe that the data and information gathered with this survey accurately represent the experiences of persons with disabilities who use or need AT, and how they went about obtaining and paying for the devices.

Findings

Demographics

The survey gathered information about gender, race, education, income levels and employment status of respondents. Sample characteristics were: 58 percent female, 42 percent male and 81 percent white. About 45 percent of respondents had gone to or had completed high school, 33 percent had some college, and 15 percent graduated from college or did some post graduate work, or both. Overall:

- The modal occupational status was “unable to work because of a disability.”
- More than 100 conditions were mentioned as causing the respondents’ limitations. The most frequently mentioned ailments were osteoarthritis, hearing loss, lingering effects of injury, back disorders, multiple sclerosis, diabetes and heart disease.

Type of Assistive Technology Used

- Of all respondents, 901 (64 percent) used some assistive technology. The prevalence of AT and IT use at school and at work was 36 percent; use at home was 49 percent; and use in the community was 50 percent. (These estimates are based on an 18.6 percent prevalence rate of disability among persons age 18 and older in the United States in 2001).

- Most of the assistive devices used were designed to enhance mobility: canes, crutches, walkers, scooters and wheelchairs. Hearing aids, oxygen tanks and other personal-use devices were also among the most frequently used devices.
- Most respondents who used AT said it made them more productive and more aware of their rights. In contrast, more than 24 percent of respondents reported that AT had not substantially reduced their dependence on other people.

Factors Influencing Assistive Technology Use

The main determinants of AT use and need were the severity of the impairments and the levels of education. Respondents whose conditions were more severe were found to have the following characteristics, when compared to less impaired respondents:

- Greater use of assistive technology, both in likelihood of use and number of devices used;
- More likely to have had their AT paid for by Medicare or the Veterans Administration;
- Less likely to pay for it themselves or from private medical insurance;
- Lower education levels;
- A greater likelihood of having been unable to work because of their conditions;
- Lower family incomes;
- More likely to be males than females; and
- More likely to be black than white.

Analysis of a number of factors influencing the use of AT revealed that AT use was not related to gender, age, race or level of impairment. Respondents with higher levels of education were more likely users of AT. Overall, 72 percent of the variance within the amount of AT use could be attributed to the amount of education attained by the respondent. In addition:

- Respondent age, race, sex, severity of respondent condition or the perceived need for more assistance were unrelated to the level of education achieved (thereby eliminating these variables as sources of confounding).
- Persons with higher levels of education made use of more sources of information to obtain AT, were more likely to contact another person or agency to obtain more help, were more aware that help is available in obtaining AT, and were more satisfied with their AT and the assistance they got in obtaining it.
- There was no effect of education level on the likelihood of having tried, and failed, to obtain AT.
- There was a strong, positive relationship between level of education and both personal and family incomes—but the level of income and AT use were negatively correlated.

Factors Influencing Assistive Technology Need

The influence of severity on perceived need for additional AT was more complicated. The greatest unmet need occurred among the moderately impaired in the home, while the smallest unmet need for AT occurred among the severely impaired in the workplace. A likely explanation is that respondents who were severely impaired were not only less likely to be gainfully employed, but even when they were working, were more likely to already be using AT than the other, less severely impaired respondents.

On the attitude and opinion questions, persons with severe impairments were more positive in their responses about the information they had received, the use of that information, and the help they received from improved products and AT in general, but more negative in judging improvements over the past decade.

Sources of Information About How to Obtain Assistive Technology

Our findings show that the source of information had a major effect on respondents' attitudes about the utility of the information and of AT. For example, the information respondents obtained from family and friends was seen less positively than from other sources in general, and vocational rehabilitation counselors in particular. In addition:

- Most respondents learned about AT devices from their doctors and obtained them from medical or orthopedic supply houses.
- More than one-half of the respondents (52 percent) said that they received little or no information about AT, and 62 percent said they received little or no information on how to obtain it.
- Those who had received information said that it was useful.

Sources of Payment and Funding for Assistive Technology

Respondents were asked a series of questions about the process of acquiring AT. Most respondents (51 percent) said they learned about AT devices from doctors and other health care providers and obtained the devices from medical or orthopedic supply houses. More than one-third of respondents (37 percent) said they paid for the devices themselves or had a family member pay for them. A similar number (38 percent) paid for the devices primarily through private insurance, Medicare and Medicaid. Regarding help in the selection and purchase of AT, only about 1 in 5 respondents said they received assistance. Most who asked for help said they received it, but the most common response was that the respondents did not feel the need to ask for help.

Funding of AT can present a barrier to some persons who need to acquire AT or IT. Almost 40 percent of respondents said they paid for the AT or IT themselves or with help from a family member, and a similar percentage relied on a third-party payer, such as private health insurance, Medicare or Medicaid, to pay for the needed AT or IT.

Information Technology Use

Although respondents said they encountered virtually no difficulties in using information technology such as telephones, a significant number said that they had problems with computer use. The survey showed that 36 percent of the respondents required the assistance of another person to use the computer, and 14 percent of respondents required special modifications to use the computer. However, the majority of respondents said they believed that they were well served regarding their need, ability and opportunity to use telephones and computers.

Attitudes and Opinions About AT and IT Use

Respondents were asked four questions to obtain their opinions on whether awareness of the need for AT, laws regarding AT, awareness of the benefits of AT, and assistance for purchasing AT, have changed compared to 10 years ago. Respondents were largely in agreement with the statements that, compared to 10 years ago, people are more aware of the need for AT, that they understand AT, that the laws have changed, and it is easier to get assistance in obtaining AT. In all cases, the responses of persons who are using AT were more positive than those of the non-AT users.

Conclusions

The major shortfall of all studies about technical assistance on AT has been the lack of state-based data on how well the technical assistance programs have worked in the past, and if there are reasons to believe that future investment in these programs will yield measurable benefits for persons with disabilities. Such information is crucial for understanding how the various state-based programs have worked, considering that each state had a large amount of independence and control over what services were provided, to whom, by whom, when, where and how. States and territories provided different amounts of additional funding in addition to federal funds, but more importantly, the population size of the states and their political, economic and geographic characteristics may have affected the quality and amount of AT services provided to persons with disabilities as well. There is no evidence today that can tell us how well the 56 programs have worked as a whole or individually when compared to each other.

Finally, the effectiveness of a federal program to assist persons with disabilities in the selection and purchase of AT should be measured in terms of specific outcomes, such as employment and higher levels of social integration. There is anecdotal evidence of how AT has helped persons with disabilities and their families, but AT alone is not the sole contributor to such success. Other factors such as adequate education and job training of AT users play a major role as well. In that regard, more research that measures the direct and indirect benefits resulting from the purchase and use of AT in conjunction with these other factors is needed.

Part I. Legislative Background, Need for the Study and Study Design

1. Overview of Legislation and Policy Related to Assistive Technology and Information Technology

Legislative Background

Assistive technology devices, including adaptations to existing products and devices that are part of daily living, significantly benefit persons with disabilities of all ages.[1] Such devices and adaptations can increase the involvement of persons with disabilities in programs and activities such as early intervention, education, rehabilitation, training, employment, residential living, independent living, recreation and other aspects of daily living and reduce the costs associated with such program participation.

The importance of assistive technology in the lives of people with disabilities was appropriately acknowledged with the passage of the *Technology-Related Assistance for Individuals with Disabilities Act of 1988* (29 U.S.C. 2201 et seq.) also called the *Tech Act*.

Assistive technology device is defined by the *Tech Act* as "any device, piece of equipment, or product system, whether acquired commercially or off the shelf, modified or customized that is used to increase, maintain or improve functional capabilities of individuals with disabilities." This broad definition of assistive technology encompasses the vast number of everyday and specialized devices that can provide assistance to individuals with disabilities.

The *Tech Act of 1988* authorized systems change grants to states to increase access to assistive technology devices and services. This legislation, along with the *Americans with Disabilities Act*, brought an increased awareness of assistive technology to the general public and to people with disabilities; placed a greater emphasis on the rights of people with disabilities to obtain needed technology; and initiated the beginning of systems changes to remove barriers to obtaining assistive technology.

Subsequent legislation, including the 1994 amendments to the *Tech Act*, placed greater emphasis on state responsibility, advocacy, systems change and consumer responsiveness as well as providing additional funding for assistive technology services (Flippo, 1995). The *Assistive Technology Act of 1998*, or *AT Act* (Public Law 105-394), provided additional funding to states, territories and outlying areas; expanded national activities and increased government coordination; and increased alternative financing efforts. The *AT Act* consists of three titles:

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[1] The term "person with a disability" means any individual of any age, race or ethnicity who has a disability and who is or would be enabled by an assistive technology device or an assistive technology service to minimize deterioration in functioning, to maintain a level of functioning, or to achieve a greater level of functioning, in any major life activity.

Title I authorized funding for multiple continuity grants and grants for protection and advocacy systems, as well as funding for a technical assistance program. The law specified activities that states are required to undertake: establishing public awareness programs; promoting interagency cooperation; providing technical assistance and training; and conducting community outreach. State grantees are expected to set measurable goals in connection to their use of *AT Act* funds, and both the goals and the approach to measuring the goals had to be based on input from individuals with disabilities in the state.

Title II promoted increased coordination of federal efforts related to assistive technology and universal design, a strengthening of the mandate of the Interagency Committee on Disability Research (ICDR) to include assistive technology and universal design research, and authorization for funding joint research projects by ICDR members. In addition, Title II authorized funding for:

- Small Business Innovative Research grants (an existing program under the *Small Business Act*) related to assistive technology;
- Grants to commercial or other organizations for research and development related to universal design concepts;
- Grants or other mechanisms to address the unique assistive technology needs of urban and rural areas, and of children and the elderly;
- Grants or other mechanisms to improve training of rehabilitation engineers and technicians; and
- The President's Commission on the Employment of People With Disabilities to work with the private sector to promote the development of accessible information technologies.

Title III established alternative financing programs for people with disabilities to purchase assistive technology devices and services through grants to states and outlying areas. These funds could be used to establish specified types of loan programs for individuals with disabilities, but could not be used simply to purchase assistive technology for individuals.

The *Tech Act of 1988*, the *Tech Act* reauthorization of 1994, and the *AT Act of 1998* included a "sunset" provision that reduced federal funding to states in their ninth year by 25 percent of their eighth-year allocation, and in their tenth year by 50 percent less than their eighth-year allocation. The *AT Act* authorized states to receive an additional three years at the 50 percent level for a total of 13 years of federal support, but after 13 years, no more funds could be obtained. Since the *AT Act* was authorized through FY 2004, the states funded in 1989, 1990 and 1991 were expected to gradually phase out of the program.

Since the enactment of the *Tech Act* in 1988, a total of over $475 million in federal funds have been appropriated. Table 1.1 contains the annual amounts. Please note that 1995 was the first year that all 56 states and territories participated in the program.

Table 1.1 Tech Act Appropriations, Including Title III[2]

Fiscal Year	State Projects	Appropriation
1989	9	$5,150,000
1990	23	$14,814,000
1991	31	$20,982,000
1992	42	$28,000,000
1993	53	$34,068,000
1994	55	$27,744,000
1995	56	$39,239,000
1996	56	$36,109,000
1997	56	$36,109,000
1998	56	$36,109,000
1999	56	$34,000,000
2000	56	$34,000,000*
2001	56	$41,100,000*
2002	56	$60,884,000*
2003	56	$26,824,000

** These amounts include appropriations for Title III.*

Legislative Update: *Assistive Technology Act of 2004*

Since this survey was conducted, the *Assistive Technology Act of 2004* was enacted on Oct. 25, 2004 (Public Law 108-364). This law renews federal assistive technology aid to states and requires states to spend the bulk of state grants on direct services for individuals with disabilities.

The 2004 act updates the purpose of the *Assistive Technology Act* to reflect the priority of increasing access to needed devices for individuals with disabilities. The Assistive Technology State Grant Program was established in 1988 as a 10-year program to provide seed money to enable states to create systems for improving access to assistive technology devices for individuals with disabilities. However, this program has been extended beyond the original 10-year window. In the 16 years since the inception of this program, states have established the needed infrastructure to effectively administer assistive technology resources. The new law redefines the primary purpose of this program from establishing systems to directly helping the individuals with disabilities who need assistive technology devices.

Under the *Assistive Technology Act of 2004*, states would be required to use a majority of federal funds to directly help individuals. States would chose between two options for assistive technology state grants. States would be required to:

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[2] Amounts provided in an unpublished report to the National Institute on Disability and Rehabilitation Research by the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA*), Progress and Outcomes: A Report on the State of Assistive Technology Act Programs*. Arlington, Va., September 2004

- Use 60 percent of assistive technology state grants on direct aid programs, including assistive technology reutilization programs, assistive technology demonstration programs, alternative financing programs and device loan programs; or

- Use 70 percent of assistive technology state grants on direct aid programs, but have full discretion on how to allocate funds for at least two, and up to all four, of the programs listed above.

The law creates greater accountability for how states use assistive technology grants. It requires states to submit an application with detailed descriptions of planned activities and measurable goals relating to education, employment, telecommunication or information technology, and community living. The law also includes detailed criteria for the Department's annual report to Congress to determine the effectiveness of the program.

Other Legislation Related to Assistive Technology and Information Technology

Section 504 of the *Rehabilitation Act of 1973* (29 U.S.C. §794) requires that the services, programs and activities, including information services, of a covered entity which receives federal funds must be accessible to and usable by persons with disabilities, with or without "reasonable modifications." It further provides that such entities not discriminate in the hiring, placement and advancement of persons with disabilities, and shall make "reasonable accommodation" for their otherwise qualified employees with disabilities.

Section 508 of the *Rehabilitation Act of 1973* (29 U.S.C. §794d) requires that employees with disabilities and citizens with disabilities have comparable access to electronic and information technology. "Electronic and information technology" means any equipment, software, interface systems, operating systems, or interconnected system or subsystem of equipment used in the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. "Comparable access" means that individuals with disabilities must be able to produce and have access to the same or equivalent information processing resources, with or without special peripherals, as individuals without disabilities.

The *Telecommunications Act of 1996* (47 U.S.C. §255) requires telecommunications products and services to be accessible to people with disabilities. Manufacturers must ensure that products are "designed, developed and fabricated to be accessible to and usable by individuals with disabilities" when it is "readily achievable" to do so. Section 255 applies only to products designed, developed and fabricated after the law took effect on Feb. 8, 1996.

The *Hearing Aid Compatibility Act of 1988* (47 U.S.C. §610) requires that the Federal Communications Commission (FCC) ensure that all telephones manufactured or imported for use in the United States after August 1989 and all "essential" telephones are hearing aid compatible. "Essential" phones are defined as "coin-operated telephones, telephones provided for emergency use, and other telephones frequently needed for use by persons using such hearing aids." These might include workplace telephones, telephones in confined settings (like hospitals and nursing homes), and telephones in hotel and motel rooms. Secure telephones, as well as telephones used with public mobile and private radio services, are exempt from the *HAC Act*. In June 1996, the FCC adopted rules to address the needs of telephone users with hearing disabilities. To be hearing-aid compatible, the telephone receiver must contain an electromagnetic coil that emits a magnetic field. At present, the FCC's HAC requirements only apply to wireline and cordless telephones, not to telephones used with mobile services, such as cellular telephones.

The *Individuals with Disabilities Education Act* (20 U.S.C. §1400 et seq.) mandates the provision of assistive technology devices and services if they are required as part of a child's individualized education program. On Dec. 3, 2004, the president signed the *Individuals with Disabilities Education Improvement Act* into law. Most provisions of the new law take effect on Jul. 1, 2005.

The *Americans with Disabilities Act* (42 U.S.C. §12101 et seq.) addresses access to the workplace (Title I), state and local government services (Title II), and places of public accommodation and commercial facilities (Title III). Title IV addresses assistive technology specifically as it requires phone companies to provide telecommunications relay services for people who have hearing or speech impairments.

Current Federal Policy Efforts

Effective use of AT depends on the availability of trained service providers. Persons with disabilities require assistance in selecting appropriate devices, training in the proper use of equipment, and access to maintenance and repair work and replacements when equipment becomes nonfunctional or obsolete. Two questions that frequently arise in this context are:

1. Who should provide technical assistance services for persons with disabilities?
2. Who should pay for these services?

Medicare and Medicaid provide funding for some forms of assistive technology but the implications for access posed by coverage rules related to "medical necessity" are not entirely clear. Differences across states in interpretation of medical need limitations have given rise to equity concerns (Seelman, 1993). For instance, in a 1993 study published by the National Council on Disability, respondents complained about the complexity of the system, poor information on how to access devices, lack of coordination among funding agencies, lack of training and maintenance resources, lack of individual choice over assistive technology services, and the significant numbers of people who remained unserved or underserved.

Seelman (1993) noted the following additional access barriers: lack of consumer information on technology, lack of ties to the technology culture, language differences, and institutional living situations. Such observations have raised questions—particularly among disability rights advocates—if the use of technology-related services should be based solely on one's ability to pay, and if the forces of supply and demand should regulate the quantity, quality and price of such services. Opponents of such a solution maintain that the majority of persons with disabilities have very low incomes and depend on other sources of support. A market-based ability to pay solution would likely be imperfect as well. Some income would have to be redistributed, either by way of taxes and expenditures, insurance premiums and benefit payments, or charitable giving. In view of these arguments, administrative and legislative efforts continuously address a more equitable distribution of AT and technology-related services for persons with disabilities. These efforts are briefly discussed below.

As part of his New Freedom Initiative launched Feb. 1, 2001, President Bush offered a comprehensive package of initiatives to increase research in, and access to, assistive technologies, including $35 million in funding for low-interest loan programs to help people with disabilities purchase assistive technology.

The federal government promotes the interests of Americans with disabilities as it works closely with the high-tech industry and disability community to ensure full and successful implementation of Section 508. Section 508 ensures that information technology purchased by the federal government is accessible to Americans with disabilities; its implementation is critical in an era of reliance on information technology. For example:

- In 1997, about 19 million Americans were using the Internet. That number tripled in one year, and then passed 100 million in 1999. In the first quarter of 2000, more than five million Americans joined the online world—roughly 55,000 new users each day.
- Every 24 hours, the Web increases by more than 3.2 million new pages and more than 715,000 images.
- The number of electronic mailboxes worldwide reached almost 570 million in 1999. In 1998, the U.S. Postal Service delivered 101 billion pieces of paper mail; estimates of e-mails transmitted that year range as high as four trillion.

In 2000, an estimated 54 million Americans reported having some level of disability. Persons with disabilities are more likely to need software and hardware modifications in order to use computers and access the Internet. Section 508 compliance throughout the federal government will make the benefits of e-government available to all Americans, regardless of disability.

Summary

This overview of assistive technology related legislation shows that the federal government has recognized the importance of technology-related assistance for persons with disabilities. Embedded in a framework of laws that promote greater inclusion and participation of persons with disabilities in all aspects of home, school, work and community life, the *Assistive Technology Act* and other laws promote the use of assistive technology and environmental accommodations. This is accomplished through federal grants to state and community organizations. Increased availability and use of assistive technology can lead to increased access to the built environment and to the social environment, which in turn promotes independence and inclusion for persons with disabilities and their families.

2. Review of the Literature and Comparable Surveys

Background

Increased awareness and service provision has given rise to an ever-increasing list of issues and topics surrounding the use of assistive technology. Issues such as assessment, evaluation, funding, access to services, underserved populations, outcomes, product development and device selection have emerged as important topics. Thousands of articles and materials that document these issues were found on the Internet, in professional journals, and in consumer education and training materials. Yet few of the materials document the extent of assistive technology use and the long-term impact of assistive technology legislation.

The growing awareness and availability of assistive technology over the last decade has provided a greater level of independence and community participation for people with disabilities. The *Technology-Related Assistance for Individuals with Disabilities Act of 1988* created a structure for growth in assistive technology use. Research conducted since that time confirmed an increase in assistive technology use. This literature review documents relevant research on assistive technology use, including the issues surrounding assistive technology and the people who use it. The following are highlights of the review's findings:

- Mobility devices constituted the bulk of AT used by persons with disabilities. Estimated rates of mobility device use from various surveys ranged from 2.6 percent to 90 percent, depending on the population that was studied, how assistive technology was defined and how use was measured.
- Older adults represented the most studied group of individuals and demonstrated the highest assistive technology use rates among disability groups.
- Trends in assistive technology use from national surveys showed an increase in the use of assistive devices over time which can be attributed in part to an aging population.
- Assistive technology was widely used in the home, and these modifications often contributed to greater independence and increased levels of functioning.
- Along with national surveys, state and local surveys reported funding as a significant barrier to assistive technology use, contributing to many unmet needs.
- Assistive technology use in postsecondary education and in the workplace was limited despite the reported needs.
- Computer use and information technology access was acknowledged in the research as important emerging issues in assistive technology.

Scope of Literature Review

In an effort to increase the understanding of assistive technology use, an extensive review of literature was conducted using the Internet and electronic bibliographic databases to identify published research documenting the use of assistive technology among people with disabilities. Because of the vast number of issues surrounding assistive technology, the focus of this literature review was limited to: 1) adults with disabilities; 2) research published since the *Tech Act of 1988*; 3) research that used survey methods to determine assistive technology use; 4) research with sample sizes of about 30 and larger; and 5) research conducted in the United States.

This review provides a comprehensive look at assistive technology use estimates from national, state and local surveys, encompassing areas such as satisfaction, unmet needs and barriers to use, as they relate to specific surveys. The extensive scope of research identified for this literature review is organized into the following categories:

- Demographic and Geographic Scope of Assistive Technology Use
- Assistive Technology Use Among Specific Populations
- Assistive Technology Use by Type of Device
- Assistive Technology Use in Various Settings

The section Demographic and Geographic Scope of Assistive Technology Use addresses the broader picture of utilization rates, types of devices used, and trends in assistive technology use with an emphasis on national population-based research, supplemented by state-level research. Sections on assistive technology use among specific populations and use of specific devices include many local surveys that document specific research interests and issues. Because of the unique nature of assistive technology use in various settings, the final category addresses assistive technology at home, school, work and in the community.

Demographic and Geographic Scope of Assistive Technology Use

National surveys typically provided the most reliable means of determining the demographic and descriptive variables of assistive technology use among a geographically representative sample. Though limited in number, these national surveys provide the basis for overall utilization rate estimates as well as trends and other issues of assistive technology use. National surveys were supplemented with multi-state or small national surveys and single-state surveys and are discussed in the later part of this section. Small sample studies that provided a more descriptive analysis of assistive technology use among the various demographic and geographic characteristics are also discussed.

Assistive Technology Use Estimates From National Surveys

Table 2.1 includes the national surveys that estimated the use of assistive technology among persons with disabilities since the enactment of the *Tech Act of 1988*. This overview summarizes national surveys that provide some documentation of assistive technology use among adults and older adults with disabilities. Most surveys captured assistive technology use among older adults. Only the National Health Interview Survey and Survey of Income and Program Participation documented assistive technology use across the lifespan.

Table 2.1 Overview of National Surveys With Assistive Technology Components

Surveys	Population	Assistive Technology Used	Source
National Long Term Care Survey 1989	Functionally impaired elderly, age 65+	12.0% equipment only 65.1% equipment and personal assistance to accommodate difficulty with ADL and/or IADL	Manton et al., (1993)
National Health Interview Survey—Assistive Device Supplement 1990	Noninstitutionalized population screened for assistive device use	6.4 million (2.6%) mobility devices 3.8 million (1.6%) hearing devices 3.7 million (1.5%) anatomical devices 1.5 million (0.6%) vision devices 7.1 million (2.9%) home modifications	LaPlante et al., (1992)
Survey of Income and Program Participation 1991–1992	Noninstitutionalized population	4.0 million (2.0%) canes, crutches or walkers for 6 months 1.5 million (0.8%) wheelchairs	McNeil, J. 1994
Survey of Income and Program Participation 1994–1995	Noninstitutionalized population	2.1 million (1.0%) use a wheelchair 6.3 million (3.1%) canes, crutches or walkers for 6 months	McNeil, J. 1997
National Health Interview Survey—Disability Supplement 1994–1995	Noninstitutionalized population screened for any disability	7.4 million mobility devices 4.5 million anatomical devices 4.2 million hearing devices 0.5 million vision devices	Russell et al., (1997) Kaye et al., (2000)
National Health Interview Survey—Supplement on Aging	Elderly persons, Age 55+	39.0% assistive devices	Kramorow et al., (1999)
National Nursing Home Survey 1995	Nursing home facilities and residents	86.0% mobility devices 65.8% eyeglasses 11.5% toileting equipment 12.9% transfer equipment 2.0% no devices	Gabrel & Jones 2000a
National Nursing Home Survey 1997	Nursing home facilities and residents	90.0% mobility devices 64.2% eyeglasses 13.3% transfer equipment 7.9% toileting equipment	Gabrel & Jones 2000b

Surveys	Population	Assistive Technology Used	Source
National Home and Hospice Care Survey 1996	Agencies providing home health and hospice care	Of current patients: 84.0% used mobility devices 46.9% eyeglasses 12.7% hospital beds 12.1% shower chairs 5.2% hearing aids 22.4% no devices Of discharged patients: 60.0% used mobility devices 43.7% eyeglasses 5.2% hearing aids 6.3% hospital beds 7.5% shower chairs 31.7% no devices	Haupt & Jones 1999
Survey of Asset and Health Dynamics of the Oldest Old 1994	Persons age 70 and older	23.0% equipment to get across rooms 4.7% equipment to get out of bed	Rodgers & Miller 1997

One of the most striking differences found among national surveys was the variability in how disability was defined and assistive technology use was measured. Surveys measured and defined disability based on impairment, functional limitation, activity limitation, or self-perception of disability (LaPlante, 1991). Each survey also used different questions to identify assistive technology use. Some surveys asked about broad types of devices and some listed specific devices, creating room for the respondents' own definitions of assistive technology. Jones and Sanford (1996) questioned the effect of the different ways of reporting and defining AT use based on personal perception of what constitutes an AT device and the way in which a question is posed. They reported that many respondents answered "No" to the use of aids for getting around, but reported using specific devices such as leg braces or the presence of a ramp into the house. This kind of variability in reporting assistive technology use, coupled with the limited number of national surveys, limits the ability to compare utilization rates.

Trends in Assistive Technology Use From National Surveys

Despite the limitations discussed above, many researchers have used national data sets to document trends in assistive technology use among individuals with disabilities. This research provides important information on the changes and trends in assistive technology use among adults with disabilities including: 1) demographic characteristics of those who used assistive technology; 2) changes in assistive technology utilization rates over time; 3) unmet technology needs; and 4) the relationship between assistive technology and activities of daily living.

DEMOGRAPHIC TRENDS

Age-specific patterns of AT use were among the most common demographic trends reported by researchers; older adults were most likely to use AT (LaPlante et al., 1992, Russell et al., 1997). Persons over the age of 65 were more likely to use mobility devices (61.5 percent), hearing devices (68.6 percent) and vision devices (51 percent). In contrast, 54.6 percent of those using an anatomical device were 44 years of age or younger. The percent of people with home modifications also increased with age, from about 1.6 percent among those under 25 years to 14.3 percent of those 75 and older (LaPlante et al., 1992). Results from the NHIS-Supplement on Aging from the 1999 Health and Aging Chartbook reported persons 85 and older were five times as likely to use a walker and three times as likely to use hearing aids as persons 70–74 years old (Kramarow, Lentzner, Rooks, Weeks, & Saydah, 1999).

Jones and Stanford (1996) also discussed the inevitable increase in the number of people with mobility impairments. They reported the number of people using manual wheelchairs or assistive walking devices would be likely to increase dramatically over the next 20 years as the baby boomers age and people live longer. Further demonstrating higher use rates among older adults, Watts et al., (1996) used a subsample of 3,297 people from the NHIS Assistive Device Supplement who were over the age of 65 and who reported using assistive devices. Of the 23.1 percent of those over 65 years old who reported using assistive devices, the mean number of devices reported was 1.48. Further analysis showed that a greater number of total devices correlated with poorer health status and greater activity limitations, and the greater numbers of devices used correlated with lower incomes and higher ages. Females reported more limitations and more devices than males, with 36 percent of females reported using two or more devices. The most frequently owned devices were canes, manual wheelchairs, walkers, and hearing aids (Watts et al., 1996).

CHANGES IN ASSISTIVE TECHNOLOGY USE OVER TIME

Confirming the assistive technology use patterns of an aging population, Russell and colleagues (1997) found that the use of assistive devices increased rapidly when compared to the typical population growth. The use of walkers, braces and wheelchairs almost doubled between 1990 and 1994. Some of the increase in assistive devices could be attributed to an aging population (Russell et al., 1997). Changes in assistive technology use over time were also documented by Manton, Corder, and Stallard (1993) using data from the 1982 and 1989 National Long Term Care Survey. The authors examined questions about activities of daily living (ADL) and instrumental activities of daily living (IADL) as they related to equipment use among the population over the age of 65. Dependence on equipment only increased from 6.5 percent in 1982 to 12.0 percent in 1989, and dependence on equipment in conjunction with personal assistance also increased from 60.7 to 65.1 percent. During this time period, there was a 10 percent decline in dependence of personal assistance only. He also attributed some of these changes to an aging population (Manton et al., 1993).

UNMET NEED FOR ASSISTIVE TECHNOLOGY

The literature revealed that unmet technology needs were frequently associated with, or resulted from, barriers to acquiring desired assistive technology devices. LaPlante, Hendershot, and Moss (1992) reported as many as 13.1 million or 5.3 percent of population were using assistive technology to accommodate physical impairments, and 2.5 million or 1 percent expressed a need for assistive technology they did not have. Thus, 15.6 million either used assistive technology or had some awareness that they needed to use assistive technology. These unmet needs were often related to increasing age and lower incomes, as the greatest barrier to assistive technology use was often lack of funding. Of those with unmet needs, 60 percent said they could not afford the AT device. When asked how respondents pay for their assistive technology, of those who bought the devices, 48 percent said that they or their families paid for the devices with no assistance from third parties (LaPlante et al., 1992).

Unmet needs also were reported as residual difficulty with activities of daily living. Agree (1999) used data from the Survey of Asset and Health Dynamics of the Oldest Old (AHEAD) to describe how assistive technology use and personal care were related to residual difficulty (unmet ADL need). The study did not measure overall AT use among the sample, but suggested possible patterns of use among older adults. Of the respondents, 9.5 percent reported sufficient care to meet ADL needs and 20.3 percent reported residual disability because of an unmet ADL need. The number with residual disability increased to 37.4 percent of those age 85 and older. The reported residual disability varied according to the type of limitation and the severity of the limitation, indicating some benefit from personal assistance only, some from equipment only, and some from a combination. Those who used only equipment to meet ADL needs reported less residual difficulty with mobility than those who used personal assistance, either alone or in combination with equipment. The use of equipment alone was most effective for those with the least severe limitations (Agree, 1999).

ACTIVITIES OF DAILY LIVING AND ASSISTIVE TECHNOLOGY USE

Assistive technology use was often linked directly to the performance of ADLs and IADLs, especially when estimating AT use among older adults. In many surveys, difficulty with ADLs and IADLs were an indication of disability or limitation. Kaye, Kang, and LaPlante (2000) reported a significant relationship between the presence of an ADL or IADL limitation and the use of an assistive device for mobility. In addition, the presence or absence of equipment affected the use of personal assistance. These interrelationships are described in more detail in the articles discussed below.

The National Survey of Self-Care and Aging (Norburn et al., 1995) examined self-care and assistance from others in coping with functional limitations in a sample of 3,485 community-dwelling Medicare beneficiaries, aged 65 and older. Self-care coping strategies included the following categories: “use equipment or assistive devices” (43.2 percent); “change behavior” (75.4 percent); “make adaptations to living environments” (31.9 percent); and “seek/receive help from others” (69.4 percent). It is not clear if “make adaptations to living environments” indicated the presence or use of accessibility modifications. Elderly people who lived alone were more likely to use equipment related to mobility. The study found that those who received assistance from others were more likely to report using equipment. For severely impaired individuals, most of the help received was from another person, and equipment use was often supplementary.

Manton et al., (1993) reported that a person’s reliance solely on equipment was most prevalent for persons with either one IADL or one to two ADL impairments, was higher for women than for men, and was highest at younger ages. Equipment use increased over a period where institutionalization rates were stable and mortality and chronic disability prevalence rates declined. Use of personal assistance or equipment alone appeared not to be sufficient to support individuals in the community. Those persons with impairment in five to six ADLs who used personal assistance services were likely to use equipment as a supplement according to the 1989 National Long Term Care Survey. Equipment was necessary to supplement active personal assistance and could reduce long-term care costs by replacing recurrent costs from personal assistance with non-recurrent equipment costs.

Agree and Freedman (2000) used NHIS-D to examine ways in which assistive devices combined with formal and informal personal care to meet specific functional needs and attempt to identify circumstances in which AT may have the potential to substitute for or supplement personal care. They found that of those who had difficulty with one or more ADLs, 65 percent reported the use of assistive devices to meet their needs. There was a strong relationship between personal care and technology use: Those with complex equipment were more likely than those using no equipment to have formal caregivers. In addition, those using simple technology were less likely than those not using equipment to receive informal care. It appeared that simple technology substituted for personal care for those who have difficulty toileting, whereas complex technology supplemented personal care for those who have difficulty walking.

Research Documenting Assistive Technology Use at the State Level

Surveys with small samples and limited geographic reach provide additional data that can supplement larger surveys. The literature review revealed that efforts to document AT use and need at the state level had grown, but still vary in terms of research design, sample size and areas of study.

SMALL NATIONAL OR MULTI-STATE SURVEYS

This section reviews surveys that provide insight into: 1) types of assistive technology; 2) settings of assistive technology use; 3) issues of use and abandonment; and 4) the positive effects of assistive technology in the lives of people with disabilities.

Chewning and Hayward (2000) surveyed 220 consumers who had contacted a state AT project and found that respondents had a wide range of disabilities. The most common was a non-orthopedic physical condition (30 percent). Over 62 percent reported having a secondary disability. After receiving assistive technology services, 94.3 percent planned to obtain or had already obtained at least one device, and 79 percent were currently using a device. The most frequent sources of funding were consumers and their families (26 percent). With 60 percent of consumers currently using high cost devices such as computers and communication devices, funding was a significant issue. The respondents reported moderate to high level of satisfaction with their assistive devices and 74 percent reported that the device they used most often was important to their increased independence.

Schact and colleagues (1999) described a two-phase community-based needs assessment of American Indians conducted in four cities. The Phase 1 sample included 532 adults from Texas, Minnesota and Colorado, of which 107 from Texas and Minnesota participated in the Phase 2 follow-up. Assistive technology use ranged from approximately 60 percent for glasses and contact lenses to 14 percent for crutches or canes. Strong and Maralani (1999) surveyed 201 farm workers with disabilities. When asked about the use of assistive devices, respondents reported using mobility devices, but often needed a device they did not have. Glasses were the most commonly reported device, used by 40 percent of respondents. Of those with glasses, 75 percent needed new ones and 18 percent of those without glasses reported needing them.

Brooks (1991) surveyed 595 highly educated, employed scientists and engineers with disabilities. The study showed that personal care devices were more likely to be used by those with neuromuscular disorders and limb loss. Employment devices were more likely to be used by those with visual impairments. Transportation devices were more likely to be used by those with neuromuscular impairments. People with hearing and visual impairments used communications aids more, but reported never using them in public settings. Individuals with visual impairments used educational devices more often. Patterns suggest that persons with sensory disabilities used devices for social tasks while those with non-sensory disabilities were more likely to use devices for general living. In general, respondents were satisfied with their devices, but 32 percent said they could be inconvenient and restricting. They reported negative attitudes toward use in public, but their actual use in public differed from the reported attitudes of those with vision and hearing impairments, as they rarely used AT in public settings. In addition, those with hearing impairments rarely used devices in employment settings (Brooks, 1991). More studies documenting AT use in various setting were included in a later section of this review.

Issues of abandonment were documented in a small national study by Phillips and Zhao (1993), who surveyed 227 adults with physical disabilities to determine how technology users decided to accept or reject assistive devices. Of the 1,732 different devices mentioned, the most frequently used were wheelchairs, followed by canes, bath chairs and walkers. Twenty-nine percent of devices were abandoned; splints, crutches, braces and walkers were more frequently abandoned. The predictors of abandonment included a change in need by the user, ease of obtaining the device, performance of the device, and the user’s involvement in the selection process.

The National Council on Disability (1993) surveyed 136 individuals with disabilities from seven states funded under the *Tech Act* to evaluate the benefits associated with the use of different kinds of technology-related assistance. The council found that 96 respondents identified specific types of assistive technology that would make a difference in their lives. Specifically, 62 percent of working-age persons were able to reduce dependence on family members, 58 percent were able to reduce dependence on paid assistance, and 37 percent were able to increase earnings with the use of AT. Eighty percent of elderly persons were also able to reduce dependence on others, half were able to reduce dependence on paid persons, and half were able to avoid entering a nursing home. Of the 42 respondents who reported having paid jobs, 92 percent reported that the assistive technology enabled them to work faster or better, and 67 percent reported that the equipment enabled them to obtain employment. Assistive technology also enabled 38 percent to pursue additional schooling.

SINGLE-STATE SURVEYS

Like the small national studies, state surveys varied in terms of areas of evaluation or needs assessment and survey methods.

Riemer-Reiss and Wacker (2000) examined assistive technology use and factors associated with discontinued use among 115 assistive technology recipients in Colorado. The study participants received 136 assistive devices from Colorado *Tech Act* agencies. The most readily obtained devices included computers (21 percent), communication devices (16 percent) and adapted software (7 percent). The survey found that 67.6 percent of the participants were still using the AT devices received from the provider and 32.4 percent discontinued use of their devices. Of those who no longer used the devices, 46.7 percent used the devices for one to three years; but 6.4 percent never used the devices at all. A significant inverse relationship was found between consumer involvement and discontinuance of assistive technology.

The Ability Program in North Carolina demonstrated multiple methods for improving access to assistive technology and documenting assistive technology use. Data from the program provided information about the scope of this privately funded statewide effort to improve access to assistive technology and measure outcomes of assistive technology use. Direct services were provided to 1,300 consumers; 40 percent had multiple disabilities, half were age 65 or older, 21 percent were age 45–64, and 64 percent were female. Of the 502 individuals who responded to an evaluation, 86 percent reported that the assistance and information provided improved their access to, ability to use, or understanding of assistive technology (Trachtman, Jones, Sauer, & Yoder, 1998).

The Kentucky Assistive Technology Network (2000) implemented a consumer and professional satisfaction survey in 2000 that included information on AT use in Kentucky. The majority of the 225 respondents had two or more disabilities (66 percent). Mobility devices were the most widely used (65 percent), followed by devices for reading or writing (62 percent), communication devices (53 percent), and personal care devices (52 percent). Approximately half of the respondents received some type of technology service and the most commonly reported problem with technology services involved funding.

The Nebraska Assistive Technology Project (1992) interviewed 244 clients and found that as many as 11 percent of individuals living in Nebraska had a disability that required the use of assistive technology. Most of those requiring assistive technology had mobility impairments (42.5 percent). Fifteen percent of those requiring assistive technology had less than an 8th-grade education, and 30 percent were unable to work. The most frequently reported needs for AT included home modifications, vehicle modifications, computers and mobility devices. An examination of the respondents' disposable income showed a very limited amount of income available to purchase assistive technology devices or services.

As a part of the Oregon Statewide Assistive Technology Needs Assessment, a total of 818 people responded to a questionnaire. Most of the respondents had some kind of physical disability; 42 percent were between the ages of 36 and 50 years old. Second to vocational services, assistive technology represented an unmet need among 20 percent of the respondents.

Specific areas of need included funding, information, opportunities to try devices and training (Brodsky, Wilson, & Fink, 1991).

Using national data and information from focus groups, Hanson and Lester (2000) reported that, of the 6.6 million Californians with a disability, about 1.7 million used some kind of assistive device. Mobility devices were the most frequently used. It was also reported that individuals with cognitive impairments have less access to assistive technology and may need more support to use it. Focus group participants reported lack of knowledge of available assistive technology services and resources.

Summary

National surveys provided information on the general variables of assistive technology use among a large geographically and demographically representative sample, providing the greatest insight into the overall percentages and changes in AT use. In addition to utilization rates, national data sets provided information to estimate and predict trends in assistive technology use, such as an increase in use with age and over time. Though few national surveys provided a comprehensive picture of assistive technology use across the lifespan, many provided information on assistive technology use among older adults.

The multi-state or small national surveys provided some important insights into patterns of AT use, but in many cases they were grounded in small convenience samples that contained descriptive data about the types of assistive technology used in addition to some demographic characteristics that were lacking in the national surveys. These state-level surveys also provided some important insight into types of AT used, specific benefits, issues of AT abandonment, and funding as a significant barrier to use.

Assistive Technology Use Among Specific Populations

While national and state surveys often sampled individuals with various disabilities, many local surveys focused on the role of assistive technology among specific groups. A large number of the studies involve older adults. Additional studies included individuals with physical disabilities, individuals with developmental disabilities, and individuals with hearing and visual impairments.

Assistive Technology Use Among Older Adults

Our review of national disability surveys provided a picture of assistive technology use among older adults, but there were several local and regional research projects that supplement the findings of these larger surveys. Research on the elderly represents a large pool of data on assistive technology use. The longitudinal data obtained from the Rehabilitation Engineering Research Center (RERC) on Aging, for instance, have been used in numerous articles documenting specific issues related to assistive technology use in the population of older adults. Smaller individual studies have also documented assistive technology use patterns in this growing population. These studies are discussed in this section.

Mann and colleagues at the RERC on Aging have been conducting a 10-year longitudinal study, the Consumer Assessment Study (CAS), to determine the need for assistive devices and home modifications among older adults with disabilities. At the time of this review, over 500 interviews had been completed with home-based elderly over the age of 60 recently or currently receiving services from 19 human service agencies and five rehabilitation hospitals in the western New York area, and considered at risk for needing assistive devices or home modifications (Mann & Tomita, 1998). The study measured multiple dimensions of health, disability, psychosocial issues, use of assistive technology and home modifications.

To determine the representativeness of the findings, Mann, Hurren, Tomita, and Charvat (1997) compared the CAS to the 1986 NHIS and 1987 NMES. The CAS sample was found to be older, more female than male, and with more functional limitations than the NHIS and NMES. The authors concluded that the data set only represents older persons with disabilities from a single geographic region. In another article, Mann and Tomita (1998) presented overall results of assistive technology use among this sample of 508 respondents. They explored issues of ownership, use and satisfaction with devices, as well as the problems consumers were having with the devices they used. Results showed that older adults owned an average of 13 devices and reported using 91 percent of the devices they owned. Although the overall satisfaction rate of 89 percent was very high, satisfaction varied among specific device types. Hearing aids, magnifiers, canes and wheelchairs were reported to be the most problematic devices when assessed relative to the number of users. Some of the reported problems included: the device did not help with the intended task; it was not affordable; it is dangerous in some situations; it created unwanted attention; it causes discomfort; it is difficult to maintain; it is difficult to use; it requires additional assistance; or it was not installed properly (Mann & Tomita, 1998).

Several articles based on the CAS sample compared AT use among the participants according to variables such as race, type of impairment and disability. Tomita, Mann, Fraas, and Burns (1997) found that black elders owned a total of 11 devices and white elders owned an average of 14 devices. White elders owned more than twice as many devices for vision and hearing as black elders, and white elders reported more home modifications. Although the findings revealed differences in AT use, living status and number of illnesses were more important predictor variables.

Mann, Hurren, and Tomita (1993) compared AT use between seven groups: minimally impaired; physically impaired; vision impaired; vision and physically impaired; cognitively impaired; cognitively and physically impaired; and cognitively and vision impaired. Across groups, subjects owned an average of 13.7 devices. Those with cognitive impairments owned the fewest number of devices (5.7), and those with vision and physical impairments owned an average of 20.1 devices. Device use ranged from 89 percent among the cognitively and vision impaired group to 70 percent among the other, mostly physically impaired group. Those with vision and physical impairments reported the highest number of problems with devices and one of the lowest satisfaction rates (67 percent). Physically impaired respondents reported the greatest number of devices needed. The authors noted the complexities that exist with the use of AT among older adults with multiple impairments.

Mann, Karuza, Hurren, and Tomita (1993) identified and categorized 86 subjects according to major impairment, visual, cognitive, hearing and physical disabilities. Older persons with visual impairments used the most assistive devices with an average of 12.4 devices per persons. Those with cognitive impairments used 5.8 devices per person. Respondents reported needing a total of 145 devices, or 1.7 devices per person that they did not currently own. Visually and physically impaired older adults reported dissatisfaction with one out of every five devices and those with cognitive impairments reported problems with one out of every three devices they own.

In addition to the work of Mann and colleagues, we found a number of studies that drew information from relatively small convenience samples, highlighting the role of professionals in the selection of devices and professional implications of nonuse. Cutrona, Russell, McCombs, and Losch (1991) surveyed 680 elderly persons from two counties in Iowa. The sample consisted primarily of white women between the ages of 60 and 95 years of age. At least one assistive device was reported by 8.1 percent of respondents, and 44.7 percent of those reported at least one functional limitation. The study found that those with arthritis were more likely to use an assistive device and reported difficulty using a telephone. Most devices were paid out-of-pocket. Lack of knowledge and reliance on others were the most frequent reasons for not using an assistive device that helped with a functional limitation.

Gitlin, Schemm, Landsberg, and Burgh (1996) used samples of older adults discharged from hospitals or rehabilitation units to describe assistive technology use, nonuse and perceptions of AT. While studying 86 older adults with a diverse range of diagnoses including stroke, orthopedic injury, and amputation they found that each person used an average of eight devices. Of the devices provided, 50 percent were used frequently, 3 percent were used occasionally, and 47 percent were seldom or never used. A follow-up of this sample revealed that the devices used in the first month after discharge were also used in later months. A smaller sample of 13 patients discharged from a rehabilitation hospital showed similar results. At one month after discharge, 45 percent of the devices were not being used (Gitlin, Levine, & Geiger, 1993). Initial perceptions of AT use after an acute illness were explored in a sample of 103 stroke survivors. The respondents reported highest satisfaction with dressing devices and lowest satisfaction ratings with seating devices (Gitlin, Luborsky, & Schemm, 1998).

A small community-based study by Klinger and Spaulding (2001) explored the use of assistive technology among a sample of 30 older adults with chronic pain. They found that 97 percent of respondents owned a total of 133 AT devices, but only 63 percent ever used those adaptive devices. The most common devices used were mobility devices, followed by bathroom devices. Many respondents reported finding and obtaining their devices without any professional help.

Individuals With Primarily Physical Disabilities

The studies documenting assistive technology use among individuals with primarily physical disabilities focused on changes in function and the types of assistive technology used as a result of these changes. Several studies reported AT use among individuals with specific physical disabilities such as cerebral palsy and spinal cord injury. This section also included research on individuals discharged from hospitals because many of the respondents had a physical disability associated with an acute illness or injury.

Campbell, Sheets, and Strong (1999) surveyed 301 people with polio, stroke and arthritis. In this study of secondary conditions, one of the variables was change in the use of assistive technology over time. Those with polio reported significantly more changes of mobility devices; as many as 47 percent of the study participants needed a new orthotic device, wheelchair or scooter. Stroke survivors reported the lowest levels of assistive technology use; only 10 percent used a mobility device. The study also reported home modifications as the greatest unmet need across all impairment groups. Another study of functional changes focused on 150 persons aging with spinal cord injury. The use of assistive technology was evaluated at three points in time, showing that the use of self-care devices increased over time, the use of hospital beds and pill organizers decreased over time, and the use of mobility devices remained constant (Thompson, 1999).

Fridie, Ferguson-Pell, and Davis (1998) sampled 246 people with multiple sclerosis. The mean age of the sample was 48.7 years, and the majority of respondents were female (71 percent.) A surprisingly large portion (48 percent) had not heard about AT before completing the survey. Of those who used AT, 54 percent used a wheeled mobility device, 35 percent used a low-tech mobility device, 20 percent made building modifications, and 18 percent used vehicle modifications. A small number of respondents used augmentative communication and environmental controls (5 percent) and computer access devices (4 percent.) The most helpful devices were powered mobility devices such as scooters or power wheelchairs.

A study of 110 adults with cerebral palsy by Murphy (1999) examined the overall health of the individuals, including the use of mobility devices. Sixty-seven percent were using a wheelchair at the time of the research, and much of the equipment showed signs of wear and improper fit. Of those using devices for ambulation, 90 percent of the canes and crutches were in disrepair or did not fit the individual. Hammel, Heller, and Ying (1998) explored the long-term use of assistive technology among 35 individuals with cerebral palsy. Of the average of eight devices per subject obtained originally, 77 percent used the devices when surveyed. Communication devices were used most commonly (33 percent), followed by transportation AT (29 percent) and self-care devices (22 percent). Over half of the assistive devices were funded by state public aid (Hammel, Heller, & Ying, 1998). Garber and Gregorio (1990), in a study of upper extremity assistive device use by 56 randomly selected individuals with quadriplegia from local areas in Texas, found that a total of 250 devices were prescribed. Twenty-five percent were feeding devices, 45 percent were splints and slings, 7 percent were dressing devices, 11 percent were communication devices, and 6 percent were grooming devices. Only between 29–39 percent of devices were still being used after the end of year two of the study. Most of the change in use was due to regained or increased function and alternative solutions.

Studies of individuals with physical disabilities discharged from a hospital or rehabilitation facility, such as the one by Geiger (1990), examined the use of prescribed assistive technology among 40 subjects with orthopedic impairments. Of the 140 self-care and dressing devices issued by an occupational therapist, 77 (54 percent) were never or rarely used. Cushman and Scherer (1996) examined the use of assistive devices recommended to maximize the independence of 47 persons discharged from an acute inpatient rehabilitation unit. There, the most common diagnoses were spinal cord injury and stroke, and the most commonly used devices were wheelchairs and commode chairs (over 60 percent). Of the 128 devices recommended, an average of 2.7 devices per person, 33 percent were not being used three months later. Adapted grooming aids had the highest overall rate of nonuse followed by quad canes. Fifty-nine percent of the respondents reported that the devices were "no longer needed." Other reasons for nonuse included difficulty obtaining equipment or receiving correct equipment. The abandonment of grooming and locomotion aids was tied to functional improvement in self-care and locomotion (Cushman and Scherer, 1996). Neville-Jan and her colleagues (1993) studied a sample of 50 patients discharged from a local hospital. They reported that of the equipment provided at discharge, 15 percent was never used. Twenty-one percent of the equipment was only used for a period of time. Of the equipment not utilized, tub and toilet equipment were the most prevalent. Reasons for nonuse included poor fit; did not know how to use; not installed; not needed; only needed for a short time; did not feel safe; or did not like using special equipment (Neville-Jan, Piersol, Kielhofner, & Davis, 1993).

In a study similar to the previously discussed hospital discharge studies, Bynum and Rogers (1988) interviewed 30 of recipients of home health care services. The participants had received 54 devices with an average of 1.8 devices per person. Bedside commodes and shower chairs, mobility aids were the most commonly used devices, but approximately half reported needing help to use the equipment. Participants used 82 percent of the devices prescribed, but only 69 percent were used on a regular basis.

Assistive Technology Use Among Adults With Developmental Disabilities

A limited number of surveys focused on AT use among adults with intellectual and developmental disabilities. Some of the studies focused on individuals living in nursing homes or residential facilities. In both cases, caregivers provided many of the survey responses.

Wehmeyer (1998) studied 1,218 family members of adults with mental retardation from 47 states and the District of Columbia. He found that mobility devices were used most frequently (at a rate of 12.7 percent), followed by hearing and vision devices (8.9 percent), communication devices (4.9 percent), home adaptations (9.7 percent), and environmental controls (5.5 percent). The need for AT ranged from 9.3 percent for communication devices and 8.4 percent for home modification, to 2.5 percent of the respondents who needed mobility devices. Cost and information were the most reported barriers to AT next to assessment and training needs. Funding for most devices came from personal sources, with government being the second most common funding source. In general, AT was underutilized, with less than 10 percent of adults using an AT device except in the area of mobility. Barriers of cost and lack of information about devices contributed to this underuse as families were not aware of the potential benefits of AT.

Parrette and Vanbiervliet (1992) surveyed 680 persons with mental retardation in a region of Arkansas. A large percentage of respondents reported other disabilities, such as speech impairments, physical disabilities or visual impairments. Seventy-three percent used mobility devices to get around and 21 percent used computers. Medicare and Medicaid were the primary sources of funds for assistive technology, and 30 percent of participants reported personal or family purchases of assistive technology. Respondents reported unmet needs in the areas of hearing aids, reading, writing, typing, building accessibility, communication and artificial limbs.

Hewitt, Larson, and Lakin (2000) reported that 33.3 percent of persons with mental retardation in Minnesota used assistive technology. Approximately 21 percent reported using an environmental adaptation or home modification. Of those who used an assistive device, 68.9 percent used mobility devices, 37.7 percent used augmentative and alternate communication, and 14.8 percent used prostheses. Of those with environmental modifications, 67.3 percent had bathroom modifications, 51.7 percent had a ramp and 4.9 percent had a vehicle lift.

Mendelson, Heller, and Factor (1995) reported results from a longitudinal study of 268 nursing home residents with developmental disabilities in Illinois. During the study, 67 subjects moved into the community (movers) and 201 remained in the nursing home (non-movers.) The non-movers had a greater prevalence of multiple functional limitations. Seventy percent of the non-movers used some type of assistive device compared to 55 percent of those who moved out of the nursing home. Among both groups the need for additional AT was significant. Only 85 percent of people with mobility impairment used AT to help with mobility and only 6 percent of people with ADL limitation and 4 percent of people with communication limitations used AT to improve those areas. In Massachusetts, Tello (1993) found that 1,738 devices were purchased for 177 consumers living in various residential settings. The majority of devices purchased (71.2 percent) were used to enable the consumer to get ready for work each day. Of the remaining devices, 18.6 percent were purchased for safety, 5.6 percent of the devices improved health and functioning, and 4.7 percent helped with money management.

Assistive Technology Use Among Individuals With Hearing and Visual Impairments

A small number of surveys focused on the assistive technology needs and uses among individuals with hearing and visual impairments.

Wendt-Harris, Pollack, and Lassere (2001) surveyed 261 members of the Self-Help for the Hard of Hearing organization. Most of the respondents (78 percent) had severe or profound hearing loss. Ninety-seven percent reported bilateral hearing loss. Almost all of the respondents used some kind of hearing devices such as a hearing aid, a cochlear implant or a vibrotactile aid. Three-fourths used a hearing aid. Background noise was the most common problem associated with the hearing devices. The most common alerting devices used included FM, amplified phone, infrared system, and alerting clock or phone.

The Lighthouse National Survey of Vision Loss (Stuen, 1997) of 1,219 respondents, with oversampling of adults over age 75, showed that among those aged 45 and over who reported a vision problem, only 30 percent were using devices to enhance vision. The percentage of those who used optical devices increased with age and severity of visual impairment. Thirty-two percent of those with severe visual impairment used a device compared with 28 percent of those with a moderate visual impairment. Only a small number of those with a visual impairment were using an adaptive device such as large print (21 percent), talking books (4 percent), and other voice output devices (5 percent).

Uslan (1992) discussed the barriers to acquiring assistive technology by individuals with visual impairments. Respondents from a sample of 30 low-income individuals with visual impairments revealed that 47 percent owned no assistive technology. More than 50 percent reported a lack of information about assistive technology and 33 percent could not afford assistive technology. Only 10 percent of this sample were employed and most were living below the poverty line. In a second survey of 39 individuals, respondents reported owning a median of 10 assistive devices. Twenty-six percent reported needing to upgrade their equipment. Though affordability was still a significant issue in this sample of employed individuals, they seemed more willing to take out a loan to purchase the equipment.

Summary

This section showed that older adults represent a population of frequent AT users. Mann and colleagues found that assistive technology use rates in this group varied according to impairment, race, cognitive status, income and age. Other studies of older adults showed varying numbers of devices and high rates of nonuse. A significant amount of assistive technology use and unmet need among those with physical disabilities related to areas of mobility and home modification. The studies of individuals with developmental disabilities showed limited assistive technology use in this population. The few studies of individuals with visual and hearing impairments showed minimal AT use by those with visual impairments.

Assistive Technology Use by Type of Device

The *Tech Act of 1988* and the subsequent funding of rehabilitation engineering research centers increased the rate of development of many new technologies and created a greater recognition of existing assistive devices. Rehabilitation engineering research centers are funded by the National Institute on Disability and Rehabilitation Research, of the U.S. Department of Education, to develop and disseminate innovative methods of applying advanced technology, scientific achievement, and psychological and social knowledge, with the goal of solving rehabilitation problems and removing environmental barriers. The authority for rehabilitation research engineering centers is contained in section 204(b)(3) of the *Rehabilitation Act of 1973*, as amended (29 U.S.C. 762(b)(3)).

Numerous articles on the use of devices have been written to evaluate their effectiveness and explain their capacity to increase independence. Because many of these articles were not designed to document AT use, only those articles that document widespread use of a type or group of devices within a survey were included in this review. The devices most frequently studied are computers, augmentative and alternate communication, prostheses and mobility devices.

Computers, Internet and Accessible Information Technology

Computers and the Internet represent forms of assistive technology with a unique potential to increase the independence of people with disabilities (Kaye, 2000a, 2000b). According to the 2000 National Organization on Disability/Harris Survey on Community Participation (2001), these technology and information tools were reported as increasingly important as a means for people with disabilities to gather information and feel more connected. Computer skills were found to be essential for employment, according to the National Council on Disability (1998) report on barriers to using multimedia technology.

The significant gaps in computer use among people with and without disabilities were described in a report from the National Telecommunications and Information Administration (2000) using data from the 1999 Survey on Income and Program Participation. The results showed that only 20.9 percent of those with a disability regularly used a personal computer and 59 percent had never used a computer. Thirty-one percent of those with a learning disability reported using a computer on a regular basis, but this percentage was significantly less for those with a walking problem or difficulty using their hands. Fewer people with disabilities used computers at home and work compared to the general population. The gaps between the computer use of people with and without disabilities are also influenced by income, age, employment status and gender.

Kaye (2000a, 2000b) analyzed 1998 data from the Current Population Survey and found that 23.9 percent of people with disabilities had access to a computer at home and 9.9 percent of people with disabilities were connected to the Internet. Using the same data, the Research and Training Center on Rural Rehabilitation Services (Rural Institute on Disability, 2000) found that people with disabilities in rural areas were less likely to own computers and use the Internet. While 28.7 percent of those with a disability living in a suburban area owned a computer and 11.6 percent used the Internet, only 19.8 percent of those living in a rural area owned a computer and 6.8 percent used the Internet. This significant difference in access between rural and urban living situations can be linked to lower educational attainment and to household income of those living in rural areas.

The National Council on Disability (1998) studied the barriers to computerized multimedia technology for people with visual and hearing disabilities and found significant gaps in access. The report noted that there were few accessible features for those with visual and hearing impairments in the area of multimedia technology.

Alternative and Augmentative Communication Devices

Alternative and augmentative communication (AAC) devices were used primarily by individuals with severe disabilities involving cognitive or speech impairments. This group of users represented a small number of individuals with disabilities. Use rates from the NHIS-Assistive Device Supplement reported that as many as 34,000 people with disabilities used a speech device in 1991, but these estimates have low statistical reliability.

Jinks and Sinteff (1994) surveyed 76 AAC device users and found 23 different devices used by individuals with cerebral palsy, traumatic brain injury, neurological conditions and other disabilities. Low technology devices accounted for 36 percent of the devices used, while high technology devices totaled 64 percent. Third party payers funded 81 percent of the AAC devices. All respondents with cerebral palsy reported using their devices often or sometimes, while 30 percent of those with TBI and 43 percent of those with neurological diagnoses reported rarely or never using their devices. A separate and smaller study of 17 AAC device users (Bryen, Slesaransky, & Baker, 1995) showed that the use of AAC device had substantially helped them with several major life activities such as working (64.7 percent), learning (58.8 percent) and communication (82.4 percent). For more than 75 percent of respondents their AAC device helped them communicate with unfamiliar people, writing and giving presentations.

Use of Prostheses by Individuals With Limb Loss

Studies on the use of prostheses covered many types of upper and lower limb prostheses and the problems participants had with their individual prosthesis, including the role of the prosthesist. Atkins, Heard, and Donovan (1996) studied 2,477 individuals with upper-limb loss who, when asked to identify the type of prostheses used, identified body-powered hooks in 63 percent of cases, and 37 percent used an electric hand. Of the original sample, 1,575 responded to a long survey. In the long survey, when asked to rate the cost of their prosthesis with respect to its function, adults with body-powered prostheses reported them to be "about right" (17.4 percent), compared to 5.6 percent of adults with electric prostheses. Electric users reported their prostheses to be "too expensive/unreasonable" more often than users of other prostheses. Respondents identified areas for improvement for different types of prostheses, and identified wrist movement, coordinated function and the ability to hold small and large objects as very important.

A survey of 45 veterans with traumatic limb amputation reported 11 upper limb and 51 lower limb amputations. Of the 43 respondents using a prosthesis, 32 percent felt their prosthesis was half as good as their original limb, while 22 percent reported the prosthesis was not very good at all. Most had problems using the prosthesis. Ten veterans did not use their prosthesis regularly because it was painful. All those who used the prosthesis reported limitations in its usefulness, specifically related to problems with fit and attachment. Another study of 109 amputees demonstrated more of the problems with the use of prosthetics. Of the 67 percent of participants who wore the prosthesis all day, 57 percent reported moderate to severe pain while wearing the prosthesis. The study emphasized the importance of the role of the prosthesist, especially as a source of information (Nielsen, Psonak, & Kalter, 1989). Nielsen (1991) surveyed an additional 21 amputees, finding similar concerns about comfort and fit of the prosthesis. However, the respondents of this survey appeared to be satisfied with the services provided by the prosthesists.

Mobility Devices

Despite the presence and awareness of assistive devices for mobility enhancement and the reported use by people with disabilities, we found few local surveys that dealt specifically with the issues of mobility devices. The most comprehensive information on utilization rates of mobility devices was found in national surveys. Kaye (1997) reported 6.8 million people used mobility devices according to the 1994 National Health Interview Survey. This included 1.7 million wheelchair users and 6.1 million users of canes, crutches or walkers.

Information on specific mobility devices was found in several studies, including that of Dunn and his colleagues (1998). They surveyed 99 individuals with a spinal cord injury on the use of standing mobility devices. Eighty-four percent of the respondents were currently using a standing device, while 14 percent reported nonuse of the device. There was no correlation between the use of the standing device and health issues, but respondents reported numerous positive benefits derived from using the standing device. A survey of 42 people with Amyotrophic Lateral Sclerosis (ALS) who use wheelchairs reported that 57.1 percent used an assistive device other than a wheelchair. Use of bathroom equipment, including 69 percent using shower seats, 61.9 percent using elevated toilet seats, and 57.1 percent using grab bars, was reported. Those using motorized wheelchairs reported a higher level of satisfaction with activity level, comfort and ease of maneuvering (Trail, Nelson, Van, Appel, & Lai, 2001).

Use of Assistive Technology in Specific Settings

Many national, state and local surveys addressed the different settings in which AT was used when reporting data on assistive technology use, but focused studies provided detailed information on AT use in specific settings. AT use in the home, school, work and community represented the major locations found in the literature. In addition to providing more depth of understanding, these studies pointed out some limitations in AT use and service provision.

Assistive Technology Use in the Home

Home modifications documented in national and state-level surveys (discussed in previous sections) were often considered types of assistive technology. Studies focusing on home modifications typically included older adults and showed how the use of these modifications increased independence by accommodating functional limitations, as the examples cited below will show.

A national survey of 2,000 individuals age 45 and over by the American Association of Retired People (Bayer & Harper, 2000) found that 80 percent of respondents reported that at least one member of the household had difficulty getting around the home. Because most of the respondents want to remain in their homes, one-third were concerned about being able to afford home modifications, being forced into a nursing home because they cannot get around, or having problems with features in their homes as they get older. Eighty-six percent of respondents have made at least one simple change, and 70 percent have made a more major change. Safety features were among the most common modifications.

Mann, Hurren, Tomita, Bengali, and Steinfeld (1994) interviewed 127 older adults to identify environmental problems in their homes that could potentially limit their functional abilities. A total of 500 environment-related problems were identified in the 127 homes and included stairs, lighting, counter height, and problems with switches and handles. Participants reported the kitchen and bathroom as the greatest problem areas, with over 60 different problems reported in each room. Many of the problems identified represented those that could be fixed easily with a change in design or maintenance task (Mann et al., 1994). In another study, the environment was used to manage problems experienced by older adults and their caregivers. A total of 17 participants used an average of 3.5 environmental solutions prior to the intervention by an occupational therapist who offered additional solutions, including the use of assistive devices, which gave the caregivers strategies for handling problems with bathing and incontinence more effectively (Gitlin & Corconan, 1993). In a study of 49 individuals in North Carolina with home modifications, Connell, Turner, and Gruber (1996) identified 122 total features. A family member or provider identified 77 percent of modification needs. Family and friends also paid for 67 percent of the modifications, but much of the labor was donated.

While there has been some research on the use of home modification devices and equipment by older adults with disabilities who were homeowners, Gitlin, Miller, and Boyce

(1999) looked at the equipment use by older adults who rent their homes. The study found older adults who rent their homes tend to be African-American, Hispanics and female, with lower incomes. This study of 34 clients with chronic conditions had an occupational therapy (OT) evaluation and received needed bathroom equipment and modifications. Prior to the OT evaluation, 41 percent had grab bars and 27 percent had a tub chair. Five additional devices were prescribed and participants reported significant improvement in the ability to bathe and transfer and in overall ADL performance. In the same study, a telephone survey of 75 clients (including 20 who received OT evaluation) who received services in the last three months, 86 percent reported equipment had made tasks easier. Since receiving the equipment, 63 percent required less personal assistance. Problems with equipment were reported by 65 percent of the clients, with the installation, safety and appropriateness of equipment being the most commonly reported (Gitlin, Miller, & Boyce, 1999).

To determine knowledge of assistive technology and home modification resources among providers, Sheets, Emerman, and LaBuda (1997) surveyed 342 Area Agencies on Aging (AAA) and 42 State Units on Aging (SUA). The study found that the AAAs were much less aware of state technology assistance programs than the SUAs. The AAAs received more inquiries, but less than 25 percent felt staff had the training needed to handle AT requests, and they reported little to no ability to handle home modification referrals and requests.

Assistive Technology Use in Postsecondary Education

With the enactment of the *Individuals with Disabilities Education Act of 1990* and more focus on the inclusion of students with disabilities in school settings, a number of studies examined the use of assistive technology in classrooms in primary and secondary educational settings. In comparison, there were few articles that documented assistive technology use among those in post secondary education, despite the fact that approximately 6 percent of all undergraduate students reported having a disability (National Center for Education Statistics, 1999). An even fewer number of surveys included the students as respondents. The majority of surveys reporting any assistive technology use among postsecondary students with disabilities were conducted with educational institutions and service providers and not with students with disabilities.

Rumrill, Kock, Murphy, and Jannarone (1999) asked 14 recent college graduates about the extent to which the technology resources utilized in college had prepared them for employment. Of the 14 graduates, 43 percent used specialized equipment and accessible buildings, and 36 percent had accessible housing. A total of 6 out of the 14 respondents reported needing accommodations that were not provided. Although respondents reported using university accommodations, 79 percent indicated that they did not receive any information about technology or accommodations in the workplace and 57 percent reported no help with job placement.

According to the National Center for Education Statistics, the majority of post secondary institutions and providers of services to students with disabilities reported high rates of environmental accommodations, but technology and adaptive equipment was often provided at a lower rate than other accommodations (National Center for Education Statistics, 1999). Seventy two percent of all institutions enrolled students with disabilities, but only 58 percent reported providing technology and adaptive equipment. The provision of AT services was highest among public two- and four-year institutions with 10,000 or more students. A study by the National Center for the Study of Postsecondary Educational Supports (2000) of 650 disability coordinators revealed that AT supports for students were not readily available. The report showed that 35 percent of the study participants never provided equipment or software and 71 percent never provided captioning services to students with disabilities in need of them. In addition, 52 percent of schools did not have accessible library services; and more than 60 percent did not have other alternate means of accessing courses, course materials or registration services.

Houghins (2001) interviewed 27 AT experts to determine the top 10 barriers and facilitators to a successful transition. The top three barriers were: 1) a lack of early transition planning; 2) insufficient AT training in high school; and 3) a lack of collaboration between secondary and postsecondary institutions. Likewise, the top three facilitators were: 1) adoption of AT early in school; 2) having AT follow the individual; and 3) systematic AT evaluation and assessment. The top three barriers reported when moving from postsecondary education to adult life were very similar to the barriers reported in the research of AT barriers among adults. The barriers included lack of funding, lack of awareness and lack of community infrastructure to respond to needs.

Assistive Technology and Environmental Accommodations in the Workplace

Assistive technology use in the workplace was found to be a major issue for individuals with disabilities. The 1994 NHIS reported that 11.6 percent of working-age adults were restricted in their ability to work, and more than half of this group were unable to work because of an activity limitation (Kaye, 1997).

According to the 1994 National Organization on Disability/Harris Survey of Americans With Disabilities, 26 percent reported needing equipment or technology to perform a job. Of the 10 percent that reported needing a computer, screen enlarger, special keyboard or input device, speech synthesizer, or voice recognition software to perform a job, only 1.3 percent owned such equipment (Kaye, 1997). Additionally, 18 percent of those working and 11 percent of those not working reported needing a computer to work effectively, and, among those not working, 10 percent needed a wheelchair.

Assistive technology used in the workplace can take many different forms based on the functional needs of the individual. A group of 96 people with post-polio or spinal cord injury was interviewed to determine problems with workplace accommodations (Inge, Wehman, Strobel, Powell, & Todd, 1998). The two problems mentioned most frequently were “using equipment/tools/furniture” and “access,” with 30.8 percent among persons with post-polio and 24.3 percent among persons with spinal cord injury reporting problems with access. Approximately 21 percent of persons with post-polio and 40 percent of persons with spinal cord injury reported problems with equipment and furniture, especially desks. Of the problems reported, 71.5 percent of the problems experienced by those with post-polio and 85.7 percent of those with spinal cord injury were accommodated, but only 55.7 percent of persons with post-polio found the accommodations to be satisfactory. Of the accommodations provided for those with spinal cord injury, 45.1 percent involved equipment and 10.8 percent involved architectural modifications. Twenty-nine percent of the accommodations for those with post-polio involved equipment, and 14 percent involved architectural modifications. Eighty percent of the accommodations cost less than $500.

Granger, Baron, and Robinson (1997) interviewed 194 job coaches and job developers to determine the types of job accommodations needed by their clients with psychiatric disabilities. Use of a job coach and flexible scheduling were among the most widely used accommodations. Physical space accommodations were used "sometimes."

The Rehabilitation Research and Training Center on Aging With a Spinal Cord Injury (Kemp, 1999) surveyed 46 individuals with spinal cord injuries. The most commonly reported problems related to worksite accommodations were difficulty using equipment (34 percent) and access (23.8 percent). Eighty-five percent of problems were accommodated, but accommodations were not always satisfactory. The most common accommodations were equipment or furniture (40 percent) followed by assistance from others (28 percent).

In many other areas of AT use, funding is often the greatest barrier to obtaining assistive technology. Yet, in the case of workplace accommodation, the Job Accommodation Network (JAN) reported that the recommended accommodations are often very low or no cost. In 52 percent of the cases, JAN's recommended accommodations cost employers less than $500 (Kaye, 1997). An evaluation of 392 calls to the Job Accommodation Network was used to demonstrate the pattern of needs for people who are deaf or hard-of-hearing. The study found 38 percent of accommodations recommended were some type of product or equipment. Over 50 percent of the product options discussed were related to communication (Dowler & Hirsh, 1994).

Assistive Technology Use in the Community

In many studies, assistive technology and accessible design of the environment were interdependent. If an individual could not realize the increased independence offered by a particular assistive device because of a barrier in the environment such as facility access or transportation, then the device was of little benefit. Environmental barriers were often measured by self-report of an individual's perception of such barriers. Facility access, communication barriers and transportation represented the more common community access issues.

Kaye (1997) reported that one-third of wheelchair users encountered accessibility problems outside the home. Twenty-four percent of people responding to the 1994 National Organization on Disability/Harris Poll reported that a lack of access to public buildings was a problem. The 1998 National Organization on Disability/Harris Poll reported 31 percent of respondents felt that access to public facilities was a problem. Despite the lack of access, 35 percent reported that the *Americans with Disabilities Act* made their lives better. Little improvement was seen in the perspective of individuals with disabilities related to accessibility. A survey by the General Accounting Office in 1993 documented the continued lack of access for individuals with disabilities in the community. Barriers such as tight spaces in store aisles and bathrooms, lack of accessible telephones, and lack of accessible signage created problems for individuals with disabilities. As many as 82 percent of buildings lacked signs and signals accessible to those with visual and hearing impairments (Kaye, 1997).

Doden, Redelsperger, and Long (1997), in a study of 90 business and government offices and 60 hotels, assessed TTY accessibility and presence of accessibility features for individuals who are deaf or hard-of-hearing. The study indicated that 59 percent of business or government offices called using TTY resulted in no communication; this included 47 percent of calls to emergency services. The accessibility of hotels was greater among those that were more expensive (77 percent) when compared to the accommodation rate of budget hotels (36 percent). Accessibility was determined by the presence of TTYs, closed-captioning, phone lights, and smoke alarms.

Transportation was also among the most often cited barriers to community participation by individuals with disabilities. Kaye, Kang, and LaPlante (2000) reported that 82 percent of wheelchair users had difficulties with public transportation systems because of difficulty using or getting to the transit options. Other problems included too few accessible transit vehicles and lack of schedules and signs in alternative formats, according to the 1993 survey by the General Accounting Office (Kaye, 1997). A study by Linden, Kamper, Reger, and Adams (1996) examined the transportation needs of 100 individuals with disabilities. Half of the respondents did not drive, and 56 percent used public transit. Of those who did drive, 47 percent drove cars and 32 percent drove modified vans (Linden et al., 1996). Springle, Morris, Nowacek, and Karg (1994) interviewed 128 consumers and 123 equipment vendors in a study of adaptive transportation technology. Of the 98 percent of consumers who drove before their injury, only 45 percent drove at the time of the interview. Personal funds were used by 92 percent of consumers to purchase vans. Ninety-five percent of consumers used a lift to enter the vehicle, but almost half reported problems with the lift in the past year. Seventy percent of passengers and drivers who remained seated in their wheelchair used a tie-down, but only 50 percent used occupant restraint (Springle et al., 1994).

Summary

Assistive technology use can take a variety of forms and purposes depending on context and setting. Assistive technology used in the home was associated with increased independence and found to compensate for functional limitations, but funding is a significant barrier to AT use. When compared with needs, assistive technology was not used in postsecondary education or in the workplace to its full potential. This was especially true of AT use in the workplace. Assistive technology in the community was strongly related to access.

Conclusion

This literature review discusses the many trends and issues surrounding assistive technology use. Individuals with disabilities reported many barriers, and AT use varied according to the type of disability, the types of AT devices, or the settings where AT was needed. In addition to the vast number of topics and issues addressed in AT research, limitations and missing information highlighted the need to continue and expand efforts to document AT use and need among individuals with disabilities.

Some of the major limitations of the studies examined here involved sample size, research design and definitions. Most of the research consisted of smaller convenience samples, with a large number of articles on older adults. In many cases, utilization rates and other information on AT use had to be extrapolated from studies with a wide variety of research designs and methods and many different research questions. Even large national studies used various definitions and methods to measure assistive technology. The differences in the way AT was defined limited the comparisons that could determine the potential impact of increased services and the heightened level of awareness brought about by the *Tech Act* and similar legislation, the aging of the population, or emerging technologies on the use of AT by people with disabilities.

Many areas of assistive technology research had a limited number of published studies with adequate samples and research designs. Areas of weakness included: data on AT use in individual states; AT use among specific disability groups, such as those with vision or hearing impairments; and data on the use of specific types of AT. Additional areas that lacked adequate research coverage were AT use in recreational settings and survey research involving universal design. Although a small number of articles and materials addressed these subjects, they were not included in this review because they lacked a rigorous research design, an adequate sample, or sufficient empirical evidence.

3. Survey Design

Background

In the last decade, there have been a few reports of AT use and need based on the National Health Interview Survey, such as a study by LaPlante, Hendershot, and Moss (1997) that measured *use and need*, and a more recent study by Russell, Hendershot, LeClere, Howie, and Adler (1997) that also reported on *use*. Carlson, Ehrlich, Berland, and Bailey (2001) revisited the Disability Followback Survey administered between 1994 and 1997 (National Center for Health Statistics, 1999a, 1999b) and found that based on a weighted sample of 41.8 million Americans with disabilities aged 18 years and older:

- 8.3 million Americans with disabilities needed special equipment or aids to perform basic activities of daily living (ADLs) such as bathing or showering, dressing, eating, getting in and out of bed or chairs, walking, getting outside and using the toilet, including getting to the toilet.

- 15.4 million Americans with disabilities reported using assistive devices or technologies (primarily medical), such as tracheotomy tubes, ostomy bags, catheterization equipment, glucose monitors, diabetic equipment and supplies, inhalers, nebulizers, hearing aids, crutches, canes, walkers, wheelchairs, scooters and feeding tubes.

- 16.6 million Americans with disabilities used special equipment, aids or assistive technology (either one or more of the above).

- 7.4 million Americans with disabilities had surgical implants such as shunts to drain away fluid, artificial joints, implanted lenses, pins, screws, nails, wires, rods or plates, artificial heart valves, pacemakers, silicone implants, infusion pumps, implanted catheters, organ implants and cochlear implants.

- 14 million Americans with disabilities lived in homes modified to meet their special needs. Among these, over 1.5 million persons reported needing further home modifications to already existing ones. An additional 1 million persons with disabilities who did not have any home modifications indicated that they needed such accommodations.

- 511,000 Americans with disabilities reported using modified cars or vans, and 369,000 persons with disabilities reported needing modifications to their cars or vans. Of these, 60,000 persons needed modifications in addition to the ones they already had, and the remaining 309,000 persons used vehicles that had no modifications but needed them.

- 15.1 million Americans with disabilities worked at the time of the interview. In this group, 4.2 million persons reported being limited in the kind or amount of work they could do.

- 714,000 Americans with disabilities reported having an accessible work environment that included: hand rails or ramps; accessible parking or an accessible transportation stop close to the building; elevators (including elevators designed for persons with special needs); specially adapted work stations; restrooms designed for persons with special needs; automatic doors; voice synthesizers; TDDs; infrared systems or other technical devices; Braille; enlarged print; special lighting or audiotape devices; and special pens or pencils, chairs or other office supplies.

- 1.3 million Americans with disabilities working at the time of the interview reported needing one or more of the abovementioned workplace designs and accessories.

- 402,000 Americans with disabilities were provided with special accommodations that included: readers; oral and sign language interpreters; job coaches; personal assistants; job redesign or slowing the pace of tasks; reduced work hours and more breaks; part-time work and other types of equipment; help; and work arrangements not named above.

- 531,000 Americans with disabilities, working at the time of the interview, indicated a need for one or more of the previously mentioned special accommodations.

However, due to the narrow scope of questions and the dated information provided by the survey data, these figures may substantially underestimate the full scope of AT use and need in the United States.

As the review of the literature presented in 2 revealed, smaller surveys and studies on AT use that have been conducted were of less general interest. Either they measured certain selected aspects of the use of AT by persons with disabilities, such as wheelchair use, or they focused on select populations with varying types of impairments.

Given the limitations of existing surveys, a national survey of persons with disabilities using or needing AT was necessary to give a detailed, comprehensive picture of how persons with disabilities function in their daily lives, with particular attention to how they may benefit from assistive technology.

Survey Purpose

The Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) operates the Technical Assistance Project, an activity funded by the National Institute on Disability and Rehabilitation Research (NIDRR) under the *Assistive Technology Act of 1998*. In August 2000, RESNA contracted with the Survey Research Center at the University of Michigan Institute for Social Research (ISR) to conduct the comprehensive survey.

The survey was designed to add a dimension to the existing framework of information about the lives of persons with disabilities. Previously, surveys of persons with disabilities put primary emphasis on identifying the conditions that cause impairment and disability. In these surveys, disability was measured by self-reported functional impairments (e.g. visual impairment, blindness, hearing loss, deafness or other conditions that limit a person's ability to perform daily tasks and activities). The key to this definition is the phrase "ability to perform." Two important aspects of a person's ability to perform that are often overlooked are: 1) the presence of environmental barriers and constraints that can *reduce* ability to perform; and 2) the existence of assistive devices and technologies that can *enhance* it. Indeed, inhospitable environments and helpful technologies influence the abilities of all persons, regardless of any limiting health conditions.

The added dimension provided by the survey was the inclusion of questions that allowed quantifying the impact on the lives of persons with disabilities of AT devices and services and environmental barriers and constraints. The areas investigated in the survey included:

- How persons with disabilities learned about, selected and paid for the AT devices and services that they used;
- How well the AT they were presently using met their needs;
- The ease or difficulty they had in learning about and acquiring their assistive technology;
- Their thoughts about what AT they would use *in addition to any they were presently using*;
- The agencies they had contacted and used, or tried to use, to learn about and acquire AT in the past, and those they would contact or use in the future;
- Whether they were aware of the possibility of getting help;
- Why they had not sought help, if they were aware of the possibility and did not avail themselves to it;
- The limits of their ability to use telephones and computers in their daily lives;
- Their occupational status—employed, retired, homemaker, able to work but unemployed, in school, or not able to work; and
- Their opinions as to the extent that AT had improved various aspects of their lives, and whether there had been improvement in their ability to function more independently as a result of developments over the past decade.

Method

Sampling: The Dual-Frame Approach

The major impediment to conducting survey research among persons with disabilities who use or need AT is their relative scarcity in the general population. On the one hand, the most representative sample frame for telephone research is the random-digit dial (RDD) frame. Since this was designed to be a national survey, the use of an RDD frame comes closest to allowing all respondents an equal chance at participation. On the other hand, RDD telephone surveys are the most costly procedure available, regardless of the target group. Since the numbers are computer generated, a purchased list will, by necessity, contain a large percentage of numbers that are not valid targets for a household survey. These include the following categories:

- Numbers Never Issued
- Non-Residential Listings

- Non-Working Numbers
- Non-Telephone (e.g., computer modem, fax modem, etc.)

The costs involved will be a function of the calling algorithms used by the researchers. In this survey, the number of attempts was not limited to a fixed number; interviewers kept calling each number until a final disposition could be established—a procedure which ensures the most accurate assessment of response rate, but at considerable cost.

Sirken and Casady (1988) wrote, “When the available sampling frame is complete but requires a costly data collection mode, efficiency considerations suggest the joint use of the complete frame and an incomplete frame.” The dual-frame design is accomplished by combining names, addresses and phone numbers obtained from targeted list samples with phone numbers generated for RDD samples. Dual-frame designs are in use in the Health and Retirement Survey (HRS) sponsored by the National Institute on Aging (Heeringa and Connor, 1995 [mail survey, area probability and Medicare enrollees]), The 8th Annual Hispanic Federation Survey (Hispanic Federation, 1999 [telephone survey, listed and RDD]), and the annual National Health Interview Survey (Benson and Marano, 1998 [face-to-face, area probability and list]), and many others, to increase cost efficiency.

To obtain the targeted list sample, we purchased a list of telephone numbers and addresses from Survey Sampling, Inc. from their SSI-LITe^{TM} (SSI’s Low Incidence Targeted Sampling) data sets based on self-reported household information gathered via mail questionnaires, warranty cards and online surveys. The largest LITe file consists of over 48 million names, making it one of the most extensive survey-based files in the country. The following is a description of how SSI developed the LITe file:

> In order to sift out rare populations in quantity, literally millions of survey forms are distributed each year. To enhance recruitment, respondents are offered an incentive, most typically an entry into a contest or a small gift. Questionnaires take advantage of a variety of mass-distribution media in order to reach all the sectors of the national population and uncover very small subgroups. The emphasis is on large quantities (over 50 million are distributed each wave), the use of multiple distribution vehicles (product inserts, coupon mailers, magazine inserts, free standing inserts, etc.), and quantity response such as to make sampling by category practicable. Surveys are national in coverage.

The objective was to collect a sufficient number of respondents (1,000–1,500) to make statistically reliable statements about the various areas addressed in the survey. The following factors were considered in estimating the cost: the estimated prevalence of persons with disabilities in the population; the desired response rate; the estimated percentage of working numbers in a list; and the screening response rate. Table 3.1 shows the estimate of the number of completed interviews per 1,000 RDD numbers (MOR in the table refers to middle-of-the-road estimates):

Table 3.1 Completed RDD Interviews per 1,000 Telephone Numbers (Est.)

	Worst case	MOR	Best case
Prevalence	7%	12%	20%
Response rate	70%	70%	70%
Residential number	60%	70%	80%
Screening response rate	65%	75%	85%
Completed Interviews per 1,000	19.11	44.1	95.2

The final estimate was for an RDD list to be between 2 percent and 10 percent effective.

Table 3.2 Completed List Interviews per 1,000 Telephone Numbers (Est.)

	Worst case	MOR	Best case
Prevalence	40%	60%	80%
Response rate	70%	70%	70%
Residential number	85%	90%	95%
Screening response rate	65%	75%	85%
Completed Interviews per 1,000	154.7	283.5	452.2

A similar assessment for the list sample (table 3.2) determined that we could expect between 15 percent and 45 percent overall effectiveness. In comparing the two possibilities, we found that the worst-case scenario for the list sample was 62.5 percent more efficient than the best-case scenario for RDD data collection, while, at the other extreme, the best-case scenario for the list sample estimate was 24 times as efficient as the worst-case scenario for RDD.

Based on these assessments, we developed a dual-frame model and determined that 400 RDD responses would provide enough data to establish prevalence. An additional 1,000 list-based responses could be collected without exceeding the resources available. The total of 1,400 would provide enough data to make accurate analyses of relational hypotheses, and the RDD sample would be used, if necessary, to weigh the responses in the list sample.

Questionnaire

After a series of meetings and written exchanges between staff members of NIDRR, RESNA and researchers from the Survey Research Center [SRC] of the University of Michigan’s Institute for Social Research, the initial version of the instrument was completed in November 2000.

Screening

The screener was constructed to ensure that survey respondents would meet strict criteria for inclusion and therefore represent the universe of persons with mostly moderate to severe disabilities.

After a residence[3] had been contacted,[4] interviewers took a roster of all household members and selected one eligible respondent. If more than one household member was eligible, one was selected at random. Eligibility was established if a member of the household met any one of the following criteria:

- Used a wheelchair, special bed, special telephone, cane, crutches, walker, or the assistance of another person or any other assistive device, to perform daily tasks and activities in the home, at school, at work or in the community;
- Had a condition which prevents or greatly limited working at a job, walking/lifting/carrying, dressing/bathing/getting around inside the home, going outside, learning/remembering/concentrating; or
- Was blind, deaf or had a serious impairment of vision or hearing.

Pretest

A pretest was conducted on a list sample of 50 respondents. The pretest instrument was a paper-and-pencil instrument administered by experienced research technicians at SRC in December 2000. The pretest established that the instrument was user-friendly (as was evidenced by a high cooperation rate among eligible respondents), without employing extensive refusal conversion techniques. There were no break-offs or interviews which were incomplete because respondents had refused to finish. However, we made two changes in the questionnaire based on the results of the pretest.

First, interviewers noted that persons with disabilities objected to the use of the word “need” in the questionnaire. As a result, the word need was removed. Need was assessed by asking respondents to report the extent to which a device would be useful.

The second change was the inclusion of open-ended responses so respondents could list the devices they used and the conditions which limit their abilities, rather than present closed-ended checklists, as had been done during the pretest.

Final Questionnaire

The complete questionnaire is contained in the Appendix. The questionnaire was organized into 11 sections.

Section A consisted of two questions. First, the respondent was asked to indicate whether she is employed, able to work but unemployed, unable to work because of her disability, retired, in school, or a homemaker. Up to three responses per respondent were allowed [e.g., in school, homemaker, unable to work]. Second, the respondent was asked, “What condition of limitation do you have that impairs your functioning?” as an open-ended item.

The next four sections (B, C, D and E) asked the same questions about the use, need for, and general issues concerning learning about, obtaining, satisfaction with, and paying for

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[3] A residence was defined as containing no more than eight individuals, at least two of whom must be related.

[4] Provisions had been made to conduct the interview over TTY relay, if the TTY signal was established on dialing.

assistive devices. The respondent was asked Section B only if she indicated she was a student, and Section C if she was gainfully employed away from the home. All respondents were asked Section D, about AT in the home, and all those who had ventured out of the home in the two weeks prior to the interview were asked about AT in the community (Section E).

The respondent's experience with AT use, need, selection and acquisition was assessed with the following probing questions:

Current Use

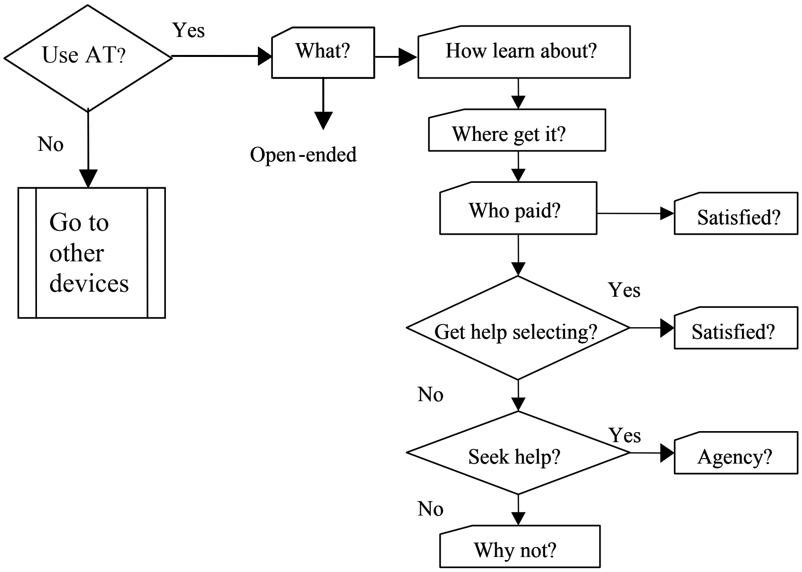
- What kind of AT/IT devices do you use?
- How did you learn about this device?
- Where did you get the device?
- How was the device paid for?
- Were you satisfied with the device?
- Did you receive help from an agency during the selection and purchase of the device?

Current Need

- What kind of AT/IT device do you need?
- How will you learn more about this device?
- What, if any, agency or organization do you plan to contact for help?
- If you do not plan to seek help from an agency, what are your reasons?

If the respondent was using an assistive device in any context, the protocol in figure 3.1 was implemented.

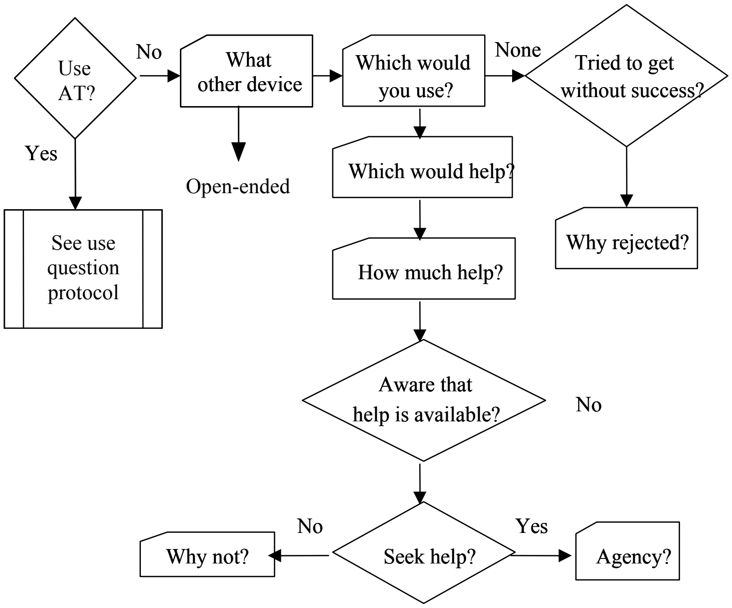
Figure 3.1 Assistive Technology Use: Probing Pattern



The questions in this section were asked wherever appropriate. Thus, if a respondent was in school and gainfully employed, she was asked the entire battery concerning use going to school, at school, going to work, and at work. The same was true of the following protocols: other assistive technology (AT), information technology (IT), and access.

If the respondent did not currently use an assistive device in some context, the protocol in figure 3.2 was implemented.

Figure 3.2 Assistive Technology Need: Probing Pattern



The next four sections assessed telephone and computer (IT) use. Sections F, G and H concerned telephone use at school, work and in the community, while Section J covered computer use at school, work and home.[5]

After the assistive devices questions, the protocol covering IT (telephone and computer) use was implemented, as shown in figure 3.3.

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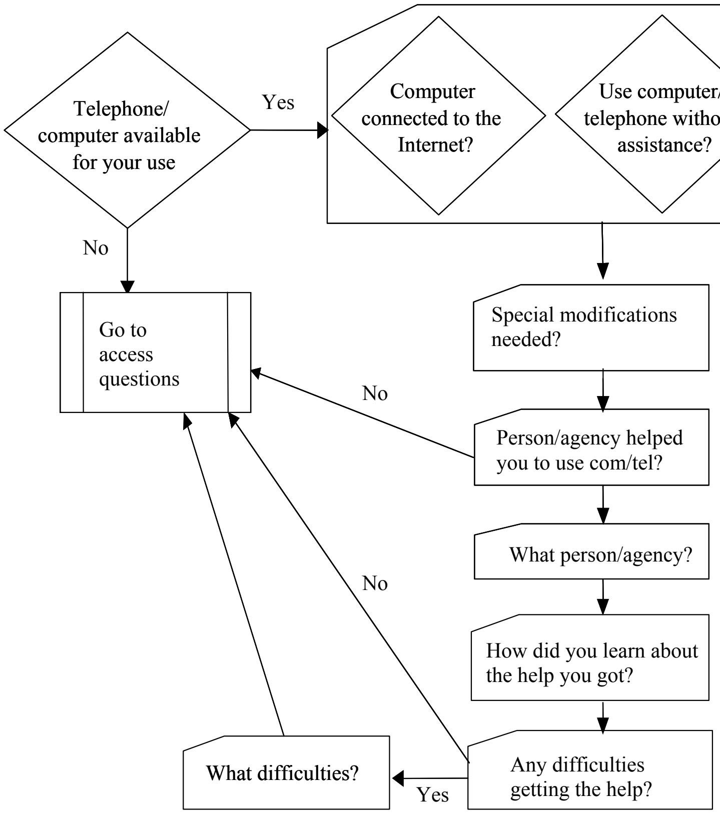
[5] There was no Section I used in order to avoid confusion with Roman numerals.

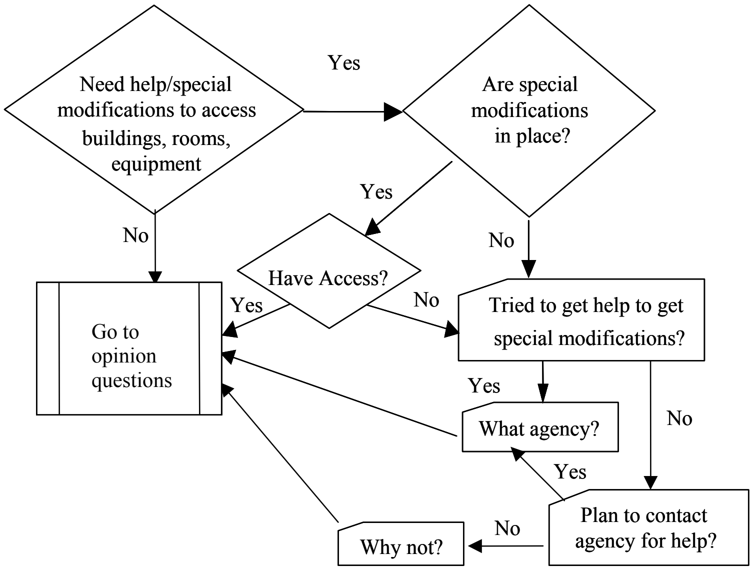
Figure 3.3 Telephone and Computer Use: Probing Pattern



Sections K, L, M and N covered access to buildings and facilities and equipment at school, work, at home and in the community.

The community activity and access protocol is outlined in figure 3.4. Respondents were first asked “About how many days in the last two weeks did you participate in social activities outside the home?” Those who responded “none” were not asked community activity questions.

Figure 3.4 Access to the Environment: Probing Pattern



Section P consisted of a set of questions probing the respondents' overall views of the availability of and information about AT, the benefits of AT, and how their existence had changed over the past decade. The purpose of these questions was to learn about how respondents viewed disability and assistive device use in a broader social and political context. The questions were also posed to give respondents an opportunity to comment on specific experiences and evaluate changes over time. The personal views and opinions questions were:

1. Overall, how much information and advice have you received about assistive technology—would you say a lot, some, a little, or none?
2. Overall, how much information and advice have you received about how to obtain it—would you say a lot, some, a little, or none?
3. Overall, how much difference would you say that the information and advice about assistive technology and how to obtain it has made in increasing your level of learning, independence, productivity and community integration?
4. Overall, how much has information and advice about assistive technology and how to obtain it helped you to become more aware of your rights?
5. How much has your use of assistive technology devices and services decreased your need for help from another person?
6. To what extent have better-designed products and environmental access features or universal design products reduced your need for assistive technology devices and services?
7. Compared to 10 years ago, people are more aware of the need for assistive technology devices and services for persons with disabilities. Would you say that you strongly agree, agree, disagree, or strongly disagree?

8. Compared to 10 years ago, laws or program policies have been changed to help persons with disabilities to get assistive technology. Would you say that you strongly agree, agree, disagree, or strongly disagree?
9. Compared to 10 years ago, more people are aware of assistive technology and understand how it can benefit persons with disabilities. Would you say that you strongly agree, agree, disagree, or strongly disagree?
10. Compared to 10 years ago, it is easier to find assistance for purchasing assistive technology devices and services. Would you say that you strongly agree, agree, disagree, or strongly disagree?

The questionnaire concluded with the following demographic questions:

- Age range. This served as an internal check, since the exact age of the respondent was established in the household screener
- Sex [Not asked: interviewer determined.]
- Are you of Spanish or Latino origin?
- Which of the following racial or ethic groups best describes you?
- Highest grade of school or year of college completed
- Household income category
- Personal income category

Interviewer Training

The University of Michigan Institute for Social Research had the technology and expertise to conduct the interviews, but had limited experience interviewing persons with disabilities. Interviewers received 16 hours of instruction, including practice calls and a training manual containing information about NIDRR, RESNA, persons with disabilities, and assistive technology. The screener and the core questionnaire were thoroughly explained, and a full section on how to use the CATI program “Blaise” was included in the manual (Survey Services Laboratory, 2001).

Survey Administration

The survey was conducted using computer-assisted telephone interview (CATI) software that administered all skips and directions automatically and with programmed internal consistency checks. All closed-ended responses and verbatim typescripts of responses to open-ended questions were automatically recorded in an electronic data file. The data were downloaded into SPSS and Microsoft Excel applications.

The study and the questionnaire were approved by the University of Michigan Institutional Review Board. All respondents were told that their participation in the survey was strictly voluntary and confidential. If respondents were not comfortable answering a particular question, they were allowed to skip that question and complete the survey (typically, education and income questions are most likely to be skipped). All respondent identification was housed separately from the main data set; respondents were assigned a project ID number, and analysts and other study personnel, including the principal investigators, never saw the names or addresses of the respondents.

Respondent Incentive

Respondents were offered an incentive of $20 as a token of appreciation for completing the questionnaire. Completion was defined as reaching the final set of questions on demographic characteristics. When a respondent had completed the interview, the interviewer requested the respondent's name and mailing address where the check could be sent.

Coding

A total of 119 different respondent conditions were coded according to the categories published in NIDRR Disability Statistics Report 7, table A-1, NHIS Impairment and ICD-9 Codes (LaPlante and Carlson, 1996). Up to three conditions per respondent were coded and judged to be the most severe. All open-end coding was 100 percent verified. If more than three were mentioned, the least serious were excluded. All cases in which the respondent mentioned an injury were also coded as to the type of limitation or condition that resulted.

The definition of disability adhered to the definitions of disability upon which the 2000 Census and the National Health Interview Survey based their estimates. These definitions include self-reported or proxy-reported physical, cognitive, and emotional impairments and limitations, activity limitations, and assistive device use. In addition, any person who used or needed help from another person because of her impairments and limitations was also included in our definition of disability.

AT services help persons with disabilities select, acquire or use adaptive devices. Such services also include functional evaluations, training on or demonstration of devices, and purchasing or leasing devices.

Information technology refers to electronic products, devices or equipment that are used to produce, exchange, send or receive information (or otherwise facilitate communication), such as computers, telephones, teletypewriters (TTYs), augmentative communication devices, or fax machines.

For purposes of this study, each respondent was asked what sort of AT she used in each of four domains (where appropriate): 1) at or getting to school; 2) at or getting to work; 3) at home; and 4) in the community. Coding was based on the document entitled AT/IT Device and Service Categories (see Appendix). As with the respondent conditions, we coded up to three AT devices per respondent.

Call Volume, Negative Codes and Response Rates

Previously we described how we arrived at the dual-frame sample, largely as a response to an anticipated large-cost differential. The prediction turned out to be true, as the data will illustrate. While a precise accounting is not possible, we estimated that each RDD interview was between 15 and 20 times the cost of each list interview. The overall call statistics for the survey are shown in table 3.3.

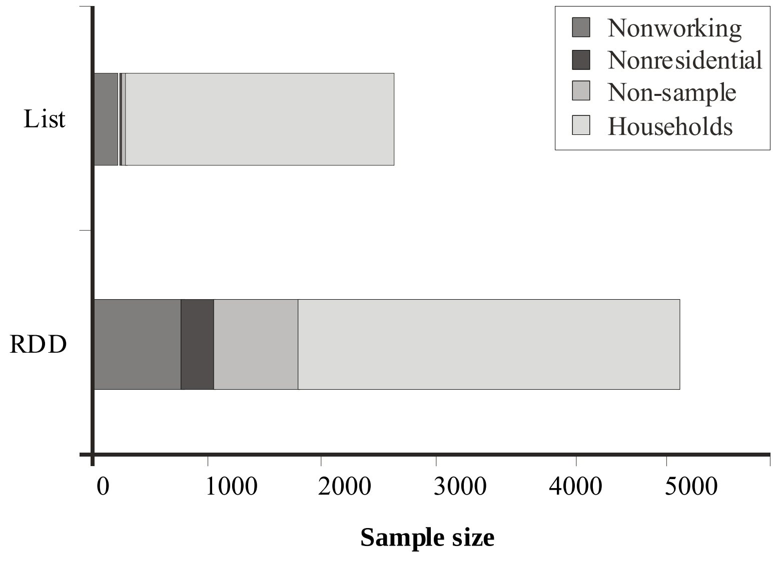
Table 3.3 Call Statistics

	List	**RDD**
Total dials	17,247	52,235
Mean [calls per completed interview]	17.2	126.8
Median	20	24
Mode	2	2

These statistics show the efficiency of obtaining data from the list was roughly seven times greater than the efficiency of obtaining interviews via RDD.

One reason for the discrepancy was the quality of the samples. Figure 3.5 shows how many more nonsample numbers were in the RDD list. Nonworking numbers, nonresidential and other nonsamples, including all problem numbers and other non-households, accounted for 35 percent of the RDD numbers as compared to 10 percent of the numbers from the list. That is, the amount of time spent in identifying non-usable numbers was roughly 3.5 times as great compared to working with a random-digit dial list.

Figure 3.5 Disposition of Sample Telephone Numbers



The results from the calls in the RDD sample were as follows:

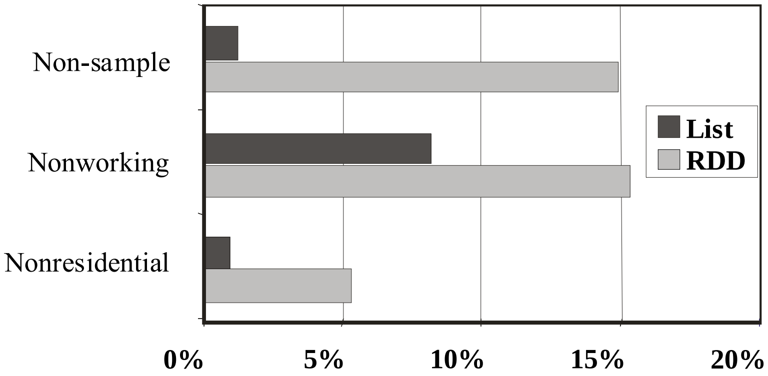
- 3,305 households reached
- 2,556 screened
- 421 eligible respondents identified as a result of screening
- 412 interviewed
- Five final refusals

In comparison, the results from the calls in the targeted list sample were as follows:

- 2,322 households reached
- 1,932 screened
- 1,014 eligible respondents identified as a result of screening
- 1,002 interviewed
- Five final refusals

The negative codes shown in figure 3.6 demonstrate that the list sample was far more economical than the RDD method. We required a sample of 2,750 to complete the list calls (1,002) versus a sample of 5,103 to complete the RDD calls (412).

Figure 3.6 Negative Codes



Response Rates

The American Association of Public Opinion Research (AAPOR) standard definitions for outcome rates for surveys specifies four different calculations. RR1 is the minimal response rate, defined as the number of completed interviews divided by the total of interviews and non-interviews; RR3 is the rate which estimates the proportion of eligibles among the non-interviews (the estimate is based on the screening rate); COOP is the cooperation rate, or the percent of eligible respondents who were interviewed; and the Overall Response rate is RR3 multiplied by COOP.

Table 3.4 Response Rates

	RDD	List	Combined
RR1	77%	83%	80%
RR3	95%	91%	92%
COOP	98%	99%	99%
Overall	93%	90%	91%

Although there are no universally accepted criteria for the goodness of response rates, as there are for statistical significance, RDD surveys surpassing 70 percent are relatively rare, and 60 percent is considered by many to be an adequate response rate. The response rate obtained in this study was the result of exhaustive and effective calling strategies.

Interviewer Notes and Observations

An informal e-mail survey of interviewers established a baseline of information on the specific characteristics of surveying the population of persons with disabilities. The following were the interviewers' impressions:

- Interviewers found that persons with disabilities were no different to deal with than the general population. If there was a difference, persons with disabilities were more compliant, more willing to contribute their opinions, and were quite open and forthcoming in discussing their conditions.
- The most difficult task was achieving household listings.
- The repetitive questioning over all the domains—school, work, home and community—was the only aspect of the protocol that drew objection from the respondents. The interviewers heard "I've already answered that question" from a number of respondents.
- There were no apparent differences between the respondents from the two sample frames.

Section Summary

This section provided a detailed background of the methods and techniques applied to this survey of AT use and need among persons with disabilities. Financial constraints and the characteristics of the target population led us to a dual-frame approach that included a certain degree of representativeness provided by the RDD part and the robustness provided by the targeted list component of the sample. By including persons with more severe disabilities through the list component, we were able to focus more clearly on a wider variety of aspects about assistive technology use and need as stated in the purpose of the study. However, the relatively small sample (n=1,412) raised questions about the extent to which the findings from this survey can be used to generalize about persons with disabilities using or needing AT. Therefore, a closer examination of the validity and representativeness of this study is presented in the next section.

Data Validity, Consistency and Limitations

Respondents were carefully screened with regard to any chronic illness, functional limitation, impairment or disability that would make them likely users of AT and recipients of personal care services. Our RDD sample of 412 cases (with a 93 percent response rate) was selected from 2,556 household interviews before given an in-depth interview, and represented the population of persons with disabilities in the United States at that point in time at a rate of 18.6 percent. This estimate was slightly lower than the 2000 Census estimate of about 20 percent of adults, and the 21.5 percent prevalence estimate obtained from the 1994–95 National Health Interview Survey.

The survey findings indicated that the sample contained a greater percentage of persons with moderate or severe disabilities, compared to the abovementioned surveys. Similarly, the targeted list sample included a relatively large number of wheelchair users and persons whose reported health condition also indicated more severe levels of disability. All of these persons were screened with the same instrument to ensure a certain degree on homogeneity. A series of split-half sample reliability tests was performed to test for differences in response patterns between the two samples. No statistically significant differences were detected, and the robustness of the sample was ensured.

By choosing the same disability assessment questions as the Census (U.S. Census Bureau, 2001; Adler, Clark, DeMaio, Miller, & Saluter,1999); and the NHIS-D (National Center for Health Statistics, 1999a, 1999b), we were able to compare our findings with those from the other two major disability surveys and determine the validity of our findings. With these quality controls in mind, we are confident that the findings presented in this paper are valid and accurately represent the experiences of persons with disabilities who use or need AT, and how they went about obtaining and paying for it.

While conducting detailed analyses, we found that a number of items had very low frequency counts. Such events commonly occur in health and disability surveys. Low frequency items or responses are generally marked as "not reliable," and rules as to the size of the relative standard error indicate the magnitude below which an estimate is deemed "not reliable." We caution the reader not to interpret ratio estimates based on low-frequency counts as reliable. Whenever possible and meaningful, we grouped similar items into larger categories and based our interpretations on these larger estimates.

Sampling Bias

This section presents an overview of the sample analyzed with a focus on gender, race and level of education.

GENDER

In the total sample, the sex of the respondent was determined by the interviewer by observation at the conclusion of the interview; 826 (58.4 percent) of the respondents were women, 588 (41.6 percent) were men. The difference was highly significant; the likelihood of such an occurrence, given equal likelihood of including both men and women in the sample, is less than one in one million [chi-square value with one degree of freedom = 40.059].

- The difference between men and women in percent of AT use was negligible.
- Women were more likely than men to be unemployed because of their disability—50 percent versus 43 percent [$t = -2.67$, $p<.01$].
- Men were more likely than women to be gainfully employed or running a business—23 percent versus 19 percent [$t = 2.18$, $p<.025$].
- Women were eight times as likely to be classified as homemakers than men—8 percent versus 1 percent, [$t = -7.21$, $p \sim 0$].
- Men were almost twice as likely as women to be retired—23 percent versus 12 percent [$t = 5.35$, $p \sim 0$].
- Men and women answered each of the public opinion questions in virtually the same manner.
- There was no difference in average age between men and women.
- There were no differences in education levels across gender.
- The family income reported by women was significantly higher than that reported by male respondents. Fifty-four percent of women and 43 percent of men reported higher than median family incomes [$\chi^2 = 10.88$, $df=1$, $p \sim 0$].
- The finding for personal income was reversed from what it was with family income. Fifty-four percent of men and 34 percent of female respondents reported higher-than-median personal incomes [$\chi^2 = 46.5$, $df=1$, $p \sim 0$].
- There was no difference in the size of states holding male and female respondents.

RACE

Each respondent was asked to provide a primary racial identification, i.e. to name the racial or ethnic group that "best describes you." The first group mentioned was coded into one of six categories: American Indian or Alaska Native; Asian; black or African-American; Native Hawaiian or other Pacific Islander; White or caucasian, or Anything Else.[6] Primary racial identification was established, with respondents who identified themselves as White/Caucasian totaling 1,204 and nonwhites totaling 203.

- The percent of white and nonwhite respondents who reported using AT was virtually identical.
- The level of education achieved by black respondents was significantly lower than that achieved by white respondents ($t= -2.03$, $p<.025$[7]). Split along the median level of education, 50 percent of whites and 42 percent of blacks were above the median level of education.
- Half of the white respondents and 35 percent of black respondents reported family income above the median level. The difference was statistically significant ($t= -2.74$, $p <.005$). When we examined family income for whites versus nonwhites along the entire

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[6] Verbatim responses were not recorded.

[7] One-tailed hypothesis testing performed. With high degrees of freedom, a t-value of +/- 1.64 equates to a probability of less than 5 percent that there is no significant difference between two independent groups; +/- 1.96 translates to a probability of less than 2.5 percent, and 2.54 to a probability of < one-half percent.

dimension, the distinction became quite clear: the greatest discrepancy was found among the lowest two income categories, where 17 percent of the nonwhites and 7 percent of whites were located. Above $70,000/year, we found a nearly equal distribution of wealth across races (nonwhites at 14.5 percent, versus 14.3 percent for whites).

- The difference in personal income between blacks and whites was not quite as significant (t= -1.7, p<.05). Thirty-six percent of black respondents and 46 percent of white respondents, reported having personal incomes higher than the median.
- White respondents averaged just over four years older than nonwhite respondents; the difference was statistically significant [t= -2.93, p<.005].
- There were consistently more nonwhites in the younger age categories and consistently more whites in the older age categories.
- The proportion of women among the black respondents was 71 percent, which was significantly higher than the 57.5 percent among white respondents, or the female proportion of all nonwhites (63.8 percent). [t= 2.82, p<.005].
- Although there was a slight tendency for black respondents to come from states with a higher population, the trend was not statistically significant.
- The relative frequency of blacks and whites who were currently gainfully employed or running a business was virtually identical.
- More than twice as many whites were retired compared to blacks (17 percent versus 7 percent) [t= -3.83, p<.001].
- There were 10 public opinion questions. There were no significant differences in the responses of black or white respondents to these questions.

EDUCATION

Each respondent was asked about the highest level of education achieved. Responses were classified as follows: 1- Kindergarten; 2- Elementary School; 3- High School Graduate; 4- Some College; 5- College Graduate; and 6- Postgraduate Study. The median level was high-school graduate. Fifty percent of the respondents had at least some college experience. Levels of education were associated with the following characteristics:

- AT use among the respondents with higher levels of education was significantly above that among the less educated respondents [t= 2.93, p<.01].
- Fifty-five percent of the less educated respondents were unemployed as a result of their disability, as compared to 40 percent of those with more education [t = -5.79, p~0].
- Twenty-eight percent of the highly educated respondents were working, as compared to 13 percent of the less educated [t = 6.98, p~0].
- The level of education achieved by black respondents was significantly lower than that achieved by white respondents (t= -2.03, p<.025[8]). Split along the median level of education, 50 percent of whites and 42 percent of blacks were above the median level of education.

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[8] One-tailed hypothesis testing performed. With high degrees of freedom, a t-value of +/- 1.64 equates to a probability of less than 5 percent that there is no significant difference between two independent groups; +/- 1.96 translates to a probability of less than 2.5 percent, and 2.54 to a probability of < one-half percent.

- Both family and personal income were related to education. Income levels were significantly higher for respondents with higher levels of education [t values for both were greater than 9.57, p~0].
- Respondents with more education were slightly younger [average 55 versus 58 years] of age. The difference was statistically significant.
- Equal proportions of high- and low-education respondents came from high and low populated states.
- No differences in education levels by gender were detected.
- Respondents with higher education levels reported positive experiences with technical assistance agencies to a significantly greater extent than those with lower education levels.

State-By-State Analysis

The survey drew respondents from all 50 states and the District of Columbia. There was an overall correlation of +.85 [coefficient of determination = 72 percent], which means that the more populous states contributed larger numbers of respondents than did the less populous states. However, the smaller states generally had greater numbers of respondents than might have been expected from their populations, while the larger states were generally underrepresented.

About one-third of the respondents were located through random-digit dialing and the rest were selected at random from a list supplied from the sampling organization. The respondent by state and state population correlation coefficient increased from +.84 in the total population to +.92 in the RDD sample, and the correlation between representativeness and population was reduced from -.34 to -.11. Since the coefficient of determination for the respondent-by-population relationship accounted for 85 percent of the covariance, and the representativeness-by-population relationship accounted for only 1 percent of the covariance, we can assert that there was no under- or over-representativeness of persons with disability in the data on a state-by-state basis. The slight, non-significant correlation was largely a function of the very small numbers of respondents in the states with low populations.

Having established that there is no evidence for a bias in selection of persons with disabilities, we may look at the ways, if any, in which the respondents within the various states differ from one another. An exhaustive comparison of the responses given by persons living in the states with larger-than-average population versus those living in the smaller states revealed no significant differences in behavioral, opinion or demographic responses with the exception of income. The respondents from the larger states were significantly higher in both personal and family incomes. Both differences were significant, but the differences in personal income were more significant than in family income (Ehrlich, 2003).

Summary and Conclusions

The survey employed a dual-frame design to collect at least 400 cases via random-digit dial from all 50 states to provide normative data on prevalence, etiology and demographics, and at least 1,000 cases via a targeted list to provide greater detail with a lower expenditure of resources. We determined a priori that we would perform statistical analyses comparing the results from the two subsamples and combine them only if the results were statistically comparable.

We found that the RDD sample appeared to have a slightly lower level of disability than the list sample. Evidence for the difference is in the proportions in each sample who are working or in school versus not working because of a disability, and in rates of use of AT devices and services. In terms of demographics, the RDD sample was more racially diverse and reported a slightly higher personal income than the list sample. However, the differences in severity of disability and demographic characteristics were not echoed by differences between the two samples in the patterns of use of assistive technology—the devices used, and the way in which the respondents learned about, paid for, obtained and were satisfied by the devices. Nor were there any meaningful, qualitative differences in respondents' opinions as a function of whether they came from the RDD or the list sample.

We conclude that the use of the dual-frame design allowed us to collect enough data via RDD to make statements about prevalence that are generally in line with previous studies, and the combined data from the RDD and list provided a robust sample from which to draw reliable conclusions about the persons with disabilities population and their use of assistive devices.

Part II: Descriptive and Bivariate Analyses

4. Respondent Characteristics and Patterns of Assistive Technology Use

The purpose of this is to provide a detailed account of the findings from survey participants—persons with disabilities who used or needed AT. We will present these details in the form of a comparison between respondents who were selected with the random digit dial (RDD) method and persons who were selected from a targeted list. The previous explained why we used this dual-frame design. The analyses in this will show the extent to which the respondents from the two samples were similar or different in terms of their personal characteristics and in terms of their respective patterns of AT use. The purpose of these analyses also is to show that there was no significant response bias due to sample selection.

The evidence presented in this is contained in cross tabulations and bar charts, and discussed in a short narrative. Whenever we detected differences between list respondents and RDD respondents, we tested the finding for statistical significance and reported the relevant statistics.

Respondent Characteristics

Gender

The interviewers established the sex of the respondents without specifically asking. There were no respondents who were not easily identifiable as male or female. As table 4.1 shows, the samples were well matched on this variable.

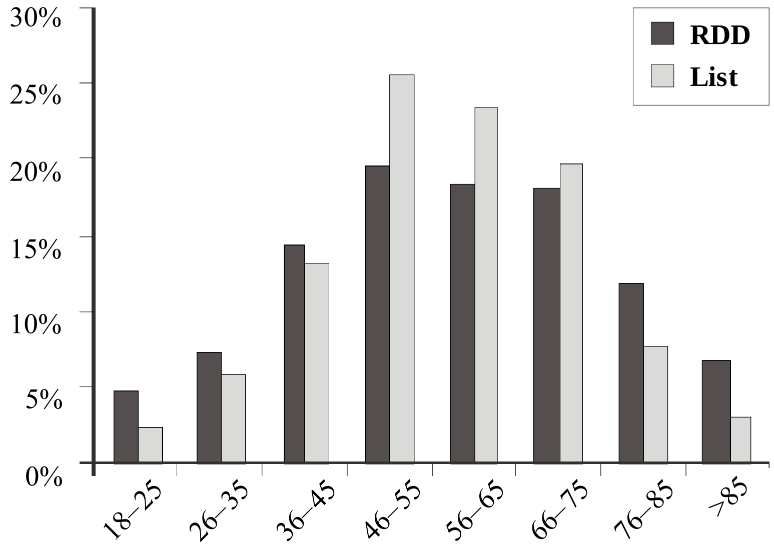
Table 4.1 Gender, by Type of Sample

	RDD		**List**	
	Number	*Percent*	*Number*	*Percent*
Male	167	41	421	42
Female	245	59	581	58

Age

We established age by asking the respondent to choose a category in which her age fell. The mean ages in the two samples, calculated by using the midpoints, were 57.9 for the RDD sample and 57.1 for the list sample. Using the actual ages as listed in the household rosters, the averages were 57.4 for the RDD respondents and 57.0 for the list sample, indicating good reliability of the use of the age categories. Although the means were virtually identical, the distributional correspondence of age across the two samples was less than what one would expect by chance (Chi square = 30.4, df = 7, $p < 0.0001$).

Figure 4.1 Age Category of Respondents, by Sample



As figure 4.1 shows, the RDD distribution was flatter than the list sample, with a greater proportion of responses in the extremes, and a greater standard deviation. The list sample was less representative of the population as a whole, since it was a self-selected group of people who included themselves as respondents to a mail survey from Survey Sampling, Inc. While equal diligence was exerted in reaching respondents from both samples, as evidenced by the response and cooperation rates noted in the discussion of call statistics, 68 percent of the list sample was contained in the 46–75 age range, compared with 56 percent of the RDD sample.

Race and Ethnicity

We followed the protocol of first asking whether the respondent was of Spanish or Latino origin, and determined that 16 RDD respondents (3.9 percent) and 15 list respondents (1.5 percent) answered in the affirmative. We then asked for the respondent's race. Table 4.2 demonstrates the greater racial diversity of the RDD sample. The apparent diversity is statistically significant (Chi square = 41.5, df = 6, $p < 0.0001$). This is another indication that the RDD sample was more representative of the population as a whole.

Table 4.2 Race and Ethnicity, by Type of Sample

	RDD		List	
	Number	*Percent*	*Number*	*Percent*
Asian	2	1	3	0
Black	49	12	51	5
Hawaiian/PI	1	0	1	0
Hispanic	16	4	15	1
Native Amer.	10	2	41	4
White	320	78	884	88
Other	20	5	20	2

Education

We asked respondents to indicate, by category, the highest level of education attained. Computing by midpoint, we found a slight difference in mean years: 12.0 for the RDD sample, 12.4 for the list sample. This difference was not significant, especially when the ranges were unequal in size (i.e., the scale used was only ordinal, not interval, and the use of means was inappropriate). The difference in distribution was not statistically significant. The preponderance of cases in both samples laid in the 9–15 year range: 76 percent in the RDD sample and 79 percent in the list sample. The modal level of education was 9–12 years (high school graduate).

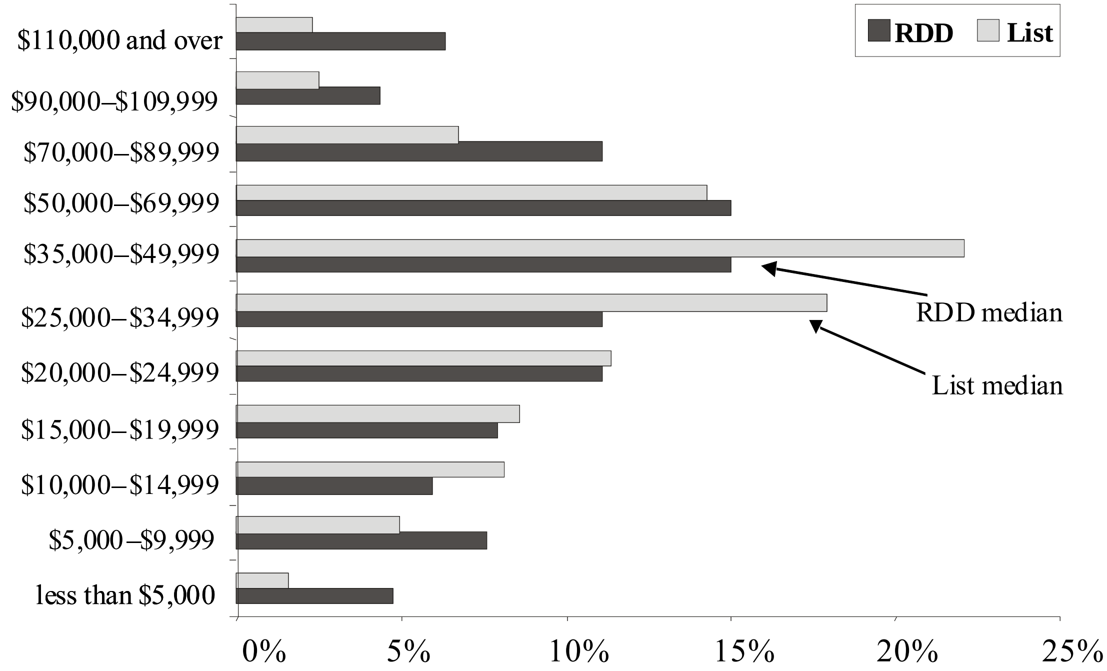
Table 4.3 Level of Education, by Type of Sample

	RDD		List	
	Number	*Percent*	*Number*	*Percent*
None, Kindergarten	3	1	7	1
1–8 (Elementary)	29	7	41	4
9–12 (High school)	203	50	426	43
1–3 Years of college	106	26	362	36
College graduate	31	8	102	10
Postgraduate	38	9	61	6

Income

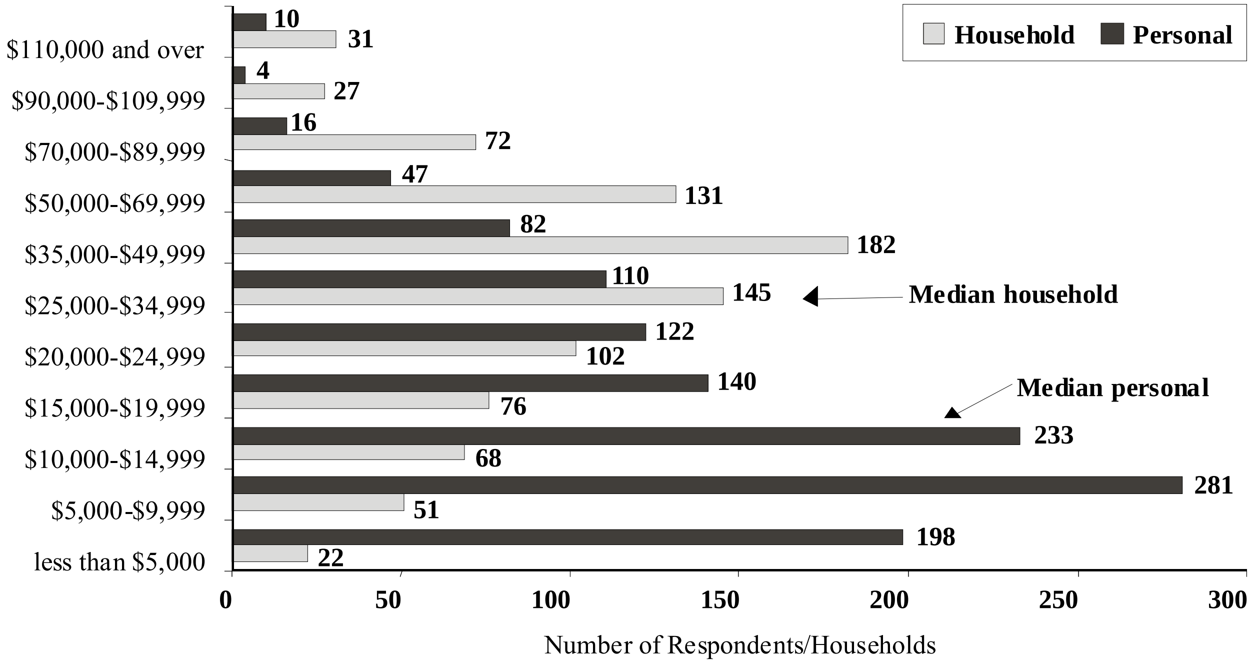
We asked respondents to indicate their household and personal income levels for the year 2000. However, only 61 percent of the RDD sample and 65 percent of the list sample answered these questions. The remaining 35 percent chose not to respond. Since we do not know the reasons why anyone refused to answer, we cannot correct the data for any consistent bias, and the results cannot be given the same credence as the rest of the study.

Figure 4.2 Household Income, Year 2000



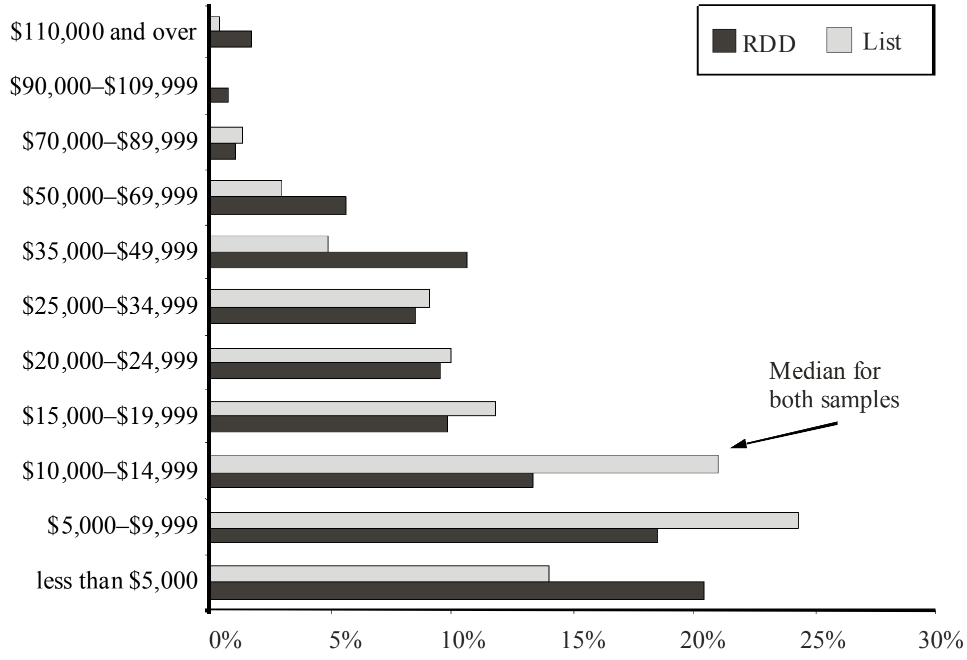
The mean household income, when calculated by midpoint, was $45,700 for RDD respondents, significantly higher than the mean household list income of $39,750. However, when the average category was computed, the difference was nonsignificant. The distributions did vary in the same way that age varied, (i.e. there are proportionally more cases in the extremes in the RDD sample than in the list sample, as shown in figure 4.2), and the RDD sample median was one category higher than the list sample median. Figure 4.3 shows the comparison of household to personal incomes for all respondents.

Figure 4.3 Personal Income and Household Income for 2000



As might be expected, household income greatly exceeded the personal income reported for these individuals. As shown in figure 4.4, the personal median for both samples was in Category 3: $10,000 to $14,999. The RDD group was significantly higher on average, computed on categories; more importantly, however, the list sample was again more clustered around the central tendency—the RDD sample more variable—with greater representation in the extremes.

Figure 4.4 Personal Income, Year 2000



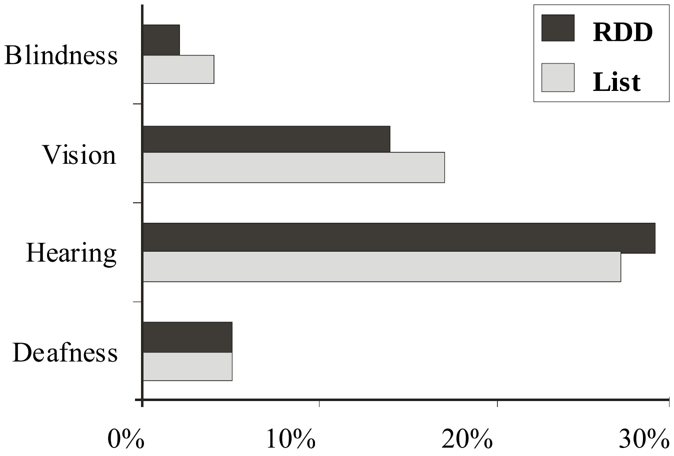
Type of Impairment

The Census 2000 and National Health Interview Survey both asked about visual and hearing impairments. We included this question in our survey to ensure that the respondents' impairments were assessed in the same way. With that purpose in mind, the screening question asked: "Does anyone in your household who is over age 18 have any of the following conditions:

- Blindness;
- Severe vision impairment;
- A hearing impairment that is not as severe as deafness; or
- Deafness?"

Figure 4.5 shows that the respondents in both samples reported virtually the same rates for all four types of sensory impairment.

Figure 4.5 Households With a Person With Impairment, by Type: RDD vs. List



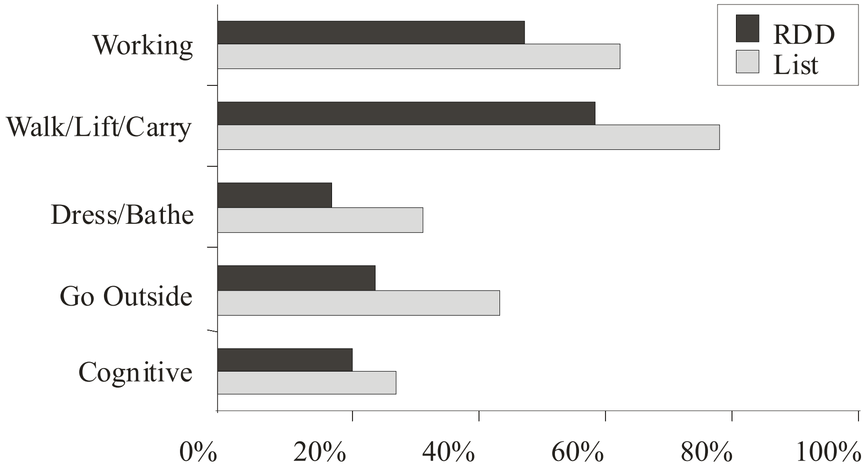
TYPE OF FUNCTIONAL LIMITATION

In keeping with our intent to make our sample comparable to that of the 2000 Census and NHIS, we included the question about functional limitations in the screener. The question was: "Does anyone in your household who is over age 18 have a condition that prevents or greatly limits such basic physical activities as:

- Working at a job or business;
- Walking, lifting or carrying;
- Dressing, bathing or getting around inside the home;
- Going outside the home alone to shop or visit a doctor's office; or
- Learning, remembering or concentrating?"

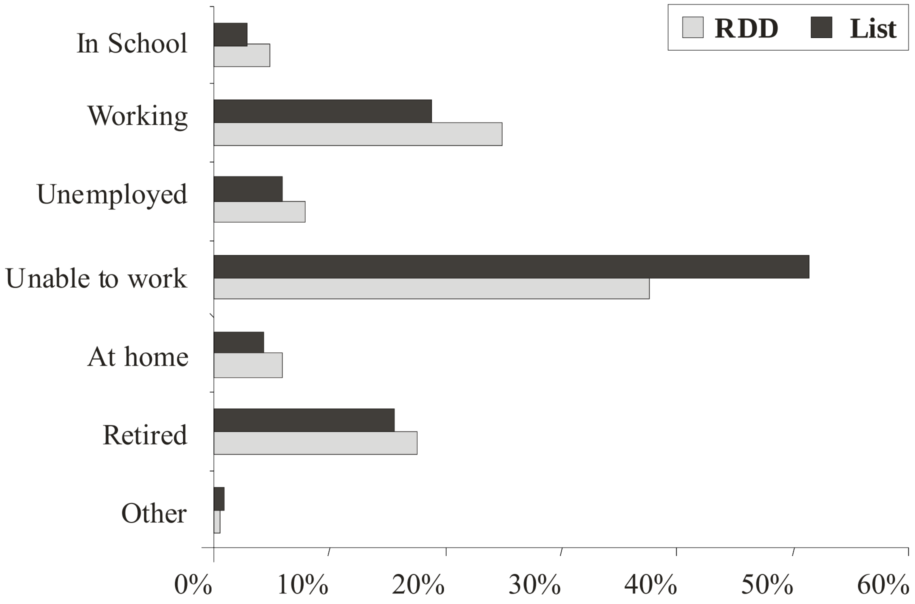
Figure 4.6 shows that the order and distribution of responses obtained from the two samples was the same, but that the proportion of persons reporting functional limitations was substantially higher in the list sample. This finding suggests that this screening question proved to be quite sensitive and specific. The higher rates of functional and activity limitations observed among respondents in the list sample were a direct result of how they were selected (i.e., based on characteristics such as heart problems, multiple sclerosis or wheelchair use).

Figure 4.6 Percent of Households With a Person With Functional Limitation, by Type: RDD vs. List



To determine respondent status (i.e., being in school, working, able to work but unemployed, unable to work because of his disability, a homemaker or retired), respondents were given the opportunity to choose all that applied. Results are shown in figure 4.7. Here, the modal category chosen as the first response was "unable to work because of a disability." The second most populated category was "working," followed by "retired," "unemployed," "homemaker," and "enrolled in school."

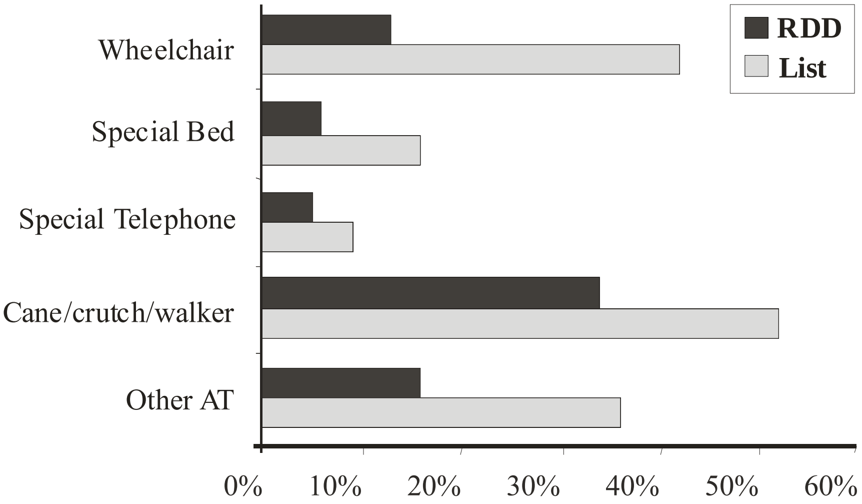
Figure 4.7 Respondent Status, by Type of Sample



Assistive Technology Device Use in the Two Samples

Assistive device use was assessed in the screener and in the questionnaire. The questions on the screener asked: "Is there anyone in the household who uses ... ," and then followed up by "Who would that be?" Figure 4.8 shows that in virtually every category asked during the screener, the proportion of households screening in was substantially higher for the list sample.

Figure 4.8 Percent of Households Reporting AT Device Use



Although not shown in the figure, 42 percent of the list sample, as compared to 18 percent of the RDD sample, used the assistance of another person in their daily lives. AT use among Asians, blacks and whites across both samples showed virtually no differences in the percentage of respondents using AT.

A further comparison of AT device use reported by respondents in the RDD and list samples in the questionnaire itself showed that six of the top seven devices used were mobility devices. The list in table 4.4 contains the 11 most frequently mentioned AT devices for respondents from both samples. (Eleven devices were listed because crutches and back braces each received equal mentions from the RDD group.)

Table 4.4 Most Mentioned AT Devices Used

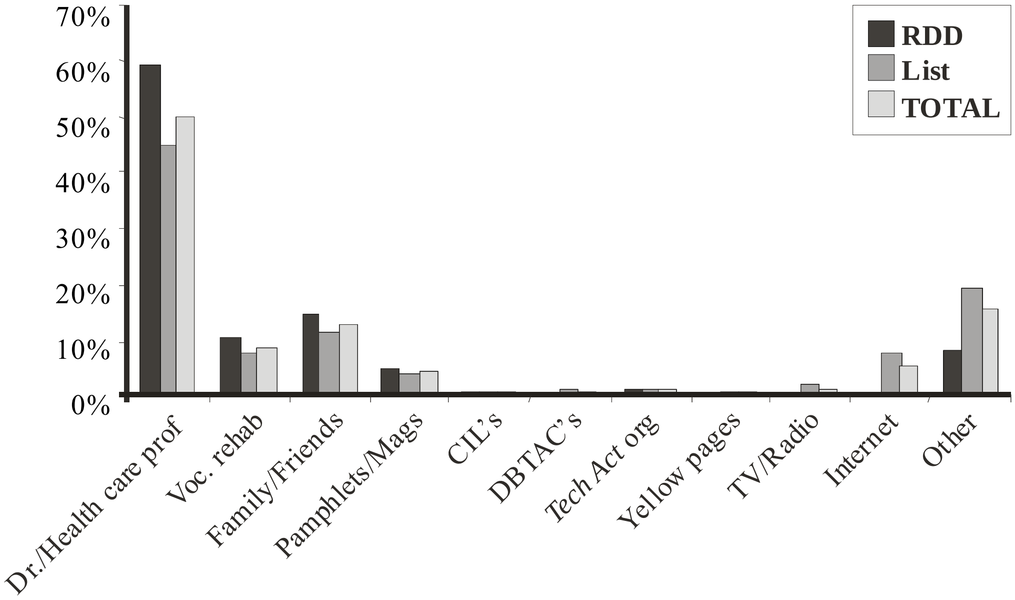
RDD	List
Cane or walking stick	Wheelchair
Wheelchair	Cane or walking stick
Hearing aid	Walker
Walker	Hearing aid
Scooter	Scooter
Other personal-use AT	Crutch
Oxygen tank	Electric wheelchair
Other brace	Oxygen tank
Forceps, “grabbers”	Other personal-use AT
Crutch	Shower seat
Back brace	Back brace

As a check on the distribution of devices, we examined the devices used at home—the one location used by all respondents. The same four devices (canes, wheelchairs, hearing aids and walkers) remained the most prevalent, used by a total of 62 percent of the respondents. Scooters (the majority of which are used at stores that provide them, like Wal-Mart), crutches and electric wheelchairs fell out of the top-10 devices used at home, but there was excellent agreement between the samples as to which devices were most used, and the use pattern at home was a good, general index.

Overall, 690 of 1,003 list respondents (69 percent) and 211 of 412 RDD respondents (51 percent) said that they used an assistive device in one or more of the contexts asked: either going to or at school or work; at home; or in the community. The higher levels of AT use among list respondents gave the impression that impairment levels were higher in this group as compared to the RDD sample.

Where did the respondents learn about the devices? Figure 4.9 summarizes all of the information sources in all contexts.

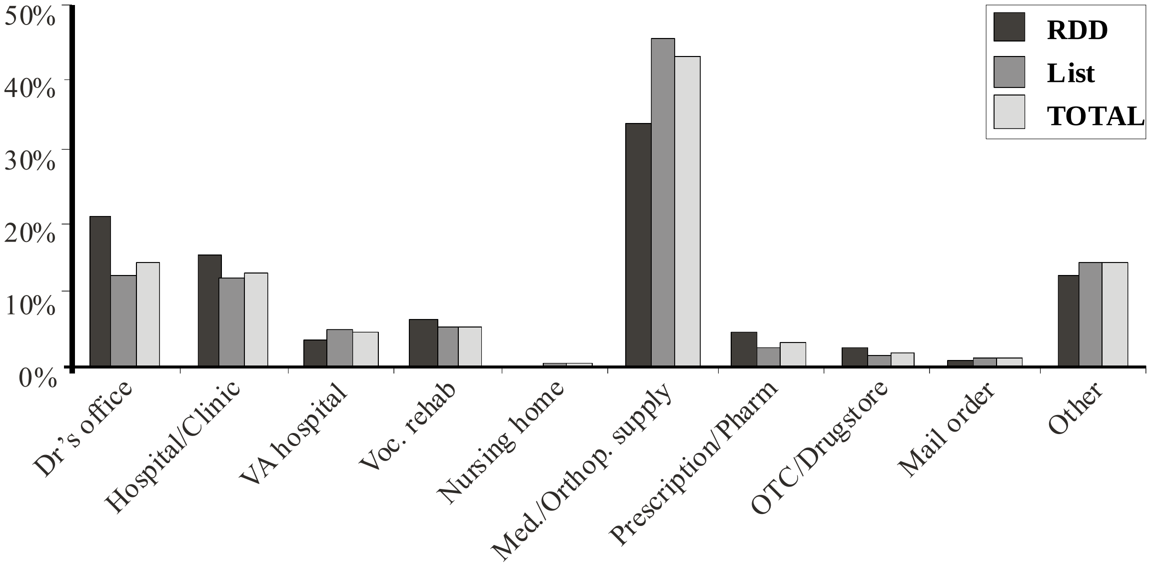
Figure 4.9 Sources of Information About AT



While there were some minor discrepancies, the trend was clear: most respondents learned about AT devices from their doctors.

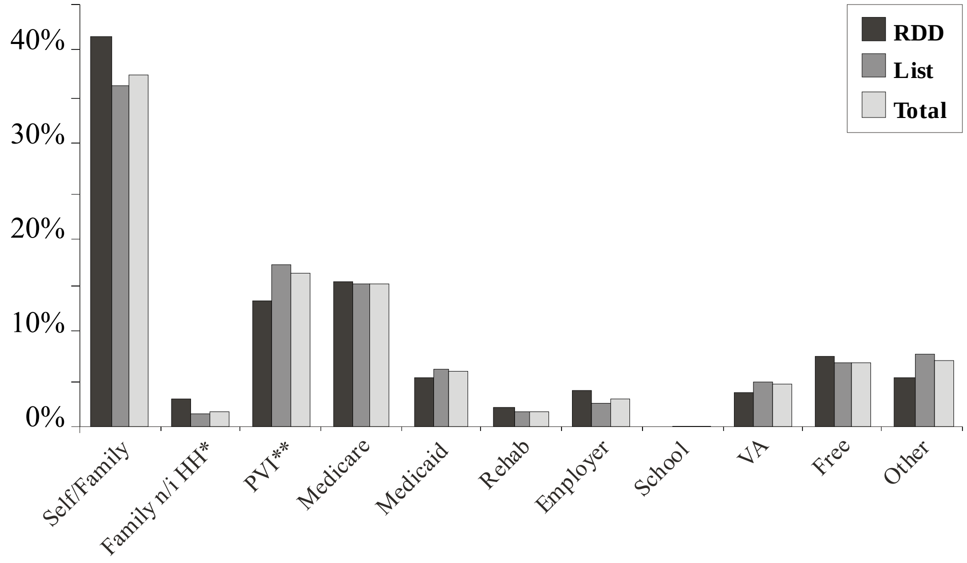
The next item asked was: "Where did the respondent obtain the AT device?" Figure 4.10 shows the overall results in all contexts. The modal source of assistive technology was the same for both samples: the medical or orthopedic supply store.

Figure 4.10 Source of Supply of AT



The next item was: “Who paid for the device?” Figure 4.11 shows the distribution of payment sources. In both samples, 37 percent of devices were paid for by the respondent or someone in the respondent’s family. However, 38 percent were covered under the combined categories of private health insurance, Medicare and Medicaid. We also note that 6 percent said their AT devices were free.

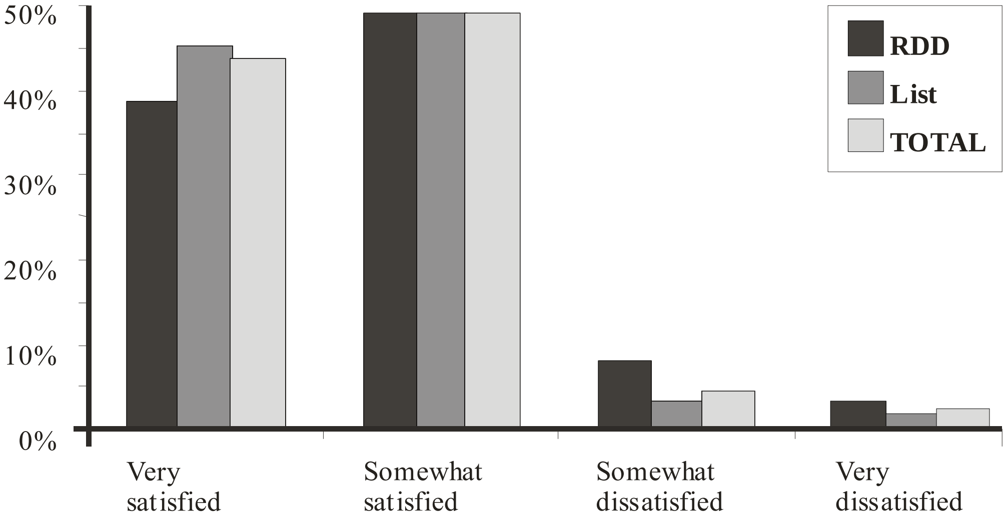
Figure 4.11 Source of Payment for AT



*Family n/i HH = Family Member not in Household
**PVI = Private Insurance

As shown in figure 4.12, satisfaction with the device was uniformly high:

Figure 4.12 Level of Satisfaction With AT



As to the question of getting help in the selection and purchase of their devices, 92 respondents from the RDD sample (19 percent) and 344 respondents from the list sample (21 percent) reported receiving such help. The difference between the samples was not statistically significant. (Chi square with Yates' correction for continuity = 1.48, df = 1, p = 0.22 > 0.05).

As to the propensity for seeking help, we encountered the first meaningful difference in response between the two samples: 9 percent of the respondents in the RDD sample sought help, compared to 25 percent of the respondents in the list sample. The RDD respondents were significantly less likely to have sought help than the list respondents. (Chi square with Yates' correction for continuity = 13.24, df = 1, p = 0.0002 < 0.001). Note that only respondents who reported no help were asked whether they had sought help. Perhaps there was no advantage to seeking help, since there was no significant difference in the likelihood of receiving it between the two groups.

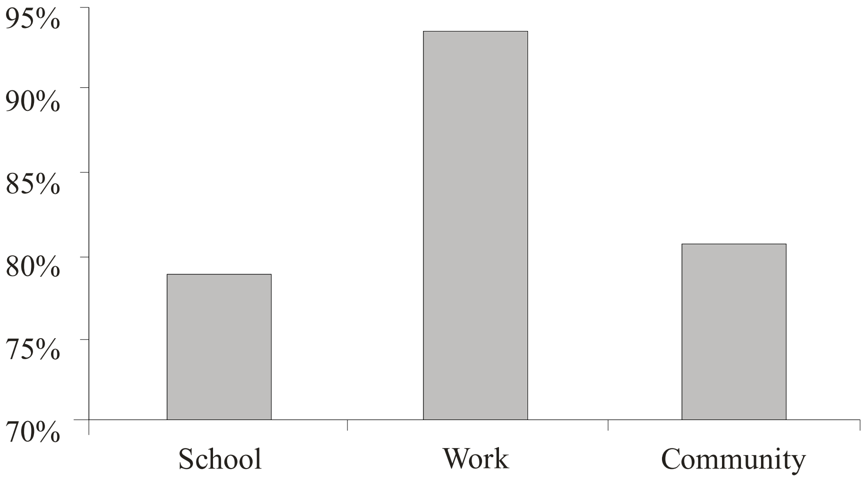
Finally, all respondents were asked, in each section, whether they planned to contact an agency for help or advice in the future. Seventeen percent of the RDD sample respondents and 20 percent of the list sample respondents answered that they would contact an agency for help or advice in the future. The difference between the two groups was not significant (Chi square with Yates' correction for continuity = 3.66, df = 1, p = > 0.05).

Telephone Use

We asked all respondents about the availability of telephones for their use in the community, as well as their ability to use a standard phone without assistance. Where appropriate (with the student and working populations), we asked about telephone availability and ability to use without assistance at school or at work. We found that 94 percent of the respondents from the RDD sample and 97 percent of the respondents from the list sample had access to telephones in school, at work and in the community. The differences between the samples were not significant. Similarly, 85 percent of the respondents from the RDD sample and 82 percent of the respondents from the list sample were able to use the telephone without assistance. Again, the between group difference was not statistically significant.

Since there was no significant difference between the groups, we can examine where telephones were most and least available across the entire sample. Figure 4.13 shows, somewhat surprisingly, that availability at work far exceeded availability in school or in the community. The difference was statistically significant (Chi square=30.48, df=2, p <.001). Since the interview was conducted via telephone, the availability of telephones in the home was assumed to be 100 percent.

Figure 4.13 Telephone Availability Outside the Home

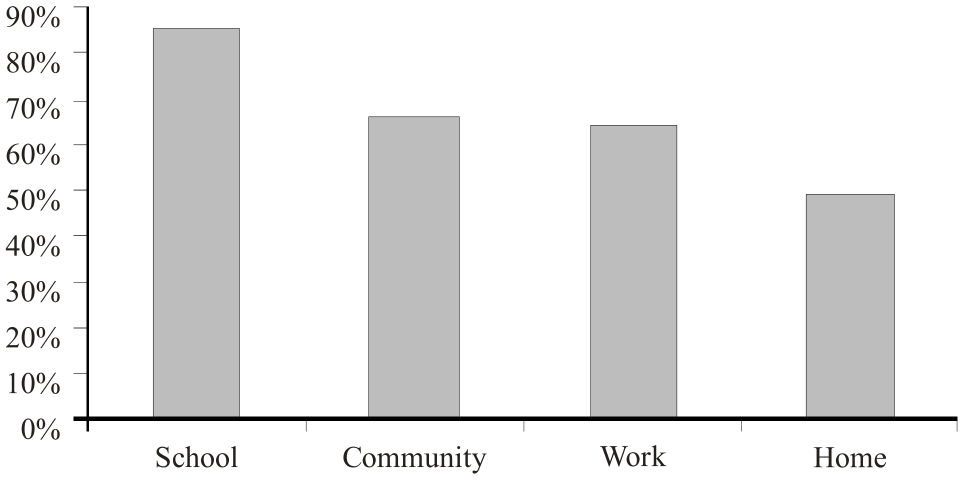


Only six respondents—one in the RDD sample and five in the list—reported needing special modifications, such as TTY or relay services, to make a telephone call, and only three respondents—two RDD and one list—reported having received advice or help using the telephone.

Computer Use

We asked all respondents about the availability of computers for their use in the community and in the home. In addition, where appropriate (i.e., with the student and working populations, we asked about computer availability at school or at work). Overall, 67 percent of the respondents in the RDD sample and 69 percent of the respondents in the list sample had access to a computer. There was no significant difference between the samples. The locations at which computers were available are shown in figure 4.14.

Figure 4.14 Computer Availability



As might be expected, schools were more likely to have computers than any of the other locations. The distribution was significantly different from what could be expected by chance (Chi-square = 81.46, df = 3, $p < 0.0001$).

In addition, respondents reported that 91 percent of the computers they can use were connected to the Internet, 36 percent required the assistance of another person, and 14 percent required special modifications to use a computer. Twenty-one percent had received advice in using the computer.

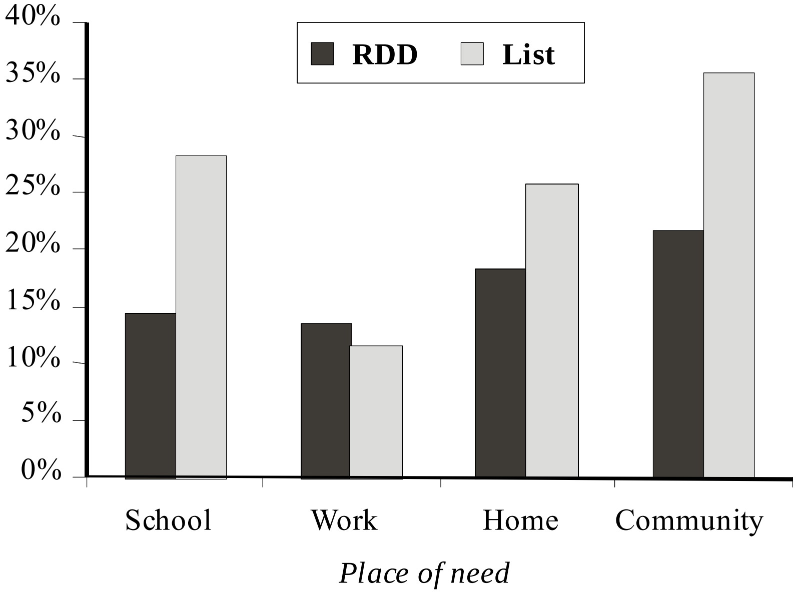
Access to Buildings and Equipment at Home, School, Work and the Community

We asked six questions about access: 1) did the respondent need the help of another person; 2) did the respondent need special modifications to gain access to facilities, buildings or equipment; 3) were special modifications provided; 4) did the respondent have access; 5) did the respondent try to get help in getting special modifications or accommodations; and 6) did the respondent plan to contact anyone to get help.

All respondents were questioned about home. Those who were not homebound were asked about access in the community at large outside the home; students and workers were asked about access at school and at work.

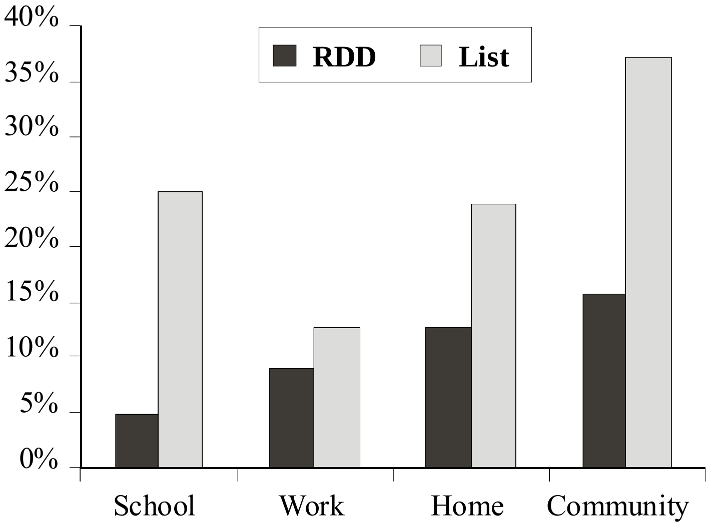
The first question in all locales was: "Do you need the help or assistance of another person to access or use buildings, rooms or equipment at [school/work/home/community]. Nineteen percent of the RDD sample respondents and 29 percent of the list sample respondents answered that they needed the assistance of another person to gain access to, or use buildings, rooms and equipment. The inter-sample difference was statistically significant (Chi square with Yates' correction = 33.27, df = 1, $p < 0.0001$), pointing once again to the greater level of mobility impairment in the list sample compared to the RDD sample. The locations where assistance was needed are shown in figure 4.15. The home and community differences were statistically significant but the school difference was not, due to the small number of respondents who were in school. Once again, the list respondents were more impaired than RDD respondents.

Figure 4.15 Need for Assistance to Access the Environment



We also asked if respondents needed special modifications, adaptations or accommodations to enter or use buildings and facilities, rooms, and equipment at school, work, home or in the community. Overall, 13 percent of the RDD sample respondents and 29 percent of the list sample respondents needed special modifications to access such locations. As was true in the assistance category, the inter-sample difference was statistically significant [Chi-square with Yates' correction for continuity = 86.6, df = 1, $p < 0.0001$]. Figure 4.16 shows how the need for modifications was distributed over the four locations. The home and community differences were statistically significant. Also note that the percentages of school modifications needed represented responses totaling only 15 responses.

Figure 4.16 Need for Environmental Modifications



We asked if the needed modifications at work had been provided by the respondents' employers. In 38 cases, the answer was positive; in 40 cases, their employers had not provided the needed modifications. There was no significant difference between the samples in this respect.

Similarly, we asked if access was available at school, at work, at home and in the community. Accessibility was evenly distributed at 95–96 percent across all locations. The inter-sample differences were not statistically significant.

Next, we asked if the respondent had tried to obtain help in getting special modifications, and whether the respondent planned to contact any agency or organization to get the needed modifications. Over all locations, only 17 (13 percent) mentions were made of attempts to obtain help, and there were only 10 (9 percent) positive intentions to contact an agency.

Open-Ended Questions

Respondent Conditions

The first question asked of each respondent, after establishing the respondent's current status, was worded: "What condition or limitation do you have that impairs your functioning?" The verbatim responses were coded according to the categories published in NIDRR Disability Statistics Report 7, table A-1, NHIS Impairment and ICD Codes corresponding to conditions listed in text table B and detailed tables 6–8. Up to three impairments were coded for each respondent; if more than three items were coded, the less severe impairments were omitted. For example, if a respondent reported having had a stroke, congestive heart failure, an amputated limb and carpal tunnel syndrome, carpal tunnel syndrome was not scored. The coded impairments were distributed across the two samples as shown in table 4.5.

Table 4.5 Number of Conditions Coded, by Type of Sample

	RDD		**List**	
	Number	*Percent*	*Number*	*Percent*
One	412	100	1,002	100
Two	155	38	271	27
Three	42	10	97	10

We coded a total of 119 different conditions. Table 4.6 lists the 10 most frequently listed conditions for each sample.

Table 4.6 List of Frequently Mentioned Health Conditions

RDD	List
Hearing loss, both ears	Osteoarthritis
Osteoarthritis	Injury, chronic or late effects
Unspecified mobility disorder	Hearing loss, both ears
Injury, chronic or late effects	*Unknown, unspecified other*
Back disorders, other	Multiple sclerosis
Diabetes	Heart disease, other
Orthopedic impairment, lower extremity	Diabetes
Heart disease, other	Back disorders, other
Visual impairment, both eyes	*Stroke*
Multiple sclerosis	*Nervous system, unspecified*

Conditions in italics were unique to the sample listed. It should be noted that the category "Injury, Chronic or Late Effects" was high on both lists; all such cases were combined with a secondary diagnosis.

Assistive Devices Used

We asked each respondent what sort of AT she used in all locations where appropriate: at or getting to school or work; at home; and in the community. A total of 75 different AT devices were coded. Averaged over all mentions, the RDD sample provided 1.0 devices per respondent, while the list group accounted for 1.6 devices per respondent. The distribution of responses was very markedly skewed for both groups, as shown in table 4.7. In this table, sorted by responses given across both samples, six of the top seven devices are mobility devices. The column at the far right indicates the ratio of percentage use in the two samples. For example, list respondents were five times as likely to use unclassified home-use AT devices than were RDD respondents, while RDD respondents were four times more likely to use personal-use AT than list respondents. However, the main point here was that there was excellent agreement between the samples as to which devices were most used.

Table 4.7 Type of AT Device Used at Home, School, Work and in the Community

	TOTAL		**RDD**		**List**		**RDD to List**
Device Type	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	**Ratio 1 : x**
Cane or walking stick	466	22.7	116	27.4	350	21.5	0.78
Wheelchair	461	22.5	55	13.0	406	25.0	1.92
Walker	201	9.8	44	10.4	157	9.6	0.93
Hearing aid	161	7.9	51	12.1	110	6.8	0.56
Scooter	122	6.0	21	5.0	101	6.2	1.25
Crutch	55	2.7	7	1.7	48	3.0	1.78
Electric wheelchair	48	2.3	4	0.9	44	2.7	2.86
Other AT at home	41	2.0	2	0.5	39	2.4	5.07
Other personal-use AT	40	2.0	21	5.0	19	1.2	0.24
Oxygen tank	39	1.9	10	2.4	29	1.8	0.75
Bathroom modifications	26	1.3	2	0.5	24	1.5	3.12
Shower seat	23	1.1	4	0.9	19	1.2	1.23
Nebulizer	20	1.0	3	0.7	17	1.0	1.47
Leg brace	20	1.0	2	0.5	18	1.1	2.34
Other brace	19	0.9	9	2.1	10	0.6	0.29
Back brace	18	0.9	7	1.7	11	0.7	0.41

As a check on the distribution of devices, we examined the devices used at home, the one location used by all respondents. Table 4.8 shows the same four devices as most prevalent, used by a total of 62 percent of the respondents. Scooters (the majority of which were used at stores that provide them, like Wal-Mart), crutches and electric wheelchairs fell out of the top-10 devices used at home, but we concluded that the overall use pattern at home was a good, general index.

Table 4.8 AT Use in the Home

Type of AT	*Percent of Respondents Using*
Cane or walking stick	23
Wheelchair	19
Walker	13
Hearing aid	7
Other personal-use AT	4
Bathroom modifications	3
Walker	3
Other personal-use AT	2
Shower seat	2
Oxygen tank	2

Reasons for Not Contacting an Agency for Technical Assistance

Whenever a respondent reported that she didn't plan to contact an agency for help, we asked: "Why not?" We recorded 817 verbatim responses from the RDD respondents. The initial impression we had was that the respondent did not consider herself to be in need of assistance. To confirm that, we performed a search that located 400 uses of the word "need," and another 17 uses of wording indicating a lack of need, such as "get along" and "ok." A word search of the word "insurance" revealed 18 uses, "money" was used six times, and "know" was used 92 times. A similar overview was made of the verbatim responses from the list respondents. The general conclusion was that the primary reason persons with disabilities did not plan to contact an agency for help was that they did not feel the need to do so; the secondary reason was that they did not know whom to contact.

We also asked each respondent who did not contact an agency, "What were the reasons that you did not contact an organization or agency?" and found a similar set of responses.

Unmet Need for Assistive Technology

We divided the total respondent population into three categories: 1) those who did not need modifications; 2) those who needed them and had those needs met; and 3) those who expressed unmet needs. To be considered a person needing modifications, a respondent would have had to express that need in at least one, but possibly as many as four, different domains. To be a person in Category 2 ("Needs Expressed and Met"), a respondent would have given the answer that modifications are available in at least one domain, and to be a person in Category 3, ("Expressed Needs Unmet"), a respondent would have given a "No" answer that modifications are available. Thus, it might have been possible for a person to have expressed a need for modifications in all four domains and found them available in one, and be counted in the "Needs Met" category (i.e., the "Needs Unmet" category was a minimalist estimate, but with so small a sample, further differentiation of level of meeting needs was not feasible).

Given the limitation stated above, we compared the three groups on all independent and dependent variables, and arrived at the following conclusions.

Level of Education

To illustrate the effects of the independent variables, we arbitrarily set the mean value for those not in need of modification ("No Need") as the comparative standard, then normalized the scores for those needing and having available the modifications ("Need/Has AT") and those who had unmet needs ("Need/Does Not Have AT") relative to the group not in need. Figure 4.17[9] shows how the three groups compared in the level of education attained.

Figure 4.17 Unmet Need for AT and Level of Education

"No Need" set as normalized mean.

The finding corroborates the overall finding that education level was related to acquiring AT, or, in this case, a lower education level was associated with not acquiring needed modifications.

Attitude and Opinions About Assistive Technology

Each respondent answered six attitude questions about the knowledge to acquire AT, the availability of such knowledge, and the utility of AT in improving life, as well as four questions that compared the respondents' perceptions of their situations at the time versus 10 years ago. Figure 4.18 shows the attitudes of the respondents on the two topics. Note that those in need of modifications were generally more negative in assessing how their current situations compared to what they were 10 years ago, and those who did not have the modifications were considerably more negative than those who had them. It is also important to note that those who had modifications available to them in some domain were more positive than the respondents who did not need modifications.

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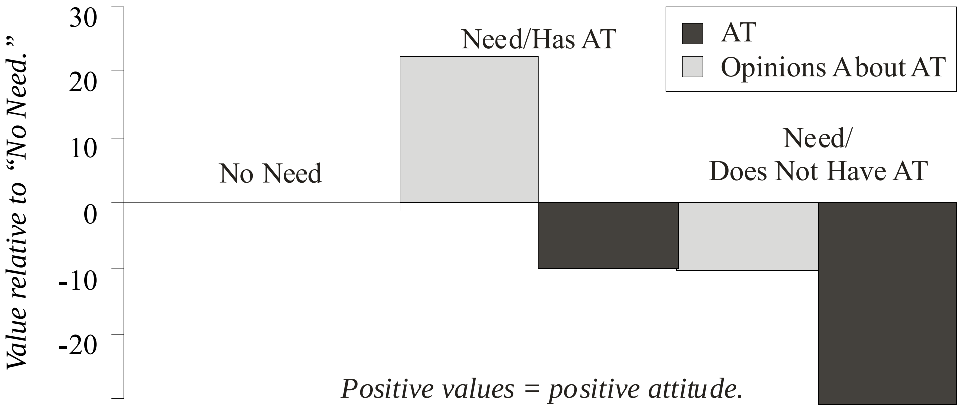
[9] In this chart, and in similar charts following, the mean is set at zero, and one standard deviation is set to 100 (standard score method). Thus, on average, those with unmet needs [far right column] are about one-quarter of a standard deviation below the value for those who need no modifications.

Figure 4.18 Unmet Need for AT and Attitudes and Opinions About AT



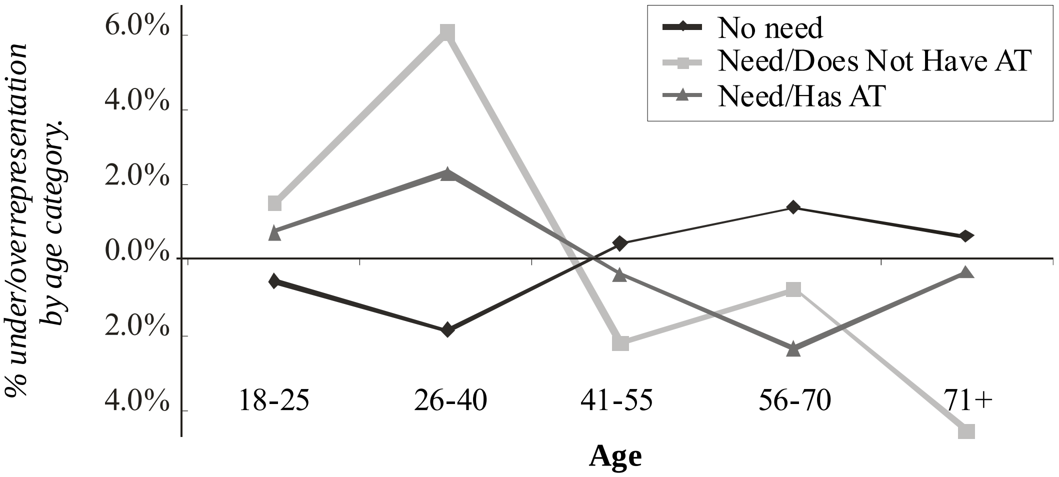
Race

Among nonwhite respondents, 60 percent expressed no need for modifications; among whites the proportion was also 60 percent. Therefore, we focused attention on those who expressed some need. Among whites, 13.8 percent of those needing some modification failed to obtain it in any domain, compared with 22 percent of nonwhites whose needs were similarly unsatisfied. This means that nonwhites with a need for modifications were 59 percent more likely to experience unmet need.

Age

Respondents who needed modifications were, on average, slightly younger than those who did not. Figure 4.19 illustrates the distributions of the three groups (not needing, needing and having, and not having) in terms of their underrepresentation or overrepresentation relative to the total sample.

Figure 4.19 Unmet Need for AT and Age

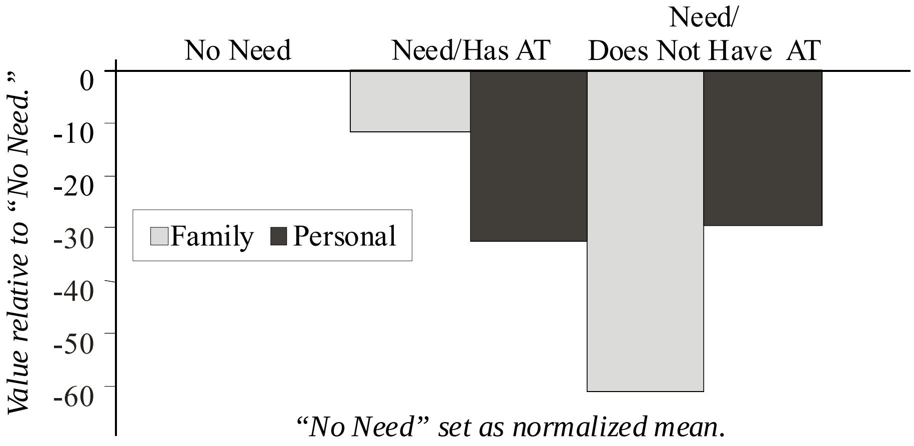


It is evident that, for the youngest two cohorts (under 40 years old), those who needed modifications were overrepresented, and for the highest two cohorts (over 55), they were underrepresented. A possible interpretation for this is that persons in need of modifications needed them at younger ages and were less likely to survive to older ages, especially if they did not receive them.

Income

We measured personal and family income. As shown in figure 4.20, all persons in need fell below the income levels attained by those who did not need modifications. The family income level was far lower for those who needed modifications and did not receive them, while the personal income level was roughly equal for both groups.

Figure 4.20 Unmet Need for AT and Personal and Family Income

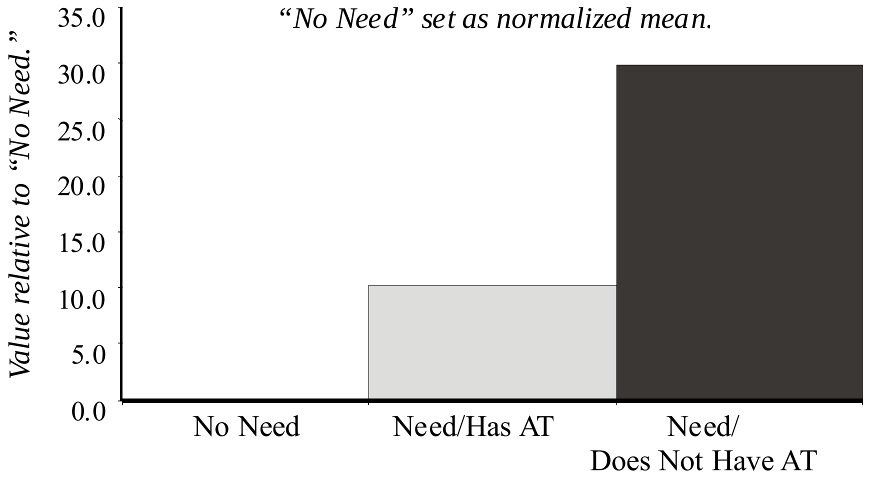


"No Need" set as normalized mean.

Gender

Male respondents were coded as "1," and females as "2;" thus, in figure 4.21, positive values indicated a higher level of females in the group.

Figure 4.21 Gender and Unmet Need for AT



"No Need" set as normalized mean.

Positive values indicate higher proportions of females in the group.

As we moved from those not in need of modification, and those needing and having modifications available and to those with unmet needs, we found an increasing proportion of females in each successive group.

Summary

Respondents from the RDD sample were found to have experienced somewhat lower levels of disability than those from the list sample. They were about one-third less likely to describe themselves as unable to work because of their disabilities, and about one-third more likely to describe themselves as able to work. When all status statements were combined, a total of 729 respondents (52 percent) reported being unable to work because of their disabilities.

The respondents cited more than 100 different conditions as causing their limitations. Major contributors included osteoarthritis, hearing loss, chronic or late effects of injury, multiple sclerosis, heart disease and diabetes.

Almost two-thirds (64 percent) of all respondents reported using AT in one or more of the six contexts asked: either going to or at school or work, at home or in the community. This question was asked at the beginning of the survey. When asked later in the questionnaire whether their use of assistive technology had reduced their dependence on help from another person, only 13 percent said they did not use AT or the assistance of another person.

More than any other source, doctors and other health care professionals were named as the source of information about AT 51 percent of the time. The next highest category was family and friends, at 13 percent; *Tech Act* agencies comprised less than 1 percent of the responses.

AT was most likely obtained from a medical or orthopedic supply store, as cited by 44 percent of the respondents; an additional 19 percent got AT from hospitals and clinics, of which 74 percent were non-VA and 26 percent were VA, and 12 percent obtained their AT directly from a doctor’s office.

Persons with disabilities paid for their devices primarily through insurance (38 percent, including the combined categories of private health insurance, Medicare and Medicaid) and by themselves or through family members (37 percent). Six percent of AT devices were free to the respondents.

The respondents were quite well satisfied with their AT; 90 percent were very satisfied or satisfied with the AT that they used.

Nineteen of the respondents received an agency’s or organization’s assistance in the process of selecting and purchasing their AT. However, only 23 percent of the respondents had sought such help. Similarly, 24 percent of the respondents indicated that they intended to seek out help in the future. Of those who did not intend to seek help, the majority gave responses that indicated that they did not feel that help was necessary.

Fewer than 1 percent of the respondents reported a need for special modifications to use the telephone. We also found that the overall availability of telephones was about 85 percent (this was exclusive of the home; since the questionnaires were administered over the telephone, home availability was *de facto* 100 percent). Telephones were almost universally available at work, and somewhat less available in schools and in the community.

More than two-thirds of the respondents reported that they had a computer available for their use. As to where the computers were located, schools were more likely to have had computers (about 85 percent) than any of the other locations, followed by places in the community, the workplace, and the home (just over 50 percent). In addition, respondents reported that: 91 percent of the computers they could use were connected to the Internet; 36 percent of the respondents required the assistance of another person to use a computer; 14 percent of the respondents required special modifications to use a computer; and 21 percent had received advice in using computers.

Just over one-quarter (26 percent) of the answers given by respondents to the question "Do you need the help or assistance of another person to access or use buildings, rooms or equipment at [school /work/ home/ community]" were in the affirmative, over all locations. The place where the fewest individuals needed help was work, a finding which is most likely attributable to the fact that the working population was operationally defined as less impaired than the nonworking population.

For each location where it was appropriate, we asked if the respondent did, in fact, have access: 95 percent answered "Yes."

Our study showed that the unmet need for modification correlated with low levels of education, personal and family income, nonwhite racial category, nonworking status, younger age, and a more negative attitude.

In all, we found that persons with disabilities used assistive technology devices and environmental access features to a very large extent. Compared to the surveys discussed in 2, our respondents had higher rates of access to computers and the Internet.

5. Assistive Technology Use at Home, in School, at Work and in the Community

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The previous contained a section on assistive technology use that provided a general overview of how AT users learned about AT, where they got it, how AT was paid for, and how satisfied they were with the devices and the services they obtained in the process of selecting and purchasing the needed equipment or technology. We found high rates of overall use of AT (64 percent) and high rates of satisfaction with technology related assistance. In addition, we found that medical and rehabilitation professionals were not only the key source of AT-related information and assistance, but also frequent suppliers of AT devices and services.

In this chapter, we take a closer look at how AT was acquired for use in the various domains of daily living (i.e., home, school, work and community). Making these analytical distinctions is helpful for the identification of potential gaps in the availability of assistive technology for tasks specific to home, school or place of work. An improved understanding of AT use and need in these domains will also assist in the development of better technical solutions for increased access to these environments.

Assistive Technology Use in the Home

We asked each respondent: "Do you use an AT device or service to help or assist you with doing daily tasks and chores at home?" In the RDD sample, 149 respondents (36.2 percent) reported using AT in the home, whereas 542 list sample respondents (54.1 percent) reported using AT in the home. The difference is obvious. A greater percentage of persons from the list sample used AT. We then asked how the respondents learned about the device. Their responses are shown in table 5.1.

Table 5.1 Sources of Information (AT at Home)

	RDD		List	
Doctor, health care professional	332	62%	325	43%
Vocational rehab center	67	13%	61	8%
Family/friends/neighbors	83	16%	77	10%
Pamphlets, magazines	34	6%	32	4%
Center for independent living	2	0%	2	0%
Tech assistance center	0	0%	4	1%
Tech Act/other state organization	1	0%	7	1%
TV/Radio	0	0%	9	1%
Yellow pages	0	0%	2	0%
Internet	1	0%	104	14%
Other	13	2%	120	16%

We noticed that while respondents from both samples get more information from the medical profession, a higher percentage of list sample respondents get their information from the Internet or other sources.

The next question asked respondents where they got their AT devices. Table 5.2 shows that the RDD sample respondents were twice as likely to obtain their devices from a doctor's office than were the list sample respondents. The main source for all respondents, however, was the medical or orthopedic supply store. The next question asked who paid for it.

Table 5.2 Sources of Supply (AT at Home)

	RDD		List	
Doctor's office	31	20%	62	10%
Hospital/clinic [not VA]	28	18%	83	13%
VA Hospital/clinic	4	3%	35	5%
Vocational rehab center	9	6%	39	6%
Nursing home	0	0%	4	1%
Medical/orthopedic supply store	55	36%	292	46%
Prescription from drugstore, including Wal-Mart	6	4%	22	3%
OTC from drugstore, including Wal-Mart	2	1%	7	1%
Mail order	2	1%	8	1%
Other	15	10%	85	13%

Table 5.3 shows that the distribution pattern for the two subsamples of AT users at home was virtually identical.

Table 5.3 Sources of Payment (AT at Home)

	RDD		List	
Self, family member	76	44%	257	37%
Private health insurance	24	14%	113	16%
Medicare	33	19%	116	17%
Medicaid	11	6%	41	6%
Rehab program	4	2%	7	1%
Employer	5	3%	22	3%
School system	0	0%	1	0%
VA program	4	2%	35	5%
Free	11	6%	43	6%
Other	9	5%	53	8%

Next, we asked the respondent's satisfaction with the AT device. The responses to this question are shown in table 5.4.

Table 5.4 Level of Satisfaction With AT (AT at Home)

	RDD		List	
Very satisfied	80	54%	320	59%
Somewhat satisfied	52	35%	178	33%
Somewhat dissatisfied	10	7%	27	5%
Very dissatisfied	7	5%	16	3%

The results in this section showed that the respondents' primary source of information for AT in the home was the medical profession; however most obtained AT from a medical supply house. Most paid for the device by themselves, or through insurance, and most were very satisfied with the device they obtained.

The next section of the questionnaire asked about help received during the selection and purchase of the home AT device. Of the list respondents who used a device at home, 383 of 543 (71 percent) said they did not receive help from an agency or organization during the selection and purchase of the services. In the list sample, 108 of 149 (73 percent) did not receive help.

We asked about satisfaction with the help received, with the following results:

Table 5.5 Level of Satisfaction With Advice (AT at Home)

	RDD		List	
Very satisfied	29	62%	116	73%
Somewhat satisfied	16	34%	34	21%
Somewhat dissatisfied	1	2%	5	3%
Very dissatisfied	1	2%	4	3%

Of those who did not receive help, only 51 of 383 (13 percent) from the list sample, and four of the 108 from the RDD sample (4 percent) actually sought help.

We then asked whether there are additional AT devices that respondents would use at home; 193 of 530 (36 percent) from the list sample and 43 of 104 respondents in the RDD sample said they believed there are such devices.

We asked all respondents whether they had ever tried and failed to obtain an assistive device for use in the home. Of the 1,002 list respondents, 163 (16 percent) list sample said yes, as did 29 of 411 (7 percent) RDD respondents. Of the 163 in the list sample, 104 came from the 542 (19 percent) in the home who use devices at home, 59 from the 460 (13 percent) who do not. Of the 29 respondents in the RDD sample who failed to obtain assistive devices for use in the home, 16 (11 percent) came from the 149 respondents who use devices, 13 (5 percent) from the non-AT using group.

Next, we found that 464 (47 percent) of the 995 list respondents and 192 of 408 RDD respondents (also 47 percent) said they were aware that they could get help to obtain AT. They said they would seek that help learning about the devices from the agencies tabulated below. Forty-eight percent (225 of 464) of list respondents and 40 percent of RDD respondents (77 of 192) who were aware that they could get help planned to contact an agency. None specified an agency that they planned to contact. Table 5.6 shows the distribution of possible sources of information across the two samples. Doctors and health care professionals were mentioned most frequently as a source of information.

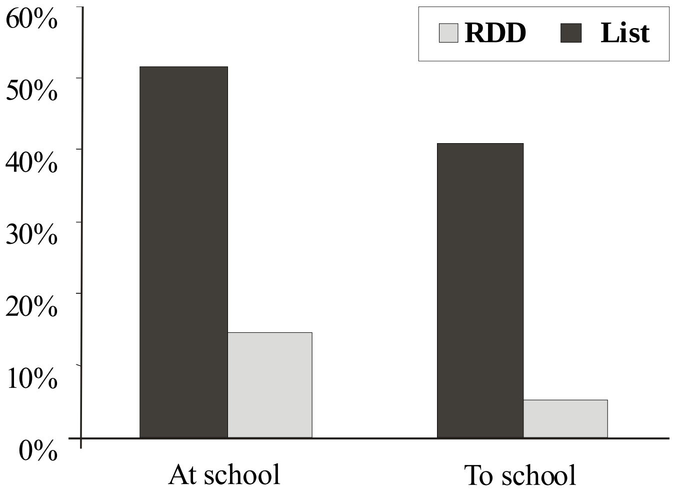
Table 5.6 Sources of Help (AT at Home)

	RDD		**List**	
Doctor, health care professional	104	47%	188	34%
Vocational rehab center	12	5%	40	7%
Family/friends/neighbors	11	5%	28	5%
Pamphlets, magazines	6	3%	18	3%
Center for independent living	10	4%	12	2%
Tech assistance center	7	3%	15	3%
Tech Act/other state organization	7	3%	21	4%
TV/Radio	5	2%	11	2%
Yellow pages	2	1%	5	1%
Internet	6	3%	41	7%
Other	53	24%	168	31%

Detailed Findings of the Student Population

We asked: “Do you use an assistive technology device or service to help you with getting to or from school, or while you are at school?” Clearly, the two samples were different. The respondents from the list sample were more likely to use assistive devices than were those from the RDD sample, as shown in figure 5.1.

Figure 5.1 Use of AT by Enrolled Students



We then asked how the respondents learned about the device. Their answers are tabulated in table 5.7. Doctors and health care professionals were the primary source of information about assistive devices for the students in the sample.

Table 5.7 Source of Information (AT in School)

	RDD		List	
Doctor, health care professional	1	33%	7	47%
Vocational rehab center	1	33%	3	20%
Family/friends	0	0%	1	7%
Tech assistance center	0	0%	1	7%
Tech Act/other state organization	0	0%	1	7%
TV/Radio	0	0%	1	7%
Internet	0	0%	1	7%
Other	1	33%	0	0%

The next question asked where the student respondents got their AT devices.

Table 5.8 Source of Supply (AT in School)

	RDD		List	
Doctor's office	2	67%	5	42%
Medical supply store	1	33%	7	58%

Then the next question asked who paid for it.

Table 5.9 Source of Payment (AT in School)

	RDD		List	
Self, household member	2	67%	6	43%
Private health insurance	0	0%	2	14%
Medicare	0	0%	1	7%
Medicaid	0	0%	1	7%
Rehab program	1	33%	2	14%
Employer	0	0%	1	7%
Free	0	0%	1	7%

This was followed by the respondents' satisfaction with the AT devices.

Table 5.10 Level of Satisfaction With AT (AT in School)

	RDD		List	
Very satisfied	1	33%	10	63%
Somewhat satisfied	2	67%	4	25%
Somewhat dissatisfied	0	0%	2	13%
Very dissatisfied	0	0%	0	0%

The student respondents' primary source of information and supply was the medical profession. Most paid for the devices by themselves, or through insurance, and most were very satisfied with the devices they obtained.

The next section of the questionnaire asked about help received during the selection and purchase of the AT devices. In the list sample, 12 of the 16 respondents who had a device said they received no help from an agency or organization during the selection and purchase of the services; none of the RDD respondents received help.

We then asked whether there were additional devices that the respondents would use: 1) to get to or from school; or 2) while at school. Four of the 16 users from the list, and none from the RDD sample, said there were additional devices to get to or from school. Eight of the 16 users from the list sample, and one from the RDD sample, said there were additional devices to use while at school. We also asked the students who did not use a device to get to school or while at school whether there were devices available that might help. None said that there were any.

We asked all students whether they had ever tried and failed to obtain an assistive device. In the list sample, 10 of the 29 (34 percent) said yes, they had experienced failure. Of these 10, six came from the 16 (38 percent) who used devices and four from the 13 (31 percent) who did not. In the RDD sample, there were three who had tried without success to obtain devices; all three are individuals who did not use AT.

Next, we found that 14 (48 percent) of the students from the list sample and 12 (57 percent) from the RDD sample said they were aware that they could get help to obtain AT. Those who were aware were asked where they would go to learn more about the devices or services. Their responses were shown in table 5.11. Other organizations included agencies such as insurance companies, hospitals or social workers.

Table 5.11 Sources of Help (AT in School)

	RDD		List	
Doctor, health care professional	4	36%	5	33%
Vocational rehab center	2	18%	1	7%
Tech assistance center	0	0%	1	7%
Tech Act/Other state organization	1	9%	1	7%
Yellow pages	0	0%	1	7%
Other	4	36%	6	40%

In the list sample, 13 of 14 of those who were aware that they could get help planned to contact an agency. In contrast, five of the 12 RDD respondents planned to contact an agency. No one from either sample specified an agency that she planned to contact.

In summary, the results from the student population showed some measurable differences between the respondents in the two samples. Most obviously, the RDD sample was less severely impaired as defined by their self-assigned status, and as confirmed by their lower use of AT in their lives as students.

Detailed Findings of the Working Population

The results from the question: “Do you use an assistive technology device or service to help you with getting to or from work, or while you are at work?” were similar to those found in the student population. As shown in figure 5.2, the list sample respondents were more likely to use AT than those from the RDD sample.

Figure 5.2 Use of AT by Employed Respondents

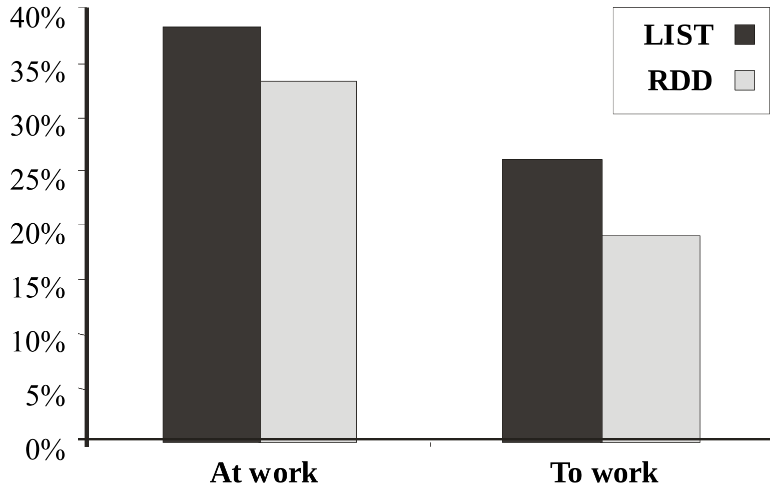


Table 5.12 shows how the respondents learned about the device. Most of the respondents from both samples learned about the device from doctors or a health care professional.

Table 5.12 Source of Information (AT at Work)

	RDD		List	
Doctor, health care professional	26	60%	45	44%
Vocational rehab center	0	0%	7	7%
Family/Friends/Neighbors	3	7%	11	11%
Pamphlets, magazines, etc.	0	0%	6	6%
Tech assistance center	1	2%	1	1%
Center for independent living	0	0%	2	2%
Tech Act/Other state organization	1	2%	1	1%
TV/Radio	1	2%	1	1%
Other	11	26%	29	28%

The next question asked where the respondents obtained their AT devices. Table 5.13 summarizes the source of AT at work.

Table 5.13 Source of Supply (AT at Work)

	RDD		List	
Doctor's office	10	24%	15	22%
Hospital/clinic [not VA]	6	14%	7	10%
VA Hospital/clinic	1	2%	2	3%
Vocational rehab center	2	5%	3	4%
Medical/orthopedic supply store	11	26%	35	51%
Prescription from drugstore, including Wal-Mart	4	10%	3	4%
OTC from drugstore, including, Wal-Mart	3	7%	1	1%
Mail order	0	0%	2	3%
Other	5	12%	0	0%

Table 5.14 shows the source of payment for the AT.

Table 5.14 Source of Payment (AT at Work)

	RDD		List	
Self, household member	30	68%	49	55%
Private health insurance	7	16%	18	20%
Medicare	1	2%	5	6%
Medicaid	0	0%	1	1%
Rehab program	0	0%	3	3%
Employer	4	9%	7	8%
VA program	1	2%	3	3%
Free	1	2%	3	3%

The final question assessed the respondents' satisfaction with the AT devices. Table 5.15 shows that the satisfaction levels were similar between RDD and list respondents, with most being somewhat or very satisfied with AT at work.

Table 5.15 Level of Satisfaction with AT (AT at Work)

	RDD		List	
Very satisfied	23	53%	50	50%
Somewhat satisfied	13	30%	47	47%
Somewhat dissatisfied	7	16%	1	1%
Very dissatisfied	0	0%	2	2%

The next section of the questionnaire asked about help received during the selection and the purchase of the AT device. In the list sample, 58 of 81 (72 percent) working respondents who had a device said they received no help from an agency or organization during the selection and purchase of the services. In the RDD sample, 35 of 43 (81 percent) said they had not received help.

Of those who did not receive help, 20 of the 23 list sample respondents were very satisfied, and three were somewhat satisfied with the help they received. Seven of the eight RDD respondents were very satisfied, while the other was somewhat satisfied.

Of those who did not receive help, only seven (12 percent) in the list sample and one (3 percent) in the RDD sample sought help.

When asked whether there were additional AT devices that respondents would use to get to or from work, 10 of 80 (13 percent) list sample workers and two of 40 (5 percent) of RDD workers said there were. Asked about additional devices they would use while at work, 17 of 81 (21 percent) from the list sample and 10 of 42 (24 percent) from the RDD sample said there were.

We also asked the working respondents who did not use a device to get to work or while at work whether there were devices available that might help getting to or from work. Only five of 104 (5 percent) from the list sample and eight of 67 (2 percent) of the RDD sample said that there were any. Over both samples, nine said AT would help “A lot,” two each said AT would help “Somewhat” or “A little.” When asked about AT that would help them at work, 13 (13 percent) from the list sample and 19 (28 percent) from the RDD sample said there were, with 18 saying that it would help “A lot,” 11 “Somewhat” and two “A little.”

We asked all workers whether they had ever tried and failed to obtain an assistive device. In the list sample, 23 of 189 (12 percent) said yes, they had experienced failure. Of these 23, 12 came from the 82 (15 percent) who used devices, and 11 from the 107 (10 percent) who did not. In the RDD sample, 10 of 102 (10 percent) had failed to get a device; five of these were from persons who used devices.

Next, 89 (47 percent) of the list sample workers and 55 (49 percent) of workers from the RDD sample said that they were aware that they could get help to obtain AT. Those who were aware were asked where they would go to learn more about the devices or services. The responses are shown in table 5.16.

Table 5.16 Source of Help (AT at Work)

	RDD		List	
Doctor, health care professional	26	47%	31	26%
Vocational rehab center	3	5%	9	8%
Family/Friends/Neighbors	1	2%	8	7%
Pamphlets, magazines	1	2%	4	3%
Center for independent living	0	0%	5	4%
Tech assistance center	1	2%	3	3%
Tech Act/Other state organization	2	4%	7	6%
TV/Radio	0	0%	1	1%
Yellow pages	3	5%	1	1%
Internet	3	5%	16	14%
Other	15	27%	32	27%

Thirty-eight percent (34 of 89) of the list sample workers and 21 percent (23 of 111) of the RDD workers who were aware that they could get help planned to contact an agency.

In summary, the workers from the RDD sample were less frequent users of AT. The working respondents' primary source of information was the medical profession, and most obtained AT from a medical supply house. The majority of respondents paid for the devices themselves, or through insurance, and most were very satisfied with the devices they obtained.

Detailed Findings on Assistive Technology Use in the Community

Respondents were asked about the use of AT outside the home. Fourteen of the respondents in the list sample and five in the RDD were homebound, and consequently were not asked this set of questions. We asked each respondent: "Do you use an AT device or service to help or assist you with activities outside the home such as shopping or visiting friends and family?" Of the 983 list respondents, 548 (56 percent) answered "Yes," as did 153 of the 407 RDD respondents (38 percent). The difference between proportions was significant at the .01 level. We then asked how the respondents learned about the device. The distribution of their responses is shown in table 5.17. There was good correspondence about the source of information between the two groups.

Table 5.17 Source of Information (AT in the Community)

	RDD		List	
Doctor, health care professional	84	51%	288	48%
Vocational rehab center	10	6%	43	7%
Family/Friends/Neighbors	26	16%	82	14%
Pamphlets, magazines	2	1%	20	3%
Center for independent living	1	1%	6	1%
Tech assistance center	1	1%	8	1%
Tech Act/Other state organization	4	2%	5	1%
TV/Radio	1	1%	15	2%
Yellow pages	1	1%	5	1%
Internet	0	0%	4	1%
Other	36	22%	129	21%

The next question asked where the respondents got their AT devices. Table 5.18 shows that the sources for obtaining the devices were very similar across the two samples.

Table 5.18 Source of Supply (AT in the Community)

	RDD		List	
Doctor's office	29	19%	79	11%
Hospital/Clinic [not VA]	21	14%	68	10%
VA Hospital/Clinic	7	5%	26	4%
Vocational rehab center	11	7%	27	4%
Nursing home	0	0%	3	0%
Medical/Orthopedic supply store	50	33%	257	37%
Prescription from drugstore, including Wal-Mart	6	4%	11	2%
OTC from drugstore, including Wal-Mart	5	3%	12	2%
Mail order	1	1%	2	0%
Other	23	15%	103	15%

We then asked who paid for the community AT device, and obtained the following results shown in table 5.19. There were no significant differences between the two samples regarding the sources of payment for the AT devices and the services used outside of the home.

Table 5.19 Source of Payment (AT in the Community)

	RDD		List	
Self, family member	67	37%	281	36%
Private health insurance	22	12%	138	18%
Medicare	27	15%	118	15%
Medicaid	9	5%	54	7%
Rehab program	3	2%	13	2%
Employer	6	3%	12	2%
School system	0	0%	1	0%
VA program	9	5%	38	5%
Free	18	10%	61	8%
Other	11	6%	69	9%

The questionnaire next assessed the respondents' satisfaction with the AT devices used outside the home. Table 5.20 shows a significant difference in the amount of satisfaction between the samples. While the difference between the ratings of positive satisfaction (i.e., very satisfied versus somewhat satisfied) was statistically significant, there was no indication of dissatisfaction among the majority of the respondent population.

Table 5.20 Level of Satisfaction (AT in the Community)

	RDD		List	
Very satisfied	85	29%	339	62%
Somewhat satisfied	173	59%	173	32%
Somewhat dissatisfied	23	8%	23	4%
Very dissatisfied	10	3%	10	2%

The next section of the questionnaire asked about help received during the selection and purchase of the community AT device. Of the respondents who used a device outside the home, 400 of 545 (73 percent) list respondents and 116 of 153 (76 percent) RDD respondents said they received no help from an agency or organization during the selection and purchase of the services. Table 5.21 shows the frequencies and percentages for satisfaction with advice received during the selection and purchase of AT for use outside the home. As in previous examples, there was a good correspondence between list and RDD samples.

Table 5.21 Satisfaction With Advice (AT in the Community)

	RDD		List	
Very satisfied	26	67%	110	76%
Somewhat satisfied	8	21%	26	18%
Somewhat dissatisfied	3	8%	6	4%
Very dissatisfied	0	0%	3	2%

We asked whether there were additional AT devices that respondents would use outside the home; 171 of 540 AT users in the list sample (32 percent) and 44 of 153 RDD AT users (29 percent) said there were. When asked how much help additional AT outside the home would be, the proportion of list sample respondents who answered “A lot” was about the same as in the RDD sample (73 percent versus 76 percent).

We asked all respondents whether they had ever tried and failed to obtain an assistive device. In the list sample, 137 of 980 (14 percent) said “Yes.” Of these 137, 87 came from the 548 (16 percent) who used devices, and 50 came from the 454 (11 percent)] who did not. In the RDD sample, 31 of 406 (8 percent) had tried without success—18 from the 153 (12 percent) who used devices, and 13 (5 percent) from the 259 who did not.

Next, we found that 477 (49 percent) of 980 list respondents and 184 (46 percent) of 402 RDD respondents said they were aware that they could get help to obtain AT. They said they might seek help about the devices from the agencies shown in table 5.22.

Table 5.22 Sources of Help (AT in the Community)

	RDD		List	
Doctor, health care professional	115	52%	229	35%
Vocational rehab center	8	4%	44	7%
Family/Friends/Neighbors	10	5%	48	7%
Pamphlets, magazines	9	4%	37	6%
Center for independent living	10	5%	15	2%
Tech assistance center	5	2%	13	2%
Tech Act/Other state organization	7	3%	17	3%
TV/Radio	0	0%	11	2%
Yellow pages	5	2%	18	3%
Internet	7	3%	51	8%
Other	45	20%	164	25%

Thirty-eight percent (179 of 477) of list respondents and 35 percent of RDD respondents (64 of 184) who were aware that they could get help planned to contact an agency. None specified an agency that they planned to contact.

Summary

Analysis of AT use at home, in school, at work and in the community showed that the community was the domain where most devices and accommodations were used. There, 56 percent of the list sample respondents and 38 percent of the RDD sample respondents reported using some type of AT. The home was the second site of use by 54 percent of the list sample respondents, and by 36 percent of the RDD sample. School was reported as a place of use by 52 percent of the list respondents (versus 15 percent of RDD respondents), and work by 38 percent of list sample respondents (versus 34 percent of RDD sample respondents).

List sample respondents used AT at a significantly higher rate than RDD sample respondents. For all four domains, information about AT was obtained from medical and rehabilitation professionals in 50 to 75 percent of the cases. The doctor's office or the medical supply store were the most frequently mentioned sources of supply, and self and family were the most frequently mentioned sources of payment.

Satisfaction with the devices and with the help in obtaining AT frequently exceeded 90 percent, with list respondents expressing higher levels of satisfaction than RDD respondents. Persons in the RDD sample who used or needed AT at work expressed the lowest levels of satisfaction with AT, but were otherwise very satisfied with the help they received selecting or buying AT. Failure to obtain AT-related help or advice, depending on sample membership, was observed in 13 percent or less of the cases.

There was also a strong reliance on conventional professional sources of advice about, and supply of, AT. Altogether, centers of independent living, *Tech Act* organizations and state-based technical assistance agencies were mentioned as a source of information, help or advice in less than 10 percent of the cases. In comparison, the Internet was mentioned as a source of information in as many as 14 percent of the cases, again depending on sample membership. Generally, however, list respondents were more likely to use a wider variety of sources of information, advice and help about AT than RDD respondents.

The differing patterns of use of AT in the two samples resulted from the inclusion criteria that determined the composition of the list sample. Compared to the general population represented in the RDD sample, higher levels of AT use observed in the list sample appeared to have had a substantial effect on such items as knowledge and awareness of AT. List respondents were more informed about AT and interacted with AT-related service providers to a greater extent. In the next chapter, we will examine the effects that different patterns of AT knowledge and use had on attitudes and opinions about AT-related services, policies and legislation.

6. Attitudes and Opinions About Assistive Technology-Related Services, Policies and Legislation

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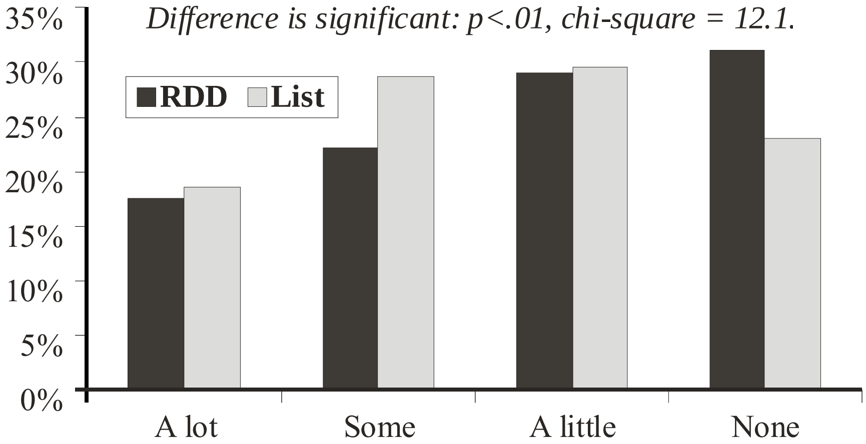
The purpose of this is to present the trends and developments since the enactment of the *Tech Act*. General as well as specific questions about the likely impact of this law and other related legislation were posed. The purpose of the questions was to assess the extent to which the various provisions of the *Tech Act*—raising awareness, aiding in the selection and purchase of AT, and providing technology related assistance—have influenced public attitudes and opinions about AT-related services and policies. In the case of assistive technology-related legislation, we expected that persons with disabilities would have some knowledge about how lawmakers address their needs for AT-related information and assistance. While we did not expect the majority of respondents to know about specific laws, we nevertheless expected that respondents would be able to identify sources of information and help in case they needed technology-related assistance. This presents the results of the 10 opinion questions.

Question 1: "Overall, how much information and advice have you received about assistive technology? Would you say a lot, some, a little, or none?"

As shown in figure 6.1, the two groups differed significantly in their responses to this question. The modal response of the RDD sample was "None," and the modal response for the list sample was "A little." The least-used response for both samples was "A lot." In general, we could characterize the response to this question as essentially negative (i.e., that whatever information and advice they received was perceived as minimal).

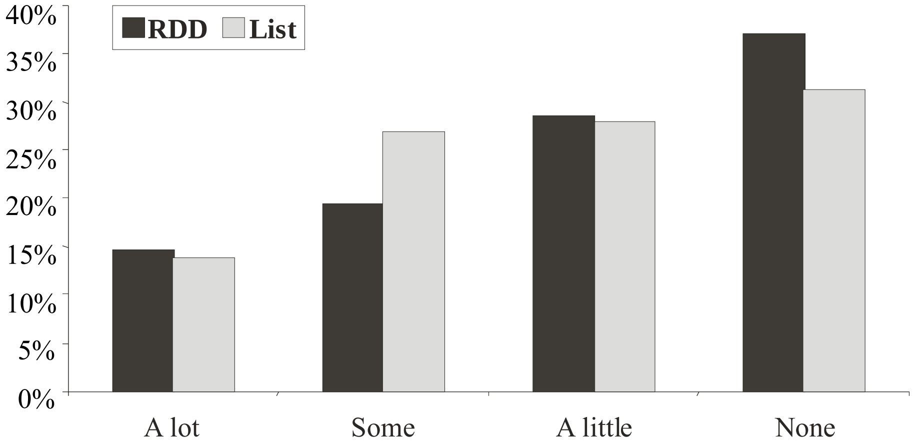
Figure 6.1 Amount of Information Received About AT



Question 2: "Overall, how much information and advice have you received about how to obtain it? Would you say a lot, some, a little, or none?"

For this question, there was no significant difference between the two samples. The modal response was "None," and the median was "A little." Figure 6.2 shows that compared to the response given to question 1, the population was even more negative. The implication here is that, while there was a general lack of information about assistive technology, there was less information available about how to obtain it than there was about assistive technology in general.

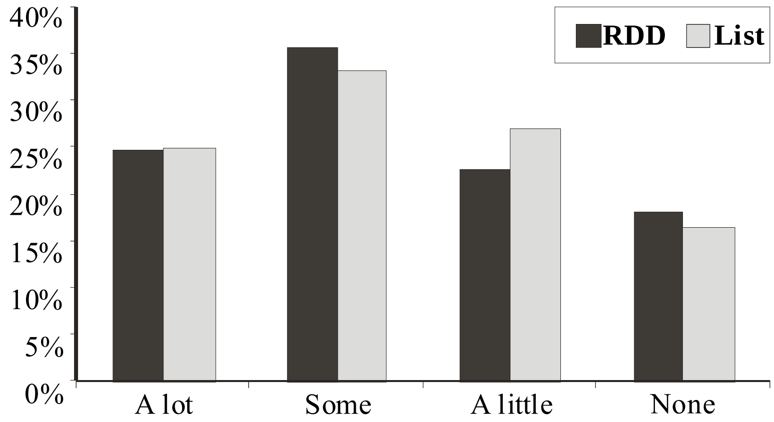
Figure 6.2 Amount of Information About How to Obtain AT



Question 3: "Overall, how much difference would you say that the information and advice about assistive technology and how to obtain it has made in increasing your level of learning, independence, productivity and community integration?"

This result was much more positive. There was no significant difference between the two samples, although the trend has been established that the respondents in the RDD sample were somewhat more negative than those in the list sample. The modal and median response was "Some," indicating that the central tendency was closer to "A lot" than "None."

Figure 6.3 Impact of Information About AT



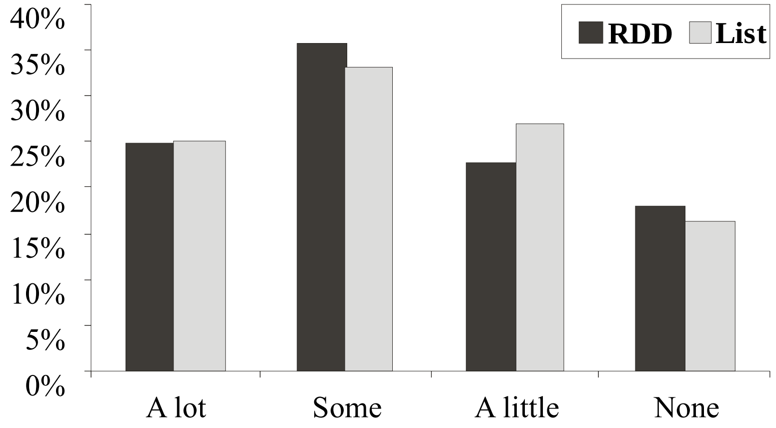
Considered in the light of the previous two responses, we have an indication that the perception of the respondents was that the information and advice they *did* receive about assistive devices and how to obtain them was worthwhile. However, we must be cautious in our interpretation: it could well be that the respondents were getting some information and advice that they judged to be inadequate, and hence not, in the literal sense, information at all.

The fact is, we have determined that all respondents who used AT gave some answer to the question: "Where did you learn about the device?" If the respondents learned about the device, it could be argued that they received information about it, and in that case, the answer "None" to either of the first two questions would be invalid. A more reasonable interpretation is, as stated above, that the respondents were judging the utility of the information and advice that they had received over and above some putative baseline.

Question 4: "Overall, how much has information and advice about assistive technology and how to obtain it helped you to become more aware of your rights?"

The results here were very similar to those for the previous question, with the mode and median again residing the in response "Some." There was no significant difference in the responses given by the two samples. The only unusual aspect of the responses to this question, compared to the preceding three, was that the two samples were almost equally positive, and for the first time, a proportionally smaller group of respondents from the RDD sample answered "None" as compared to the respondents from the list sample.

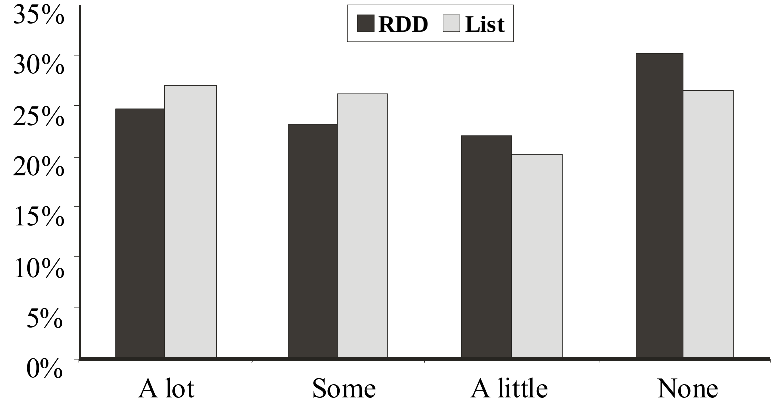
Figure 6.4 Awareness Raised Through Information About AT



Question 5: "How much has your use of AT devices and services decreased your need for help from another person?"

One-hundred twenty-two respondents (12 percent) from the list sample and 68 (17 percent) from the RDD sample reported that they used no AT device or service. Almost as many said "None" as the modal response of "A lot." It is unclear from these results whether those who answered "None" meant that they did not need assistance from another person even without the device, or that at least part of their disability was not ameliorated by AT (which could be the case for the respondents who do not use AT as well).

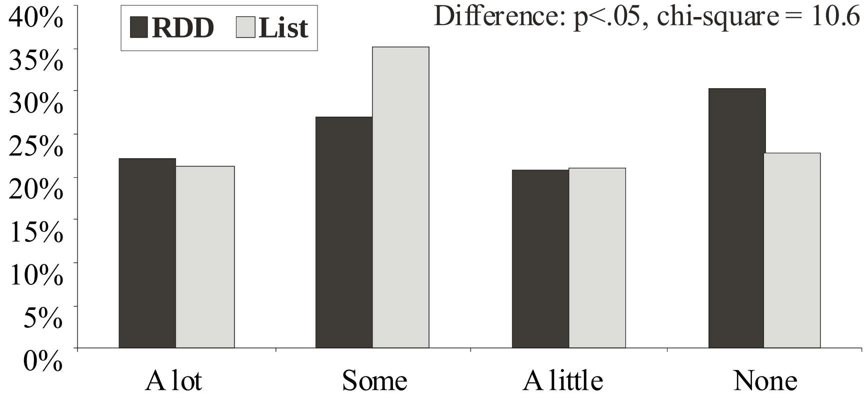
Figure 6.5 AT Use and Decreased Need for Personal Assistance



Question 6: "To what extent have better-designed products and environmental access features or universal design products reduced your need for AT devices and services?"

Respondents here stated clearly that improved design was a factor that reduced their reliance on assistive technology devices and services. The significant difference here—again, the RDD respondents were more negative in their responses to this question—can be interpreted as a reflection of the fact that RDD respondents, as a group, appeared to be less severely impaired than those from the list; and consequently, they perceived themselves as less "needy" than the others. Thus, the "reduction in need" is likely to be smaller for them than for the respondents from the list sample.

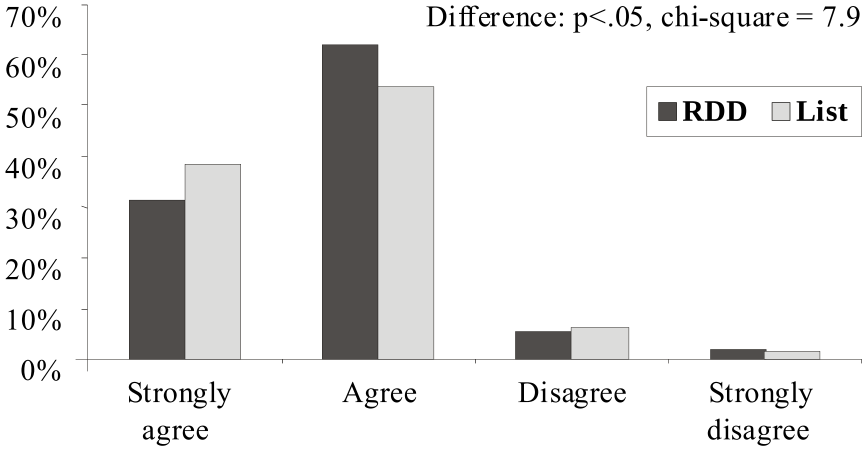
Figure 6.6 Impact of Better Designed Environmental Access Features



Question 7: "Compared to 10 years ago, people are more aware of the need for assistive technology devices and services for persons with disabilities. Would you say that you strongly agree, agree, disagree, or strongly disagree?"

The response to this question leaves little doubt that public awareness of the need for AT is greater now than 10 years ago. The difference between the two samples occurred in the level of agreement, but both groups were overwhelmingly positive in their response to this question.

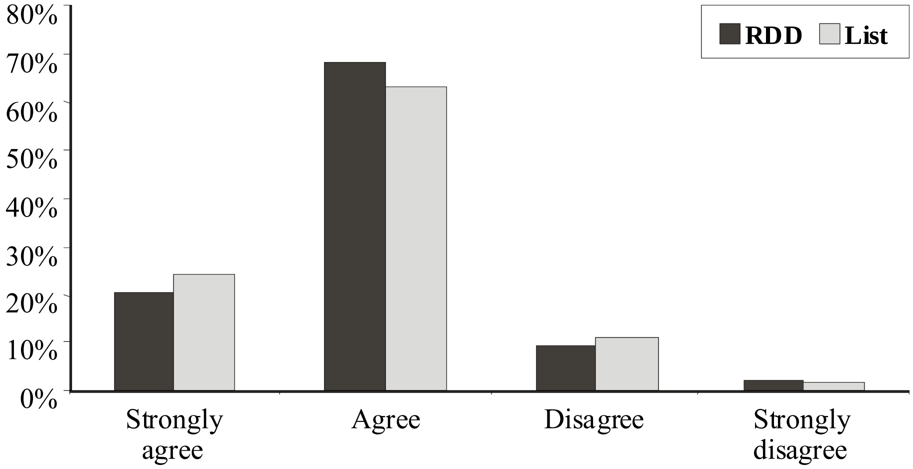
Figure 6.7 Increased Awareness of Need for AT



Question 8: "Compared to 10 years ago, laws or program policies have been changed to help persons with disabilities to get assistive technology. Would you say that you strongly agree, agree, disagree, or strongly disagree?"

Similar to question 7, the mode and median response was an overwhelming agreement. The difference between the two samples did not reach statistical significance.

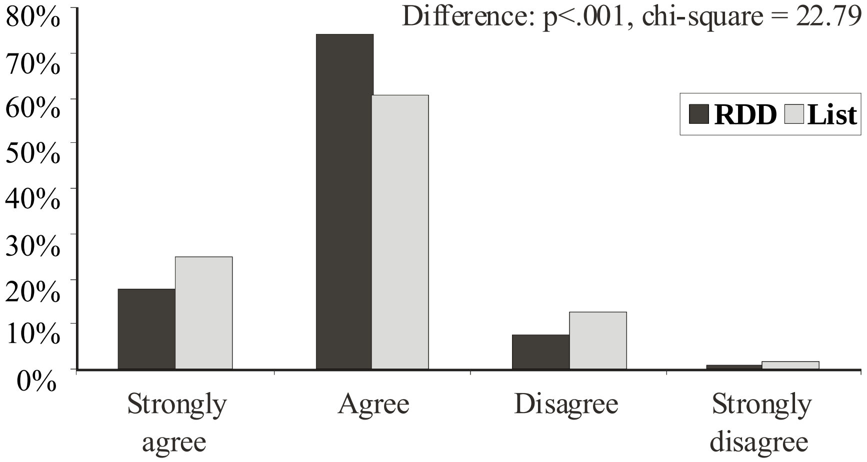
Figure 6.8 Systems' Changes Helped to Get AT



Question 9: "Compared to 10 years ago, more people are aware of assistive technology and understand how it can benefit persons with disabilities. Would you say that you strongly agree, agree, disagree, or strongly disagree?"

Question nine had virtually the same result as the previous two questions. The respondents asserted that the public is more aware of how AT can help them. The difference between the two samples in the respondents' responses here was similar to what occurred in question 7 (i.e., the response of both samples was positive, but there were more extreme positives, proportionally, among the list respondents than the RDD respondents).

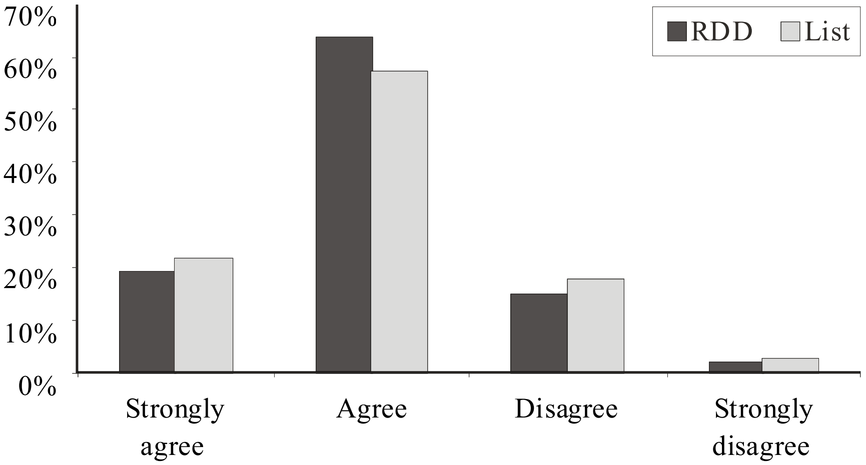
Figure 6.9 Increased Awareness About AT



Question 10: "Compared to 10 years ago, it is easier to find assistance for purchasing assistive technology devices and services. Would you say that you strongly agree, agree, disagree, or strongly disagree?"

This question received a less positive result than the three preceding questions. The level of disagreement was higher here. We note the similarity of this item to question 2. Given the general level of agreement to questions 7, 8 and 9, the more negative response here was consistent with the opinion expressed in question 2 that there was little information and advice available about purchasing AT.

Figure 6.10 Availability of Technical Assistance



Summary

The respondents generally felt that there was little or no information given to them about AT and less about how to obtain it, but that the information that they did receive was generally helpful and made them more aware of their rights.

Respondents also stated that their use of AT did not generally reduce their independence on help from another person, but that improved design in products and improved environmental access had reduced their reliance on AT.

Compared to 10 years ago, the respondents were very largely in agreement with the statements that people are more aware of the need for AT, that they understand AT, that laws have changed, and that it is easier to get assistance in obtaining AT. In all cases, the responses of the persons who were using AT were more positive than those of the non-AT users.

Overall, the differences between the two samples on the opinion questions were more a matter of degree than direction. The mean difference—where the two samples were significantly different—was one-tenth of a scale point, and did not meet the level of power necessary for meaningful distinction.

7. Assistive Technology Use and Personal Assistance Services

Until recently, research in the area of assistive technology and personal assistance services (PAS) had been largely clinically oriented, pertaining to specific devices and assessments of their ability to meet physiological long-term care needs (Agree, 1994; Batavia & DeJong, 1990). However, assistive technologies—especially those that could substitute for human assistance—have also been recognized for their potential to reduce the costs of personal assistance services (Mann, Hurren, Tomita, & Charvat, 1995a, 1995b; Agree, 2000; Hoenig, Taylor, & Sloan, 2003). They hold out the promise of making persons with disabilities more independent by reducing their reliance on other persons.

Kennedy, LaPlante, & Kaye (1997) studied data from the 1991–92 Survey of Income Program Participation (SIPP) and found that 3.7 million persons aged 15 and over, or about 1.9 percent of the U. S. population needed assistance with at least one ADL—in most cases bathing. Most of these services were provided by family members. Paid help was used in less than 10 percent of the cases. McNeil (2001) estimated that at the end of the decade, the number of persons in need for personal assistance services had grown to 10.1 million persons, or 3.8 percent of the U.S. population, with 4.1 million of this figure being represented by persons aged 65 and over. With the rapid aging of the population, this figure is expected to grow rapidly, and so is the demand for personal care services and the cost of care.

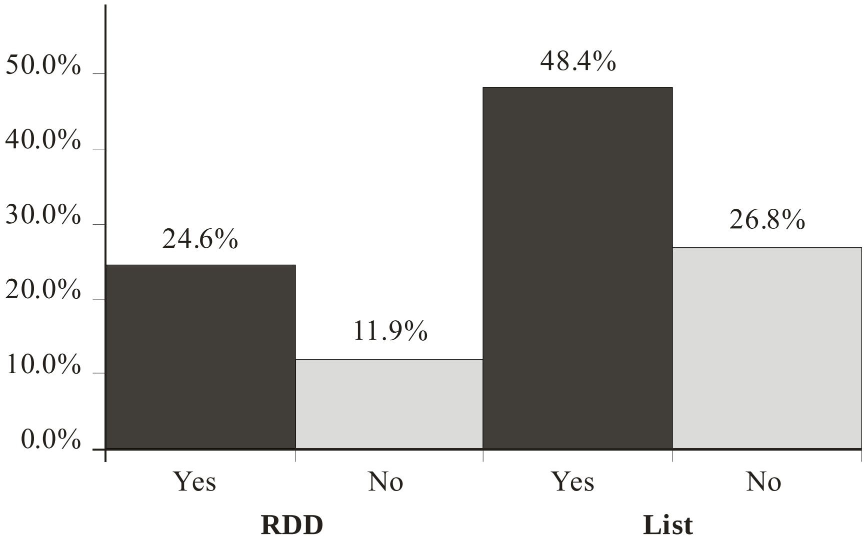
Ken Manton and his colleagues at Duke University explored the question of substitutability of technology for human help. Their findings indicated that the use of assistive technology was growing and that some substitution of technology for human assistance had been taking place (Manton et al., 1993). Agree (1994) suggests that the use of assistive technology by older persons tends more often to supplement, rather than substitute, human assistance. However, while there can be some substitution, PAS and assistive technology are complementary and needed. Consumers need access to assistive technology and flexibility in combining AT with PAS. In this chapter, we will explore the extent to which persons with disabilities consider AT a complement or a substitute to personal assistance services, and how personal characteristics and needs may have shaped these views.

Findings

In the survey, potential respondents were screened to determine who among the residents of a household used a personal assistant. The screener began with the general question: “Does anyone in your household who is over age 18 use or need any of the following special equipment to perform daily tasks and activities in the home, at school, at work or in the community?” After asking about the use of a wheelchair, a special bed or telephone, the informant was given the alternative “… The assistance of another person?” and “Who is that?”

Over the entire sample, 34.9 percent (494 of 1414) said that they used a personal assistant to perform daily tasks. However, this screening question produced different results from the list and RDD samples. Only 18.4 percent of the RDD sample used a personal assistant, compared with 41.7 percent of the list sample. In this chapter, we will report the results separately for both samples. The chart below shows the relationship between use of PAS and use of AT.

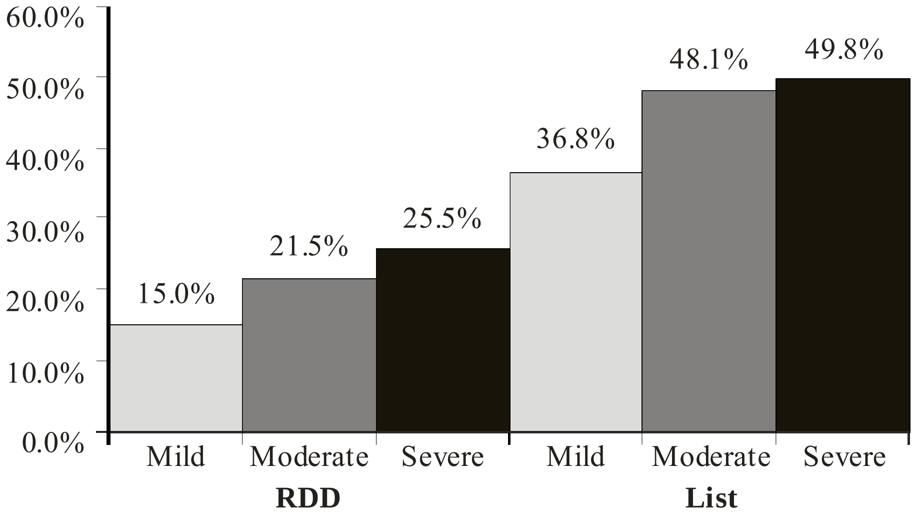
Figure 7.1 Use of AT and Personal Assistance Services



In figure 7.1, the x-axis has four categories: those who used AT and those who did not from the two samples. For both samples, respondents who used AT were about twice as likely to use PAS as those who did not (i.e., that the relative use of AT for the two samples shows the same pattern, although a higher percentage of respondents in the list sample use PAS).

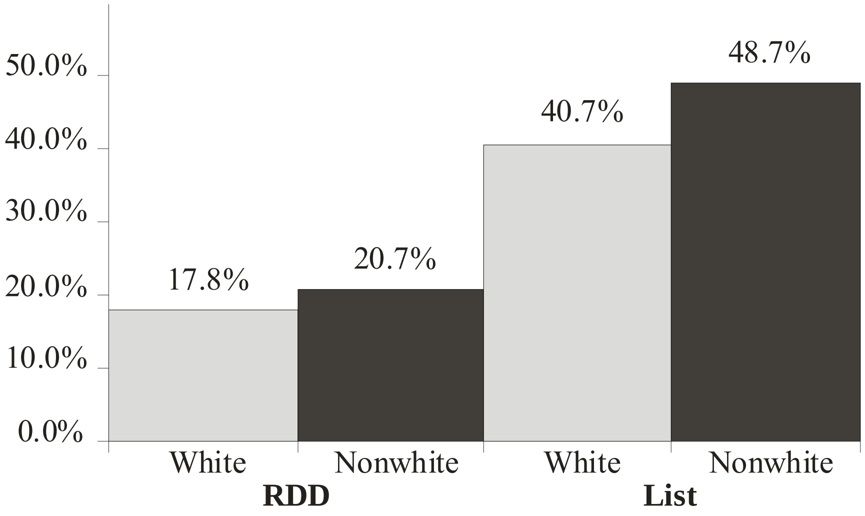
A similar pattern emerged when we considered the severity of the impairment. As might be expected, the use of PAS increased as the severity of the impairment increased in each sample.

Figure 7.2 Use of Personal Assistance and Severity of Impairment



Again, the pattern within the two samples was similar with regard to the race of the respondents: in both RDD and list samples, slightly more PAS users were nonwhite than white.

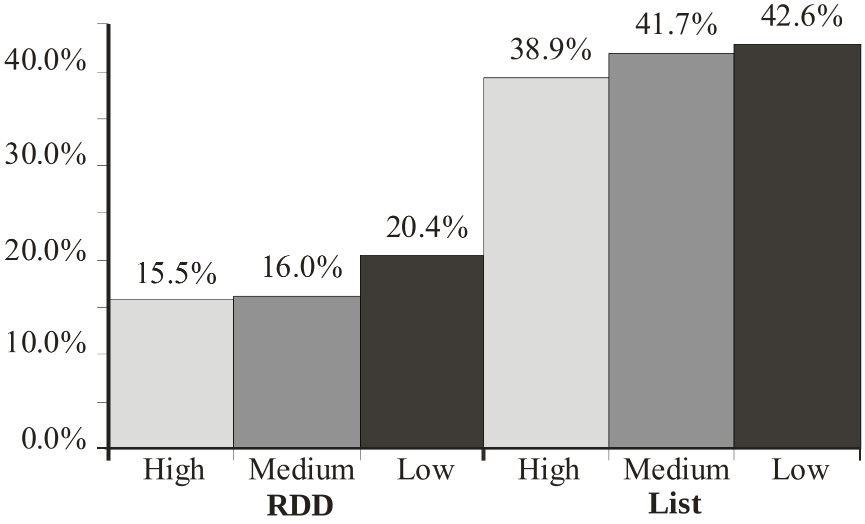
Figure 7.3 Use of Personal Assistance and Race



The nonwhite to white ratio for the RDD sample was 1.16:1, versus 1.20:1 for the list sample. The difference between whites and nonwhites was not significant in both samples.

The level of education showed only a very slight relationship to the use of PAS among the respondents. The direction of the effect was that the higher the level of education, the lower the incidence of PAS use.

Figure 7.4 Use of Personal Assistance and Education

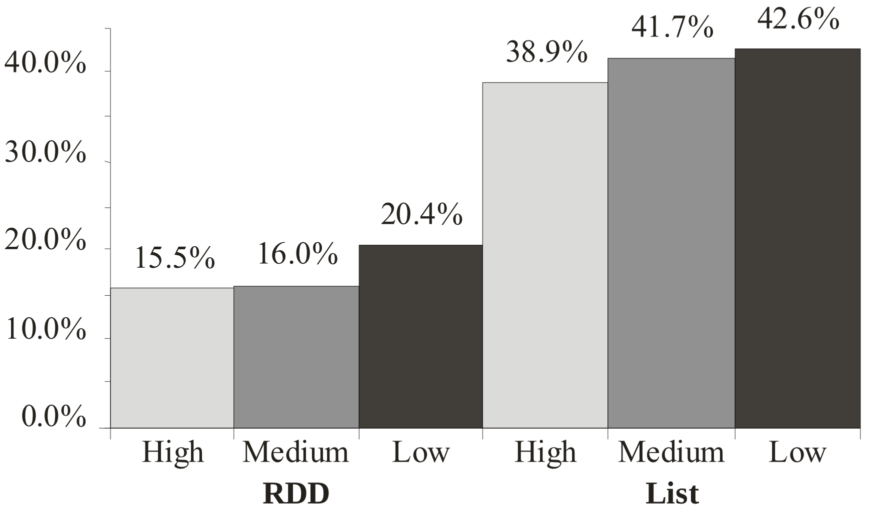


Taken together with the strong relationship between level of education and AT use, a relationship that occurred in the opposite direction, we can say that the use of a personal assistant was indicative of a particular combination of impairments different from those associated with respondents who used AT.

An exhaustive compilation of respondent conditions revealed that there were some significant differences in the impairments of those who did and did not use the help of another person. PAS users listed four conditions—stroke, nervous system disorders, soft-tissue disorders and rheumatoid arthritis—among the 10 most frequent conditions that did not appear in the top 10 for nonusers. Nonusers reported hearing loss, back disorders, orthopedic impairments of the lower extremities and unspecified mobility problems that did not appear in the users' top 10 conditions. Six conditions—osteoarthritis, multiple sclerosis, chronic injuries, heart disease and diabetes, and unknown, unspecified conditions—were among the most frequent impairments for both users and nonusers of PAS.

Further, PAS users were more than twice as likely to have had multiple sclerosis or stroke as nonusers; all but one of the 16 quadriplegics in the sample required a personal assistant; at the other end of the spectrum, only about 10 percent of persons with some hearing loss less than deafness used a personal assistant.

Figure 7.5 Use of Personal Assistance and Family Income



With regard to income, there was a slight tendency for more use of a PAS with lower family income, but a very pronounced tendency, in the same direction, for personal income—most likely an indication that respondents who needed PAS were generally too disabled to work.

The data support this hypothesis (see figure 7.6). Respondents who did not need a personal assistant were more than twice as likely to be employed as those who did (26.2 percent versus 10.3 percent), and were more likely to count themselves able to work but unemployed (7.6 percent versus 4.3 percent). But the most dramatic statistic was that almost two-thirds of persons who needed to have the assistance of another person (64.4 percent) said they were so disabled that they were unable to work, versus 38.3 percent of the respondents who did not need the assistance of another person.

Figure 7.6 Use of Personal Assistance and Personal Income Level

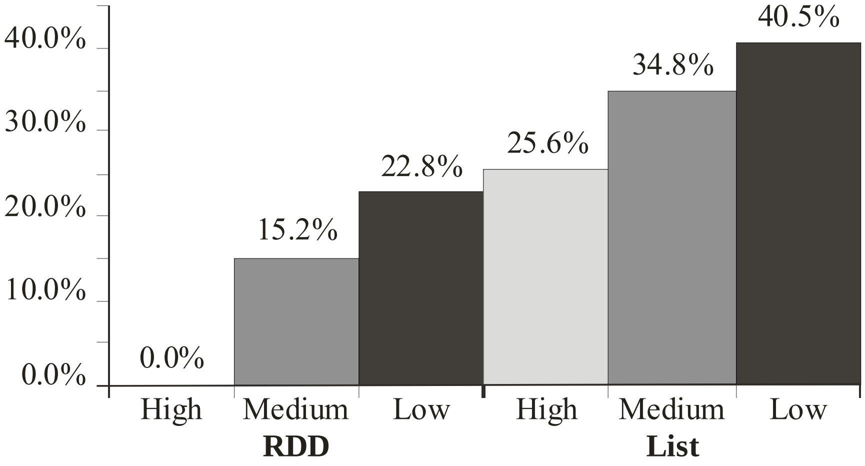
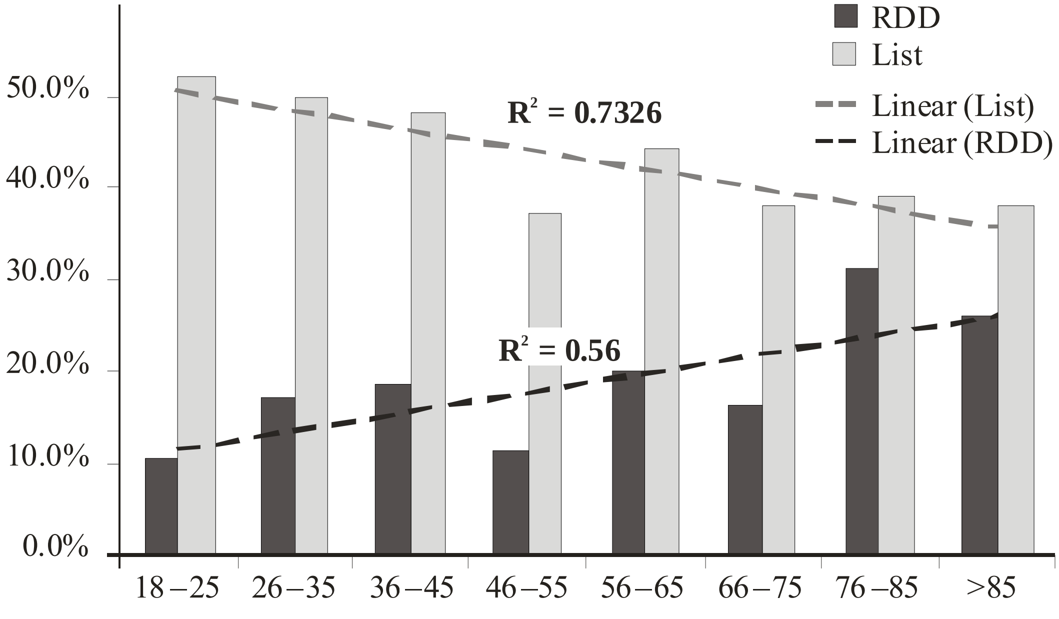


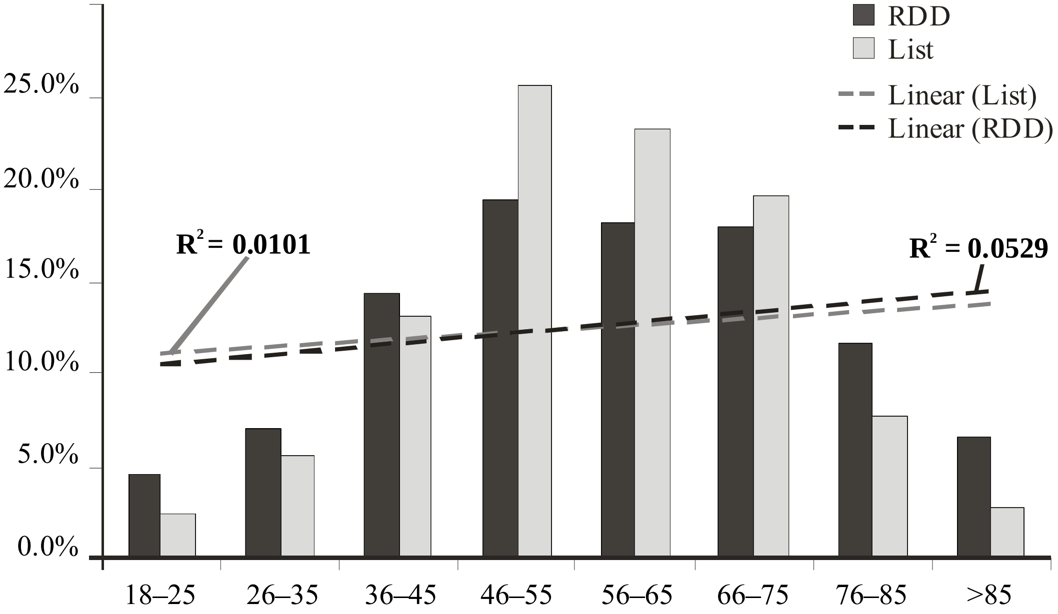
Figure 7.7 illustrates the distribution of persons who used the assistance of another person within age categories.

Figure 7.7 Percent Within Age Groups Using Personal Assistance RDD vs. List Sample Respondents



The linear trend lines show that, in the list sample, use of PAS decreased with increasing age, while the trend was in the opposite direction for the RDD sample. Among the youngest RDD respondents, only about one in 10 used PAS, compared to more than half of the youngest list respondents. As stated earlier, personal assistance was the one variable in which there was a systematic difference between the two samples.

Figure 7.8 Percent Within Age Groups, All Respondents RDD vs. List Sample Respondents



It is instructive to note the distribution of all respondents plotted as an identical chart in figure 7.8. Note that the R^2 figures for the overall distribution are close to zero, indicating no linearity to speak of, and are virtually identical.

Summary

For purposes of this study, persons who used the assistance of another person to conduct daily activities were considered a subset of the population of persons with a disability. They differed from other persons with a disability in the following ways:

- They were more likely to use some form of assistive technology;
- They were more severely impaired;
- Their level of personal income was much lower; and
- They were much less likely to be employed.

There were no significant differences in race, level of education or age, with the exception that the RDD sample respondents were slightly more likely to use PAS with increasing age. The type of impairment (e.g., paralysis resulting from stroke, central nervous system disorders and rheumatoid arthritis) was associated with a higher likelihood of using PAS. With reference to our discussion of the substitutability of assistive technology for personal assistance services, we were not able to provide conclusive evidence that AT can substantially reduce the need for PAS; persons with severe disabilities need both.

8. Assistive Technology Use and Community Integration

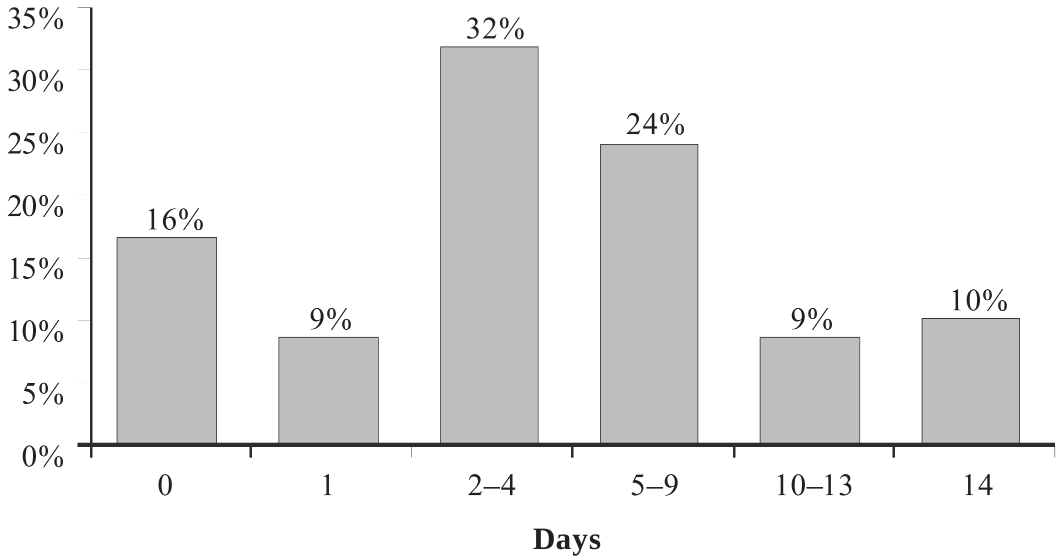
In the context of this study, community integration refers to a person's active involvement in all aspects of daily living. This includes social contacts with family, friends or strangers; the ability to move around (e.g., to go shopping, to go to school, work or the doctor's office; and in other ways independently, spontaneously and with the least constraints participate in activities and events). Community integration means that the person does not live in an institution, that the freedom to choose is not unnecessarily restricted, and that with technological or personal assistance the person would be able to live as independently as circumstances permit.

Over the past decades, a significant number of community-based organizations and independent living centers (ILCs) emerged that, with funds authorized in the *Rehabilitation Act*, help persons with disabilities with housing, schooling, work, technology and legal questions (National Council on Independent Living, 2003). However, large parts of the country remain underserved, and persons with disabilities continue to face problems with unemployment, lack of adequate education and training opportunities, lack of access to technology, and inadequate housing and transportation. As a result, persons with disabilities participate less in social events and feel less integrated into the community than persons without disabilities.

Participation in Social Activities Outside the Home

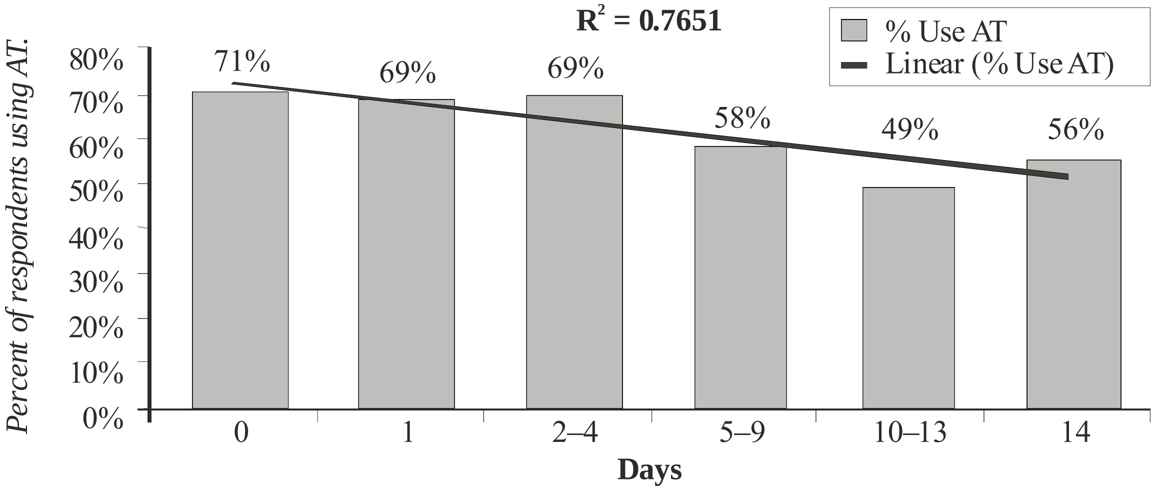
The survey contained one diagnostic item to characterize the degree to which the respondent was likely to be involved in community activities. We asked each respondent, "How many days in the last two weeks did you participate in social activities outside your home such as visiting friends and family, going to a restaurant or movie, or going to church?" The respondent's answers were coded from 1 to 6, with one being zero days out of the house, and 6 being out every day in the past two weeks. Figure 8.1 shows how respondents answered.

Figure 8.1 Days Out of the Home 14 Days Prior to Interview



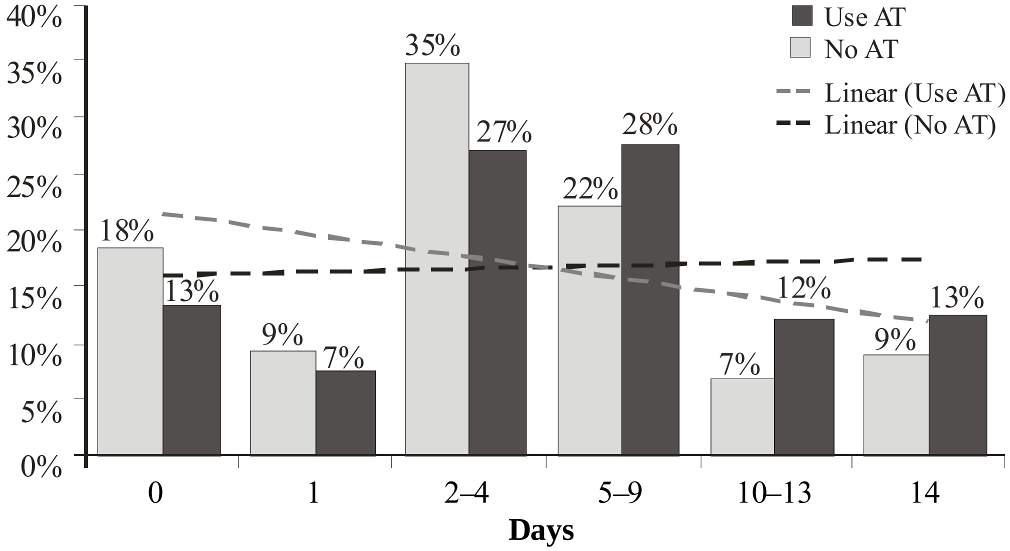
Overall, 86 percent of respondents spent every other day at home. Fifty-seven percent of the respondents spent at least 10 days out of the 14 without leaving their homes, 16.5 percent were completely homebound, and 10 percent were out every day. While comparable figures for the nondisabled population are not available, we can assume that what we found was a barrier to community integration among persons with disabilities. The relationship between AT use and being homebound is shown in figure 8.2.

Figure 8.2 AT Use and Number of Days Spent Out of the Home



The linear regression between AT use and days out of the home is -.87; that is, the more days that the respondent ventured out of the home, the less likely she used AT. Figure 8.3 illustrates how the AT users differ from nonusers with respect to venturing outside the home.

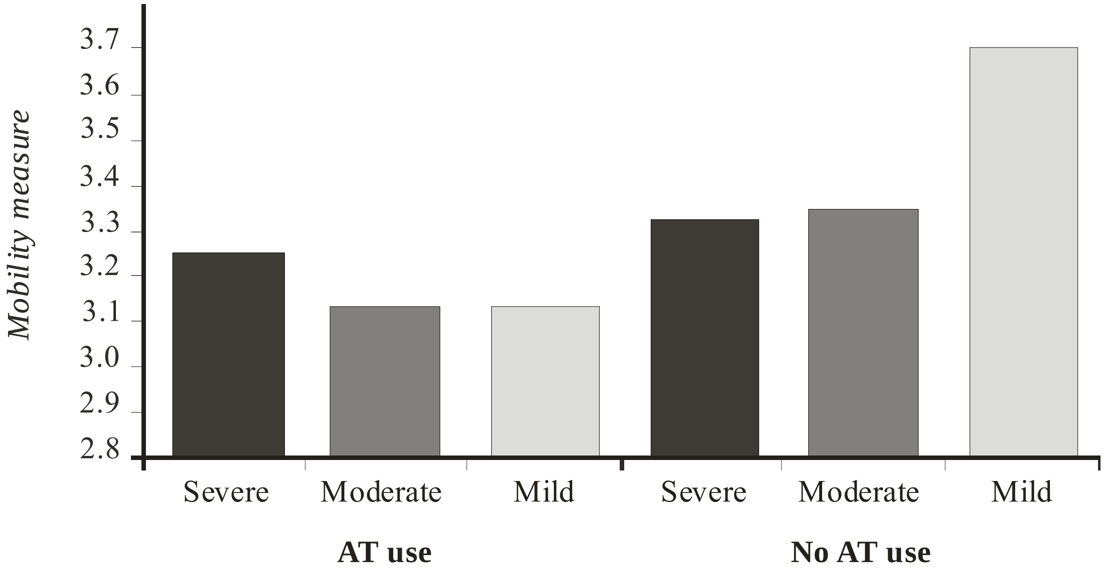
Figure 8.3 Days Out of the Home and AT Use



The trend lines illustrate that AT users were less integrated into the community than those who did not use AT. For the three lowest categories that relate to going out of the home, there was a greater likelihood that the respondent would be an AT user than not; the reverse was true for those who got out of the home more than four days out of 14.

Figure 8.4 illustrates the relationship between the severity of the condition, the use of AT, and the propensity of persons with disabilities to leave the home.

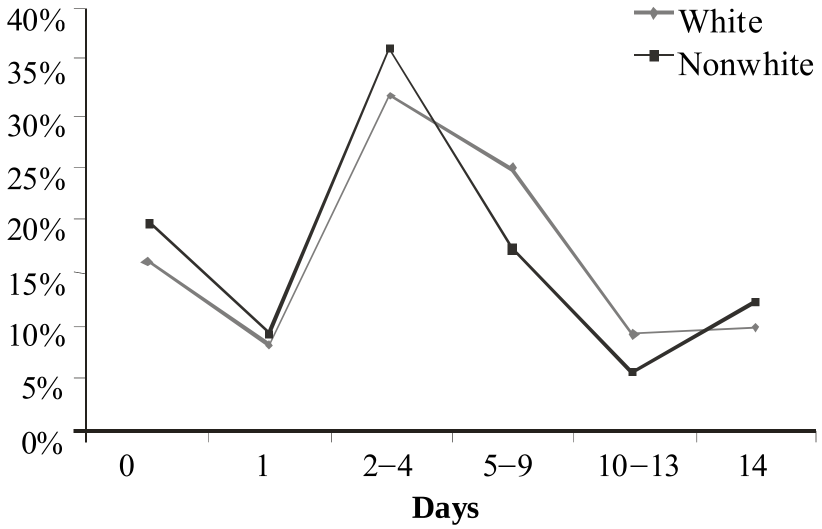
Figure 8.4 Leaving Home, Level of Impairment and AT Use



The respondents who did not use AT were, across the board, more mobile. If we compare the levels of extra-home mobility (i.e., the average number of days a person spent out of the home) within severity levels for those using AT with those who did not use AT at all, we see that severely impaired AT users were highly mobile, but nonusers were among the least severely impaired. It seems counterintuitive—we expect that AT will be most helpful to those with the most severe conditions. This could be an artifact of the way the respondent conditions were assigned levels of severity. But perhaps it is more heuristically valuable to consider that persons with mild impairments that do not hinder mobility are far less likely to use AT.

An examination of the issue of race and being homebound, by dividing the sample into whites versus nonwhites, showed that race in and of itself is not a meaningful factor in community integration. Figure 8.5 shows considerable overlap between the races and the pattern is essentially the same.

Figure 8.5 Race and Days Out of the Home



However, the data supported an interaction effect among age, race and disability in the respondent population. As shown in table 8.1*, the likelihood of finding a nonwhite person with a disability decreased with each increasing age category. The Pearson Correlation Coefficient of White Percentage and Age is +.92, $R^2 = .85$, which was a statistically significant result [$t= 5.9$, $p<.01$].

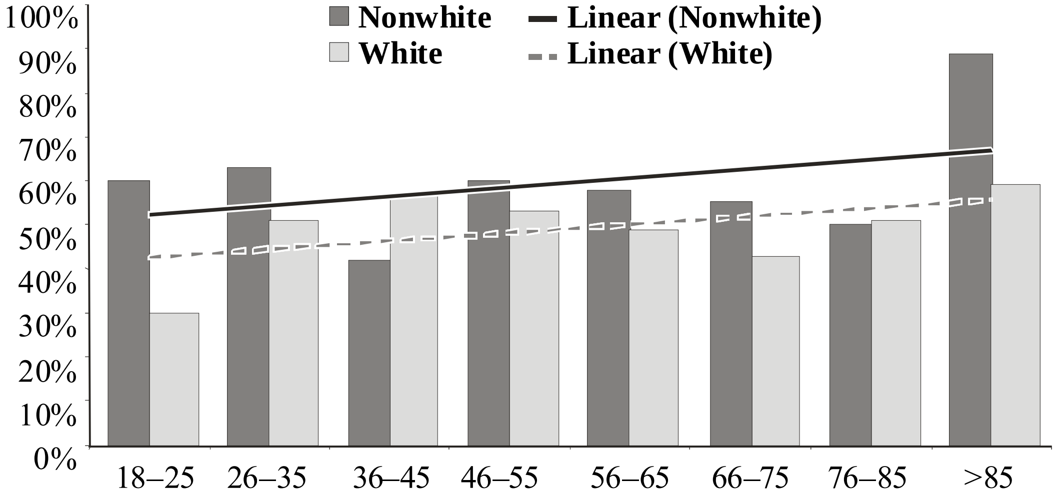
Table 8.1 Race, Age and Disability

Age Range	Total	White	Nonwhite	White %
18-25	42	30	12	71
26-35	85	68	17	80
36-45	189	160	29	85
46-55	334	283	51	85
56-65	308	263	45	85
66-75	269	240	29	89
76-85	124	107	17	86
>85	55	53	2	96
Total	1,406	1,204	202	

**Eight respondents did not identify themselves by race.*

Application of the age and race breakdown to the number of days out of the home showed an interesting pattern. Figure 8.6 illustrates the three-way interaction by computing the percentage of whites and nonwhites in each age category who were below the median in number of days that they left the home.

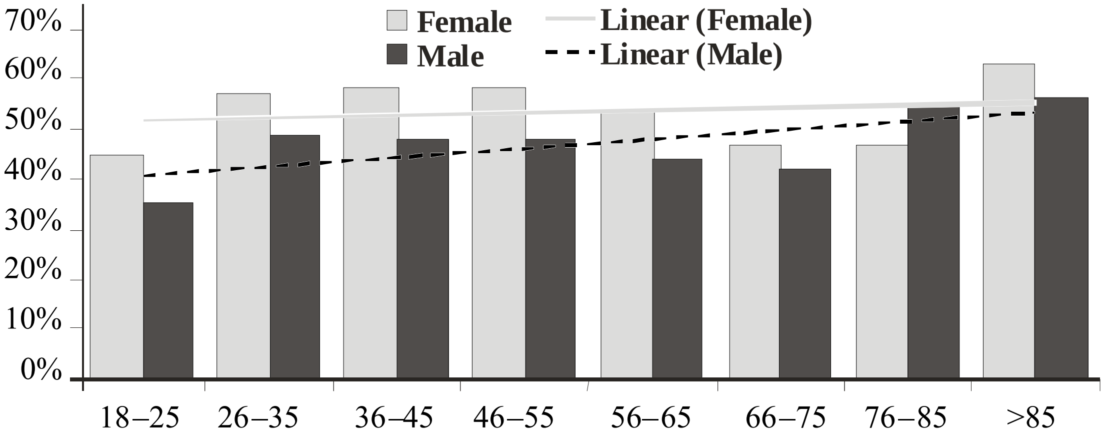
Figure 8.6 Proportion of Respondents Below Median in Number of Days Out of the Home, by Race and Age



Note that for all but the 36–45 year-old age range, nonwhites were more likely to be below the median for extra-home mobility than whites. However, the overall average number of days out of the home was not significantly different for nonwhites (scale value of 3.2) as compared to whites (scale value of 3.3).

Men were slightly, but significantly, more mobile than women, and as figure 8.7 shows, the difference was consistent over age groups.

Figure 8.7 Proportion of Respondents Below Median in Number of Days Out of the Home, by Gender and Age



Only in the 76–85 year-old group were women who were more able to get out of the house than were men. Personal income was also a significant factor.

Figure 8.8 Respondent Level of Personal Income and Days Out of the Home

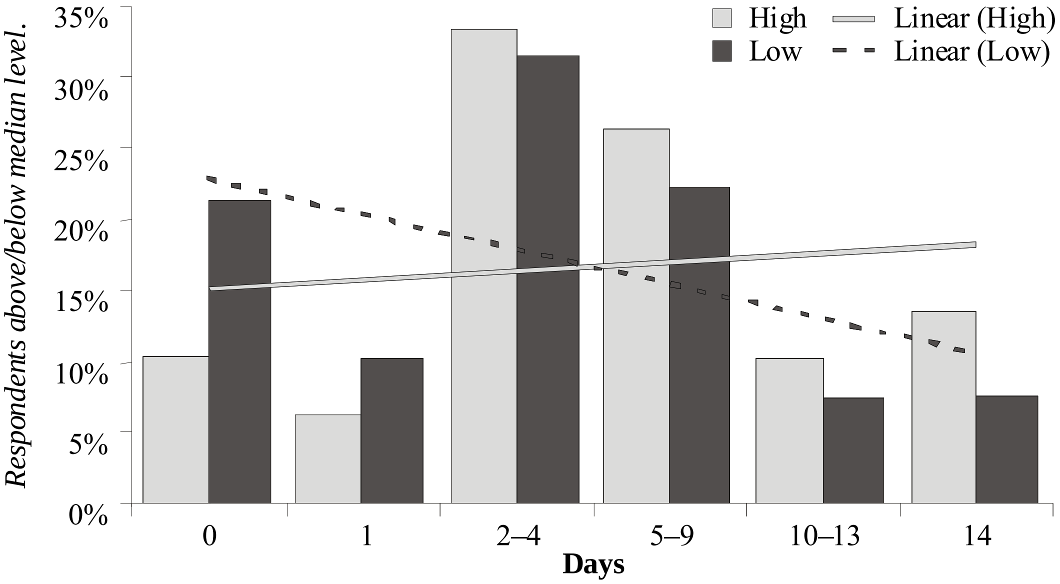


Figure 8.8 shows the divergent pattern for high- and low-income respondents (high- and low-income being relative terms, defined as above and below the median personal incomes for the sample). For those below the median in personal income, there was a clear tendency toward decreased frequency of leaving the home, versus a slightly reversed trend for those above the median in personal income. Note that the linear trendline for the low-income group is steeper than the line for the high income group (as well as pointing in the opposite direction). Simply stated, under-average earners were more than twice as likely to be homebound than those whose income was above average.

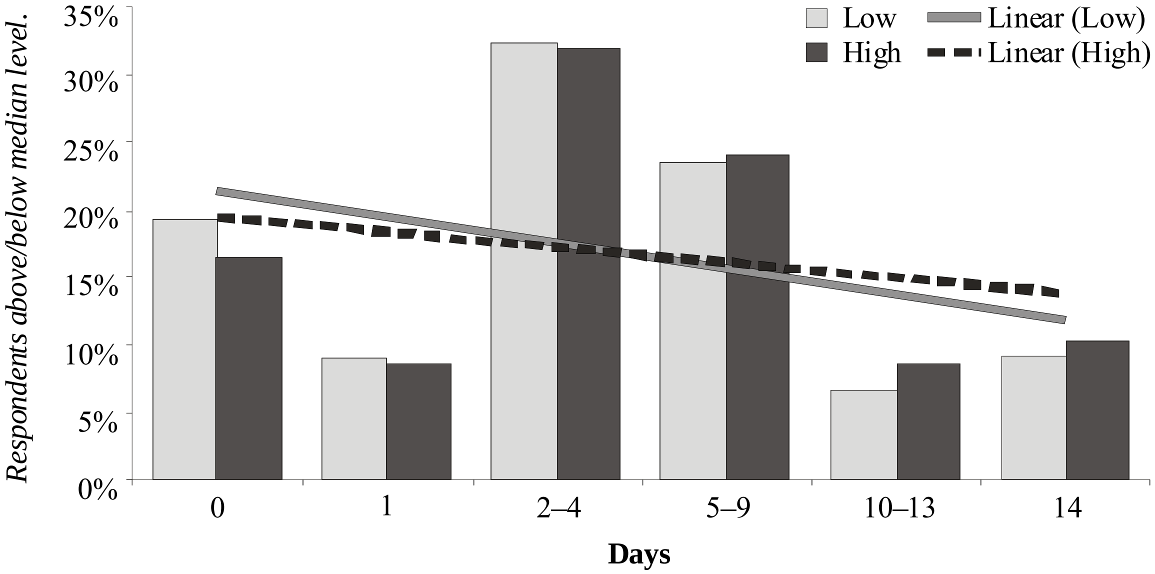
Mobility and Opinions About Assistive Technology

There was no relationship between an individual's history of leaving the home and any of the 10 opinion questions posed in the survey. This was almost certainly a direct function of the extremely high response concordance to the opinion questions.

Education

As shown in figure 8.9, the level of education, again split on the median, had virtually no effect on community integration. That is, there was virtually no difference between the two plotted trend lines. Education was evidently not a factor in leaving the home.

Figure 8.9 Respondent Level of Education and Days Out of the Home



Barriers to Access

While the frequency of leaving one's home provided a partial insight into a person's level of community integration, for persons with disabilities, one must assess the impact of the barriers to use and access once the person has ventured out. To address this issue, we asked a series of questions about access and modifications to the environments of all respondents.

- To the question—"People who have physical impairments or health problems sometimes need assistance in obtaining access to all the places they need to go and to facilities and equipment they need to use. Do you need the help of another person to access or use public buildings and facilities such as libraries, government buildings, public transportation, restaurants, theaters, stores and shopping malls?"—444 respondents (31.5 percent) answered "Yes," and 964 respondents (68.5 percent) answered "No."
- 435 respondents (30.9 percent) needed special modifications, adaptations or accommodations to enter or use public buildings and facilities, while 975 respondents (69.1 percent) did not.
- When asked if there are special modifications, adaptations or accommodations to enable persons with disabilities to enter and use public buildings and facilities, 870 respondents (62.9 percent) answered "Yes," and 513 persons (37.1 percent) answered "No."
- To the question—"Do you have access to public buildings and facilities?"—1,358 respondents (96.3 percent) answered "Yes," and 52 respondents (3.7 percent) answered "No."

The overall picture indicated that persons with disabilities generally did have access to public buildings and facilities, albeit with the assistance of others or with special modifications in many cases. The stated need for assistance or modifications had only a minor effect on accessibility.

The findings presented on page 113 applied only to those individuals who were not homebound and applied only to access to public buildings and facilities. Similar questions were posed to all respondents regarding school, work and home environments.

Table 8.2 Need for Personal Assistance and Environment Modifications

	Assistance	Modifications	Mods Available	Have Access
School	22.6%	17.0%	66.7%	95.7%
Work	12.2%	11.3%	69.1%	96.2%
Home	23.6%	20.6%	23.6%	95.4%
Public	31.5%	30.9%	62.9%	96.3%

As might be expected, respondents who were gainfully employed or running a business were significantly lower in their need for assistance and modifications. Also note that in answer to the question, "Are there special modifications … available at home?" 23.6 percent answered "Yes," the lowest percentage by far of any of the four domains, as shown in table 8.2. It should be noted that of the respondents who needed modifications in the home, 66 percent say they were available; in other words, of the 23.6 percent of respondents who said their homes had special modifications, 58 percent were respondents who said they needed such modifications.

Table 8.3 shows the need for modifications and the availability of those modifications for those who stated a need, broken down by occupational status.

Table 8.3 Need for Environmental Modifications and Major Activity

	Need Modifications	Modifications Available If Needed	Total	Percent of Total
Overall	**40%**	**85%**	**1,415**	**100**
In School	38%	84%	50	4
Working	24%	83%	292	21
Able to work, unemployed	23%	90%	91	6
Unable to work	53%	85%	671	47
Homemaker	23%	81%	69	5
Retired	32%	88%	229	16
Other	38%	80%	13	1

An individual who expressed a need for modifications in any of the four domains was counted as a positive instance. For example, 24 percent of working respondents expressed a need for modifications in general, while the previous table showed 12 percent of respondents expressing a need for modifications in the workplace.

By far, the highest need for modifications to improve accessibility is in the group who were unable to work because of their disability, while the lowest percentage occurred in the working and homemaker groups. Overall, 85 percent of persons needing modifications had them available, while 15 percent did not have them.

Summary

Analyses showed that persons with disabilities experienced varying levels of community integration and access to places in the community. The type of health condition, level of impairment and disability, as well as factors such as age, use of technology and personal assistance, can determine a person's likelihood to leave the home and participate in social and community events. For instance, while we observed a general tendency among AT users to go out less often, those with severe mobility impairments using mobility technology were able to leave the house at frequent intervals.

We also found that persons with lower incomes and women were less likely to leave the home. However, levels of education had no effect on one's propensity to participate in activities outside the home.

We explored the extent to which a lack of environmental access features and environmental accommodations prevent persons with disabilities to go out into the community. We found that substantially more access features and environmental accommodations were available in the community than in the home. This confirms earlier observations that the need for AT in the home was greatest among the severely disabled and the unemployed.

Part III: In-Depth Analyses

9. Severity of Impairment and Assistive Technology Use and Need

The research presented in this draws some tentative conclusions about the relation between the severity of the impairment and AT use and need, based on a person's self-reported health conditions. The proposed rating method can be employed to show why and where AT is likely to be used or needed, and how AT can improve a person's ability to perform daily tasks and activities.

The level of impairment is an important correlate and predictor of disability and is significantly related to levels of education, income, independence and quality of life (Barbotte, Guillemin, & Chau, 2001). High levels of impairment are frequently associated with lower levels of education and income (Russell et al., 1997; Kaye, Kang, & LaPlante, 2000), and increased dependence on the help of others (Carlson, Ehrlich, Berland, & Bailey, 2002a, 2002b, 2002c). While there are numerous examples of severely impaired persons who pursued successful careers or reported relatively high levels of quality of life (Albrecht & Devlieger, 1999), in a large number of cases, basic functioning is maintained only with mechanical or personal assistance (LaPlante, Hendershot, & Moss, 1992).

Most of our current disability assessment, disability measurement and disability survey research is based on models that associate physical and emotional illnesses, injuries or disorders with a person's reduced ability to perform a range of daily tasks and activities that are frequently grouped under activities of daily living (ADLs) such as dressing, walking or self-care, and instrumental activities of daily living (IADLs) that include shopping or money management (LaPlante & Carlson, 1996; Pope & Tarlov, 1991; Brandt & Pope, 1997).

The severity of the disease or disorder is related to the level of impairment primarily by the presence of disease-specific symptoms or characteristics. Co-morbidities, or secondary conditions, often add to levels of impairment. Furthermore, certain types of injuries, illnesses and disorders are frequently associated with higher levels of impairment than others (Social Security Administration, 2002). For example, the loss of a leg may be associated with higher levels of impairment than the loss of a finger or a toe; multiple sclerosis may be considered more severely impairing than chronic back pain; or schizophrenia may be viewed to be more disabling than mild anxiety. While these ranking methods may not be as specific as clinical diagnoses and assessments—and while there may be differences in judgment and opinion between clinicians and non-clinicians—these ordering preferences indicate probabilities that can be used for descriptive purposes, formulation of hypotheses and statistical analyses.

Depending on the purpose of a study, disability and rehabilitation researchers can draw from a variety of models and definitions for the measurement of severity of impairment and disability (Murray, 1994; Albrecht, Seelman, & Bury, 2001; World Health Organization; 2001).

While this is not an exhaustive list, the most common approaches for determining levels of impairment and disability are based on:

1. The clinical model;
2. The bio-psycho-social and ecological model;
3. The public health or epidemiological model;
4. The disability services and benefits entitlement model; and
5. The statistical or probabilistic model.

The clinical or medical model rests on the premise that the evaluation of impairments requires a complete medical examination that includes an accurate and objective measure of function. Such evaluations play a key role in the treatment and rehabilitation process, but they frequently are narrow in scope. Medical diagnoses and assessments provide important information to persons with disabilities, their families and caregivers as well as researchers and practitioners, and have led to such impairment measures as the Functional Independence Measure or FIM (Deutsch, Braun, & Granger, 1997).

The bio-psycho-social and ecological model, sometimes referred to as the new model for the enabling process or the new paradigm of disability, takes into account the complete person and his or her environment (Brandt & Pope, 1997). According to this model, adverse manifestations of injury, illness or impairment can be mitigated by psychosocial, environmental or technological interventions. As a result of such interventions, levels of impairment can be reduced or accommodated in ways that are perceived as less restricting. Because of the complexity of this model, it is difficult to determine what interventions are most appropriate, given limited financial resources. It is also difficult to assess the multiplicity of factors associated with impairment and disability and their interaction in research.

The public health or epidemiological model is used for surveillance purposes and to study the impact of disability incidence and prevalence on broad societal indices such as health care costs, lost productivity, or burden of disease measures (Murray & Lopez, 1996; Nord, 1992). Severity of illness and impairment are major indicators for estimating unemployment, health service use, or other adverse effects of reduced participation due to disability on economy and society.

The disability services and benefits entitlement model defines levels of impairment in a context of benefits providers and payers of services determining eligibility and the disbursement of benefits based on stringent medical and administrative criteria of severity (Wunderlich, Rice, & Amado, 2002). For instance, in case of the Social Security Administration, a listing of impairments, also known as “the Blue Book” contains a description of severe health conditions and guidelines for clinicians to diagnose and evaluate them (Social Security Administration, 2002). In essence, this model is the strict application of medical principles and practices followed by an administrative review.

The statistical or probabilistic model is analogous to the public health model in that it is concerned with measuring levels of impairment in population samples, but it expands the public health model by using more advanced statistical concepts[10]. Typically, one begins with an ordinal scale of severity of impairment, then imputes rank-order relationships, and finally uses statistical models to validate them. The statistical model is most useful when there is limited information about the level of impairment among self-reported health conditions, and other indicators of impairment, such as the reported inability to walk or work, have to be considered in the rating process.

As this brief discussion has shown, all of the models have limitations. Since our study did not include independent clinical diagnoses and evaluations, and only a few systematic questions about levels of functioning and impairment had been asked primarily for screening purposes, we employed the statistical model to evaluate the level of impairment of each respondent, thereby allowing us to quantify severity of impairment at the ordinal level of scaling, taking into account both the nature of specific conditions and co-morbidities. The construction of even a simple scale of severity of impairment permitted us to identify factors that are significantly related, but the extent to which each relationship can be quantified is limited.

Findings

Level of impairment was coded on a three-point scale of severity of disability. The three levels were labeled mild, moderate and severe disability. The coding was accomplished in the following manner: each respondent was asked this open-ended question early on: “What condition or limitation do you have that impairs your functioning?” We recorded up to three conditions for each respondent. The final classification was a simple addition of all respondent conditions, yielding a distribution of 862 respondents classified as mildly disabled (total disability score <3), 227 moderate (total disability score = 3) and 327 classified as severe (total disability score >3). The use of an arithmetic ranking system, rather than an intuitive case-by-case analysis, is in line with the research of Dawes (1988) and Meehl (1954), who have established that, over a period of almost 50 years, there has yet to be a study which has shown a superiority of clinical over statistical validity in classification or predictive schemes.

Our first calculations showed that the more severely impaired respondents used more AT (figure 9.1).

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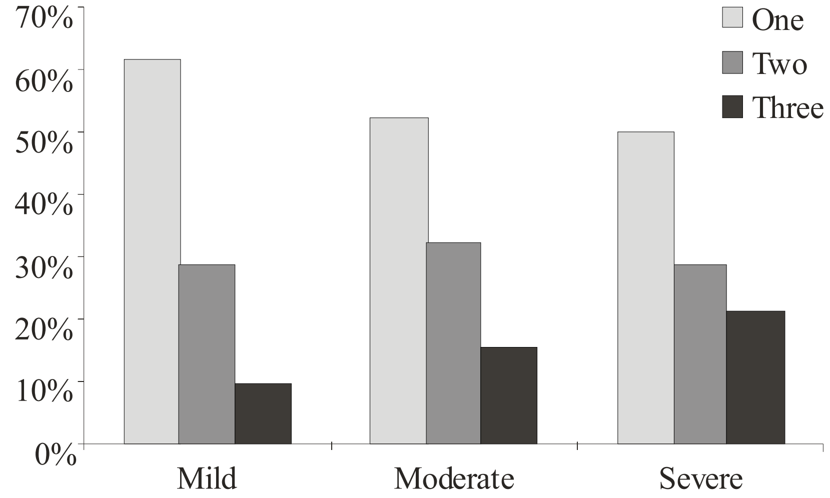
[10] Concepts such as Bayes’ theorem, Boolean expressions or genetic algorithms.

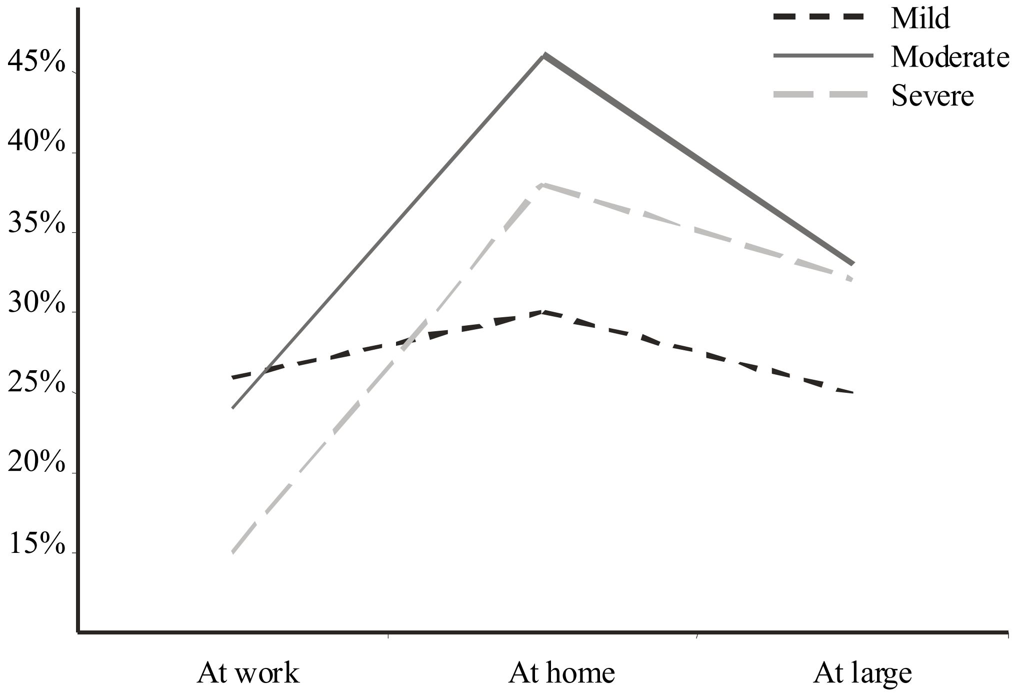
Figure 9.1 AT Used by Respondents, by Severity of Impairment



We asked respondents about their use of AT in four domains: at school and at work—getting to and at both locations—at home and in the community. The only domain which all respondents identified was the home. There, 49 percent of all respondents used assistive technology. Within the group of mildly impaired respondents, 44 percent were likely to use AT, followed by moderately impaired respondents who used AT in 54 percent of the cases. Within the group of severely impaired persons, AT was used in 59 percent of the cases.

The influence of severity on the perceived need for additional AT was more complicated. The greatest unmet needs occurred among the moderately impaired in the home, while the smallest unmet need for AT occurred among the severely impaired expressed in the workplace (see figure 9.2).

Figure 9.2 Unmet Need for AT, by Severity of Impairment and Domain of Living



A likely explanation is that respondents who were severely impaired were not only less likely to be gainfully employed, but also, when they were working, were more likely to already employ AT than the other, less severely impaired respondents. However, when we multiplied the percentage of respondents having each level of severity in the workplace by the percent of each using AT in the workplace, we found that the joint probability of AT use and workplace participation was lowest for the severely impaired, and highest for those with mild levels of impairment. This suggests that the bulk of AT use in the workplace occurred among the less severely impaired. The severely disabled who would benefit most from AT at work were least likely to be employed, or if employed, least likely to obtain needed AT. This can also be confirmed by our general observation that the more severely impaired respondents were more likely to express a need for more AT (see figure 9.3).

Figure 9.3 Expressed Need for More AT

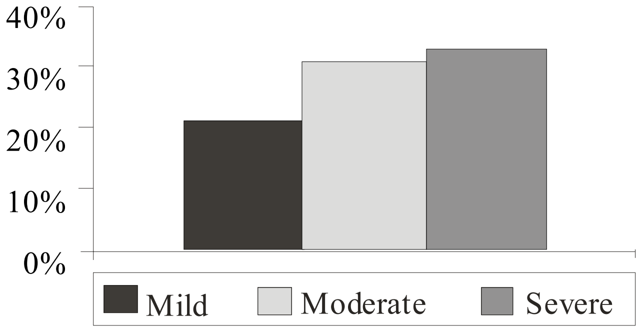


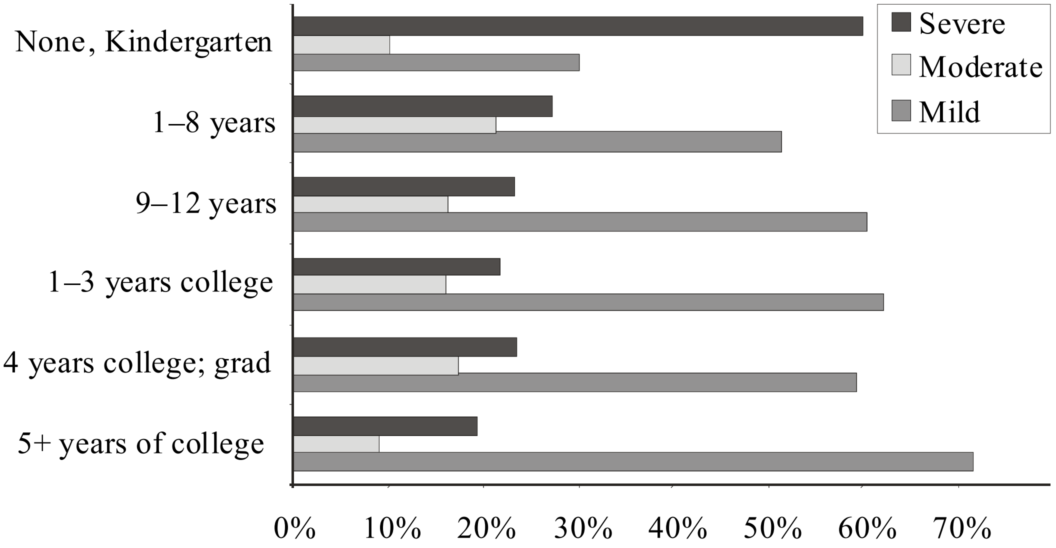
Table 9.1 illustrates the use of AT in the home by level of severity. Persons with the highest levels of mobility impairment, for instance, were most likely to use a wheelchair, whereas persons with moderate mobility impairments were most likely to use canes, walking sticks or walkers. Persons using hearing aids were likely to be rated mildly impaired.

Table 9.1 Type of Devices Used, by Level of Impairment

Device	Severe	Moderate	Mild	Overall
Cane or walking stick	19%	29%	13%	17%
Manual Wheelchair	23%	15%	10%	13%
Walker	10%	11%	8%	9%
Hearing aid	4%	2%	6%	5%
Bathroom modifications	4%	4%	1%	2%
Other in-home devices	5%	3%	2%	2%
Stool, seat or chair for bathing or showering	5%	3%	1%	2%
Other personal use	1%	3%	2%	2%
Crutch	1%	2%	2%	1%
Oxygen tank	2%	0%	2%	1%

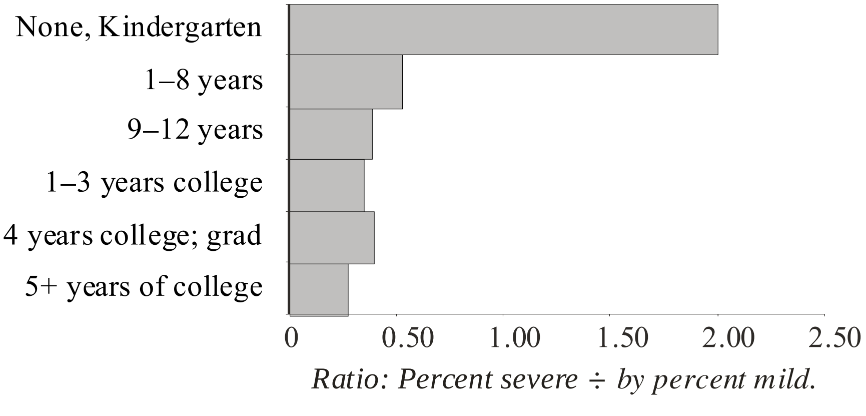
Severity ratios were an alternative method of conceptualizing the relationship between the level of disability and various other factors, because in cases where there were many levels of the independent variable, the use of the severity ratio was graphically more compelling than would be similar data presented in traditional form.

Figure 9.4 Level of Educational Attainment and Severity of Impairment



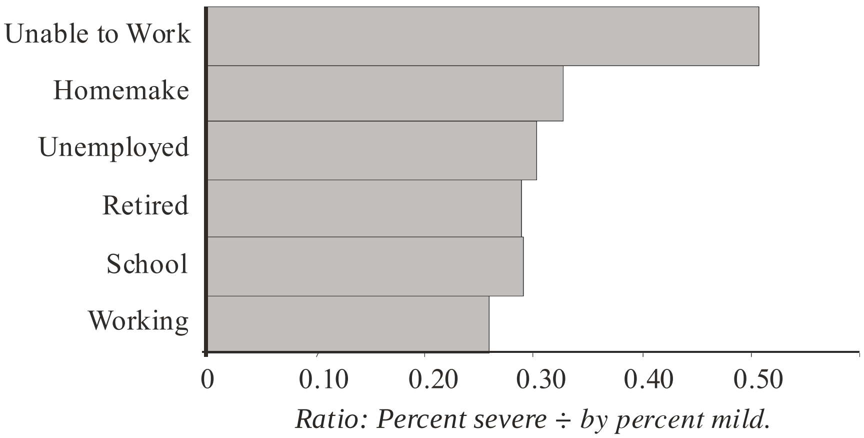
As an example, consider the question of level of disability and highest level of education attained by the respondent. Figure 9.4 is a traditional bar chart showing the education level as a function of the level of disability. Figure 9.5 shows the same data displayed as a severity ratio.

Figure 9.5 Severity of Impairment and Level of Educational Attainment



Using the simpler chart (figure 9.5), we can see that while the effect is roughly monotonic, only the least educated had a severity ratio of greater than one, which accounted for most of the covariance between the two independent variables.

Figure 9.6 Severity of Impairment and Major Activity Status



Similarly, the severity ratio for occupational status revealed some subtleties that would have been difficult to discern from a more complex chart. For example, in figure 9.6, we see that the persons who classified themselves as able to work but were currently unemployed were, in fact, more severely disabled than the working population. Even considering the sexes of the respondents, differences which might otherwise have been overlooked were clarified by the technique of computing the severity ratio, as shown in table 9.2. A three-percentage point difference in mild and moderate scores is seen as a more compelling seven-point difference, amounting to a ratio of 5:6, demonstrating that in this population, men were more severely impaired than women.

Table 9.2 Severity of Impairment, by Gender

	Mild	Moderate	Severe	Severity Ratio
Male	59%	16%	25%	0.42
Female	62%	16%	22%	0.35

The overall severity index for the entire survey population was 327 divided by 862, or 0.38. The severity ratio for respondents using AT was 1.36. Thus, the respondents who used AT were more than 3.5 times more disabled than the total survey population. Finally, the respondent who did not use AT had a severity ratio of 0.27, one-fifth of the 1.36 ratio for those respondents who used AT. Thus, we can say AT was used in direct relation to the severity of the impairment.

In the course of our analyses, we noted that the SR (Severity Ratio) was higher for blacks than for whites (.45 versus .38), and lower family incomes were associated with higher levels of severity of impairment, with an R^2 (Coefficient of Determination) that indicates that 31 percent of the covariance was explained. The results of the self-income were much weaker than the family income trend. The R^2 value of 0.01 indicates that the amount of covariance predicted by the linear regression was about 1 percent, meaning that individual income and severity were unrelated.

Next, we looked at the ages of the respondents. While we might have expected the severity of their impairments to be a factor that increases with increasing age, the results, while weak, show exactly the opposite. The R^2 indicated that about 15 percent of the covariance is accounted for, meaning that the oldest respondents are less impaired.

Last, we found the SR for the lower echelon of family income respondents was .38, and for the younger group, the SR was .42; however, for the younger and poorer taken together, the SR rose to .48. And, if we add in sex, and look only at the younger, poorer men, the SR reaches .86. We could add additional respondent characteristics and obtain even higher values, but the point is that for our purposes the scaling of severity has both predictive validity and heuristic utility. By using this method, we were able to show that respondents whose conditions were more severe had the following characteristics, compared to less impaired respondents:

- Greater use of AT, both in the likelihood of use and in the number of devices used;
- More likely to have had their AT paid for by Medicare or the Veterans Administration, and less likely to have had it paid by self or private medical insurance;
- Lower education levels;
- Greater likelihood of being unable to work because of their conditions;
- Lower family incomes;
- More likely to be males than females;
- More likely to be black than white; and
- More likely to have a broader base of information about AT.

We also found that persons who were more severely impaired were more positive in their responses about the information they had received, the use of that information, and the help they received from improved products and AT in general, but more negative in judging improvements over the past decade.

Looking at severity ratios among AT users (the proportion of severely impaired respondents using AT divided by the proportion of mildly impaired respondents using AT), we found a clear monotonic relationship between the severity of their impairments and AT-related knowledge, attitudes and opinions. We asked the following 10 questions:

1. Overall, how much information and advice have you received about assistive technology? Would you say a lot, some, a little, or none?
2. Overall, how much information and advice have you received about how to obtain it? Would you say a lot, some, a little, or none?
3. Overall, how much difference would you say that the information and advice about assistive technology and how to obtain it has made in increasing your level of learning, independence, productivity and community integration? Would you say a lot, some, a little, or none?
4. Overall, how much has information and advice about assistive technology and how to obtain it helped you to become more aware of your rights? Would you say a lot, some, a little, or none?
5. How much has your use of assistive technology devices and services decreased your need for help from another person? Would you say a lot, some, a little, or none?

6. To what extent have better designed products and environmental access features or universal design products reduced your need for assistive technology devices and services? Would you say a lot, some, a little, or none?
7. Compared to 10 years ago, people are more aware of the need for assistive technology devices and services for persons with disabilities. Would you say you strongly disagree, disagree, agree, or strongly agree?
8. Compared to 10 years ago, laws or program policies have been changed to help persons with disabilities to get assistive technology. Would you say you strongly disagree, disagree, agree, or strongly agree?
9. Compared to 10 years ago, more people are aware of assistive technology and understand how it can benefit persons with disabilities. Would you say you strongly disagree, disagree, agree, or strongly agree?
10. Compared to 10 years ago, it is easier to find assistance for purchasing assistive technology devices and services. Would you say you strongly disagree, disagree, agree, or strongly agree?

The most extreme answers in the positive direction for the first six questions on information and utility of AT, and the most extreme disagreement as to improvement over the past 10 years, were expressed by the more seriously impaired respondents. The first questions showed that the more severely disabled persons received the greatest amount of information and the most information about obtaining assistive devices.

The third question asked how much all of the information and advice, both on the devices and how to obtain them, had increased the respondents' levels of learning, independence, productivity and community integration. The greatest help was obtained by the more severely impaired. Question 4, how the information had helped the respondents' awareness of their rights, showed the same pattern of response as Question 3, but the severity curve once again was completely monotonic. Taken together, these two questions on the utility of information about AT and how to obtain it showed that, in general, information was seen as more useful by the more severely impaired individuals. Recall that they asserted, in the first two questions, that the amount of information they received was greater. If we can make the assumption that the more severe a person's disability, the more information about AT and how to obtain it is needed, then we could assert that the information was getting to the proper customers, and they were making good use of it.

Questions 5 and 6 concerned how the use of AT reduced the respondents' reliance on the assistance of other persons and the extent to which product designs reduce the need for AT, establishing a hierarchy of assistance. Once again, the most positive responses were characteristic of the more severely impaired. Universal product design was, once again, seen as most salutary by the more severely impaired respondents.

When asked about how things had changed in the past 10 years, more people were aware now of the need for AT. But while there was strong agreement to this set of questions, strong disagreement was associated with the severest levels of impairment. Thus, we might conclude that those individuals who were most severely disabled were less likely to have noted improvement in their situations over the past decade. The few respondents who disagreed strongly were more severely impaired. Taken together with the findings from the first six opinion questions, the indication is that, for the more severely impaired among the disabled, there was a great deal of helpful information about AT and how to obtain it, and AT use had improved their lives in many ways; however, the general social context—people's awareness of the need for AT, their understanding of the benefits of AT, the ease of getting help purchasing AT, and the help coming from laws and program policies—had not improved over the past 10 years.

Summary and Conclusion

This showed that there was a strong association between level of impairment and AT use and need among our study participants. This finding is not surprising, given the overwhelming evidence from this survey and ones similar to it, and it provided an indication that the scaling of severity had a degree of contextual validity. We found that the more severely disabled were:

- More likely to have had greater needs for AT and environmental accommodations;
- Less likely to work and participate in social activities;
- Least likely to report that AT has made them less dependent on the help of other persons; and
- Least likely to conclude that disability-related legislation has helped them to improve their lives.

The study gives substantial support to the thesis that disabilities in general, and severe disabilities in particular, systematically deny opportunities to millions of citizens. Persons with disabilities cannot participate fully in activities in school, at work or in the community without assistance. Such assistance, whether provided by technology or human beings, is necessary in proportion to the severity of the impairments.

In spite of our efforts to better understand the need for AT by persons with disabilities, gaps in knowledge about the costs and benefits associated with the use of AT remain. We therefore conclude that a careful study—with special emphasis on persons with more severe impairments—of the costs and benefits of investing into AT should be conducted. This should include a better assessment of the severity of the impairments and a better classification of AT. If we have that, we will obtain a better understanding of how much persons with disabilities and their families are able to invest in AT on their own, how much private entities can contribute, and what share of the cost the public should bear.

10. Education As a Predictor of Assistive Technology Use and Need

Assistive technology and education are major factors in the process of enabling persons with disabilities to participate to a greater extent at home, school, work and in the community (Flippo, Inge, & Barcus, 1995). Education plays a pivotal role in this process. Technology can assist in the process of learning (Cavanaugh, 2002; Gitlow, 2000). Such technologies include: talking software; scan and screen readers; word prediction programs; portable word processors; touch screens; graphic organizers; alternative keyboards; track balls; multimedia programs; and e-books (White, Wepner, & Wetzel, 2003). Schools throughout the country now use technologies to ensure that students with disabilities can obtain a free and appropriate education in an integrated school environment, as provided by the *Individuals with Disabilities Education Act*. Educational technology-related assistance is available through numerous agencies and organizations such as the Assistive Technology Educational Network (2003), Disability Resources (2003) or the American Speech-Language-Hearing Association (2003).

Assistive technology use by younger persons with disabilities plays a crucial role in the transition from school to work (Goodman, 1998). For many students with disabilities, this transition can be facilitated through continued and improved provision of assistive technology, vocational rehabilitation services, and support in the workplace (Inge, Strobel, & Shepherd, 1999). Adequate preparation, planning and assistance from teachers and parents also contribute to a successful transition from school to work (Canfield & Reed, 2001).

There is now a growing body of evidence that suggests that assistive technology use, workplace accommodations and level of education result in better employment outcomes for persons with disabilities. Hendershot (2001) found that assistive technology use is positively associated with employment. McNeil (1994) found that persons with disabilities who used wheelchairs and were employed had similar earning levels than persons without disabilities. Carlson (2002) showed that levels of employment and income of persons with disabilities were significantly related to levels of education and assistive technology use. These survey-based findings, supported by anecdotal accounts (National Council on Disability, 1993) and legislative findings (United States Senate, 1998) strongly suggest that education and assistive technology use can improve levels of independence, participation and overall quality of life of persons with disabilities.

Training and education regarding assistive technology, particularly high-tech AT, leads to a growing number of persons who are “technology savvy” and understand how AT can help them to better perform their tasks at home, in school and at work. An informed understanding of the power inherent in technology fosters the demand for AT devices, programs and services. We would therefore expect that persons with higher levels of education and familiarity with technological issues use AT with greater frequency and demand better products. We therefore examined if and how levels of education affect a person’s propensity to use or need assistive technology.

Findings

The first step in this analysis was to investigate the percentage of the population who use AT in any of the four domains as a function of the highest level of education that they had attained. This variable proved to be the most influential of all variables examined, as shown in Table 10.1[11].

Table 10.1 AT Use and Level of Education, by Severity of Impairment

	Percent Using AT			
Education Level	**Severe**	**Moderate**	**Mild**	**Overall**
Postgraduate	84%	78%	59%	66%
College graduate	71%	74%	67%	69%
Some college	75%	69%	64%	67%
High-school graduate	69%	62%	57%	60%
Elementary	53%	47%	56%	53%
Kindergarten				
Correlation coefficient	**0.90**	**0.96**	**0.54**	**0.85**
Coefficient of determination	**80%**	**92%**	**29%**	**72%**

All of the correlation coefficients, computed on the rank of education level and percent of AT use within each level, are statistically significant. The coefficients of determination, reported as percentages, indicate the amount of covariance accounted for by the individual correlations.

Overall, then, 72 percent of the variance within the amount of AT use can be attributed to the amount of education attained by the respondent. Figure 10.1 demonstrates that there was no discernible pattern relating severity of impairment to education level, thereby eliminating one possible source of confounding.

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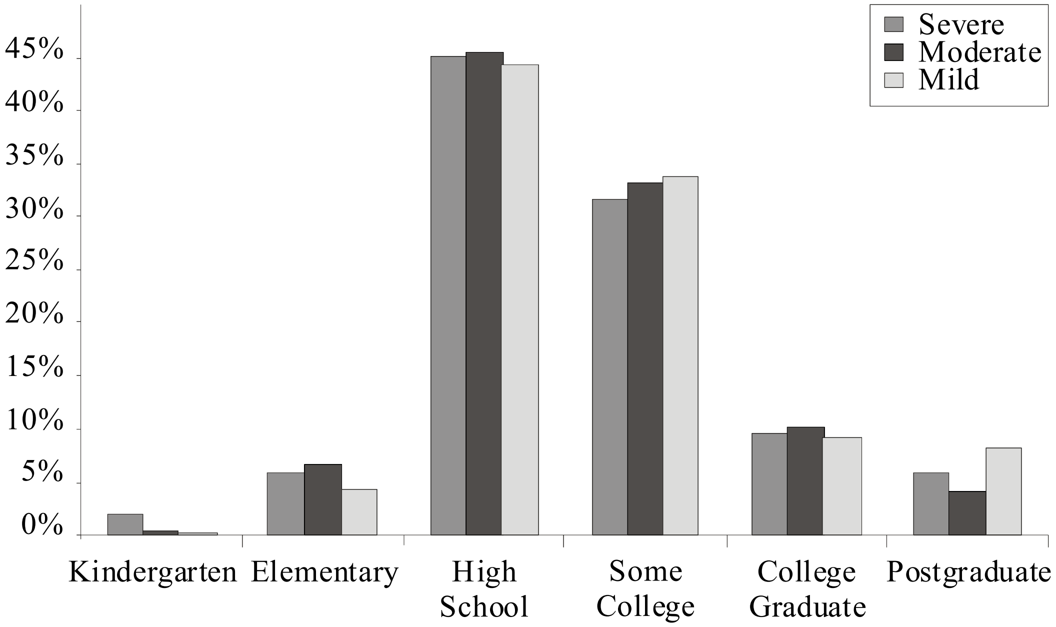
[11] There were only 10 respondents overall with a kindergarten education.

Figure 10.1 Distribution of Respondents, by Severity and Educational Level



Further, there was no statistically significant relationship between the age of the respondents and their education levels. The highest reported age was associated with respondents who had attained elementary school education (up to the 8th grade), followed by high school, postgraduates, college graduates, and then respondents with some college—in short, a non-monotonic pattern.

Level of Education and Learning About AT

Each respondent who used AT in any location was asked: "Where did you learn about the device that you now use?" Although the original intent of the question was to determine the particular sources of information accessed by the respondents, we summed all mentions of all sources of learning and compared the totals, for each level of education, that said the respondents got their information from any number of sources with the totals of each level of education extant in the population.

The result of the comparison, splitting the data at the median level of education, was a chi-square of association of 27.61, df=1[12], $p<0.000007$[13]; in short, those who were more educated accessed more sources of information than those who were less educated. While this may seem to be an obvious conclusion, it lends support to the finding that the relationship between education and the use of AT is a causal one.

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[12] Degrees of freedom calculated by the formula (r-1)(c-1), where r=rows and c=columns. Thus, a 2x2 matrix has one degree of freedom, and a 3x6 matrix has 10. The more degrees of freedom in the matrix, the higher the value of chi-square must be to achieve statistical significance.

[13] The chi-square test of association (i.e., the 2x2 matrix chi-square) is a nominal-scale statistic of extremely low power. Significant findings using a weak statistic are *ipso facto* high in validity.

In a similar vein, we asked respondents whether they planned to contact any person or agency to get advice. There was a clear indication that the more educated the person, the more likely they were to say that they planned to contact someone. (Spearman-Brown rank-order correlation [rho] = +.83, coefficient of determination = 69 percent of covariance explained by the relationship.)

There was an even more pronounced effect of education when we asked the respondents if they were aware that they could get help or advice in obtaining AT. Here the rho reached +.89; the coefficient of determination was 78 percent.

There was also a tendency for the better-educated respondents to be more satisfied with the AT they use and with the assistance they got in selecting and obtaining AT, but the small numbers of respondents render these findings inconclusive.

In contrast, when we asked the question, "Have you ever tried to obtain AT without success?," we found no relationship between education and the likelihood of failure to obtain AT. (rho= -.08, coefficient of determination <1 percent.) Nor did we find any relationship between the level of education and the perceived need for additional AT (rho= -.03, coefficient of determination <1 percent).

It is also important to note that level of education was unrelated to severity of impairment (chi-square = 16.77, *df*=10, p>0.05, ns), and similarly, education was unrelated to the sex of the respondent (chi-square = 10.2, *df*=5, p>.05, ns), or to the respondent's race[14] (chi-square = 6.1, *df*=5, p>.05, ns). On the other hand, there was a strong relationship between education and family income (rho= +.66, coefficient of determination 43 percent), and an even stronger relationship between education and personal income (rho= +.94, coefficient of determination 89 percent).

Given that both personal and family income were related to education, and level of education was related to AT use, it would seem reasonable to assume that income level is also related positively to AT use.

However, there was no relationship between family income and AT use, and a strong negative relationship between personal income and AT use (rho= -.77, coefficient of determination 60 percent). And while AT users were, on average, more educated than nonusers, they were slightly lower in both family and personal income. So, education emerged as the controlling variable.

Learning About Assistive Technology As a Function of Severity of Disability

Table 10.2 relates the severity of one's disabling condition to the source respondents used to learn about assistive technology. The percentages are the percent of total mentions per severity category. The table shows that, once again, severity of disability made a difference. The severely

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[14] We had enough data to accurately compare black and white respondents only.

disabled individuals were roughly twice as likely to get information from alternative sources. Since this item was not probed, there were only four mentions of what these other sources might have been (American Arthritis Association, VA, high school and a conversation with a family member).

Table 10.2 Source of Information, by Level of Impairment

	Level of Impairment		
Source of Information	**Severe**	**Moderate**	**Mild**
Doctor/Other health care prov.	53%	61%	64%
Vocational rehab counselor	9%	6%	6%
Family/Friends/Neighbors	10%	11%	12%
Pamphlets, magazines	2%	4%	2%
Centers for independent living	0%	0%	1%
Tech assistance centers	0%	2%	0%
Tech Act/Other state orgs.	2%	0%	1%
TV/Radio	1%	2%	1%
Yellow pages	0%	0%	1%
Internet	1%	2%	0%
Other	23%	12%	13%

Indeed, the number of devices used per person increased with severity, as shown in table 10.3.

Table 10.3 Number of AT Devices Used, by Level of Impairment

	Level of Impairment		
AT Device Use	**Severe**	**Moderate**	**Mild**
Total number of devices	322	192	536
Number of respondents	327	227	862
Devices per respondent	0.98	0.85	0.62

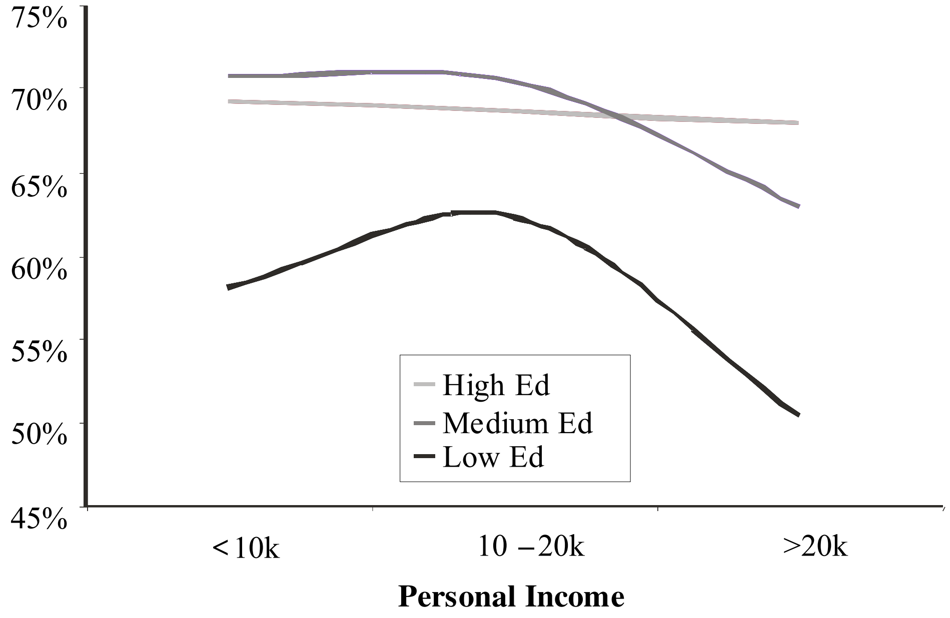
Referring again to Severity Ratio, the SR for respondents using one device was 0.78; for those respondents using two devices, 1.03, and for those using three or more AT devices, 2.04.

Income and Employment Status

As might be expected, both personal and family incomes were positively related to education levels (correlations of +.94 and +.66, education with personal and family income, respectively), a fact that might lead one to believe that income and AT use were also positively related. However, the relationship between personal income and AT use was negative—

minus .77—and there was no relationship between family income and AT use. The reason that the two positives produced a negative can be explained with reference to figure 10.2.

Figure 10.2 AT Use as a Joint Function of Education and Personal Income



Total N's /Category: Education: High–210, Medium–411, Low–601;
Personal Income: <10k 470, 10–20k 372, >20k 388

The AT use by income negative correlation was strongest for the least-educated, who were the largest group (totaling almost as many respondents as in the medium and highly educated groups combined) and the group which was clearly lower in percent of respondents using AT than either of the others.

The percentage of respondents using AT was virtually constant for the highly educated, declining from 69.2 percent for the low income to 68 percent for the highest income category; for the respondents with median education levels, the decline was steeper—from 70.8 percent to 63.1 percent as one moves from low to high income. For the least-educated, who comprised the largest group, the decline was equally steep, from a lower base, which translated into a larger percentage loss—from 58.1 percent to 50.5 percent.

Finally, if we ignore the interaction between education and income and look only at the percentage of respondents above and below the median in both variables who used AT, the better-educated respondents exceeded their less-educated counterparts by 9 percent, 68 percent for the higher-educated, 59 percent for the lower-educated, while the lower-than-median earners exceeded their better-paid counterparts 65 percent to 60 percent. Comparing the two main effects, education was almost twice as powerful as income.

In addition, we found that:

- Respondent age, race, sex, severity of respondent condition, or perceived need for more assistance, were unrelated to the level of education achieved (thereby eliminating these variables as sources of confounding);
- Persons with higher levels of education made use of more sources of information to obtain AT, were more likely to contact another person or agency to obtain more help, were more aware that help is available in obtaining AT, and were more satisfied with their AT and the assistance they got in obtaining it;
- There was no effect of educational level on the likelihood of having tried, and failed, to obtain AT;
- Age, sex and race were uncorrelated with AT use; and
- Although Asian respondents were more educated than any other race, there were so few Asians in the sample that the result did not reach statistical significance.

Summary and Conclusion

For many persons with moderate and severe disabilities, education, income and assistive technology are key determinants for independence and higher levels of participation in community and society. Whereas education provides the intellectual prerequisite for greater levels of engagement in school, work and beyond, AT and environmental accommodations provide the engineered means for participation.

We found that persons with higher levels of education were more aware of the benefits they obtained from using AT, and subsequently appeared more savvy about what AT to get, how to get it, and from where to get it. Our analysis showed clearly that the more educated respondents:

- Had more sources of information about how to obtain AT;
- Were more aware that help to obtain AT is available; and
- Were more likely to contact someone about getting help.

In addition, the more educated respondents were more likely to be satisfied with the AT they had and with the assistance they received, but they were also more likely to express a need for more AT.

Our findings provide evidence for what has been suggested elsewhere—namely that awareness and knowledge of assistive technology (AT) are key factors in supporting the empowerment of people with disabilities (Andrich & Besio, 2002). Awareness and knowledge of AT contribute greatly to the success of AT solutions, and above all, enable persons with disabilities to fully enjoy the rights granted in the *Americans with Disabilities Act* (Button & Wobschall, 1994).

This study shows that education plays a key role in the acquisition and use of AT. Education, if defined as the ability to acquire and use knowledge and information, enables persons with disabilities to select and use the most appropriate technologies and devices necessary to enhance physical and cognitive functions, provided that knowledge and information about assistive technology are made available and accessible to the greatest extent possible. Knowing about AT and its benefits leads to a reassessment of one’s need and the recognition that particular devices and technologies provide venues for new opportunities, as well as new and better things to do.

Getting the right AT largely depends on access to information and help. While such help is increasingly more available, there are segments of the population that do not get this information quickly or easily.

11. Sources of Information About Assistive Technology

Accessible information about assistive technology devices and technology-related assistance services play a major role in the successful rehabilitation and integration of persons with disabilities into school, work and the community (United States Senate, 1998; United States House of Representatives, 1998). Based on data from this survey, we estimate that as many as 25 million adults with disabilities in the United States in 2001 used AT in one form or another (Carlson, Ehrlich, Berland, & Bailey, 2001). A substantial number of AT users reported that the overall benefits of AT use and environmental accommodations at work, for instance, included a higher likelihood of being employed while having a work disability, and earning higher levels of income (Carlson, 2002).

Careful matching of AT products with personal needs is essential for optimal use (Scherer, 2001). Poorly designed or poorly fitted products may cause serious health problems (Nelson, 1997; Taylor, 1987). Dissatisfied users are likely to abandon poorly fitted products and are forced to look for better ones elsewhere (Riemer-Reiss & Wacher, 2000; Phillips & Zhao, 1993).

Matching persons with disabilities with the appropriate technology can be a difficult process. For example, Abledata's database contains over 19,000 currently available products from over 2,000 different companies (Abledata, 2003). While each product record contains a detailed description of the product as well as the price, and the manufacturer and distributor information, the sheer volume of items available for review is daunting. To answer the question of what products and services are available and how and where persons with disabilities can learn more about these products and services and possibly test them or try them out, requires information and assistance provided by trained professionals and organizations who are committed to offering the best possible services to current and potential AT users.

Persons with disabilities using or needing AT can turn to several sources of information. The most common ones are medical professionals and rehabilitation specialists, vocational and occupational rehabilitation counselors, AT practitioners, and family and friends. There are also several comprehensive directories (Grey House Publishing, 2003), Internet sites, trade association meetings and trade shows that inform persons with disabilities and practitioners alike about their latest products and services.

For example, the Assistive Technology Industry Association (ATIA) (2003) serves as the collective voice of the AT industry to ensure that the best products and services are delivered to people with disabilities. ATIA and other trade organizations organize large meetings and fairs to introduce new and improved AT products and services as well as equipment trial and training opportunities. Professional organizations such as the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA, 2003a) promote technology development and application and train AT practitioners, but also disseminate useful and important information to persons with disabilities. In addition, a wide network of state-based technical assistance projects reach out to persons with disabilities by organizing awareness campaigns, distributing pamphlets and flyers, and using radio broadcasts and other information dissemination techniques (RESNA, 2003b). There are also hundreds of Web sites available on the Internet, many of them put up by

NIDRR grantees, that provide excellent information about assistive technology (Ehrlich, Carlson, & Bailey, 2003).

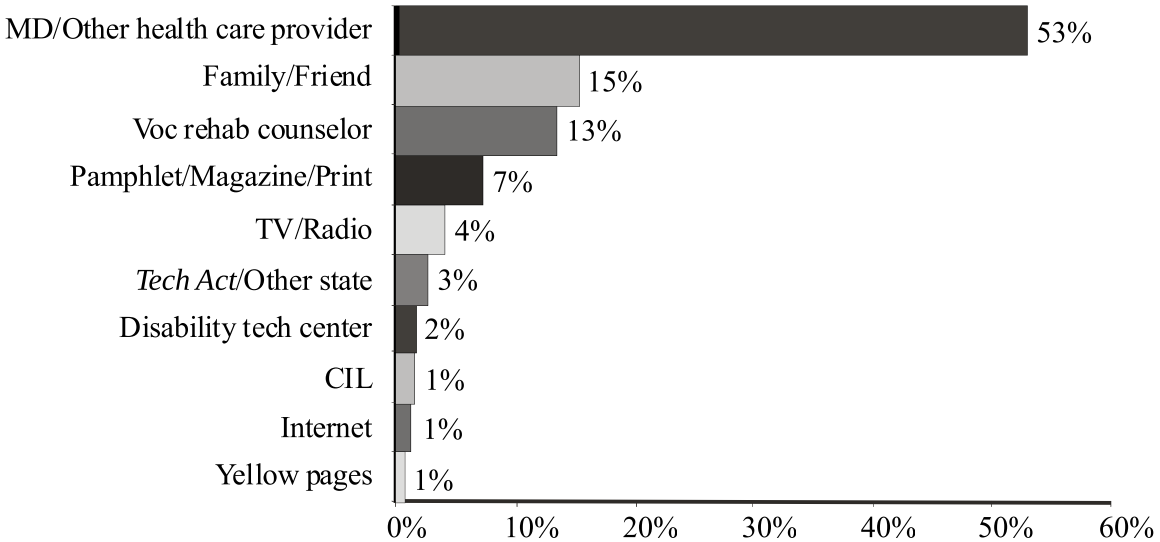
However, there remains a limited understanding about the sources of information on assistive technology that are available and accessible to persons with disabilities, how useful the information is, and how the information helps with the selection and acquisition of suitable devices and technologies. The debates surrounding the *Technology-Related Assistance for Individuals with Disabilities Act of 1988*, amended in 1994, and the *Assistive Technology Act of 1998* revealed that information about how to obtain AT plays a crucial role in the rehabilitation process of persons with disabilities (Carlson & Ehrlich, 2002; National Council on Disability, 2000).

This presents findings on how persons with disabilities obtain information on selecting and acquiring AT.

Sources of Information About Assistive Technology

Figure 11.1 shows the relative frequency with which each information source was reported. The most often-mentioned information source (53 percent of all sources) was a physician or other health care professional, followed by family or a friend (15 percent) and vocational rehabilitation counselor (13 percent).

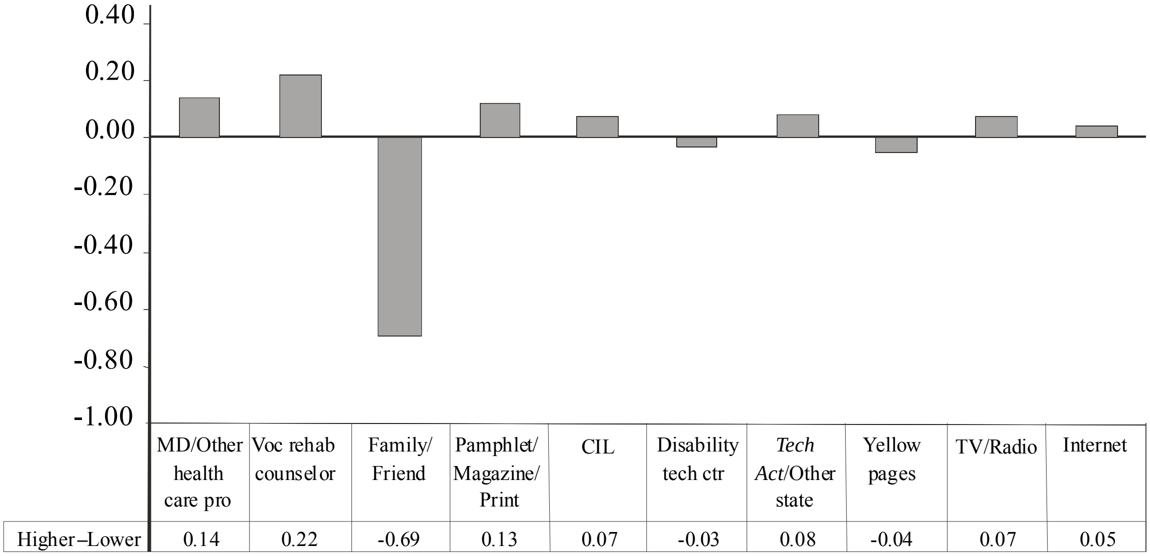
Figure 11.1 Sources of Information About AT



To demonstrate the effects of each source of information on the attitudes and opinions of persons with disabilities who use or need AT, we performed a series of discriminant function analyses (DFA), a precursor of logistic regression (Fisher & Van Belle, 1993). We used this technique to accommodate a range of variables of different scale properties, from true nominal scale dichotomies (working/not working, white/nonwhite) to ordinal scales (level of education, scaled from 1–kindergarten to 6–postgraduate degree), to interval (equal-interval categories of income) and ratio scales (age of respondent at the time of the interview). For all scales above the nominal level, the data were split at the median so that the two groups, for example older and younger, would have approximately equal representation.

The variable producing the greatest overall discriminant factor (DF) was the dichotomy constructed from the opinion questions, named here “AT Opinion.” There were six questions that respondents answered about their opinions about the helpfulness or the amount of information they received about AT, the usefulness of AT, and the like. For each of these questions, the answers ranged from “A lot” to “None.” The scores for each individual were averaged across the six items and divided at the median for all AT users. Figure 11.2 illustrates how this method was employed to show these effects.

Figure 11.2 Opinions About the Usefulness of Information About AT As a Discriminant Factor Across Information Sources



	MD/Other health care pro	Voc rehab counselor	Family/ Friend	Pamphlet/ Magazine/ Print	CIL	Disability tech ctr	*Tech Act*/Other state	Yellow pages	TV/Radio	Internet
Higher–Lower	0.14	0.22	-0.69	0.13	0.07	-0.03	0.08	-0.04	0.07	0.05

Accordingly, AT users who received their information from family and friends were less positive in their assessments of that information than those who received their information from all others, but especially those who received their information from vocational rehabilitation counselors (total difference = .91 σ) or from physicians or other health care professionals (total difference = .81 σ). This result would seem to be intuitively obvious (i.e., that information from professionals would be more helpful than that received from well-meaning but untrained acquaintances and relatives).

Occupational Status

We dichotomized the AT users into those who reported themselves to be gainfully employed as one group, and all other AT users. Respondents who used AT and were not working at the time of the interview were more likely to obtain their information from vocational rehabilitation counselors or family and friends, and less likely to get information from printed material than those who were employed.

Race

The variable “race” was dichotomized as white versus nonwhite. The only trend revealed is that nonwhites were less likely to receive information from vocational rehabilitation counselors than whites.

Severity of Impairment

Each respondent was asked to describe the conditions that caused her disability, and up to three independent conditions were recorded and scored for the level of disability on a four-point scale. We added the scores across all mentions to arrive at a summary level of disability. The variable was dichotomized according to the nearest sum to the median. The results indicated that the more severely impaired respondents were more likely to receive information from family and friends than those less severely impaired.

Age

We found that there was a slight tendency for the older population to receive more information from family and friends and less from vocational rehabilitation counselors.

Impact of AT related legislation

Respondents answered four questions comparing conditions at the time of the survey with how things were 10 years ago. Again, the scores were averaged over those four questions and then split at the median. Our findings suggest that neither positive opinions nor negative opinions about improvement and change over the past 10 years were associated with any particular source of information about AT.

Income

Respondents gave figures within ranges on an 11-point scale for both family and personal income in the year previous to the survey. Splits were made at the median for both sets of responses. Neither personal nor family income was found to be a reliable discriminant factor.

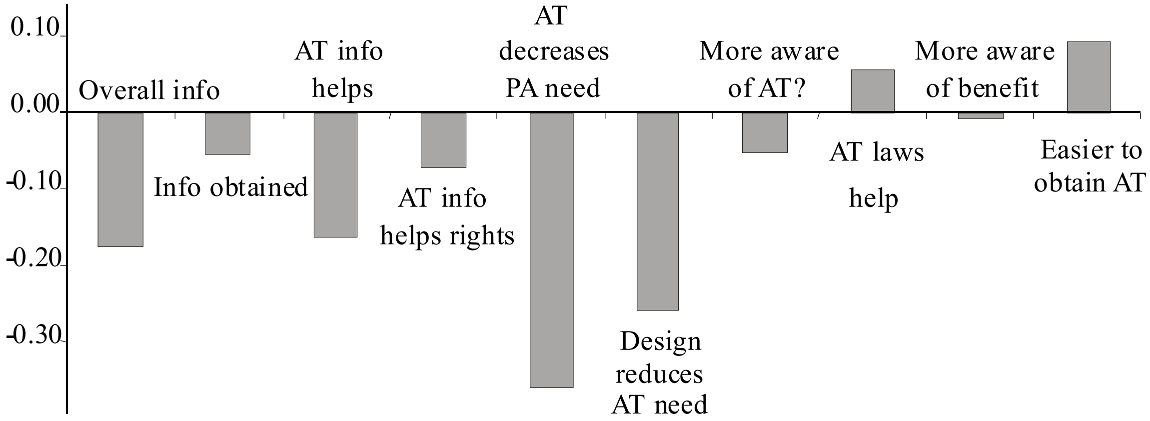
Education

Each respondent provided the highest level of education attained, and the results were coded into six ordinal categories. Data were split at the median. The data provided some indication that the more educated individuals were more likely to get information from vocational rehabilitation counselors than those with lower levels of education. The result is supported by the fact that working AT users were significantly higher in educational attainment levels than nonworking AT users, and would therefore have been more likely to visit vocational rehabilitation counselors.

Personal Assistance Services

When respondents using personal assistance services (PAS) were asked the 10 opinion questions, we found that the greatest difference was that personal assistance users were less positive about AT decreasing their need for personal assistance. This is illustrated figure 11.3.

Figure 11.3 Attitudes and Opinions About AT, by Persons With Disabilities Using Personal Assistance (PAS) vs. Non-PAS Users



The obvious interpretation is that a large segment of personal assistance is outside of the range of activities that AT can address. And this in turn suggests that the greatest need in the AT field is not for technological advancement in existing AT, but extending the range of AT to areas that are now addressed only by the assistance of another person.

State of Residence

The *AT Act* placed emphasis on states to provide technology-related assistance to persons with disabilities, and granted a large degree of freedom in how this assistance was to be provided. We were particularly interested in finding out if any differences at the state level between modes of information delivery or effectiveness of information dissemination could be detected. However, the small sample of the survey raised concerns about whether or not we could detect valid and meaningful differences. We therefore chose total state population and state population density instead of state-by-state comparisons because the total sample size was not sufficient to allow a full state-by-state comparison.

Frequency estimates of use were based on the sum of all mentions of each source of information about AT. In the course of administering the questionnaire, the question “Where did you learn about the AT that you use?” could have been asked up to nine times; each respondent mentioned all possible sources, and the interviewer noted each mention of the 10 source categories included in the questionnaire.

In our analysis, the states were grouped according to population into “High” (average population of ~14.6 million) “Medium” (average population of ~5.7 million) and “Low” (average of ~2.1 million). There were 11 states with a population greater than 8.0 million, 10 with a population between 4.5 and 8.0 million. The remaining 39 states and the District of Columbia comprised the low population group. The data are summarized in table 11.1. The overall figures show good consistency across the population categories, with a slight decline in the use of the primary source (physician or other health care professional) with decreasing population, and a corresponding increase in the use of the vocational rehabilitation counselor. Print media diminishes as a source of information in the less populous states.

Table 11.1 Sources of Information About AT, by State Population Characteristics

	High		**Medium**		**Low**	
Source of Information	*Sum*	*Percent*	*Sum*	*Percent*	*Sum*	*Percent*
MD/Other health care prov.	256	56	122	56	130	50
Voc rehab counselor	47	10	24	11	41	16
Family/Friends	72	16	44	20	43	17
Pamphlet/Magazine/Print	38	8	12	6	17	7
CIL	4	1	3	1	4	2
Disability Tech Center	8	2	2	1	5	2
Tech Act/Other state orgs	7	2	2	1	7	3
Yellow pages	4	1	0	0	2	1
TV/Radio	13	3	7	3	9	3
Internet	5	1	1	0	1	0
TOTAL	**454**	**100**	**217**	**100**	**259**	**100**

Summary and Conclusion

Each respondent was asked about the sources of AT information that they used. More than half of all respondents mentioned receiving some or all of their information from physicians or other health care professionals, followed by family and friends, and vocational rehabilitation counselors.

We examined 10 sources of information and nine demographic factors, and found that physicians and health care professionals provided information to all groups without significant variance. With regard to the users of assistive technology who got information from family and friends we found:

- Strong evidence that they were less positive in their attitudes toward the information they received and the utility of assistive technology;
- These respondents were likely to be more severely impaired and older than those who did not receive information from family and friends; and
- There was a lesser tendency for these individuals to be in the nonworking group, to have a less positive view of changes over the previous decade, have lower family and personal incomes and to be nonwhite.

Users of AT who mentioned receiving information from vocational rehabilitation counselors were likely to be nonwhite, unemployed and have a higher level of education.

Our overall conclusion is that the source of information had a major effect on one's attitudes about the utility of that information and of AT. The information respondents got from family and friends was seen less positively than that received from other sources in general, and vocational rehabilitation counselors in particular. The demographic characteristics that defined this group—older, more severely impaired (recall that severity of impairment and age are uncorrelated), tending to be unemployed and coming from poorer, minority backgrounds—indicate where information from knowledgeable sources should be directed. This group was accessing information from the most convenient, rather than the most knowledgeable, source.

The relatively small sample size of this national survey (n = 1,412), and the low number of responses indicating a state-based agency as the source of information, prevented us from detecting significant differences between states clustered by total population and population density.

Two final observations also needing further study point out that state-based agencies providing technical assistance to persons with disabilities using or needing AT appear to have raised awareness about themselves in a relatively small number of respondents (about 3 to 5 percent). This proportion may be higher, assuming that a large proportion of pamphlets and publications mentioned by 7 percent of the respondents originated in state-based technical assistance agencies. Second, centers for independent living and the Internet as a source of information about AT were mentioned each by 1 percent of respondents. These findings suggest that two rich sources of information about AT may be underutilized.

12. Sources of Payment for Assistive Technology

Estimates from the Survey of Income Program Participation showed that 54 million persons, or about 20 percent of the U.S. population, have activity limitations or disabilities (McNeil, 1997). About half of them used assistive devices and technologies or special equipment (canes, wheelchairs, special beds or special telephones) as well as medical devices (prosthetics, orthotics, respirators or diabetic equipment), and rely on home modifications, school or workplace accommodations, or modified cars or vans to perform daily tasks and activities (Carlson et al., 2002). These estimates indicate that a rather large segment of the population utilize AT devices and services. However, little is known about how much is paid for these products and who pays for it. It was in part because of the lack of quantitative knowledge on this subject that the 2001 AT survey was conducted.

A review of the literature revealed three payment studies that showed that when asked how respondents pay for their assistive technology, 48 percent said that they or their families paid for the devices with no assistance from third parties (LaPlante et al., 1992). According to the same source, more than 75 percent of persons with home accessibility features said they were paid for entirely by themselves or by their families. The Agency for Healthcare Research and Quality (2000), based on findings from the Medical Expenditure Panel Survey of 1996, reported that in 54 percent of all "Other Medical Expenses" (this includes medically necessary equipment and supplies), payments were made out-of-pocket. This is the highest ratio of out-of-pocket expenses for any type of medical service-related payments. In a similar vein, Connell, Turner and Gruber (1996) found in a study of 49 North Carolinians who modified their homes that 67 percent of the modifications were paid for by family and friends, and much of the labor was donated.

The shifting of the burden of paying for AT onto the consumer and limiting the involvement of third party payers in the payment for AT was observed a decade ago as being inherent in "programs that help people in poverty and those over 65 to acquire assistive technology devices, but a third or more are purchased by poor individuals and their families without contributions from other parties" (LaPlante et al., 1992). The ability to pay for much-needed AT continues to constitute a barrier to equal participation and inclusion in work and community that the *Tech Act* aimed at reducing (National Council on Disability, 2000). As LaPlante et al. further pointed out, "Despite financial problems in acquiring assistive technology devices, use of devices has increased dramatically over the past decade" (1992). At that time, over 13 million people used AT. Now, after another decade has passed, we estimate that about 25 million people use some form of AT to help them perform their daily tasks and activities (Carlson et al., 2002b). Because the population of AT users has nearly doubled, new and better estimates are needed to understand how AT is paid for today.

Our review of the literature revealed that payment for AT by oneself or others often depends on the type of device or adaptation, and anecdotal evidence suggests that expenses for many items used as AT, such as tub mats to prevent slipping and falling (and thus preventing injuries and disabilities) are not considered reimbursable by third parties. At a more general level, there are no good estimates of the proportion of payments made by whom, and for what. Third-party payers such as private insurance companies, Medicare, Medicaid or the vocational rehabilitation system have no consistent or compatible payment formulas across geographic regions, by types of impairment or disability, or by eligibility criteria (Arcarese, 2002). Personal, social and economic characteristics of persons with disabilities using or needing AT greatly affect the modes of acquisition of AT. In addition, the multifaceted nature of AT, especially when multiple devices are used, further confuse the understanding of who pays for what, and under what circumstances. Finally, the legislative framework surrounding the provision of AT, public assistance, and the role of third-party payers complicate the modes of payment for AT even more.

For example, in the case of the *Individuals with Disabilities Education Act* (IDEA), a child's need for assistive technology must be determined on a case-by-case basis, made part of the individualized education plan (IEP), and paid for by the public school system to ensure that the child gets a free, appropriate public education. To learn about how many respondents got their AT through IDEA was not part of our study design, as the primary focus was to study the AT needs of adults with disabilities. For adults, laws such as the *Rehabilitation Act of 1973* as amended, (particularly Sections 504 and 508), the *Workforce Investment Act of 1998*, the *Americans with Disabilities Act*, the *Telecommunications Act of 1996*, and the *AT Act* guide the provision of assistive technology and technology-related services. With regard to the effects of these laws on payment for AT, vocational rehabilitation agencies provide "rehabilitation technology services" to a relatively small number of their clients. The bulk of payments for AT authorized by these laws goes into making the built environment and the means of public transportation and communication accessible to persons with disabilities.

Frequently mentioned sources of payment for AT—Medicare and Medicaid—require a certificate of medical necessity issued by a physician or otherwise qualified health care professional to a person seeking payment for AT. The type of device and the amount paid for a device by Medicare and Medicaid is determined by administrative panels that issue National Coverage Decisions (NCDs). The *Coverage Issues Manual* contains a list of these devices (termed durable medical equipment). In the durable medical equipment (DME) category, the Centers for Medicare and Medicaid Services (CMS) includes outpatient prescription drugs, other nondurable medical supplies, and durable medical equipment based on CMS' healthcare common procedure coding system (HCPCS) designations. In 2001, CMS spent about $7.7 billion on durable medical equipment. Payments for two items, oxygen and capped rentals, constituted nearly half of this sum ($3.5 billion). CMS' reporting practices, however, do not make it possible to identify what type of AT device was paid for and to whom the payment was made, unless one occasionally comes across a press release on a particular issue, such as the power wheelchair program in Medicare. According to one such release, CMS spent $845 million on 159,000 claims for a power wheelchair in 2002 (Centers for Medicare and Medicaid Services, 2003). However, obtaining national estimates on AT payment by CMS and other payers would have gone far beyond the scope of this survey. The Department of Veterans Affairs pays for AT, particularly for service-connected disabilities, although some degree of determination of what is needed and how it is paid for is made on a case-by-case basis.

The AT Survey did not attempt to estimate how much money is spent for AT in the United States. At present, there is no information on this subject. To obtain such information, a number of data sources would have to be explored, including proprietary data from AT suppliers and third-party payers.

To briefly sum up the findings relevant for our study of payment for AT:

- Low-tech devices, adaptations and accommodations made up the bulk of AT used by persons with disabilities;
- Regardless of type or level of technology, out-of-pocket expenses by persons with disabilities were mentioned as the most frequent source of payment;
- AT that enhances physical functioning and mobility was most likely to be paid by third parties, and environmental adaptations and universal design products were least likely to be paid for by third parties; and
- Inadequate funding of AT continued to be a barrier to the more equal inclusion of persons with disabilities in the community and in society.

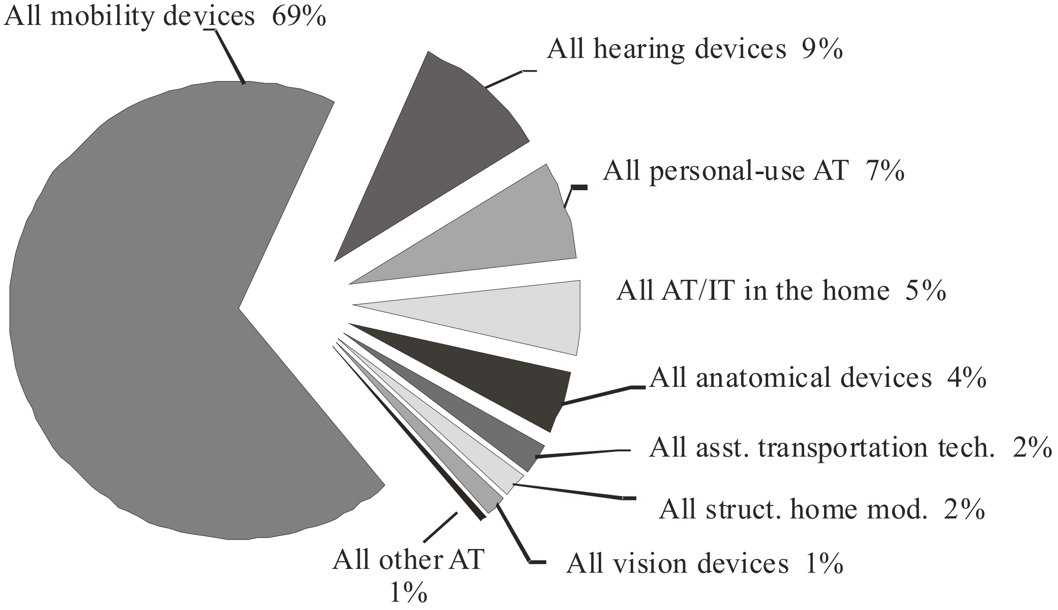
The findings presented in this provide a summary of who paid for what types of AT. Factors that affect a person's ability to pay for AT were also explored.

Findings

Respondents were asked about their use of assistive technology to get to school and work, in school or at work, in the home, and in the community. Of all respondents, 901 (64 percent) used some assistive technology. Use at school and at work was 36 percent; use at home was 49 percent; and use in the community was 50 percent. Most of the assistive devices used were designed to enhance mobility: canes, crutches, walkers, scooters and wheelchairs. Hearing aids, oxygen tanks and other personal-use devices were also among the most frequently used devices.

After the respondents were asked what type of AT they used at home, work or in the community, they were asked who paid for it. Many devices mentioned in the course of the interviews were used by a few respondents only, and therefore were grouped into larger categories. Figure 12.1 provides an overview of these categories.

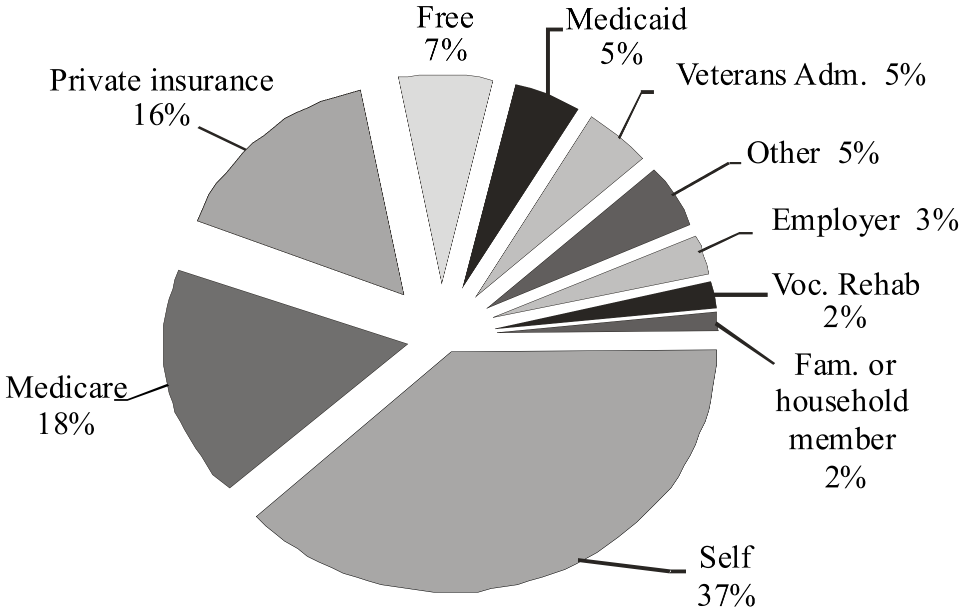
Figure 12.1 Types of AT Used



The largest AT component was made up of mobility devices (over 68 percent), followed by hearing devices (9.4 percent) and personal or medical use AT such as respirators, nebulizers, oxygen tanks or diabetic equipment (7 percent). The next category included AT devices used in the home but that were not part of the "built" structure of the home, such as modified kitchen appliances or special kitchen or bathroom utensils. These devices accounted for 5.4 percent of the devices for which a source of payment was reported. Home AT use was followed by the anatomical devices category that included prosthetics and orthotics, and the assistive transportation technology that included modified vans or portable ramps. Finally, the smallest AT categories contained structural home modifications (2 percent), visual AT (1 percent), and other AT, primarily for persons with sensory or speech impairments (also 1 percent).

We asked the respondents: "Who paid for the device or service?" and interviewers checked all that applied from the following list: self; a family or household member; private health insurance; Medicare; Medicaid; the vocational rehabilitation system; the employer; the Veterans Administration; free; or other. Figure 12.2 contains a breakdown of these payment sources. Out-of-pocket expenses by the direct beneficiaries constituted the largest share of all payments (37 percent), followed by Medicare, private health insurance, and free items. Medicaid payments accounted for a relatively small share (5 percent), about equal in size to payments by the Veterans Administration and other sources. The smallest shares consisted of payments made by employers (3 percent), the vocational rehabilitation system (2 percent), and a family or household member (also 2 percent).

Figure 12.2 Sources of Payment for AT



Tables 12.1 and 12.2 contain the counts and proportions of payment source cross-tabulated by type of AT category. A total of 737 AT devices, adaptations or environmental accommodations were reported that had an identifiable source of payment. In terms of absolute numbers, persons with mobility impairments used most AT devices. Hearing devices constituted the second largest component. Table 12.1 also shows that respondents themselves most often paid for mobility devices, hearing devices and home AT. In absolute numbers, Medicare was the second largest source of payment for mobility devices, followed by private insurance and "free" mobility devices (mostly canes and a few manual wheelchairs).

Table 12.1 Sources of Payment, by Type of Device*

Device	% of Total	SEL	F/H	PHI	MC	MA	VR	EMP	VA	FR	OTH
All anatomical devices	32	9	0	8	4	1	0	3	5	0	2
All mobility devices	502	174	8	82	104	24	10	11	22	43	24
All hearing devices	69	47	1	4	4	3	1	1	5	1	2
All vision devices	10	7	0	1	0	0	1	0	0	0	1
All asst. transportation tech.	16	7	0	3	3	1	1	0	1	0	0
All personal/medical use AT	51	7	0	15	11	5	0	3	2	3	5
All struct. home modifications	13	6	1	0	2	3	0	0	0	0	1
All AT/IT in the home	40	21	1	5	3	1	1	4	1	3	0
All other AT	4	3	0	1	0	0	0	0	0	0	0
All	**737**	**281**	**11**	**119**	**131**	**38**	**14**	**22**	**36**	**50**	**35**

***Legend:** SEL = Self; F/H = Family or Household Member; PHI = Private Health Insurance; MC = Medicare; MA = Medicaid; VR = Voc. Rehab; EMP = Employer; VA = Veterans Administration; FR = Free; OTH = Other

In terms of relative numbers, table 12.2 shows that whereas mobility devices made up the bulk of AT (68.1 percent), about 35 percent of these devices were paid for by respondents, and hearing devices that made up a much smaller part of the “AT market” in terms of numbers were paid for by the respondents in 68 percent of the cases.

Table 12.2 Sources of Payment, by Type of Assistive Device in Percent*

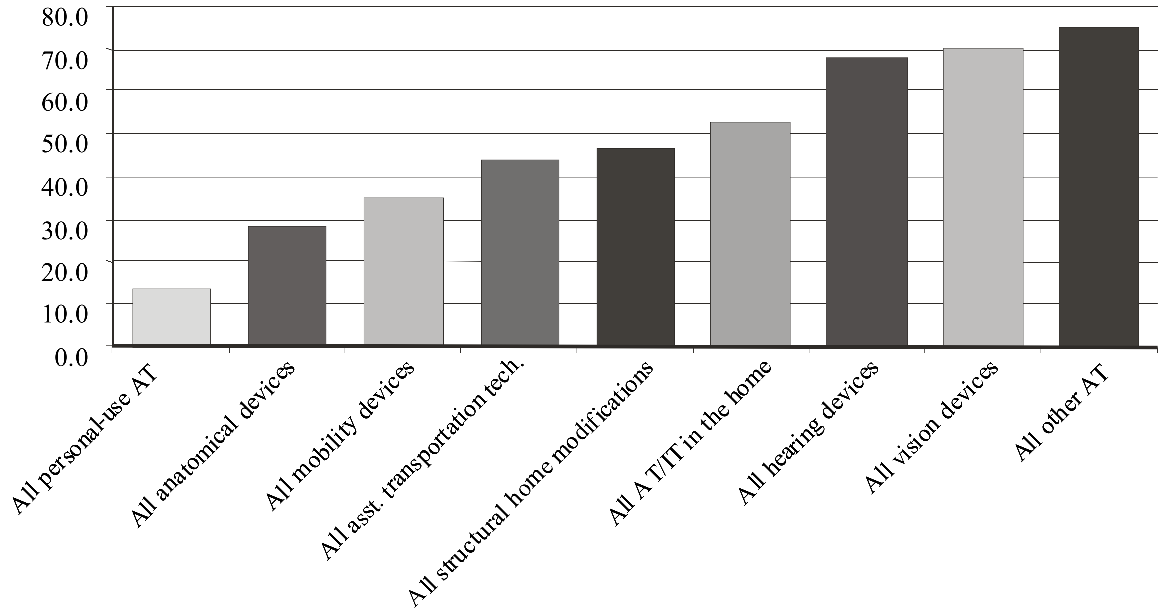
		Proportion of Payment by Payer in Percent.									
Device	**% of Total**	**SELF**	**F/H**	**PHI**	**MC**	**MA**	**VR**	**EMP**	**VA**	**FR**	**OTH**
All anatomical devices	**4.3**	28.1	0.0	25.0	12.5	3.1	0.0	9.4	15.6	0.0	6.3
All mobility devices	**68.1**	37.7	1.6	16.3	20.7	4.8	2.0	2.2	4.4	8.6	4.8
All hearing devices	**9.4**	68.1	1.4	5.8	5.8.	4.3	1.4	1.4	7.2	1.4	2.9
All vision devices	**1.4**	70.0	0.0	10.0	0.0	0.0	10.0	0.0	0.0	0.0	10.0
All asst. transportation tech.	**2.2**	43.8	0.0	18.8	18.8	6.3	6.3	0.0	6.3	0.0	0.0
All personal/medical use AT	**6.9**	13.7	0.0	29.4	21.6	9.8	0.0	5.9	3.9	5.9	9.8
All struct. home modifications	**1.8**	46.2	7.7	0.0	15.4	23.1	0.0	0.0	0.0	0.0	7.7
All AT/IT in the home	**5.4**	52.5	2.5	12.5	7.5	2.5	2.5	10.0	2.5	7.5	0.0
All other AT	**0.5**	75.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All	**100.0**	38.1	1.5	16.1	17.8	5.2	1.9	3.0	4.9	6.8	4.7

***Legend:** SEL = Self; F/H = Family or Household Member; PHI = Private Health Insurance; MC = Medicare; MA = Medicaid; VR = Voc. Rehab; EMP = Employer; VA = Veterans Administration; FR = Free; OTH = Other

The smallest share of out-of-pocket expenses for AT went toward “medically needed or necessary” devices such as respirators or oxygen tanks (about 14 percent), as third parties such as private health insurance, Medicare or Medicaid paid over 60 percent of these expenses. These same agencies also paid for anatomical devices or assistive transportation technologies in about half of the cases, but paid very little for hearing, vision or communication AT.

Technologies that foster independence and community integration (home AT and communication devices) were paid for in large part by the respondents themselves. Figure 12.3 shows this pattern in more detail.

Figure 12.3 Share of Out–of–Pocket Expenses, by Type of AT



A glance at out-of-pocket expenditures for AT illustrates the impact of third parties who paid for AT that enhances mobility and personal functioning. In this domain, out-of-pocket expenses were the lowest. The middle range of third party involvement limited payments to about half of transportation and home AT/home modification expenses. Although most important for functioning in public environments such as work, school and the community, sensory and communication enhancing technologies were least likely to be paid for by third parties (i.e., they had to be paid for by persons with disabilities who often did not have the means to pay for these sometimes very expensive technologies).

In the following section, the results of a variable-by-variable discriminant function analysis of the relationship between respondent characteristics and sources of payment for AT is presented in both table and graphic form. The purpose of these analyses is to show what factors associated with disability influence the way AT was paid for. Table 12.3 below shows the values for the discriminant function analysis in a variable-by-pay source matrix. Numbers in bold type indicate a value well within the top quartile of absolute values. As mentioned earlier, the most often mentioned payment source was self or a family member living in the household, followed by private health insurance and Medicare.

Table 12.3 Respondent Characteristics and Sources of Payment*

Characteristic / Source	SELF	F/OTH	PHI	MC	MA	VR	EMP	School[a]	VA	FR	OTH
Working, Not Working	**0.34**	0.18	-0.02	**-1.17**	-0.23	**0.33**	**0.48**	0.23	0.04	**-0.27**	0.09
Education: High, Low	0.24	0.01	0.23	**-0.82**	**-0.31**	0.13	0.12	0.08	**0.26**	-0.12	0.19
Impairment: Severe, Mild	**-0.32**	-0.22	-0.03	**0.59**	-0.01	0.01	-0.15	**-0.26**	0.10	-0.10	**0.40**
AT Opinion: High, Low[b]	-0.18	**-0.29**	**0.52**	0.10	-0.10	-0.01	-0.14	-0.06	0.12	-0.21	**0.43**
Personal Income: High, Low	0.14	0.12	-0.01	**-0.32**	**-0.38**	0.10	**0.29**	0.13	**0.29**	-0.17	-0.19
Age: High, Low	-0.07	0.17	-0.22	**0.52**	-0.23	-0.04	-0.08	0.09	0.16	-0.12	-0.19
Family Income: High, Low[c]	0.10	0.14	0.05	-0.23	**-0.29**	0.09	0.08	0.10	0.22	-0.14	-0.13
AT Opinion: High, Low	-0.05	0.04	-0.04	0.24	-0.06	0.00	0.03	0.01	-0.04	-0.18	0.05
Race: White, Nonwhite	0.01	0.10	0.02	0.13	-0.16	-0.01	-0.03	0.03	0.07	-0.03	-0.11

***Legend:** SEL = Self; F = Family; PHI = Private Health Insurance; MC = Medicare; MA = Medicaid; VR = Voc. Rehab; EMP = Employer; VA = Veterans Administration; FR = Free; OTH = Other

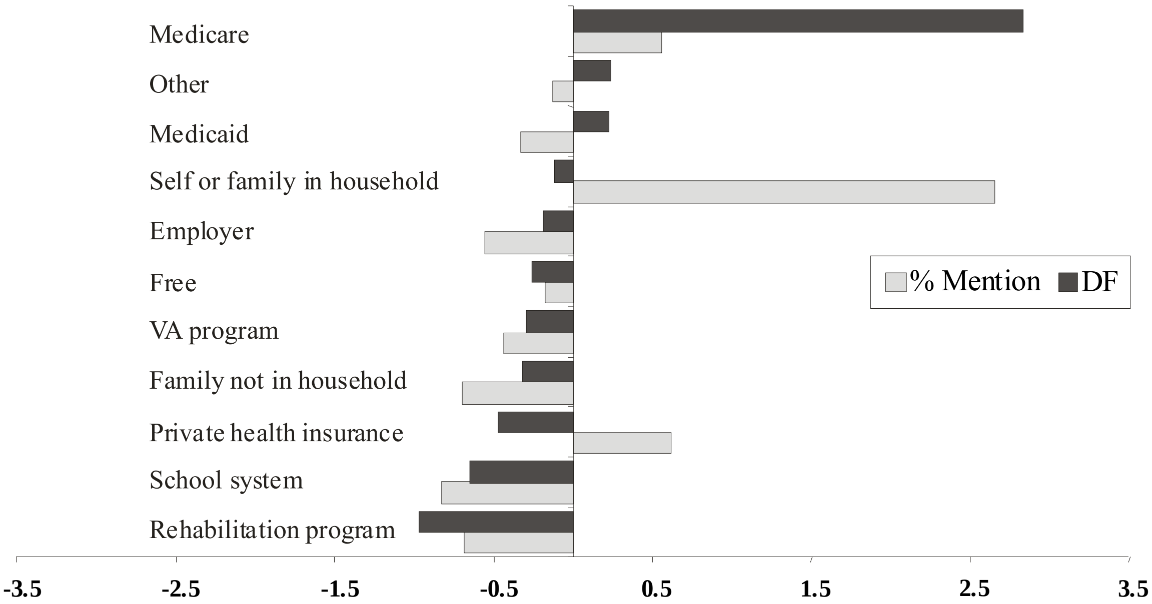
[a] *This category had so few respondents that the percentage registered as zero in most cases. As a result, this category has not been included in subsequent tables.*

[b] *These percentages reflect responses to questions 1–6 on the survey (see p. 189).*

[c] *These percentages reflect responses to questions 7–10 on the survey (see p. 189).*

Figure 12.4 compares the frequency of mention with the discriminant power of the various payment sources. The values for the discriminating factors "DF" and "Percent Mention" have been normalized. The payment sources are displayed from top to bottom in descending order of DF. The figure indicates that Medicare played the major role as a discriminating source of payment.

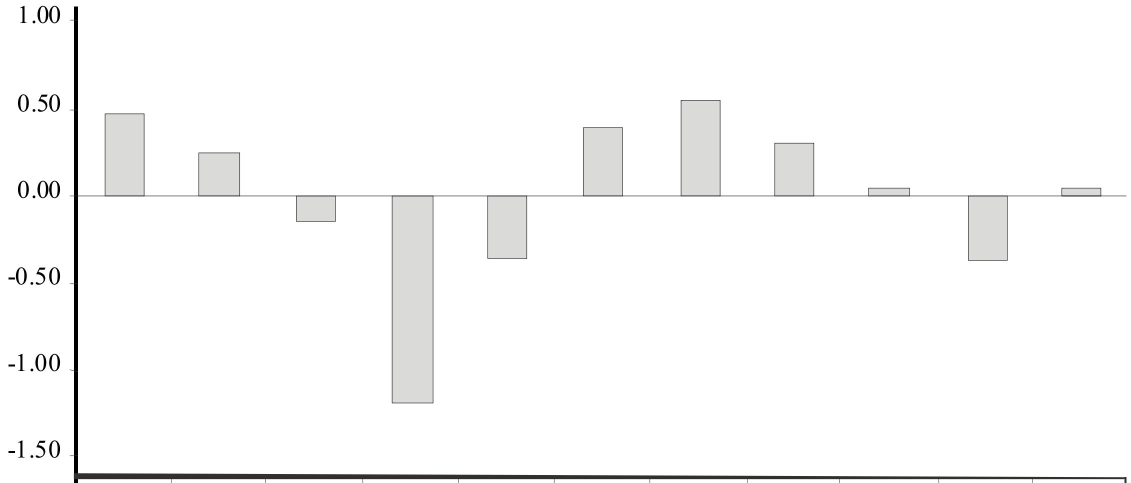
Figure 12.4 Source of Payment for AT, Normalized Mention vs. DF



Occupational Status

The variable producing the greatest overall DF was the dichotomy "Working, Not Working."

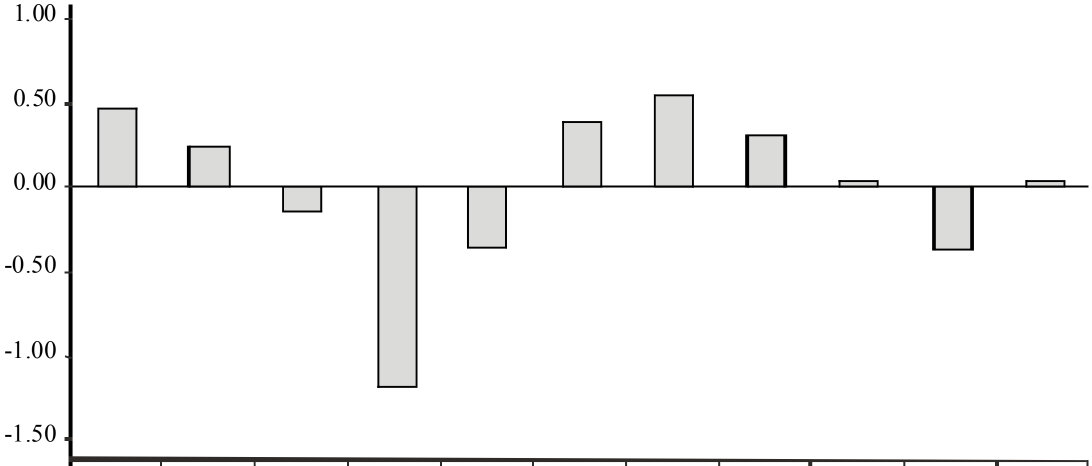
Figure 12.5 Discriminant Function Analysis: Working, Not Working



	Self or family in household	Family not in household	Private health insurance	Medicare	Medicaid	Rehabili-tation program	Employer	School system	VA program	Free	Other
Working, Not Working	0.48	0.24	- 0.15	-1.21	-0.36	0.40	0.57	0.31	0.04	-0.37	0.03

Those persons using AT who were working were much less likely to receive payment from Medicare than those who were not working. The situation is about the same when the comparison was made between those working and those unable to work because of disability, as shown in figure 12.6.

Figure 12.6 Discriminant Function Analysis: Working, Unable to Work

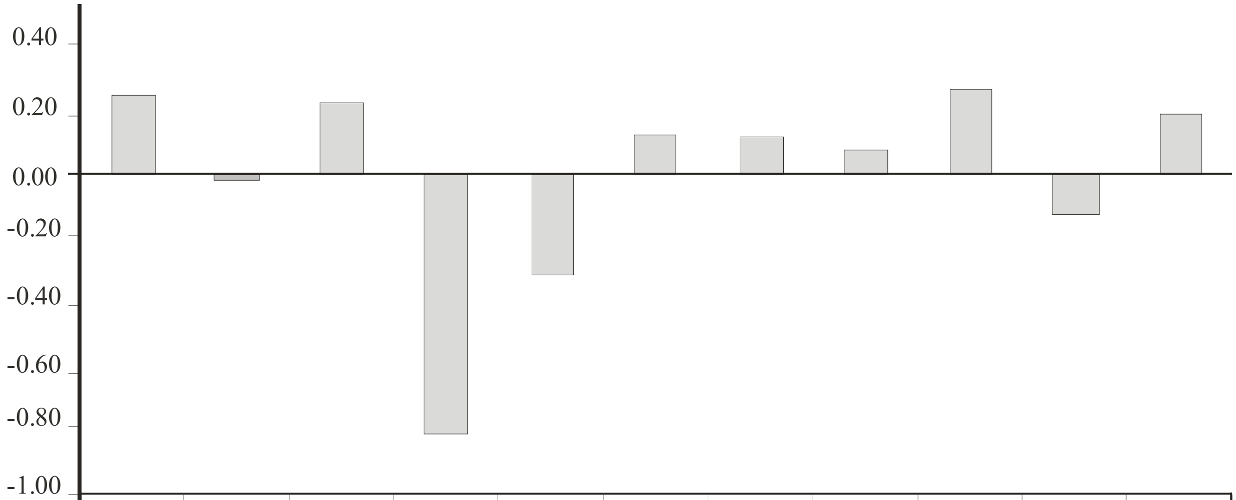


	Self or family in household	Family not in household	Private health insurance	Medicare	Medicaid	Rehabilitation program	Employer	School system	VA program	Free	Other
Working, Unable to Work	0.48	0.24	-0.15	-1.21	-0.36	0.40	0.57	0.31	0.04	-0.37	0.03

Education

Education emerged as the single most influential factor in determining AT use. Among those who used AT, the same variable produced a pattern similar to that produced by the working/not working and working/unable to work dichotomies.

Figure 12.7 Discriminant Function Analysis: High Education, Low Education



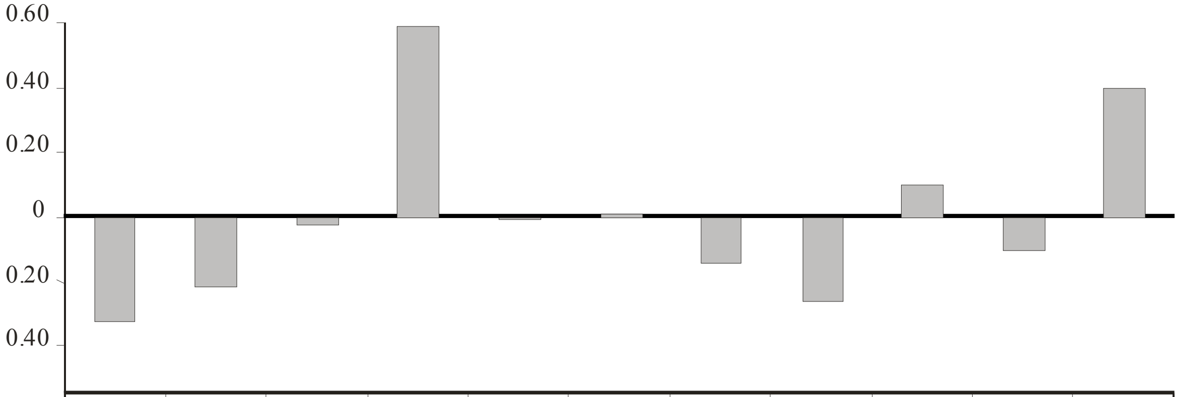
	Self or family in household	Family not in household	Private health insurance	Medicare	Medicaid	Rehabili-tation program	Employer	School system	VA program	Free	Other
Hi-Lo	0.24	0.01	0.23	0.82	-0.31	0.13	0.11	0.08	0.26	-0.12	0.18

Respondents who used AT and who were above the median in educational level attained were significantly less likely to mention Medicare as a payment source than those whose level of education was below the median.

Severity of Impairment

Severity of impairment for AT users was dichotomized by using only those categorized as mild or severe in level of impairment.

Figure 12.8 Discriminant Function Analysis: Impairment, Severe–Mild



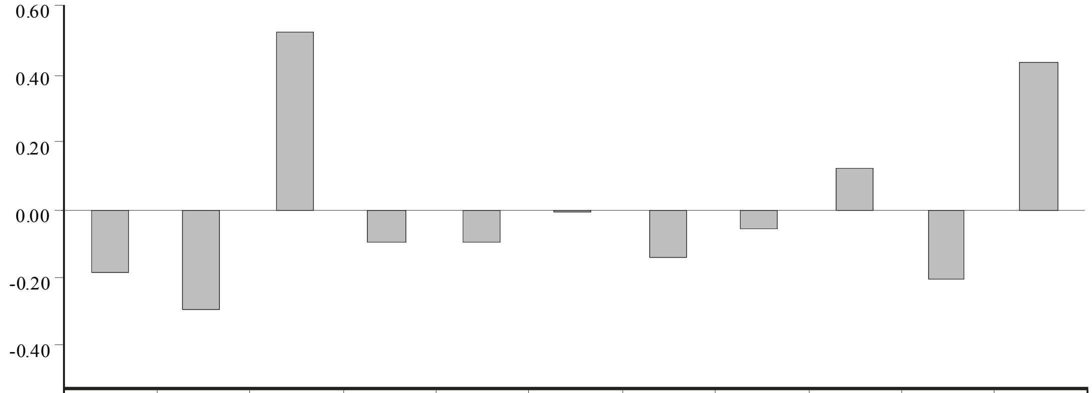
	Self or family in household	Family not in household	Private health insurance	Medicare	Medicaid	Rehabili-tation program	Employer	School system	VA program	Free	Other
Severe-Mild	-0.32	-0.22	-0.02	0.59	-0.01	0.01	-0.15	-0.26	0.10	-0.10	0.40

Here, the pattern shown in the previous two variables, work status and education, was reversed. The more severely impaired respondents were more likely to use Medicare than the mildly impaired.

AT Attitudes and Opinions

The questionnaire contained six questions about the respondents' attitudes on the benefits of AT and on receiving information about AT and how to obtain it. A total opinion score was created, averaging the scores across all items answered for each respondent, and the respondents were scored as positive in attitude for scores below the median (strong agreement with the positive statement earned a score of 1; strong disagreement was scored as 4) and negative in attitude for scores above the median.

Figure 12.9 Discriminant Function Analysis: AT Opinion, Positive–Negative



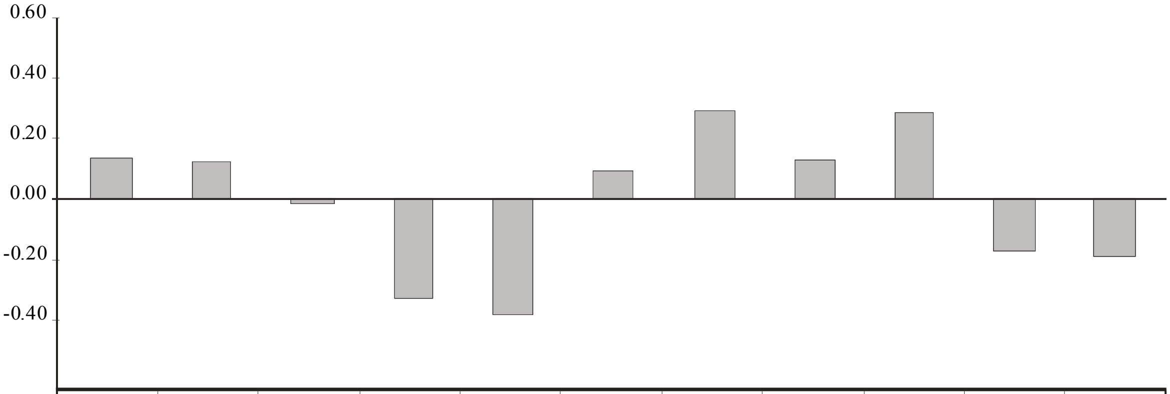
	Self or family in household	Family not in household	Private health insurance	Medicare	Medicaid	Rehabilitation program	Employer	School system	VA program	Free	Other
High-Low	-0.18	-0.29	0.52	-0.09	-0.10	-0.01	-0.14	-0.06	0.12	-0.21	0.43

Figure 12.9 indicates that those individuals who used private health insurance were more positive in attitude compared to those using any of the other assigned categories of payment.

Personal Income

Each respondent was asked the amount of income earned in the previous year. The question was answered by 1,243 (88 percent) of respondents overall, and 778 (87 percent) of respondents who used AT. While there was some indication that those with lower personal incomes were more likely to employ Medicare and Medicaid and less likely to have had their AT provided by a VA program or an employer, the values shown in figure 12.10 are not compelling, and should not be given great weight in evaluating the strength of the variable. Recall that the median personal income was in the $10,000–$14,999 range; a significant proportion of those above the median range in personal income still fell below the poverty line.

Figure 12.10 Discriminant Function Analysis: Personal Income, High–Low

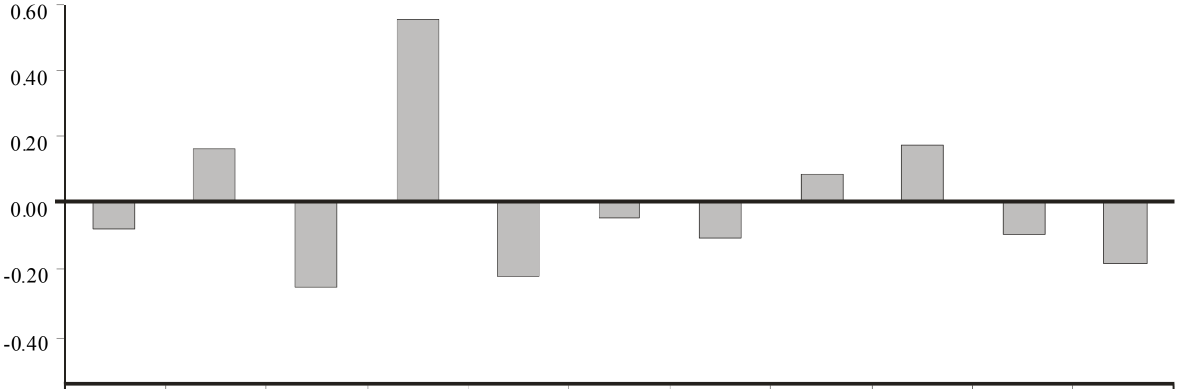


	Self or family in household	Family not in household	Private health insurance	Medicare	Medicaid	Rehabilitation program	Employer	School system	VA program	Free	Other
High-Low	0.14	0.12	-0.01	-0.32	-0.38	0.10	0.29	0.13	0.28	-0.17	-0.19

Age

Figure 12.11 indicates that the older respondents were more likely to use Medicare. No other values exceed what might be expected by chance. Furthermore, family income, race and opinions about changes in policies over the last 10 years had little or no influence on how AT was paid for.

Figure 12.11 Discriminant Function Analysis: Age, Older–Younger



	Self or family in household	Family not in household	Private health insurance	Medicare	Medicaid	Rehabilitation program	Employer	School system	VA program	Free	Other
Older-Younger	-0.08	0.16	-0.25	0.55	-0.22	-0.04	-0.19	0.08	0.17	-0.10	-0.18

Summary and Conclusion

This study revealed an important overall trend in payment practices for AT. About 10 years ago, “medically necessary” AT to enhance physical functioning and mobility was paid in part or in full by third parties. This pattern of use and payment did not appear to have changed significantly. Low-tech devices, adaptations and accommodations used by persons with disabilities for purposes of improved mobility remained the bulk of AT and were paid by third parties in more than half of the cases. In 9 percent of the cases, mobility devices were provided free.

About 10 years ago, home AT and other environmental accommodations were paid, according to some estimates, by persons with disabilities and their families in 67 to 75 percent of the cases, whereas in 2001 this share of the burden to persons with disabilities dropped to less than 60 percent. In some cases, Medicaid or Medicare paid for railings and other structural adaptations, and in almost 8 percent of the cases, smaller home AT items were obtained at no cost.

With advances in modern technology, however, a third type of AT—mostly high-tech and high-cost—demanded the largest share of payment from personal funds (about 70 percent and more). These items included technologically advanced wheelchairs and scooters, hearing devices, vision technology and high-tech communication devices. The latter were particularly important for persons with disabilities who want to participate in school, at work, and in the community, and who are most likely to depend on financial assistance or alternative financing mechanisms to obtain the needed devices and technologies.

To answer the question of whether inadequate funding of AT continues to be a barrier to the more equal inclusion of persons with disabilities in society, this study found that while the absolute number of persons paying for AT themselves continued to grow from over 6 million in 1990 to about 10 million in 2001, the proportion of persons with disabilities who paid for AT appears to have decreased from about 48 percent in 1990 to under 40 percent in 2001. Whether or not this decrease was due at least in part to the *AT Act* is difficult to ascertain. Findings from this survey published elsewhere (Carlson et al., 2002) suggest that technology-related legislation has had a positive impact on the lives of persons with disabilities. We are therefore inclined to propose this as a hypothesis to be tested by further research.

Summary and Conclusion

Among the key components of the technology-related assistance legislation was the nationwide effort to raise awareness about the benefits of assistive technology and environmental accommodations—namely that with the use of AT, persons with disabilities could live more independent and productive lives. To help with the selection and acquisition of appropriate AT, Congress included a provision in the *Tech Act* that allowed state-based agencies and organizations to provide direct support and assistance to persons with disabilities and their families who needed such services.

We began our survey by asking respondents about their occupational status. We found that the modal response for all (52 percent) was that they are unable to work because of their disabilities. The next largest category was respondents working; fewer than 10 percent were able to work but were unemployed. When we asked respondents to explain in detail what condition was responsible for their disabilities, osteoarthritis, hearing loss, the lingering effects of injury, back disorders, multiple sclerosis, diabetes and heart ailments were the most often mentioned causes.

Respondents were asked about their need for and the use of assistive technology in getting to school and to work, in school or at work, in the home, and in the community. Of all respondents, 901 (64 percent) used some assistive technology. Use at school and at work was 36 percent; use at home was 49 percent; and use in the community was 50 percent. Most of the assistive devices used were designed to enhance mobility: canes, crutches, walkers, scooters and wheelchairs. Hearing aids, oxygen tanks and other personal-use devices were also among the most frequently used devices.

We then asked respondents about the process of acquiring such technology: how they learned about it, whether they had help acquiring it, how it was paid for, whether they had attempted to get help, and their successes or failures in these attempts. The most mentioned information source was a physician or other health care professional, accounting for 53 percent of all sources mentioned. The only other frequently mentioned sources were family and friends (15 percent) and vocational rehabilitation counselors (13 percent). We found that physicians and health care professionals provided information to all groups without significant variance. Respondents who used family and friends as a source of information tended to be older, poorer, unemployed, more severely impaired and nonwhite; most significantly, they rendered a more negative opinion of the amount and utility of information they had received about AT, and about the helpfulness of AT in general. Persons obtaining information from vocational rehabilitation counselors tended to be better educated, nonwhite, and unemployed, and had a more positive opinion about AT. In all, over 90 percent of the respondents reported being satisfied or very satisfied with the help that they received in the selection and purchase of AT.

More than one-third of the respondents had their devices paid for by themselves or by family members; and a like number paid for them with private insurance, Medicare and Medicaid. Only about one in five respondents had help in the selection and purchase of their assistive technology. Most of those who had asked for help received it, but the prevailing sentiment was that the respondents did not feel the need to ask for help.

We asked respondents about their use, need and ability regarding information technology, such as telephones and computers. We found virtually no difficulties encountered in using telephones, and significantly more in the use of computers; however, the majority of respondents were well served in both areas.

The analysis included respondents' reported behaviors in leaving the home, the need for modifications to access buildings and facilities outside the home, and the need for personal assistance, all measured against the variables of severity of impairment, education, income, race and age. The primary finding was that socioeconomic factors play the larger role in determining who, among persons with disabilities, had the ability to be integrated into the community. The poor, young, undereducated, and nonwhite encountered more barriers to community integration.

We asked respondents about access and accommodations in the buildings and living spaces they encountered in schools, at work, at home and in their communities. We found greater needs in the home than in the community and at school, and the least need at work—most likely because working persons with disabilities tended to be less impaired than those unable to work because of their disability. We also learned that one in six respondents could be classified as homebound, having not left their homes once in the two weeks preceding the interview.

The attitude and opinion questions centered on: information about AT and how to obtain it; and the effects of AT on the respondents' lives. The respondents asserted that:

- They had received little information about assistive technology and less on how to acquire it, but those who had received information said that it was helpful; and
- AT had made them more productive and more aware of their rights, but had not substantially reduced their dependence on other people.

We also asked their views on how AT had changed compared to 10 years ago. The findings suggest that since the passage of the *Tech Act*:

- The availability of, funding for, access to, and provision of AT devices and services have increased;
- Awareness of AT-related laws, regulations and policies has increased over the past 10 years;
- Awareness and knowledge of benefits of AT devices and services have increased; and
- Awareness of the needs of persons with disabilities age 18 and over has increased.

We asked a series of demographic questions. The primary finding was that persons with disabilities were well below the norm in personal income. Furthermore, we were able to document and quantify the extent to which gender and race were distributed in the disabled population. In short, it was more likely that persons with disabilities were female than male when compared to national statistics, but race did not seem to be a factor.

Another factor that was considered to be of great importance in disability research was age. But there was in the data no statistical relationship between age and severity of impairment or AT use, and the relationship between age and race (Nonwhites were significantly younger than Whites in the sample) merely mirrors the national norm. Furthermore, while age is a factor worthy of consideration in discussing ability, there was also a rationale for making a distinction between the gradual lessening of abilities due to aging and the condition of disability *per se* that is independent of aging. In the 2001 study, it would seem that our respondents measured their levels of ability against their age peers, rather than some ageless ideal of performance.

Persons who used the assistance of another person to conduct their daily lives differed from other persons with a disability in the following ways:

- They were more likely to use some form of assistive technology;
- They were more severely impaired;
- Their levels of personal income were much lower; and
- They were much less likely to be employed.

However, we found no significant differences in their races, levels of education, or ages. When we compared the attitude statements of the respondents who used personal assistance to those of the other persons with disabilities, we found the greatest difference was that personal assistance users were less positive about AT use decreasing the need for personal assistance. The obvious interpretation is that a large segment of personal assistance services was outside of the range of activities that AT can address. This in turn points out that the greatest need in the AT field is not for technological advancement in existing AT, but the extension of the range of AT to areas that are now addressed only by the assistance of another person.

In the case of severity of impairment, the research did document the widely-held belief that the more severely impaired a person was, the more likely that person needed or used assistive technology. The measurement of severity was based on the independent assessment of the level of severity of all respondent conditions reported, assigning numerical weights to the conditions and then summing the weights for individuals. This statistical evaluation was done in lieu of a case-by-case analysis.

Open-ended questions provided much qualitative and quantitative detail. While our analysis of these had centered on the quantitative—the prevalence of predisposing conditions and the types of assistive technologies employed by the respondents, one qualitative result is worth noting. The population of persons with disabilities strongly rejects the perception of themselves as being in need. Rather, the quality of their responses shows considerable pride in their ability to live full and productive lives regardless of the severity of their impairments.

The survey revealed that the widely held belief among experts in the field of assistive technology services that money is the key was erroneous. Instead, we found that there is a strong, positive relationship between level of education and both personal and family income, but level of income and AT use were negatively correlated.

Education's role in the use of assistive technology was the major unanticipated finding. We found that persons with disabilities who had attained a higher level of education were more likely to use AT. In the absence of more specific data, we cannot explain what drives this relationship.

The relatively small sample size of this national survey (n = 1,414) and the low number of responses indicating a state-based agency as the source of information prevented us from detecting significant differences between states clustered by total population and population density.

Two related observations, also needing further study, point out that state-based agencies providing technical assistance to persons with disabilities using or needing AT appear to have raised awareness about their existence in a relatively small number of respondents (about 3 to 5 percent). This proportion may be higher assuming that a large proportion of pamphlets and publications mentioned as a source of information by 7 percent of the respondents originated in state-based technical assistance agencies. Second, centers for independent living and the Internet as a source of information about AT were mentioned each by 1 percent of respondents. These findings suggest that two rich sources of information about AT may be underutilized.

The major shortfall of all studies about technical assistance on AT has been the lack of state-based data on how well the technical assistance programs have worked in the past, and if there are reasons to believe that future investment in these programs will yield measurable benefits for persons with disabilities. Such information is crucial for understanding how the various state-based programs have worked, considering that each state had a large amount of independence and control over what services were provided, to whom, by whom, when, where and how. States and territories provided different amounts of additional funding in addition to federal funds, but more importantly, the population size of the states and their political, economic and geographic characteristics may have affected the quality and amount of AT services provided differently to persons with disabilities as well. There is no evidence today that can tell us how well the 56 programs have worked as a whole or individually when compared to each other.

Finally, the effectiveness of a federal program to assist persons with disabilities in the selection and purchase of AT should be measured in terms of specific outcomes, such as employment and higher levels of social integration. There is anecdotal evidence of how AT has helped persons with disabilities and their families, but AT alone is not the sole contributor to such success. Other factors such as adequate education and job training of AT users play a major role as well. In that regard, more research that measures the direct and indirect benefits resulting from the purchase and use of AT in conjunction with these other factors is needed.

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Appendix A: Screening Instrument

Hello, my name is __________, and I am calling from the University of Michigan Survey Research Center in Ann Arbor, Michigan. We're doing a survey for the RESNA, the Rehabilitation Engineering Society of North America, [if asked to define, RESNA is a group of people who design, engineer and build devices and technology to help persons with disabilities] about people who might use, need or want an assistive device or assistive technology to help them in their daily lives.

What we mean by an assistive device is any equipment that helps people who have some limitations on their abilities to complete tasks with less effort, or more efficiently. For instance, people with a condition that limits their mobility might use crutches, a walker or a wheelchair, or people with carpal tunnel syndrome might use a special computer; in addition, people with some hearing loss might use a hearing aid, or a special telephone.

Assistive technology is a much broader category: it includes such things as software to help people with brain injuries to use computers and automatic door openers**.**

Your telephone number was taken from a computer-generated list. If you or anyone in your household qualifies for and chooses to participate in the study, we will pay you $20 as a token of our appreciation. Your participation is completely voluntary, and your responses will be kept strictly confidential.

In order to determine whether your household qualifies, I need first to make a list of the members of your household, by obtaining only their first names or their relationship to you—whichever you prefer—and then ask a couple of brief questions. I am listing you first. [Record "informant" or informant's first name, in row 1 of "person" column.] Are there any other people 18 or older living there with you? [Ask informant for either relationship to him or her or first names of other household members 18 or older and list them in subsequent rows in the "Person" column.]

1. Does anyone in your household who is over age 18 use or need any of the following special equipment to perform daily tasks and activities in the home, at school or at work, or in the community:

   I-1 A wheelchair? (Who is that?) [Mark next to person in column I-1]

   I-2 A special bed? (Who is that?) [Mark next to person in column I-2]

   I-3 A special telephone? (Who is that?) [Mark next to person in column I-3]

   I-4 The assistance of another person? (Who is that?) [Mark next to person in column I-4]

   I-5 A cane, crutches or a walker? (Who is that?) [Mark next to person in column I-5]

   I-6 Any other type of assistive device? (Who is that?) [Mark next to person in column I-6]

2. Does anyone in your household who is over age 18 have a condition that prevents or greatly limits such basic physical activities as:

II-1 Working at a job or business? (Who is that?) [Mark next to person in column II-1]

II-2 Walking, lifting or carrying? (Who is that?) [Mark next to person in column II-2]

II-3 Dressing, bathing or getting around inside the home? (Who is that?) [Mark next to person in column II-3]

II-4 Going outside the home alone to shop or visit a doctor's office? (Who is that?) [Mark next to person in column II-4]

II-5 Learning, remembering or concentrating? (Who is that?) [Mark next to person in column II-5]

3. Does anyone in your household who is over age 18 have any of the following conditions:

III-1 Blindness? (Who is that?) [Mark next to person in column III-1]

III-2 Severe vision impairment? (Who is that?) [Mark next to person in column III-2]

III-3 A hearing impairment that is not as severe as deafness? (Who is that?) [Mark next to person in column III-3]

III-4 Deafness? (Who is that?) [Mark next to person in column III-4][15]

Person	I 1	I 2	I 3	I 4	I 5	I 6	II 1	II 2	II 3	II 4	II 5	III 1	III 2	III 3	III 4

Interviewer: Record the person with the highest priority condition (lowest Roman and Arabic numbers) on the line if one or more adults in the household have conditions. If no adult household member has any of these conditions, thank the informant and terminate contact.

Person's name or relationship to informant ________________________________

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[15] Template not drawn to scale.

I would now like to speak with [PERSON]. Is he/she available? [If yes, go to questionnaire; if no, schedule a callback.]

Interviewer: If Informant says that [PERSON] is unable to do the interview over the phone *at all* (because of a disability such as hearing impairment or because he/she does not speak English), ask: “Are you or is someone else in the household able to answer some questions about [PERSON’S] use of technology and services or his/her need for technology and services?”

Yes ☐ No ☐

Proxy name or relationship to [PERSON]____

Are you (or this other person) available to answer the questions now? [If yes, go to proxy questionnaire; if no, schedule a call back. If no one in the household can serve as proxy, explain in call notes on page 4 of the coversheet.

Appendix B: Simplified Questionnaire—Content Only

This version presents the instrument in minimal complete version, without repetition for designated subsamples.

Section A: Employment And Disability Status

Status

A1. Are you currently: *Choose all that apply.*

Enrolled in school or any other educational program (college or university)?..1
Gainfully employed or running a business?..2
Able to work, but currently not working?..3
Unable to work because of your disability?..4
A homemaker? 5
Retired? 6
Anything else (specify) (vol) 7

A1b. *If respondent answered retired, probe for reason.*
Did you:

Retire, and then become disabled?..1
Take an early retirement because of disability?..2
Go on disability without becoming eligible for retirement benefits? 3
Never worked because of disability? 4

A2. What condition or limitation do you have that impairs your functioning? [OE]

Sections B, C, D and E: Assistive Devices

These questions were asked of respondents at school or work (if appropriate), and of all respondents about assistive devices at home and in the community.

Questions here show the word “school;” content was repeated for work, home and community.

Interviewer reads: As I mentioned earlier, an assistive device is any equipment that helps people who have some limitations on their abilities to function more efficiently, while an assistive service is any service that directly helps someone select and get or buy any assistive device.

1. Do you use an assistive technology device or service to help you with getting to or from school? Y/N

2. Do you use an assistive technology device or service to help you while you are at school? Y/N

3. What is the assistive device or service that you are now using? (Any others?)

4. How did you learn about the device(s) or service(s)?

Choose all that apply; do not read list.

Doctor or Other Health Care Professional	1
Vocational Rehabilitation Counselor	2
Family, Friends and Neighbors	3
Pamphlets, Magazines and Announcements	4
Centers for Independent Living	5
Disability Business Technical Assistance Centers	6
Tech Act Organizations or Other State Organizations	7
Yellow Pages	8
Television/Radio	9
Internet	10
Anything Else (Specify) (Vol)	11

5. Where did you get the device(s) or service(s)?

If respondent mentions a drugstore, pharmacy or department store such as Wal-Mart or K-Mart, please probe:

Doctor’s Office	1
Hospital or Clinic (Not VA)	2
VA Hospital	3
Vocational Rehabilitation Facility	4
Nursing Home	5
Medical or Orthopedic Supply Store	6

Prescription from Drugstore or Pharmacy, Including Wal-Mart, K-Mart or Other Dept. Store Pharmacy..	7
Over-the-Counter from Drugstore or Department Store, Including Wal-Mart or K-Mart	8
Mail Order Catalogue	9
Anything Else (Specify) (Vol)	10

6. Who paid for the device or service?

Self or Family in Household	1
Family Not in Household	2
Private Health Insurance	3
Medicare	4
Medicaid	5
Rehabilitation Program	6
Employer	7
School System	8
VA Program	9
Free	10
Anything Else (Specify) (Vol)	11

7. Overall, how satisfied are you with the device(s) or service(s)—would you say very satisfied, somewhat satisfied, somewhat dissatisfied, or very dissatisfied?

8. Did you receive help from an agency or organization during the selection and purchase of the device(s) or service(s)? [Y/N]

9. Overall, how satisfied were you with the help you received—would you say very satisfied, somewhat satisfied, somewhat dissatisfied, or very dissatisfied?

10. Did you seek help from an organization or agency with the selection and purchase of the device(s) or service(s)? [Y/N]

11. From which agency or organization did you seek help? (Any others?)

12. What were your reasons for not contacting an organization or agency? (Any other reasons?)

13. In addition to the devices that you are using now, are there any additional assistive technology devices or services that would help you with getting to or from school? [Y/N]

14. In addition to the devices that you are using now, are there any additional assistive technology devices or services that would help you while you are at school? [Y/N]

15. What assistive devices or services would you use? (Any others?)

16. Is there an assistive technology device or service that would help you with getting to or from school? [Y/N]

16b. What assistive devices or services would you use? (Any others?)

16c. To what extent would these additional devices or services help? Would you say a lot, somewhat, or a little?

17a. Is there an assistive technology device or service that would help you while you are at school? [Y/N]

17b. What assistive devices or services would you use? (Any others?)

17c. To what extent would these additional devices or services help? Would you say a lot, somewhat, or a little?

18a. Have you ever tried to get a device or service without any success? [Y/N]

18b. What was the reason you were turned down? [OE]

18c. Are you aware you can get help to obtain the device or service? [Y/N]

19. Where will you go to learn more about the device(s) or service(s)?

Choose all that apply; do not read list.

Doctor or Other Health Care Professional	1
Vocational Rehabilitation Counselor	2
Family, Friends and Neighbors	3
Pamphlets, Magazines and Announcements	4
Centers for Independent Living	5
Disability Business Technical Assistance Centers	6
Tech Act Organizations or Other State Organizations	7
Yellow Pages	8
Television/Radio	9
Internet	10
Anything Else (Specify) (Vol)	11

20. Do you plan to contact any agency or organization for help or advice? [Y/N]

21. Which agency or organization do you plan to contact? (Any others?)

22. What are your reasons for not contacting any agency or organization? [OE]

Sections F, G and H: Telephone Use At School/Work/In Community

Since the interview was conducted via home telephone, none of the telephone questions asked about availability at home. Questions here show the word “school;” content was repeated for work and the community.

1. Is there a telephone available for you to use at school? [Y/N]

2. (Please remind me) Can you use a standard telephone without any assistance? [Y/N]

3. (Please remind me) Do you need the help of another person to use the telephone? [Y/N]

4. (Please remind me) Do you need any special modifications, such as TTY or relay services, in order to make a telephone call? [Y/N]

5. Has any person or agency given you advice or help in using the telephone at school? [Y/N]

6. What person or agency helped you? [OE] (Any others?)

7. How did you learn about this service?

   Choose all that apply; do not read list.

Doctor or Other Health Care Professional	1
Vocational Rehabilitation Counselor	2
Family, Friends and Neighbors	3
Pamphlets, Magazines and Announcements	4
Centers for Independent Living	5
Disability Business Technical Assistance Centers	6
Tech Act Organizations or Other State Organizations	7
Yellow Pages	8
Television/Radio	9
Internet	10
Anything Else (Specify) (Vol)	11

8. Have you had any difficulties in obtaining this service? [Y/N]

9. What kind of difficulties have you had? [OE] (Any others?)

Section J: Computer Use

1. Is there a computer available for you to use at school?
    - Yes 1
    - No..5
    - Yes, but not needed for school (vol)....................................2
    - Yes, but do not know how to use (vol)................................3
    - No, but not needed for school (vol)......................................6
    - No, but do not know how to use (vol) 7

2. Is there a computer available for you to use at work?
    - Yes 1
    - No..5
    - Yes, but not needed for school (vol)....................................2
    - Yes, but do not know how to use (vol)................................3
    - No, but not needed for school (vol)......................................6
    - No, but do not know how to use (vol) 7

3. Is there a computer available for you to use at home?
    - Yes 1
    - No..5
    - Yes, but do not know how to use (vol)................................3
    - No, but do not know how to use (vol) 7

4. Is there a computer available for you to use in the community?
    - Yes 1
    - No..5
    - Yes, but do not know how to use (vol)................................3
    - No, but do not know how to use (vol) 7

5. (Is the/are any of the) computer(s) available to you connected to the Internet? [Y/N]

6. Do you need the help of another person to use a computer? [Y/N]

7. Do you need special modifications or accommodations in order to use a computer such as a special monitor, keyboard or accessories? [Y/N]

8. Has any person or agency helped or advised you in using a computer?

9. What person or agency helped you? [OE] (Any others?)

10. How did you learn about this service?

Choose all that apply; do not read list.

Doctor or Other Health Care Professional	1
Vocational Rehabilitation Counselor	2
Family, Friends and Neighbors	3
Pamphlets, Magazines and Announcements	4
Centers for Independent Living	5
Disability Business Technical Assistance Centers	6
Tech Act Organizations or Other State Organizations	7
Yellow Pages	8
Television/Radio	9
Internet	10
Anything Else (Specify) (Vol)	11

11. Have you had any difficulties in obtaining this service? [Y/N]

12. What kind of difficulties have you had? [OE] (Any others?)

Sections K, L, M and N: Access to Community Facilities

Questions here show the word “community;” content was repeated for work, home and school.

1. How many days in the last two weeks did you participate in social activities outside your home such as visiting friends and family, going to a restaurant or movie, or going to church?

   NONE / 1 / 2–4 / 5–9 / 10–13 / 14

If respondent answered NONE, these questions were not asked about community access.

2. People who have physical impairments or health problems sometimes need assistance in obtaining access to all the places they need to go and to facilities and equipment they need to use. Do you need the help of another person to access or use public buildings and facilities such as libraries, government buildings, or public transportation, or restaurants, theaters, stores and shopping malls? [Y/N]
3. Do you need special modifications, adaptations or accommodations to enter or use public buildings and facilities? [Y/N]
4. Are there special modifications, adaptations or accommodations to enable you to enter and use public buildings and facilities? [Y/N]
5. Do you have access to public buildings and facilities? [Y/N]
6. Have you tried to obtain help in getting special modifications? [Y/N]
7. What agency or organization did you contact to get help? [OE] (Any others?)
8. Do you plan to contact any agency or organization to obtain help in getting these special modifications? [Y/N]
9. What agency or organization do you plan to contact to get help? [OE] (Any others?)
10. What are your reasons for not planning to seek help from any agency or organization? [OE] (Any other reasons?)

Section P: Impact of Information and Assistance

PA. Now I’d like to ask you some questions about information and advice on assistive devices that you may have received.

P1. Overall, how much information and advice have you received about assistive technology? Would you say a lot, some, a little, or none?

P2. Overall, how much information and advice have you received about how to obtain it? Would you say a lot, some, a little, or none?

P3. Overall, how much difference would you say that the information and advice about assistive technology and how to obtain it has made in increasing your level of learning, independence, productivity and community integration? Would you say a lot, some, a little, or none?

P4. Overall, how much has information and advice about assistive technology and how to obtain it helped you to become more aware of your rights? Would you say a lot, some, a little, or none?

P5. How much has your use of assistive technology devices and services decreased your need for help from another person? Would you say a lot, some, a little, or none?

P6. To what extent have better-designed products and environmental access features or universal design products reduced your need for assistive technology devices and services? Would you say a lot, some, a little, or none?

P7. Compared to 10 years ago, people are more aware of the need for assistive technology devices and services for persons with disabilities. Would you say that you strongly agree, agree, disagree, or strongly disagree?

P8. Compared to 10 years ago laws or program policies have been changed to help persons with disabilities to get assistive technology. Would you say that you strongly agree, agree, disagree, or strongly disagree?

P9. Compared to 10 years ago more people are aware of assistive technology and understand how it can benefit persons with disabilities. Would you say that you strongly agree, agree, disagree, or strongly disagree?

P10. Compared to 10 years ago it is easier to find assistance for purchasing assistive technology devices and services. Would you say that you strongly agree, agree, disagree, or strongly disagree?

Section Q: Demographics

Q1. What is your age?

18–25..........................1
26–35..........................2
36–45..........................3
46–55..........................4
56–65..........................5
66–75..........................6
76–85..........................7
>85 8

Q2. Are you of Spanish or Latino origin? [Y/N]

Yes 1
No...............................5

Q3. Which of the following racial or ethnic group(s) best describes you?

Choose all that apply; do not read list.

American Indian or Alaska Native 1
Asian 2
Black or African-American..........................3
Native Hawaiian or Other Pacific Islander ..4
White/Caucasian 5
Anything Else (Vol).....................................6

Q4. What is the highest grade of school or year of college you have completed?

None; Kindergarten......................................1
1–8 (Elementary) 2
9–12 (High School Graduate)......................3
1–3 Yrs. College 4
4 Yrs. College Graduate...............................5
5+ Yrs. College 6

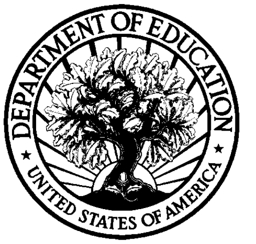
Q5. I am going to read you a list of income categories. Please tell me which category best describes the total income of all members of your family living in your house in 2000 before taxes. This figure should include salaries, wages, pensions, dividends, interest, and all other income.

< \$5,000	1
\$5,000–\$9,999	2
\$10,000–\$14,999	3
\$15,000–\$19,999	4
\$20,000–\$24,999	5
\$25,000–\$34,999	6
\$35,000–\$49,999	7
\$50,000–\$69,999	8
\$70,000–\$89,999	9
\$90,000–\$109,999	10
\$110,000 +	11

Q6. Now we are interested in the income that you yourself received in 2000. This does not include any of the income received by the rest of your family. Please stop me when I get to your income category.

< \$5,000	1
\$5,000–\$9,999	2
\$10,000–\$14,999	3
\$15,000–\$19,999	4
\$20,000–\$24,999	5
\$25,000–\$34,999	6
\$35,000–\$49,999	7
\$50,000–\$69,999	8
\$70,000–\$89,999	9
\$90,000–\$109,999	10
\$110,000+	11

Thank you very much for your time and your help with our research. I would like to get your name and mailing address in case my office should wish to get in touch with you to verify this interview. And, as I mentioned before, the University of Michigan would like to send you a check for \$20 as a token of our appreciation for your help.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