

Disparities in Usage of Assistive Technology Among People With Disabilities

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Assistive technology is essential to the lives of many people with disabilities, but disparities in usage put certain segments of the disability population at a particular disadvantage. This article uses survey data and statistical modeling to explore differences in technology usage across disability subpopulations. Responses to a 2005 survey of nearly 2,000 adult consumers of California Independent Living Centers reveal large differences in technology usage by age, race, ethnicity, education, income, and type and severity of disability. Statistical modeling of overall device usage, number of devices used, and usage of high-, medium-, and low-tech devices reveals several factors that appear to put people with disabilities at a disadvantage in accessing and using assistive devices. These factors include lower educational attainment, racial or ethnic minority status, lower household income, later disability onset, and disability related to mental as opposed to physical or sensory functioning. Findings highlight approaches needed to expand usage of and to promote equal access to technologies that enable greater social and economic participation for people with disabilities.

Key Words: Assistive Technology—Disability—Disparities—Independent Living—Participatory Action Research.

INTRODUCTION

Assistive technology (AT) enables many people with disabilities to live independently, take care of their basic needs, participate in community activities, and engage in gainful employment. But not everyone who could benefit from AT uses it. Some

may not know about relevant technologies or appreciate their potential benefits, or they may not know how to obtain AT or where to go for good advice; others may not be able to obtain devices they need but cannot afford through public programs or private health insurers. Unmet need for AT means that a person is not as fully integrated into society as he or she might be, potentially experiencing social or physical isolation, economic disadvantage, or even failure to meet basic needs. Across disability populations, differences in AT usage may imply that some groups experience relative disadvantage in their ability to be full participants in community life.

Based on a 2005 survey of consumers of Independent Living Centers (ILCs) throughout California, this article explores differences in the rate, extent, and nature of AT usage among people in different age groups, of different educational backgrounds and economic means, of different races, ethnicities, and genders, and with different impairment types and severities.

BACKGROUND

In analyses of survey data on the general U.S. population, AT usage has been found to vary by such factors as age (LaPlante, Hendershot, & Moss, 1992; Russell, Hendershot, LeClere, Howie, & Adler, 1997), gender, educational attainment, income, race, and ethnicity (Carrasquillo, Lantigua, & Shea, 2000; Kaye, Kang, & LaPlante, 2000). Because the prevalence of disability also varies by the same characteristics, however, these differences in usage rates may simply be the result of different levels of need and therefore may not reflect disparities in access to technology. There are, however, quite a few studies of AT usage, generally

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limited to a specific disability population or age group or to a particular kind of technology, that either control for the level of need or restrict the sample to a relatively homogeneous disability population. We believe that ours is the first study to explore disparities in usage of a broad range of AT among a population of both elderly and nonelderly adults with all types of disabilities, taking into account the nature and severity of the disability.

Several studies have explored factors influencing AT usage among elderly adults identified as having a particular type of disability. Among a sample of frail elders with hearing impairments, African Americans were found to be substantially less likely to use hearing-related technology, including hearing aids, than their white counterparts (Tomita, Mann, & Welch, 2001). In a second study of older adults with difficulties in activities of daily living (ADLs), African American participants used fewer assistive devices than white participants, with most of the gap in devices for hearing and vision (Tomita, Mann, Fraas, & Burns, 1997). In another study of frail older adults with physical impairments, racial or ethnic minority status and lower educational attainment were associated with usage of fewer assistive devices (Tomita, Mann, Fraas, & Stanton, 2004).

Other researchers have used survey data to explore AT usage among representative samples of elderly adults, controlling for disability status. Such studies have identified the following predictors of lower device usage: racial minority status and lower educational attainment (Hartke, Prohaska, & Furner, 1998), racial minority status and socioeconomic factors (Rubin & White-Means, 2001), lower educational attainment, female gender, and rural residency (Forbes, Hayward, & Agwani, 1993), and urban residency and younger age for mobility device usage (Zimmer & Chappell, 1994). In one of the few studies to include both elderly and nonelderly adults, African American racial identity was found to actually increase the likelihood of mobility device use among people with mobility impairments, both before and after controlling for the level of impairment (Resnik & Allen, 2006).

In a study comparing usage of equipment with that of personal assistance for ADL tasks among elderly adults, older age, racial minority status, and more education were all associated with greater likelihood of equipment usage (Agree, Freedman, & Sengupta, 2004). A similar study found that greater education and older age predicted AT usage (Freedman, Martin, Cornman, Agree, & Schoeni, 2005). Educational attainment also pre-

dicted usage of assistive devices to help cope with ADL disabilities in another recent study of elderly adults (Cutler, Landrum, & Stewart, 2006).

METHODS

The Community Research for Assistive Technology project used a research philosophy known as Participatory Action Research (PAR) to explore usage and efficacy of AT. In PAR the population under study are essential participants in all phases of the research, including the formulation of research questions and the interpretation of findings (Whyte, 1989; Whyte, 1991; Whyte, Greenwood, & Lazes, 1989); the goal is to make the research more relevant to the population under study and more useful in advocating for policy change. The focus on both active participation of the population being researched and the practical objectives to be achieved resonates strongly with the principles of the Independent Living Movement, in which people with disabilities are empowered to make their own choices and work to achieve societal change (Zola, 1988).

The project culminated in a survey of consumers using the services of ILCs throughout California. This survey was developed through an extensive qualitative and semiquantitative research process (Doe, 2004), including key informant interviews, community-based focus groups, extraction of key themes using grounded theory methods (Glaser & Strauss, 1967; Strauss & Corbin, 1998), pilot testing of the initial questionnaire in multiple response modes, and extensive revisions to both the instrument and the survey procedures based on lessons learned from the pilot. In the final survey, a paper questionnaire was offered as the primary response mode, with telephone or Internet response available as accommodations for respondents who could not or preferred not to respond in writing.

After human subjects approval was obtained, 20 of California's 29 ILCs mailed out questionnaires to a sample of adult consumers listed in their databases. An incentive of \$20 was offered to each respondent for his or her participation, and an additional \$10 was offered to the ILC for each consumer responding. A reminder postcard was mailed out a few weeks following the initial mailing.

Of the 14,104 questionnaires mailed out (less the 1,026 returned as undeliverable), 1,919 people responded to the survey in all modes, for a response rate of 14.7%. By focusing exclusively on ILC users, we were able to assemble a large and diverse

pool of adults with disabilities throughout California, but we make no claims that our sample is representative of the experiences of all Californians with disabilities. Respondents were typically working-age adults with relatively low incomes and one or more type of disability (mobility impairment is the most common type), as indicated in Table 1.

The sample for the present analysis began with 1,903 records for respondents who had completed the entire survey. Some 189 records, or 9.9% of the sample, were then dropped because of missing responses to one or more of the demographic variables needed in the statistical models: age (2.2% missing values), age of disability onset (3.8%), sex (1.5%), educational attainment (2.4%), and race/ethnicity (2.8%). Of the remaining sample of 1,714 records, 193 (11.3%) are missing data on household income. Concerned that dropping these records would have biased our findings, we instead chose to retain such records and add an "income unknown" category to the models.

Logistic regression was used for the four models with binary outcomes: namely, whether or not the respondent uses any AT or a particular type of AT. In modeling the number of AT devices used, we used negative binomial regression.

Measurement of AT usage is based on responses to a series of three questions asking, "What do you use to help yourself?" and offering a checklist of 22 common AT devices followed by a blank space for "Other." The first two questions asked about the most and second-most important devices used, and the third asked the respondent to check off or name as many other devices as he or she used. Devices listed included mobility devices (electric and manual wheelchairs, scooters, canes, crutches, and walkers), other technologies for people with limited mobility (reachers/grabbers, adapted eating or cooking utensils, adapted vehicles), devices to aid breathing (ventilators, oxygen), computer technology (ordinary computers, specialized hardware or software, and communication devices), devices or technologies for people with hearing impairments (adapted telephones, hearing aids, TTYs or text pagers, flashing/vibrating alerting devices, and relay services), and devices for people with visual impairments (talking devices, white canes, magnifiers, and books on tape). Devices that were not included on the checklist but were frequently mentioned by respondents included prostheses, braces, bathroom or shower chairs, grab bars, eyeglasses or lenses, breathing machines (CPAP/BiPAP), and ergonomic furniture.

A person was classified as an AT user if he or she

checked off or named one or more devices in response to any of the questions. A count of devices was obtained by adding up devices checked or mentioned in response to all three questions. Users of *high-tech devices* are those checking off any digitally based equipment, such as computer hardware or software or a communication device. Users of *medium-tech devices* are those checking off any other electronic or motorized equipment, such as a power wheelchair, scooter, or hearing aid. Users of *low-tech devices* are those who checked off any other, nonmotorized, nonelectronic device, such as a magnifier, cane, or oxygen tank. The three categories are not mutually exclusive and are treated in separate models.

Variables used in the models are listed in Table 1, along with the omitted categories, which are indicated in bold. Classification of disability type and severity is based on a list of 13 statements presented to the respondents, indicating the presence of a sensory, speech, mobility, or cognitive impairment, a mental health disability, or some other type of disability as specified by the respondent. People naming chronic illnesses or mentioning general pain, fatigue, or poor health were classified as having "other physical disabilities."

RESULTS

Shown in Table 1 are raw rates of overall AT usage, mean number of AT devices used (including zeros for nonusers), and rates of usage of low-, medium-, and high-tech AT devices. Usage increases markedly with age, especially for low-tech devices; however, there is a significant decline with age in usage of high-tech devices. In contrast, differences by gender are relatively modest, with women indicating greater overall usage. African Americans and Latinos have lower levels of AT usage, particularly of high-tech devices, than non-Hispanic whites. AT usage increases with educational attainment, especially for medium- and high-tech devices. Usage also increases with income, but not as dramatically as with education.

People with childhood-onset disabilities are the least likely to use any AT, and people acquiring their disabilities late in life are the most likely. Low-tech device usage is highest among people with elderly-onset disabilities, medium-tech device usage is high among both the birth- and elderly-onset groups, and high-tech device usage is highest for people with birth-onset disabilities.

As might be expected, people with more severe mobility or sensory disabilities have high levels of usage of all types of devices. In contrast, people

TABLE 1. Number and percentage distribution of respondents, proportion using AT, mean number of AT devices used, and proportion using low-, medium-, and high-tech devices, by age, sex, race/ethnicity, education, income, and disability onset, type, and severity

Characteristic	Category (Bold = omitted category)	Percentage of sample	Uses any AT (%)	Mean devices used	Low-tech AT (%)	Medium-tech AT (%)	High-tech AT (%)
Entire sample		100.0	67.6	2.0	53.2	36.0	19.4
Age group	18-44	28.8	55.3**	1.6	36.0**	30.6	21.5
	45-54	28.4	64.3	1.8	50.5	32.9	18.5
	55-64	23.9	72.4*	2.2**	59.7**	36.7	22.5
	65-74	9.3	79.2**	2.4**	66.7**	46.5**	17.0
	75+	9.6	90.9**	2.6**	83.6**	49.7**	10.9*
Sex	Male	38.7	63.0**	1.8**	46.9**	33.3	21.0
	Female	61.3	70.4	2.1	57.2	37.7	18.5
Race/ethnicity	White non-Latino	56.6	72.4	2.3	57.9	40.5	23.1
	African American	16.5	57.8**	1.4**	45.0**	28.0**	12.8**
	Other race	13.9	65.1*	2.2	48.3**	37.4	22.7
	Latino/Hispanic	17.0	61.2**	1.5**	46.7**	28.2**	11.3**
Educational attainment	Not HS graduate	16.9	65.1	1.5**	49.1	31.1	8.7**
	HS diploma/GED	20.6	62.9	1.5**	51.3	30.3	10.8**
	Some college	36.4	66.3	2.0	54.0	33.2	19.6
	College graduate	14.4	68.8	2.4*	52.2	42.1*	31.2**
	Graduate degree	11.7	81.6**	3.0**	61.2	54.2**	35.3**
Annual household income	<\$10,000	38.0	62.9	1.8	50.6	31.7	17.0
	\$10K-19,999	29.0	69.0*	2.1*	54.3	34.2	19.3
	\$20K-34,999	12.1	72.0*	2.4**	57.0	45.9**	24.2*
	\$35K+	9.6	77.6**	2.5**	58.2	47.9**	32.1**
	Unknown	11.3	66.3	1.8	50.8	34.2	11.9
Disability onset	Birth	13.1	69.6	2.3**	43.3**	46.9**	25.9*
	Childhood	12.8	55.3**	1.9	40.6**	33.3	22.8
	Ages 18-64	66.5	66.9	1.9	54.3	32.8	18.4
	Ages 65+	7.6	90.1**	2.6**	81.7**	49.6**	11.5
Mobility impairment	Severe	29.6	95.9**	3.3**	88.2**	59.3**	23.8**
	Moderate	29.3	76.3**	2.1**	64.9**	33.5**	20.3*
	Other	6.7	51.8*	1.2	24.6	23.7	15.8
	None	34.4	38.8	0.9	18.6	20.5	15.6
Other physical disability	Any	14.8	70.4	2.1	54.2	33.2	19.4
	None	85.2	67.1	2.0	53.0	36.5	19.4
Visual impairment	Blind	3.9	82.1**	3.8**	74.6**	55.2**	56.7**
	Low vision	19.9	76.2**	2.5**	65.1**	43.7**	22.9**
	None	76.2	64.5	1.8	49.0	33.0	16.6
Hearing impairment	Deaf	2.5	88.1**	3.4**	33.3*	81.0**	26.2
	Hard of hearing	17.7	78.3**	2.6**	60.2*	53.6**	19.1
	None	79.8	64.5	1.8	52.3	30.7	19.3
Speech impairment	Any	13.1	70.1	2.3*	51.3	47.3**	20.1
	None	86.9	67.2	2.0	53.5	34.3	19.3
Mental health disability	Any	29.7	48.5**	1.3**	35.2**	21.6**	14.3**
	None	70.3	75.6	2.3	60.8	42.1	21.6
Cognitive impairment	Intellectual	3.0	50.0**	1.6	25.0**	32.7	21.2
	Other DD	7.0	57.5**	1.8	45.8*	30.8	17.5
	Learning disability	10.6	57.5**	1.5**	38.1**	29.8*	17.7
	Other cognitive	3.0	59.6	2.0	46.2	28.8	26.9
	None	76.4	70.9	2.1	57.4	37.7	19.5

*Comparison with omitted category is statistically significant at $p < .05$. ** $p < .01$.

TABLE 2. Regression coefficients and standard errors obtained from models of overall AT usage, number of devices used, and usage of low-, medium-, and high-tech AT devices

Variable	Usage of any AT		Number of devices		Usage of low-tech AT		Usage of medium-tech AT		Usage of high-tech AT	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Age 18-44	-0.18	0.17	-0.07	0.06	-0.34	0.18	-0.17	0.17	0.26	0.19
Age 55-64	0.05	0.18	0.03	0.06	0.09	0.17	-0.07	0.16	0.10	0.18
Age 65-74	0.46	0.26	0.09	0.08	0.56*	0.25	0.22	0.22	-0.46	0.27
Age 75+	0.64	0.42	-0.12	0.11	0.90*	0.37	-0.28	0.30	-1.20**	0.42
Male	-0.31*	0.13	-0.13**	0.05	-0.51**	0.13	-0.20	0.12	0.18	0.14
African American	-0.29	0.17	-0.26**	0.07	-0.26	0.18	-0.14	0.17	-0.43*	0.21
Other race	-0.11	0.18	0.06	0.06	-0.27	0.19	0.09	0.17	0.03	0.19
Latino	-0.23	0.17	-0.22**	0.06	-0.20	0.17	-0.33*	0.17	-0.75**	0.21
Not HS graduate	0.01	0.19	-0.23**	0.07	-0.25	0.19	-0.04	0.18	-0.95**	0.25
HS diploma	-0.18	0.18	-0.29**	0.06	-0.08	0.18	-0.25	0.17	-0.75**	0.22
College graduate	0.03	0.20	0.15*	0.07	-0.27	0.20	0.43*	0.18	0.68**	0.19
Graduate degree	0.45	0.24	0.24**	0.07	-0.26	0.22	0.72**	0.19	0.77**	0.20
Income \$10-20K	0.14	0.16	0.10	0.06	-0.03	0.16	0.03	0.15	0.05	0.17
Income \$20-35K	0.13	0.22	0.21**	0.07	-0.02	0.22	0.48*	0.19	0.32	0.21
Income \$35K+	0.37	0.25	0.11	0.08	0.05	0.24	0.39	0.21	0.42	0.23
Income unknown	-0.00	0.22	-0.06	0.08	-0.08	0.22	-0.13	0.20	-0.59	0.27
Birth onset	0.61**	0.22	0.26**	0.07	0.03	0.22	0.75**	0.20	0.25	0.21
Childhood onset	0.08	0.20	0.14	0.07	-0.00	0.21	0.38	0.19	0.37	0.21
Elderly onset	0.41	0.44	0.03	0.11	0.09	0.39	0.24	0.30	0.05	0.43
Severe mobility	3.52**	0.25	1.22**	0.06	3.46**	0.19	1.75**	0.16	0.54**	0.18
Moderate mobility	1.57**	0.15	0.82**	0.07	1.99**	0.16	0.71**	0.16	0.44*	0.19
Lesser mobility	0.46*	0.23	0.24*	0.11	0.36	0.26	0.16	0.27	-0.06	0.31
Other physical	0.41*	0.18	0.13*	0.06	0.19	0.18	0.01	0.16	0.03	0.19
Blind	1.23**	0.38	0.79**	0.10	1.94**	0.36	0.84**	0.30	2.17**	0.29
Low vision	0.40*	0.17	0.25**	0.05	0.63**	0.17	0.30*	0.15	0.63**	0.17
Deaf	2.03**	0.52	0.94**	0.12	-0.42	0.44	2.67**	0.43	0.76	0.40
Hard of hearing	0.58**	0.19	0.31**	0.06	-0.06	0.18	1.06**	0.15	0.08	0.19
Speech	-0.10	0.21	-0.01	0.07	-0.22	0.20	0.31	0.18	-0.13	0.21
Mental health	-0.54**	0.14	-0.28**	0.06	-0.45**	0.15	-0.61**	0.15	-0.42*	0.17
Intellectual	-0.41	0.38	-0.05	0.15	-0.68	0.43	-0.12	0.37	0.49	0.41
Other DD	-0.08	0.25	0.004	0.09	0.15	0.26	-0.06	0.25	0.11	0.29
Learning disability	0.02	0.21	-0.05	0.08	-0.23	0.22	-0.01	0.20	0.09	0.23
Other cognitive	-0.22	0.37	-0.02	0.13	-0.28	0.39	-0.34	0.36	0.29	0.35
Constant	-0.53*	0.24	-0.16	0.09	-1.03**	0.24	-1.77**	0.23	-1.95**	0.26
Pseudo R^2	0.30		0.12		0.34		0.19		0.15	

*Statistically significant at $p < .05$. ** $p < .01$.

with mental health disabilities or with most types of cognitive impairments are less likely to use AT than others in the sample without those types of disabilities. Because many respondents report more than one type of disability, greater clarity as to which devices are used by people with specific disabilities can be obtained from the statistical models, which control for multiple disabilities.

Coefficients from the regression models are shown in Table 2, and predictions from the models are presented in Tables 3 and 4. Table 3 shows predicted usage rates and numbers of devices for a typical respondent with a typical type and severity of disability (moderate mobility impairment and

nothing else); in other words, predictions in each row are obtained with all dummy variables set to zero except the row variable and moderate mobility impairment. Predictions in Table 4 are for a typical respondent with the level and type of disability shown in the table, but no other disability (i.e., all dummy variables in the models set to zero except the row variable).

After controlling for the type and multiplicity of disability, along with other factors, age no longer has much of an influence on overall AT usage levels. Low-tech device usage increases significantly with age, but the predicted effect is much smaller than the differences observed in the raw data. No

TABLE 3. Model predictions of overall AT usage, mean number of devices used, and usage of low-, medium-, and high-tech AT devices, by demographic variables and disability onset, controlling for other factors

Characteristic	Category (Bold = omitted category)	Uses any AT (%)	Mean devices used	Low-tech AT (%)	Medium-tech AT (%)	High-tech AT (%)
Age group	18-44	70.2	1.8	64.9	22.6	22.3
	45-54	73.9	1.9	72.3	25.7	18.2
	55-64	74.9	2.0	74.0	24.4	19.6
	65-74	81.7	2.1	82.0*	30.2	12.3
	75+	84.3	1.7	86.5*	20.8	6.2**
Sex	Male	67.4*	1.7**	61.1**	22.1	21.0
	Female	73.9	1.9	72.3	25.7	18.2
Race/ethnicity	White non-Latino	73.9	1.9	72.3	25.7	18.2
	African American	67.9	1.5**	66.7	23.1	12.6*
	Other race	71.7	2.1	66.6	27.5	18.6
	Latino/Hispanic	69.2	1.6**	68.0	19.9*	9.5**
Educational attainment	Not HS graduate	74.2	1.5**	67.0	24.9	7.9**
	HS diploma/GED	70.3	1.4**	70.6	21.3	9.5**
	Some college	73.9	1.9	72.3	25.7	18.2
	College graduate	74.5	2.2*	66.5	34.8*	30.5**
	Graduate degree	81.6	2.5**	66.7	41.5**	32.3**
Annual household income	<\$10,000	73.9	1.9	72.3	25.7	18.2
	\$10K-19,999	76.6	2.1	71.8	26.4	18.9
	\$20K-34,999	76.4	2.4**	71.9	35.8*	23.4
	\$35K+	78.0	2.1	72.0	33.3	25.3*
	Unknown	73.9	1.8	70.7	23.3	10.9
Disability onset	Birth	83.9**	2.5**	72.9	42.2**	22.2
	Childhood	75.4	2.2	72.2	33.5	24.3
	Ages 18-64	73.9	1.9	72.3	25.7	18.2
	Ages 65+	81.0	2.0	74.0	30.6	18.9

*Prediction significantly different from omitted category at $p < .05$. ** $p < .01$.

significant effect of age is seen in the medium-tech model, but in the high-tech model, the lower usage rates among older respondents achieve a greater level of statistical significance in the model than in the raw data. *Gender* remains a significant predictor in three of the models, but again its effect is relatively modest.

Unlike in the raw data, only two models show statistically significant effects of *race*. After controlling for other factors, African Americans use fewer AT devices than their nonminority counterparts and are less likely to use high-tech devices. Three models show a significant effect for Latino *ethnicity*: mean number of devices, usage of medium-tech devices, and especially usage of high-tech devices, all of which are lower for this group.

Although *educational attainment* is not a significant predictor of overall device usage, it retains its status as a highly important determinant of number of devices used and of usage of medium-tech and, most dramatically, high-tech devices. *Income*, on the other hand, loses much of its predic-

tive power once education and other factors are controlled for; with only modest statistical significance, greater income predicts increased usage of medium- and high-tech devices.

The relationship of *disability onset* and usage is somewhat different in the models than in the raw data. After controlling for other variables, such as age and type of disability, we find that birth onset now predicts substantially higher overall usage of AT, a greater number of devices used, and much higher usage of medium-tech devices. As for the *type and severity of disability*, mobility and visual impairments are associated with greater usage of AT overall in all models; hearing impairments predict greater overall usage, number of devices, and usage of medium-tech devices, such as hearing aids and TTYs. In contrast, no level of cognitive impairment has a significant effect in any of the models, nor does speech impairment.

Even more notable is the observation that the coefficients for mental health disability are statistically significant and negative in every model. Giv-

TABLE 4. Model predictions of overall AT usage, mean number of devices used, and usage of low-, medium-, and high-tech AT devices, by disability type and severity, controlling for other factors

Characteristic	Category (Bold = omitted category)	Uses any AT (%)	Mean devices used	Low-tech AT (%)	Medium-tech AT (%)	High-tech AT (%)
Mobility impairment	Severe	95.3**	2.9**	91.9**	49.5**	19.7**
	Moderate	73.9**	1.9**	72.3**	25.7**	18.2*
	Other	48.4*	1.1*	33.8	16.6	11.8
	None	37.2	0.9	26.3	14.5	12.5
Other physical disability	Any disability	47.0*	1.0*	30.1	14.6	12.8
	None	37.2	0.9	26.3	14.5	12.5
Visual impairment	Blind	66.9**	1.9**	71.2**	28.2**	55.4**
	Low vision	46.8*	1.1**	40.2**	18.7*	21.1**
	None	37.2	0.9	26.3	14.5	12.5
Hearing impairment	Deaf	81.8**	2.2**	19.0	71.1**	23.4
	Hard of hearing	51.4**	1.2**	25.1	32.8**	13.4
	None	37.2	0.9	26.3	14.5	12.5
Speech impairment	Any	34.9	0.8	21.1	18.7	11.1
	None	37.2	0.9	26.3	14.5	12.5
Mental health disability	Any	25.7**	0.6**	18.6**	8.5**	8.6*
	None	37.2	0.9	26.3	14.5	12.5
Cognitive impairment	Intellectual	28.1	0.8	15.3	13.1	18.9
	Other DD	35.4	0.9	29.2	13.7	13.7
	Learning disability	37.7	0.8	22.1	14.4	13.5
	Other cognitive	32.1	0.8	21.2	10.7	15.9
	None	37.2	0.9	26.3	14.5	12.5

*Prediction significantly different from omitted category at $p < .05$. ** $p < .01$.

en that three-quarters (76.3%) of respondents with mental health disabilities also report some other type of disability, these negative values imply that the presence of a mental health disability actually reduces the extent of AT usage among people who also have another type of disability. This is similar to a finding by Verbrugge and Sevak (2002), who compared use of equipment versus personal assistance for ADLs among older adults and found that the additional presence of a mental health disability reduced the likelihood of using equipment.

The models allow us to predict usage levels for people with each type and level of disability alone (Table 4), which differ from the raw data in that we have controlled for the presence of co-occurring disabilities. Doing so gives us a much broader range of predicted usage levels than in the raw data, with an overall usage rate of only 25.7% for people with mental health disabilities alone and 28.1% for people with intellectual disabilities alone all the way up to 95.3% for people with severe mobility impairments. Predicted usage of low-tech devices follows a similar pattern, and predicted usage of medium-tech devices ranges from 8.5% for mental health disability to 71.1% for deafness alone. High-tech device usage is also predicted to

be lowest for people with mental health disabilities alone, at 8.6%, and highest for blind respondents, at 55.4%.

DISCUSSION

In a survey of California ILC consumers, we collected information on usage of a broad range of AT devices, as well as on the disability, demographic, and socioeconomic characteristics of the respondents. We measured overall usage of any type of AT, as well as an indicator of the extent of AT usage—the number of devices used. We also divided AT devices into three categories: high-tech (computer or other essentially digital devices), medium-tech (motorized or electronic devices), and low-tech devices (everything else) and measured usage of each category. Through tabulating each of these measures by sociodemographic and disability characteristics of the respondents, and by constructing statistical models of these measures using such characteristics as explanatory variables, we discovered large, persistent, and statistically significant disparities in levels of AT usage by disability type and severity, educational attainment, income, age, race, ethnicity, and disability onset.

Although we would expect AT usage to vary with the extent of a person's disability, the tremendous variation in usage according to the nature of the disability is a revelation. On the one hand, physical and sensory disabilities are highly associated with device usage, but on the other hand, the presence of a cognitive or mental health disability does not appear to contribute to the likelihood or extent of a person's using AT. With mental health disabilities, on the contrary, the relationship between having such a disability and device usage is actually negative and significant across all models, implying that a person who has some other type of disability would actually be less likely to use relevant AT if he or she also had a mental health disability (but what is cause and what is effect?).

It is possible that our checklist of AT devices omitted those most often used by people with cognitive or mental health disabilities, but no such technologies were written in as "other" devices by those respondents (the exceptions were one user of a pocket day planner and two users of noise-canceling headsets). It appears that technologies that help with mental functioning are not being utilized to any significant extent in our sample. It is possible that these technologies are not regarded as effective or worthwhile by these consumers or their service providers, but it is still more likely that lack of awareness is the real problem.

Lack of awareness of available technologies appears to be an issue across disability types. Although educational attainment is often used as a proxy for socioeconomic status, we believe that it is largely education itself that makes this variable so important a determinant of AT usage in the models. People who are more educated are more likely to know about technologies that might help them, to feel confident about using more sophisticated technologies, and to have the wherewithal to conduct their own research to learn about devices available for people with impairments like theirs. The fact that education plays a far more prominent role than income in determining AT usage further suggests that the large disparities by education in usage of high- and medium-tech AT devices can be mostly attributed to differences in awareness of the availability and benefits of AT, as opposed to economic factors.

Despite the relatively minor role of household income in the models, we nonetheless observe significant disparities by income in usage of high-tech and especially medium-tech AT devices. Medium-tech devices such as electric wheelchairs and adapted vehicles typically cost far more than computer equipment. People who could benefit from

such devices may be relegated to using lower-tech devices that are either more affordable or easier to obtain through public programs.

Although the raw tabulations reveal large gaps in usage according to race and ethnicity, such differences are much less apparent once other factors have been controlled for. The only statistically significant differences are in the models of number of devices used (African Americans and Latinos use fewer), high-tech device usage (less for both groups), and medium-tech device usage (less for Latinos). Cultural factors may be at the root of these disparities—for example, if the stigma against using AT were greater or if there were a preference for personal assistance over technology—or there may be differences in access, such as lower utilization of health care resulting in less AT awareness.

The sharp gradient with age in overall AT usage, apparent in the raw data, all but disappears once the type, extent, and multiplicity of disability is controlled for. By and large, older respondents are more likely to use AT because they have a greater need for it. In the models that focus on a particular type of AT, however, age-related disparities remain, with elderly respondents having substantially greater usage of low-tech and substantially lower usage of high-tech devices than younger working-age respondents, controlling for other factors. This gap in technology may signal a difference in the types of activities that people of different ages use their AT to engage in, with younger respondents using their high-tech devices to enable social participation, while elderly respondents use their low-tech equipment (largely manual wheelchairs, canes, and walkers) for basic mobility within a constrained environment.

Age of disability onset is another factor found to be significant in the models. People who acquired their disabilities at birth have higher usage rates overall, use more devices, and are more likely to use medium-tech devices than those with later disability onset, after other factors have been controlled for. It is possible that acquiring a disability at a very early age gives one an advantage in obtaining and adapting to AT, a consequence of access through early intervention and special education programs. If so, people with later-onset disabilities may be at a disadvantage in access and exposure to AT.

Gender is the final category for which disparities are observed, with men having lower usage levels, particularly of low-tech devices. This seems unlikely to be an issue of access. Perhaps men are more affected by the stigma associated with using

devices like walkers or manual wheelchairs, and therefore avoid using them, possibly taking advantage of the greater availability of personal assistance as a substitute for AT.

CONCLUSIONS

This article offers evidence of a *technological divide*, which results in lower utilization of AT among certain segments of the disability population, potentially limiting their ability to live independently and to participate in the social and economic life of their communities. Groups negatively affected include people with cognitive or mental health disabilities, people with less than a college education, Latinos, African Americans, and people with acquired as opposed to congenital disabilities.

Beyond these basic disparities in AT usage are differences in the level of sophistication of the devices people use. A *digital divide*, analogous to that affecting people with disabilities in using computers and the Internet in general (Kaye, 2000), is reflected in lower usage of high-tech devices among people with disabilities in certain categories: older adults, people with less than a college education, Latinos, African Americans, and people with lower household incomes. What might be termed a *power divide*—lower usage of other motorized or electronic devices, such as power wheelchairs or hearing aids—negatively affects people with disabilities who have less education, lower income, acquired disabilities, or Latino ethnicity. People with mental health disabilities, whose usage of any type of technology is especially low, have essentially no usage of higher-tech devices, and rates of usage of these technologies among people with cognitive impairments are also very low.

There could be several explanations for the lack of appreciable usage of technology for cognitive or mental health disabilities. There may be a paucity of technology available for people with these disabilities (Bodine & Scherer, 2006), particularly mental health disabilities. Alternatively, the technology that exists may not be perceived as effective or usable by these populations. Still more plausible, however, is that there is a lack of awareness, on the part of consumers, their families, and their service providers, of both the technologies that are available and the potential benefits of using them. Outreach to these communities, perhaps coupled with research in developing effective, general-purpose technologies for these disabilities, ought to be a high priority.

Lack of awareness would seem to be a much broader concern, based on the prominence of edu-

cational attainment as an influence on AT usage. Greater efforts need to be undertaken to inform people with all kinds of disabilities, and of all ages and cultural backgrounds, of the broad range of technologies that are available to assist with all types of functioning. The stigma often associated with public use of such technologies, from wheelchairs to hearing aids to white canes, needs to be overcome through education campaigns, which emphasize the benefits of technology in enabling more active participation in community life.

Lower AT usage levels among African Americans and Latinos merits further research. Given that health care providers are a convenient source of information about AT for many people, the lower utilization of health care among Latinos may be one reason that they are underserved with respect to AT as well. Language differences may also hamper awareness for this group. But there may also be cultural factors, such as greater stigma or different approaches to coping with disability. Outreach efforts to these communities, promoting the availability and benefits of AT, must take into account such cultural differences.

Finally, the income-related divide in the more costly technologies can most readily be addressed if public programs, such as Medicaid and Medicare, are expanded to offer not only devices necessary for survival, but also technologies that promote participation, integration, and independence. These programs should offer assistive devices that foster full integration into society, not just fulfillment of basic needs.

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