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Needs for Sensory Devices: An Opinion Survey

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NEEDS FOR SENSORY DEVICES:
AN OPINION SURVEY

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Abstract
As part of a needs assessment on technology for deaf and hard of hearing people, 15 focus-group interviews were conducted with a total of 126 deaf people, hard of hearing people, and rehabilitation professionals in five states and the District of Columbia. The discussions were centered around present uses of technology, opinions of currently available devices, and desired future devices related to four areas of daily life: face-to-face communication, telephone communication, mass media, and environmental awareness. Because of the nature of the needs assessment, only technologies that make use of senses other than hearing (such as flashing signal systems, TDDs, and closed caption decoders) were considered. Consumers provided many ideas for improvements to existing devices, and repeatedly cited a need for applications of speech-to-text technology, for a videophone, and for more flexible and lower cost signalling systems.

Methodology
To elicit consumer opinion on these topics, 15 focus-group discussions were held with D/HH adults. Focus group interviews are structured discussions led by a trained moderator and recorded in detail. This method is commonly used by marketing researchers for exploring new ideas for products, determining attitudes and behaviors of consumers, and other purposes. Focus group interviews are typically two to three hours in length and involve homogeneous groups of 8 to 12 consumers. A neutral moderator leads the group and a second person observes.

One strength of focus group interviews, as contrasted with mail questionnaires and TDD surveys, is that participants need not have skill in reading and writing English. Also, the discussion format encourages creative thinking; the length of the discussion is such that consumers have ample time to reflect and comment on the issues under discussion, rather than responding quickly to a series of questions, as would be necessary in face-to-face interviews. The weaknesses of the method are that the sample is small and non-random and that responses are not independent. The sampling weakness could not be countered by alternate methods without massive expenditures; the lack of independence of responses was more than balanced by the strengths of the method.

Three moderators fluent in sign communication were trained in the conduct of focus groups by a market research firm. An agenda for the discussions was developed and the procedures were piloted with two groups of D/HH participants. The sessions were tape recorded. The content of discussions conducted in sign language was
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spoken into a hand-held recorder by the hearing moderator.

Four major areas were covered in the focus group discussions: (1) In-person communication; (2) telecommunication; (3) mass media; and (4) environmental awareness/ control. Approximately 30-45 minutes of discussion were devoted to each topic.

Homogeneous groups of adults were recruited in six states. Four categories of participants were recruited: Persons deafened at birth or during early childhood who were college-educated; persons deafened at birth or early childhood who were not college-educated; persons deafened after childhood who identify themselves as hard of hearing persons; and rehabilitation professionals familiar with the needs of low-functioning deaf persons. A brief questionnaire on demographic variables and ownership of devices was filled out by each participant.

Results

Fifteen focus groups were conducted in six states (Kansas, Arkansas, Texas, Florida, California, and Washington, D.C.) during January, February, and March 1987. A total of 126 people participated. Demographic information was collected from 105 D/HH people in 13 of the 15 focus groups. Demographic information was not collected from two groups of rehabilitation professionals and from two hearing people who attended other groups. A summary of characteristics of the groups on key variables is shown in Table 1. Hard of hearing participants were older, had lost their hearing later in life and reported less severe degrees of hearing loss than participants in the other groups.

Some of the groups represented certain sub-populations in addition to hearing impairment. Of the college-educated groups, one was composed of oral adults; another consisted of technically oriented professionals. Of the non-college-educated groups, one was composed of Hispanic Americans (mostly Cuban immigrants), and another was made up of retired deaf persons.

Participants were asked which of eight types of assistive devices they had at home. The results are given in Table 2. The hard of hearing adults reported a mean of 1.9 device-types per household, while the other groups reported a mean of 4.7 device-types.

Among all groups, TDDs and TV decoders were the most frequently owned devices, followed by telephone, clock, and doorbell lights. Only 19% of the participants had a smoke detector with a signal light. Alarm clocks with signal lights were much more popular than alarm clocks with vibrators.

### Table 1
Demographic Characteristics by Group-Type

<table>
<thead>
<tr>
<th></th>
<th>HoH Adults (5 groups)</th>
<th>College Groups (3 groups)</th>
<th>Non-College Groups (5 groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current age</td>
<td>54 (n=38)</td>
<td>37 (n=25)</td>
<td>49 (n=42)</td>
</tr>
<tr>
<td>Age at first occurrence of hearing loss</td>
<td>23</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Age at which current loss was reached</td>
<td>42</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Degree of loss (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Moderate</td>
<td>11</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Severe</td>
<td>15</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Profound</td>
<td>9</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Don’t know</td>
<td>3</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Level of education (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; H.S. Graduate</td>
<td>3</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>High School Graduate</td>
<td>2</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Some College</td>
<td>12</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>College Graduate</td>
<td>9</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Graduate School</td>
<td>12</td>
<td>14</td>
<td>0</td>
</tr>
</tbody>
</table>
TABLE 2

Participants who report having one or more of specific types of devices

<table>
<thead>
<tr>
<th>Device Type</th>
<th>HoH Groups (n=38)</th>
<th>Other Groups (n=69)</th>
<th>All Groups (n=107)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>TV Decoder</td>
<td>17</td>
<td>45</td>
<td>66</td>
</tr>
<tr>
<td>TDD</td>
<td>18</td>
<td>47</td>
<td>63</td>
</tr>
<tr>
<td>Telephone light</td>
<td>12</td>
<td>32</td>
<td>60</td>
</tr>
<tr>
<td>Alarm clock</td>
<td>10</td>
<td>26</td>
<td>49</td>
</tr>
<tr>
<td>Doorbell light</td>
<td>7</td>
<td>18</td>
<td>47</td>
</tr>
<tr>
<td>Smoke detector light</td>
<td>5</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Alarm clock vibrator</td>
<td>4</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Baby cry light</td>
<td>1</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Mean number of device types</td>
<td>1.9</td>
<td></td>
<td>4.7</td>
</tr>
</tbody>
</table>

The focus group discussions were divided into four major areas of daily life: (1) In-person communication, (2) telecommunication, (3) mass media, and (4) environmental awareness. The following section summarizes the content of discussion in each of these areas.

In-Person Communication

Communication problems were cited in many different settings: At family gatherings, at work, in banks, in restaurants. Yet few consumers use sensory-substitution devices for face-to-face communication.

Note-writing is common but few participants use a TDD terminal (unattached to the telephone) as a faster way to conduct written conversation. Some computer users reported using computer terminals to communicate with someone whose speech is difficult to understand. In most cases where a terminal was used for communication, the suggestion to do so originated from a hearing co-worker, not with the hearing impaired person.

Still, the focus groups liked this idea and suggested that a device with two keyboards and screens might be appropriate, something resembling two TDDs placed back-to-back which would allow two people to face each other and conduct a conversation in print.

Increasing use of intercom systems is causing new frustrations for D/HH people. Repeated mentions were made of difficulty in using an intercom in drive-through fast-food restaurants and in secure buildings.

When asked what could be done to help with face-to-face communication, the immediate response tended to be “to educate hearing people” – get them to use sign language, look at the D/HH person, or tap the person to get his/her attention. When asked for a technological solution, the most common response was to suggest a machine that would understand speech and convert it to print. In every group, someone suggested a variation of this concept.

Generally, the speech-recognition devices envisioned by consumers were portable, and some were wearable. Eyeglasses and calculator-sized systems were the most common form of the devices. Braille output of such a system for deaf-blind persons was mentioned in one group. A group of rehabilitation professionals suggested a computer that would translate spoken English into signs or pictures, particularly for those who cannot read. In the group of deaf Cubans, the dream was for a computer that would understand English and translate it into printed Spanish. In one group of hard of hearing adults, a voice recognition system was seen as ideal for solving the problem of announcements in public transportation depots of all kinds. In summary, it was clear that speech-to-text captured the imagination of many participants in all types of groups.

For communicating in restaurants, people in three groups suggested computerized menus that would allow patrons to make their selections without having to make themselves understood or having to understand the service personnel.

In the context of in-person communication at meetings, speech recognition was again suggested as a substitute for interpreters, because “the machine would always be there… you would not
have to line up an interpreter.” Another area of interest, at least among consumers who had seen it, was in real-time captioning as an interpreting medium at lectures, meetings, and other group events.

Lipreading aids were suggested by some hard of hearing consumers. These consumers wanted a device “to help you see better in dark places,” or “special lights that would allow conversation at night.” One hard of hearing group liked the idea of a kind of “visual amplifier” – a television monitor that would allow a close-up view of the speaker, no matter where the D/HH person was seated.

The moderator raised the idea of an eyeglass-based lipreading aid with a group of oral young adults and with a group of hard of hearing people; the description given was that of a speech-analyzing device that displays codes designed to clarify lipreading. Both groups rejected the idea. The comments indicated that consumers suspected the coded signals would be annoying.

One of the hard of hearing consumers expressed a strong interest in a wearable tactile aid that could be programmed to pick up specific speech sounds that she has trouble discriminating. She wanted such a device both for improving her ability to understand speech and as an aid to lipreading. Tactile aids were most commonly mentioned in the context of signalling and environmental awareness, as described below.

Telecommunications

This section covers the need for devices that allow communication over telephone lines, whether in two-way conversation or for electronic mail and information retrieval.

People in the focus groups acknowledged the TDD’s importance in their lives. Nearly all of the deaf participants cited either the TDD or the closed-caption decoder as their most essential device. Many said they were satisfied with their TDDs, but a few raised objections. The most common complaint was garbling of messages, attributed variously to transmission problems, incompatibility among certain models, sensitivity to acoustic disturbance, and problems with the power source. Another annoyance is the inability to interrupt the other party in the conversation.

One complaint about the TDD, which would be a problem with any device that relies on typing back and forth, is that the person called cannot tell the identity of the caller. Prank calls were mentioned in several groups as a problem. Another general problem is when businesses call and a TDD answers; the caller assumes there is a bad connection, hangs up, and redials several times.

Among hard of hearing consumers, awareness and ownership of TDDs was much less common, and complaints were related to the limited usefulness of the TDD because “I can’t reach the people I want to reach.” This complaint was by no means universal. As one hard of hearing user said of his TDD, “It’s very important. I wouldn’t leave home without it.” Only in California was there a high degree of awareness and ownership of TDDs among hard of hearing consumers, but even here, usage was generally infrequent.

Focus group participants offered many suggestions regarding TDD products, but very few related to the outward physical design of the devices. They wanted long battery life, cradles that would fit all handsets, compatibility with European TDDs, LED displays with large characters for the visually impaired, and something better than the poor quality thermal paper printers found on many machines. Keyboards are generally considered acceptable. Perceived problems with compatibility were addressed through suggestions that standards for TDDs be developed. There were many suggestions that answering machines be made compatible with TDDs. Most of the answering machines on the market are voice-activated and hang up on TDDs after a few seconds.

Relay Service. One means for improving access to the telephone is message relay service. Relay services make TDDs capable of reaching voice telephones, thus eliminating the problems cited by hard of hearing people in the focus groups. However, relay services involve the intervention of a third party in telephone conversations. Awareness of and attitudes toward relay service were explored in some of the focus groups, particularly in the hard of hearing groups where TDD usage was relatively low. At the time of the focus group meetings in California, the new California Relay Service (free service 24 hours a day) had been in operation for two months.

The major concern was that available relay services were often inaccessible because the demand for service exceeded the supply of operator hours. The frequent busy signal seemed to have deterred people from using the service. Among hard of hearing people, there was much
less awareness of relay services.

Computers for telecommunication. Although few participants owned computers and even fewer used them for telecommunication, there was interest in TDD-computer compatibility, with about half the groups suggesting that this is an area in need of attention.

Only one focus group had enough computer users to explore problems and needs relative to computers. A number of people were aware that computers and the TDD system used different codes (ASCII vs. Baudot), but few had the technical expertise to understand or discuss this.

All of the people in the technical group were familiar with computers and were very enthusiastic about the potential of computer communications. They hoped that more and more people would purchase dual capacity (ASCII/Baudot) TDDs and that the use of computers by young people would lead to increased communication by computer. Still, they noted that this would not be a rapid process; five to ten years ago, it was predicted that the use of Baudot TDDs would fall into disuse by now.

The consensus among the technical group was that money and education are the biggest barriers to a changeover from the Baudot network to ASCII-based communication. Current commercially available smart modems (capable of transmitting both in Baudot and ASCII and of detecting and converting incoming Baudot signals) cost between $300 and $500. One person noted “I could buy two TDDs for that!” Those who could afford the new products expressed appreciation for them. There were only two smart-modem users in the focus groups, both of whom were very happy with the product.

The problem of incompatibility of computers and TDDs was seen as being solved by the introduction of low-cost and easy to use products that (1) allow communication with either TDDs or computers, (2) identify the incoming signal's code and automatically convert to the host machine’s code, and (3) permit greater flexibility in using the computer simultaneously as a processor and as a TDD.

Speech recognition. When asked what future telecommunication products might be developed for their use, automatic speech recognizing systems were repeatedly suggested by all the groups. Such systems would eliminate the need for two terminals and, if so designed, could allow D/HH persons with understandable speech to speak for themselves. The inclusion of synthetic speech in such a system was also recommended in some groups. Suggestions included basing the speech recognizing system (1) in a central computer at a telephone company to serve as an automated message-relay station; (2) in a home computer; (3) in a telephone set; (4) as a separate, portable product.

TV-phone. Another desirable telecommunication device suggested was a TV-phone, capable of transmitting both voice and visual images. Such a device would allow communication by sign language and/or lipreading. Several people noted that such a system would be helpful to people with very limited skills in English, so that they could at last get some benefit from telephone communication.

Mass media

Solutions to inaccessibility of mass media tended to center on captioning. D/HH people wanted captioning, captioning, and more captioning.

Television. Many people enthusiastically praised the closed caption television decoder as a sensory device. One hard of hearing participant called the decoder “God’s gift to the hard of hearing person.” One participant noted that “We owe a lot of thanks to the government for the decoder.” Another said, “If I didn’t have a decoder I think I’d go crazy.” Most decoder owners appeared satisfied with the quality and performance of decoding equipment.

Suggestions for improving decoders tended to center on integrating functions into one appliance, to reduce the need for multiple devices and controllers - that is, television set, cable box, VCR, and so on. On the other hand, a majority thought that a separate decoder had major advantages. The decoding hardware is easier than a television to transport, and repair time does not affect the television itself. A common concern was that the decoder cannot easily be detached and carried into friends’ and relatives’ homes, or to hotels. Of course, this need for portability would be eliminated if all television sets had decoding capacity.

There was also some concern about the complexity of installing a decoder, especially when a VCR, cable box, or other equipment was involved. Several people mentioned the decoder’s cost as a deterrent to more widespread use. Other people mentioned wanting to take advantage of new,
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miniature televisions by being able to view captions on them.

It was suggested in a group of rehabilitation professionals that a means of braille output for deaf-blind users would be a useful addition to the decoder.

Most of the discussion of television tended to dwell on the captioning service, rather than the decoder itself. Most of the concerns relate either to a need for more captioning or to overcoming technical difficulties in caption transmission.

Consumers wanted more television programs captioned. Captioning of local programming was repeatedly cited as a need, especially captioning of local news and weather. Certain frustrations with captioning were also expressed: captions sometimes disappear in the middle of a program; captions do not appear when the program is listed as captioned; the position of captions obscures open captions, particularly on news shows where the speaker's identity is often open captioned; captions are sometimes hard to get on cable systems. There was no consensus about speed of presentation of captions.

A few participants suggested automating the captioning process as a means of increasing the availability of captions. One suggestion was to develop inexpensive equipment that would allow local stations to caption programs independently. Another was to work toward automation through speech recognition (speech to text).

Cinema. The participants expressed only slight interest in going to the cinema. Some people noted pointedly that they now refuse to watch anything that is not captioned. Like many hearing people, they have changed movie-going habits and wait until a movie becomes available on videocassette. Many participants owned VCRs and expressed pleasure in watching captioned videotapes.

However, the sentiment was expressed several times that, if movies in cinema houses were captioned, they might go out to a movie more often. Captioned films would have to be convenient, though; several people noted that no one wants to go to a movie on a Saturday morning, or drive an hour and a half just to see a captioned movie. These opinions were based on consumers' experiences with a few open-captioned films (most recently, "Children of a Lesser God") which were shown at special times for hearing impaired persons.

There were several suggestions for implementing closed captioning in movie houses. Most of these suggestions involved some system for generating hidden captions on a movie screen. The captions would be visible only to wearers of special eyeglasses (similar to the "3-D" concept). Another idea was a hand-held receiver with LED display that would pick up a broadcast signal of the captions for the film.

Theater. The theater was also regarded as inaccessible to D/HH people. Some consumers had seen interpreted plays, but opinions of interpreted theater varied, with the visibility and skill of the interpreters among the critical factors. Opinions were mixed as to whether captioned theater was desirable. Some people noted that it might be too hard to follow; others thought it would provide satisfactory access to plays. They pointed out that viewers cannot take their eyes off interpreters without missing some of the signs; with captions the dialogue is visible for several seconds and it is possible to catch up.

Three types of caption display systems were suggested for stage plays: (1) a personal teleprompter with a small screen or LED strip, to display captions of the dialogue as it was spoken; (2) a strip on front of the stage to print out the dialogue in large letters; (3) a television screen on one side of the stage. Presumably the displays would be generated through a steno-captioning system.

Radio. There was little interest in access to radio (via sensory substitution) among the persons in the discussion groups. Although many people had them, most radios were purchased for hearing family members. D/HH consumers noted that hearing people often listen to radio while doing something else, such as driving and exercising. D/HH people would not be able to enjoy "visual radio" in the same way because of the need to attend visually to the task at hand. Speed of captioning of radio was also anticipated as a problem. On the other hand, consumers noted radio as an important means of alerting hearing people to weather emergencies.

Signal Systems

The topic of signal systems was subdivided into day-to-day environmental awareness and emergency awareness. Signal systems were a discussion area where almost all the participants became involved. Many people recounted situations in which a signal was missed because of hearing loss, and the participants generated more
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ideas in this category than in any other.

Home Environmental Signal Systems. The use of devices and systems for alerting to environmental sounds varied. Among deaf persons in the focus groups, the use of such devices was common, but among hard of hearing persons, ownership of signalling systems was more infrequent. Signal systems were most commonly used for the doorbell and telephone. A few people reported supplementing these systems with a hearing-ear dog.

Many common household sounds go undetected, causing problems that surfaced repeatedly in the discussions. One common frustration was the inability to know when the water is running, resulting in running toilets, overflowing bathtubs and lack of hot water. Anecdotes abounded about leaving on the stove hood fan, the bathroom fan, the oven buzzer, or the car. Some consumers suggested visible signals to indicate that appliances are running; others suggested automatic-cutoff devices as a solution.

A different kind of problem is inability to use auditory signals, such as buzzers on the clothes dryer and oven. In several groups, hearing impaired people expressed concern over not having access to smoke detectors and home security systems.

Most people in the focus groups have systems that provide flashing-light displays. Designing a flashing-light system for the household requires some ingenuity. The light must be bright enough to be seen during the day and, to be truly effective, must be visible from anywhere in the house. The signals for different sounds must be easily differentiated and the visual signal needs to coincide with the auditory signal. Several consumers described home-assembled systems that combined, for example, a home security system with relays, flashers, and other components. One person mentioned color-coding the light to the signal source.

Many consumers reported that existing wireless signal systems are susceptible to interference and therefore prone to false positives. Where wireless systems came up in the discussion, there were stories about how similar systems in neighboring homes, garage door openers, television remote controllers, shortwave radios, and various other signal sources interfered and set the lights to flashing. There was also the problem of incompatibility among the products of different manufacturers and among different products from the same manufacturer. On the other hand, wireless systems can easily be moved around and some can be adapted for use with almost any sound source. They are advantageous in large houses because they do not require wiring of many floors and rooms.

The existing alternative to a wireless signal system is a hardwired system. Owners of hardwired systems spoke of their reliability. One negative feature mentioned was that such systems must often be left behind when moving from one house to another. Some hardwired systems in use are custom designed and built into the structure of a home by an electrician at high cost. Others are wired by hobbyists. There is a need for a good hardwired signal system which can be safely installed by average people without extensive electronic skills. One idea was to have standard low-voltage signal modules connected with standard telephone wire.

Some participants cited a need for a battery backup for use during power failures. Other desired features included adjustable sensitivity to the signal source; adjustable intensity and frequency of the flash, to differentiate among signal-sources; and modular design to permit additions to the system.

Multiple signalling devices are regarded as a bother, and the idea of integrated systems was one that was favored in several groups. As one woman said, “Something is needed so that you wouldn’t have to buy something for every sound . . . just one machine that would do it all.”

Several people thought signal lights or jacks for these lights should be built into all telephones. They also wanted phone lights that would turn off after a few rings because they feared a continually flashing light in the house would alert burglars that no one was home.

Wearable Environmental Signal Systems. Some people expressed a preference for detecting sound via a wearable tactile display. (The idea of a wearable visual display did not come up.) These were generally envisioned as small vibrating devices worn on the wrist, perhaps integrated into a wristwatch, or carried in a shirt pocket. Other people wanted a vibrating system that would respond to all sounds, while others preferred a device that would respond only to designated sounds. Advantages of such a device included a reduction in the need for light systems throughout the house, ability to detect signals while outside the home, and usefulness to hearing impaired people who are relatively insensi-
In this case, the concept of "wearable" is closely bound to that of "unobtrusive" and "comfortable." One woman said she used to wear a tactile aid but stopped because she found it cosmetically unappealing. Another woman, having seen an advertisement showing a hearing impaired mother with a baby, said "I was wondering how she handles the baby with that big bracelet on."

The issue of cost arose whenever discussing tactile devices. (The general issue of cost is covered in the Discussion section.)

Several groups said they needed to be alerted to someone coming up from behind. One person said, "We jump out of our skin 20 times a day."

Car Environmental Awareness. Today's automobiles are often so quiet and vibration-free that many people in the focus groups found it difficult to determine whether their cars were running and several indicated a need for both a car-running indicator and an automatic engine shutoff. Instances were cited where people had parked their car in the basement garage of a home, left the motor running, and were killed by carbon monoxide hours later. Several people pointed out that the tachometer is a useful feature for knowing when the car is running, at least while the driver is in the car.

Many participants were unable to hear noises that indicate automobile malfunctions such as worn brakes, bad wheel bearings, or a noisy muffler. Several said they routinely have hearing friends ride with them to listen for odd sounds and indicated a need for some kind of monitoring system to warn them of mechanical problems.

Public-address Signalling Systems. There was general agreement that more visual signal systems are needed in public places. For example, participants offered suggestions of visual line-dispatching signals for bank teller lines; visual paging systems for bowling alleys, airports, and other public places; visual means of communicating through intercoms in high security apartment buildings; visual communication systems for emergencies in elevators; visual announcement systems for bus stations, train depots, and airports; and more freeway-condition signs.

Clocks and Timers. Three common means of awaking were mentioned: flashing alarms, vibrating alarms, and hearing spouses. Although most consumers with special alarms favored flashing lights, a minority preferred vibration, usually because a light does not awaken them. Vibrators were also cited as useful to persons with visual impairments. Some people said they were too sensitive to vibration to be able to use vibrators. Several stories were told of leaving bed vibrators on and burning the mattress.

Those who had special clocks seemed satisfied with the functioning of their clock alarms and the question of price was not a major issue in the discussions. The concern was more with the availability of special clocks.

In the past several models of electric clocks had timed receptacles in the back. A lamp could be plugged in and used both for reading and as a signal device. Today these have almost disappeared from the market. Almost all mass-produced alarm clocks on the market have strictly auditory alarm systems. The focus group participants repeatedly mentioned this and indicated that their only choice was to buy one of the devices sold by dealers who specialize in products for D/HH people. These devices are mostly mass-produced clocks and timers which have been modified to provide a switched plug for a lamp, vibrator, or other signal device. This modification often doubles the price of the item. A clock which sells for $30 in most stores may be sold by a specialty dealer for $50 or $60 after modification to add a switched plug. D/HH people would like to be able to go into major retail outlets and buy clocks and timers with switched plugs for a reasonable price.

The need for non-auditory signal systems is not limited to conventional clocks and timers. D/HH people need non-auditory timers for ovens, washing machines, clothes dryers, microwaves, dishwashers, and other appliances. It was evident from some of the discussions that some participants were unaware that certain appliances make sounds at all.

Home Emergency Signal Systems. The focus groups repeatedly made a very general comment concerning home emergency signal systems: Most of these devices work only in a specific area or room and it is often necessary to buy a device for every room. There is need for an inexpensive way to make an emergency signal known throughout the whole house.

A primary discussion topic in the area of home emergency signals was smoke detectors with alarm lights. Such devices are on the market but they are expensive and lack a light bright enough
to wake sleeping people. Hearing people are able to purchase smoke detectors with auditory alarms for under $10 but hearing impaired people must pay at least four times that amount for a detector which flashes a light. The light intensity should be adjustable to fit the surroundings. The unit should be either battery operated and have a low-battery indicator, or operate on house current and have a battery backup.

Carbon monoxide alarm systems are needed for homes which have garages attached to them. People have been known to leave cars running and if the garage is attached to the house it is possible for carbon monoxide to spread throughout the house.

Burglar alarms need signal lights. D/HH people are particularly vulnerable to burglars because they cannot hear the noise of a forced entry. Several people in the focus groups remarked that they would never know that a burglar was breaking down the door if they were in some other part of the house when it happened. Most burglar alarms have strictly auditory warning signals and those which have visual signals suitable for hearing impaired people tend to be expensive. A D/HH person who moves into a home with a burglar alarm is almost sure to find that it is auditory and must be replaced or modified to be useful.

The same lack of light warning signals applies to swimming pool lights. One participant wanted a wave alarm for his swimming pool but was unable to find one with a visual signal rather than an auditory signal.

The Kansas, Texas, and Arkansas focus groups all wanted some kind of device to warn them of tornados. These storms can be life threatening and cities in these areas often have sirens which warn people in localized areas of approaching tornados. These sirens cannot be heard by D/HH people. A variety of suggestions were given for overcoming this problem. One suggestion was to have an agency or service organization keep a list of D/HH people and call them when there was a tornado warning. This could be handled automatically by a computer which could deliver a TDD message. Another suggestion was to have some kind of RF signal broadcast along with the siren and give D/HH people a receiver that was activated by the broadcast signal.

In Florida the problems are a little different. There people need hurricane warnings. There is usually several hours advance warning for these storms, but the information is often given verbally by radio or television announcements. The television announcements should always be open captioned as well as given verbally. Radio announcements could probably best be supplemented by the kind of automatic telephone service suggested for tornados. Since hurricanes often involve power outages, battery operated television sets and TDDs would be desirable under these conditions. A device to automatically turn on a television set when an emergency message is broadcast would also be useful.

Personal Emergency Systems. The focus group participants wanted a variety of personal emergency warning systems in addition to systems for their homes. At the top of the list were requests for a personal device to warn D/HH drivers of sirens and/or emergency vehicles. There were several stories given which told of close brushes with speeding emergency vehicles while crossing streets or walking in parking lots. This need was identified by nearly every group.

Some people also wanted portable visual fire alarms and portable visual burglar alarms, primarily for when they travelled and stayed in hotels or motels. There are such devices on the market but they are not small, convenient, or inexpensive. A personal pocket pager to warn of tornados was suggested by Arkansas and Texas participants.

Being warned of an emergency is the first part of a two-part problem faced by D/HH people. They need a reliable way of quickly contacting police, fire, or medical agencies for help. In the past they usually depended on a hearing family member or neighbor to get help. Many still do this, but other options are coming into use and more were suggested during the focus group discussions.

Some cities had TDDs installed at police, fire, and medical agencies and D/HH people can contact them by dialing special TDD numbers. In one group, we asked what the TDD number was; not a single person could remember a TDD emergency phone number other than 911. If they were fortunate, they lived in an area where the 911 phone number could handle TDD calls. In two locations, the community had instituted a “D/HH 911”, in which a D/HH person can call 911 and simply leave the phone off-hook. The enhanced 911 service informs the dispatcher of the location of the caller and the fact that the caller is D/HH. People in these locales expressed...
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the view that their emergency calling needs were well met by this service.

In addition to TDD-based systems for summoning help, several people suggested a personal call device to be hung around the neck or worn on the wrist. This would send out some kind of signal to be picked up by a base unit that would automatically call for police or medical assistance.

Car Emergency Systems. The main concern in the area of car emergency systems was a device which would visually indicate the proximity of an emergency vehicle. The need for this device was mentioned in every focus group and it was pointed out several times that the use of this device was not limited to D/HH people. With the windows up and the radio on, hearing people are often unable to hear outside noises. Some people in the focus groups suggested a device which would be activated by sirens. Others, particularly those with technical background, felt the situation was not that simple and that reliably detecting sirens from among other traffic sounds would be difficult, especially since siren frequencies are not standardized. One suggestion was that emergency vehicles should be equipped with some sort of radar signal generator and that the signals could be picked up by cars equipped with a modified radar detector.

One other device was mentioned for when a D/HH person’s car breaks down. The person often has difficulty calling for help and a pocket pager which summons assistance would be useful.

Public Emergency Systems. The need for a system to warn of emergency vehicles popped up again in discussions of emergency warning systems which should be part of the systems provided to the general public. One idea was that all emergency vehicles should activate a wearable device.

Another idea was to have siren indicators built into traffic lights. One person mentioned that such systems already exist and are in use in some European cities. With this system, emergency vehicles can cause all traffic lights in the vicinity to flash.

Concern was also expressed about fire alarms in public places. Almost all of these are strictly auditory and many D/HH people are unable to respond to them. The situation is especially dangerous in hotels where hearing impaired people might sleep through a fire alarm until it was too late to escape.

Finally, it was suggested that a general TDD emergency number should be established and that there should also be an emergency interpreter service listed in the telephone book. The problem is partially solved by 911 telephone services in some cities.

Discussion

The D/HH population who could benefit from sensory substitution devices can be divided into two basic market segments: D/HH persons whose hearing loss was acquired at birth or in childhood; and D/HH persons who acquired hearing loss in youth or adulthood. To differentiate the two segments, we have referred to members of the first group as “deaf” and members of the second as “hard of hearing.”

The deaf segment has been the mainstay of the sensory devices industry (excluding hearing devices), even though they are a small group. Hotchkiss (1987) estimates that about 346,000 persons in the United States categorize themselves as “deaf”. In addition to being the primary purchasers of these devices, deaf people have formed a distribution network that both helps with diffusion of devices and provides business opportunities for D/HH people.

The hard of hearing segment is much larger than the deaf segment. Many of these people have experienced progressive hearing loss over time. Over the next several decades there will be a larger market for sensory aids as the cohort of Americans aged 65 and older grows in size. Contrary to conventional wisdom which portrays older Americans as inordinately impoverished, currently older Americans experience the same rate of poverty as adults in general. Because of the increasing level of education in the general population, with the passage of time the cohort of older Americans has become a better educated group (Maddox, 1985). Also, adult-deafened consumers are becoming better educated about hearing loss and the full range of devices that can help in communication. These factors bode well for the possibility of increasing market strength for sensory aids of all kinds.

General Differences Among Groups.

The general impression from the group discussions was that the childhood-deafened groups, whether college-educated or not, were similar in terms of awareness and expressed need. The
main exception was the technically oriented group from the Washington, D.C. area, which was selected for technical expertise.

The groups of hard of hearing persons were much more diverse in terms of awareness of and attitude toward sensory substitution devices. In some locations, notably California, all of the participants were very knowledgeable of available devices. In other locations there were people who had never seen or heard of a TDD, the most common sensory-substitution device. These focus groups were flavored with mutual education through exchanges of information and opinions about the usefulness of sensory devices. In fact, because of this process and the need to explain the function of devices, topics were not covered as completely as in other groups.

The groups of rehabilitation professionals had the difficult task of projecting technological solutions to the problems of persons who cannot fully benefit from text output, as in decoders and TDDs, because of the inability to read. Many of these adults have additional disabilities that complicate the picture. Some of the rehabilitation professionals were pessimistic about the role that technology could play; but others made many suggestions.

**Recurrent Issues**

**Cost.** With the exception of certain tactile aids, devices in the sensory-substitution category do not require a prescription. Some are purchased by third parties, particularly employers and vocational rehabilitation agencies, for D/HH employees. More recently, state government agents, acting in the role of distributors of TDDs and signalling equipment, have become quantity purchasers of these devices. However, most sensory devices are purchased by D/HH people themselves and by organizations that serve them or sell goods to them. For this reason, the attitudes and opinions of D/HH people themselves – as opposed to clinical personnel or researchers – must carry a great deal of weight in assessing the potential success of sensory devices.

However, these opinions cannot be viewed as sole determinants of the market potential for devices and systems. The cost of a device, its ease of use, and the availability of lower cost substitutes are unpredictable influences on a consumer’s willingness to purchase and use a device.

“Being hearing impaired/deaf is expensive.”

This fact of life was frequently voiced in the focus groups. Consumers noted that they could easily spend thousands of dollars on sensory devices. The relatively low price of some devices obscures the fact that, for independent living, so many kinds of devices could be purchased:

“The thing is that most of the devices are so expensive. And if you are one person and you are on a small income, you can’t even begin to buy one of them so they don’t do us any good when you can’t buy them.”

“Hard of hearing people are accustomed to being in the normal hearing world. We’re accustomed to paying for what we get. We are not accustomed to any kind of assistance or help. And so this is one of the things that hard of hearing people are just slowly becoming awakened to . . . that we have got to have assistance or help in order to function in the normal hearing world.”

There were many instances in which consumers would prefer a higher priced device but are waiting for the price to come down. The “plain vanilla” version on hand is quite satisfactory until the price of the new product comes in line with its marginal utility. This is normal consumer behavior; but in a fragile market, it can defeat the introduction of new products. Many new products fail and their companies go out of business without their having a fair trial as a useful device.

**Between Real and Ideal.** Certain applications of technology clearly had intuitive appeal to D/HH persons. These applications were suggested repeatedly and met with approval of other members in the group. Applications of speech recognition technology were one such area. Some consumers were aware of developments in this technology, and although some of the information was incorrect, several people volunteered opinions about the technical difficulties associated with automatic speech recognition. Consumers believed that the ideal speech recognizing systems they described would revolutionize their lives.

Technologies that might achieve a less powerful effect, but that could be applied sooner, were generally overlooked in the groups. Because many...
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topics had to be covered in a three-hour discussion, the moderator could not probe for opinions about near-term applications and acceptable trade-off in performance and cost. One illustration of a near-term solution to the need to caption live speech is steno interpreting. Steno interpreting, also called "real-time caption display," is an offshoot of closed captioning technology. The system requires a skilled stenotype operator to enter the speech into a computerized processor using a phonetic code. The system's output is captions which appear on a screen. Only two participants brought up steno interpreting and both expressed enthusiasm for it; the idea did not arise spontaneously from those who were not aware of its existence.

Another illustration is the use of eyeglasses as the site of various displays of captions or as a means of seeing better in dark environments. No one mentioned the idea of having eyeglasses display codes to help in lipreading, which is the function of experimental systems such as the Upton eyeglasses and the Autocuer, neither of which has had the opportunity to be introduced on the market. These glasses were described to two groups and the groups were asked whether the glasses would be useful. The reaction was negative.

Information Issues. Hearing impaired people in a number of groups voiced the concern that they have difficulty getting information on new products, especially in rural areas. The problem was evident in that a number of devices that do exist were suggested as needs.

Timely and useful information is generally lacking for D/HH people who want to purchase devices. The deaf community uses word of mouth and its specialty dealers as sources of information and advice on electronic aids, but the larger population of hearing impaired people are not part of the deaf community and do not have access to that information.

Medical doctors seldom have knowledge of, or information about, devices for D/HH persons. Professional audiologists vary greatly on their ability to describe options to clients with severe hearing impairment.

An illustration of the role of information comes from the sales history of the closed caption decoder, which focus group participants praised as a significant contribution to their lives. When closed captioning began, Sears, Roebuck, and Co. marketed the decoder. The profit margin was low and Sears was unwilling to advertise or to provide shelf space in most of its stores. Sales soon tapered off. After the National Captioning Institute began promoting the decoder by mail and through specialty dealers sales rebounded. No matter how good a product is, people cannot buy it unless they know about it.

The Most Commonly Stated Needs

Devices that Caption Speech. The need most often expressed by the focus groups was for captioning of speech. The term captioning as used here is not limited to the familiar closed caption television system, but as a broader concept, encompassing all forms of spoken communication.

The closed caption television system is currently the best known form of captioning and for many D/HH people the TeleCaption decoder has become the most valuable sensory-substitution device. The impact of television captioning has been revolutionary, not only because it has opened up the benefits of television to D/HH people, but also because it has focussed attention on the process of converting speech to print as a general way of providing access to the spoken word.

There is a continuing effort to lower the cost of captioning television programs. This has spurred technical development and lead to several spinoffs which are just beginning to benefit hearing impaired persons. The first of these is the stenotype interpreting technique which was described earlier. Since this method of interpreting does not require knowledge of sign language, it is likely to gain acceptance as an interpreting device for D/HH people who do not know sign language.

It is conceivable that organizations that provide television captioning services will take the lead in seeking ways to further automate captioning through computer-driven speech recognition systems. Even partial automation of captioning would result in cost savings. For example, a speech recognition system could be used to provide a rough automatic transcription of speech which could then be edited into captioned form.

A second area in which speech recognition might be employed as a cost saving measure is in the at least partial automation of message relay service. Relay services require an operator on duty for every minute of relayed conversation. As telephone companies begin to provide this
service (with financial incentive coming from legislated relay-service programs), they will have an excellent motivation and resources to eliminate or at least reduce the need for full operator coverage of all calls.

In the focus groups there were two very revolutionary sensory devices suggested. The first was a speech to print machine as discussed above. The second was a TV-phone, a telephone which incorporated television technology to provide long distance visual communication as well as audio communication. Being able to see the person on the other end of a telephone line has obvious communication advantages for D/HH people. The concept of a TV-phone is revolutionary but it is certainly not new. There have been various prototypes over the last quarter-century. These prototypes have always been defeated by the inability of ordinary telephone lines to carry information at the volume and speed needed to create a television picture. Fiber optic technology has reached the point where a TV-phone system is not far from being technically possible. However, economic feasibility is an entirely different matter. Replacing the vast network of existing phone lines and convincing people to replace their $20 audio phones with video systems that may cost a hundred times as much is not something that will happen overnight.

Improved Signal Systems. Not all of the recurrent needs expressed by the focus groups required advanced, state-of-the-art technology. There were many devices requested which were relatively simply or represented minor modifications of existing devices to make them more reliable and useful.

The most common of these requests was for a portable, modular, easily installed, reliable, low cost standardized home signal system which would respond to a variety of specific noises. The focus groups felt that the systems currently on the market meet some, but not all, of these criteria. Hardwired systems are reliable, but not portable or easy to install. Wireless systems are notoriously unreliable. None of the modular signal systems on the market was considered to be low cost.

In the area of emergency warning devices, there is clearly a need for a device that responds to emergency vehicle sirens. The focus groups had many stories of accidents and near-accidents with emergency vehicles. This is an area which needs more research, not only in terms of hearing impaired persons, but also in terms of hearing auto drivers who become functionally deaf to emergency sirens when they are in their cars with the windows up and the radio on.

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Coordinator of
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(St. Louis area)

The Missouri Department of Mental Health is seeking a talented individual to serve as case manager, counselor, advocate, and coordinator of services for deaf/hearing-impaired persons in the Mental Health system.

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