Planning and Evaluation of a Rehabilitation Program in a Home for the Aged: Use of Hearing Aids and Assistive Listening Devices

Planification et évaluation d'un programme de réadaptation dans un foyer pour personnes âgées : utilisation de prothèses auditives et d'aides techniques pour malentendants

by • par

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ABSTRACT

A battery of outcome measures was developed and used to evaluate the effectiveness of an on-site audiologic rehabilitation program for residents of a home for the aged. Prior to the implementation of the program, outcome measures were obtained on two separate occasions 6 months apart to establish a baseline. Two subsequent evaluations were conducted, one six months and the other one year after the implementation of the program. The primary evaluation tool was a questionnaire designed to assess changes in the scope and quality of communication in 17 everyday situations. Key communication situations for which the residents and staff considered hearing to be important were identified. For each situation, residents were asked about their interest and rate of participation in the situation, ability to understand, satisfaction with communication, and benefit from hearing aids or assistive listening devices (ALDs). The skill of residents and staff in using these prostheses was also tested. The program resulted in an increase in the number of situations attended by residents; specifically, more residents attended chapel, meetings, and teas (Pichora-Fuller & Robertson, 1994a, 1994b). Importantly, there was a dramatic increase in the familiarity of residents and staff with ALDs. Correspondingly, the use of an FM system in the chapel and at meetings likely accounted for residents' reports of improvements in communication in those situations. There was also significant improvement in the skills of both residents and staff in operating hearing aids and ALDs. In the present article, the effect of the program on the use of prostheses is described.

ABRÉGÉ

Les auteurs ont mis au point une série de mesures des résultats qui a servi à évaluer l'efficacité d'un programme maison de réadaptation auditive pour les résidents d'un foyer pour personnes âgées. Avant la mise sur pied du programme, des mesures de résultats ont été obtenues en deux fois, à six mois d'intervalle, pour établir une base de référence. Deux évaluations ont ensuite été effectuées six et douze mois après la mise sur pied. Un questionnaire destiné à évaluer les modifications de l'étendue et de la qualité de la communication dans 17 situations quotidiennes a été le principal outil d'évaluation. Les situations de communication clés dans lesquelles les résidents et le personnel estimaient que l'audition était importante ont été définies. Pour chacune de ces situations, on a interrogé les résidents au sujet de leur intérêt et de leur degré de participation, de leur capacité de compréhension, de leurs satisfaction à l'égard de la communication, et de l'avantage à utiliser les prothèses auditives ou les aides techniques pour malentendants (ATM). L'habileté des résidents et du personnel à utiliser ces prothèses a aussi été vérifiée. Le programme a entraîné une augmentation du nombre d'activités auxquelles ont participé les résidents. En particulier, les résidents ont été plus nombreux à se rendre à la chapelle, aux réunions et aux thés (Pichora-Fuller et Robertson, 1994a, 1994b). Le plus important, ce fut l'amélioration impressionnante de la connaissance des ATM par les résidents et le personnel. Selon toute logique, l'usage d'un système FM à la chapelle et aux réunions expliquerait vraisemblablement que les résidents aient rapporté une amélioration de la communication dans ces situations. Il y a aussi une amélioration marquée de l'habileté tant des résidents que du personnel à utiliser les prothèses auditives et les ATM. Les auteurs exposent l'effet du programme sur l'emploi des prothèses.

KEY WORDS

elderly • hearing aid • assistive listening device • audiologic rehabilitation • program evaluation • institutional care

A hearing rehabilitation program delivered on-site at a home for the aged was evaluated. The program was undertaken because as many as 90% of elderly residents in institutional care have a hearing loss (Schow & Nerbonne, 1980) and traditional clinic-based audiologic services are often inadequate or inaccessible for them (Shultz & Mowry, 1995). The program was developed using an ecological approach that targeted changes in the behaviours of the residents and staff, as well as changes in the physical and social environment that would be

conducive to improving communication (for further explanation of the ecological approach see Carson & Pichora-Fuller, 1997; Jennings & Head, 1994; Noble, 1983). Although the potential merits of the program seemed obvious, it was important to demonstrate its effectiveness in improving the communication experiences of the residents in their everyday life so that it would be possible to gain support for the implementation of such programs on a more widespread basis. For this reason, a formal program evaluation was undertaken. While the outcome of hearing aid delivery to institutionalised seniors has been studied (for a review see Holmes, 1995), to our knowledge there has been no formal evaluation of an on-site ecologically-oriented audiologic rehabilitation program for seniors living in institutional care.

There were two main objectives of the project: (a) to determine if the program increased the scope and effectiveness of the residents' communication, and (b) to determine what specific behavioural or environmental changes accounted for any improvements in communication function that were observed. Expected overall outcomes from an effective program included: (a) a positive change in the scope of residents' participation in activities that demand communication, and (b) a positive change in the effectiveness of residents' communication during those activities. Furthermore, we expected the overall outcomes to be accounted for by specific outcomes such as the following: (a) a positive change in the frequency of use of hearing aids and/or ALDs, (b) a positive change in resident and staff skills in the care and handling of such prostheses, and (c) a positive change in the use of compensatory communication strategies by residents and staff. Measures were designed to document these expected overall and specific outcomes.

The program that was implemented has been described elsewhere (see Head & Jennings, 1994; Jennings & Head, 1994, this issue). The results concerning changes in the overall outcomes (i.e., the scope and effectiveness of the residents' communication), have also been described in detail elsewhere (see Pichora-Fuller & Robertson, 1994a, 1994b). In summary, there were significant increases in the following: the number of activities attended; time (hours/month) spent talking to familiar people, at chapel and at meetings; amount understood in the chapel, when talking to a person who is hard-of-hearing, and on the telephone; and, satisfaction with communication on the telephone. Additionally, residents reported higher levels of handicap in challenging communication situations that could not be avoided (e.g., attending dining hall events or services in the chapel), whereas they reported little handicap in situations that were optional (e.g., attending meetings). Because residents may have selectively opted to participate in situations that were not very handicapping and to avoid optional situations where they would have been handicapped, rather than considering only the quality of communication in the activities that they chose to attend, the scope, or number, of activities attended in evaluating the impact of the program was considered. Overall, at least in some respects, the program did have an important positive effect on the scope and quality of the communication experiences of the residents in everyday situations.

It is of interest to determine the specific changes that might account for these effects. A companion paper describes how the overall outcomes may be related to changes in the use of communication strategies (Robertson, Pichora-Fuller, Jennings, Kirson, & Roodenburg, this issue). The purpose of the present report is to describe how the overall outcomes may be related to the residents' self-reported situation-specific benefit from hearing aids and ALDs and resident and staff skill in the care and handling of hearing prostheses.

Despite the high prevalence of hearing impairment, there is a low rate of hearing aid use and benefit amongst the elderly. Furthermore, some studies have found that benefit from hearing aids declines with age, whereas other studies have found no such relationship (for a review of these issues regarding hearing aid use and benefit by the elderly see Holmes, 1995). Some of the reduction in benefit from hearing aids that has been related to aging may be due to the difficulty experienced by new users in learning how to handle and cope with a complex new device (e.g., Parving & Phillip, 1991). The potential for the elderly to benefit from training in hearing aid use has been demonstrated in the context of a hearing aid delivery program (e.g., Upfold, May, & Battaglia, 1990). We were interested in determining the benefit from hearing aids that might be realised in a more ecologically-oriented rehabilitation program (for a discussion of program issues, see Abrahamson, 1995). Furthermore, although many audiologists have espoused the potential for the elderly to benefit from assistive technology (for a review see Sandridge, 1995), we could find no reports on the use of, and benefit from ALDs by the elderly. We sought evidence that the overall effects of the program on the scope and quality of the residents' communication experiences co-occurred with changes in their knowledge of, and skill with, hearing aids or ALDs.

Method

Design of the Study

The project consisted of two phases, each lasting one year. The first phase was a preprogram phase in which baseline measures were established. In phase one, prior to the implementation of the program, the measurement instruments were administered twice, at a six-month interval. The preprogram evaluations, Evaluation 1 in months 3 to 6 (E1), and Evaluation 2 in months 9 to 12 (E2), were compared to determine the extent to which there was change over a six-month period in the absence of intervention. In the second phase, the program was implemented and evaluated. The same measures were administered to

the same subjects two more times at a six-month interval, once mid-program in months 15 to 18 (E3), and once postprogram in months 21 to 24 (E4). Using this design, variability was limited to within-subject and within-site changes over time. The timing of evaluations was such that seasonal conditions between the preprogram evaluations were the same as between the mid- and postprogram evaluations. We examined whether there was a positive change (improvement or less deterioration), following implementation, compared to change on the same measures during a nontreatment preprogram period of comparable length. It was important to determine how the communication experiences of the residents changed over time in the absence of treatment because their health and abilities were likely to decline such that a positive effect of the program might be observed as a stabilisation rather than as an improvement in their communication experiences. Furthermore, by comparing the changes measured in the first phase (possibly resulting simply from our arrival at the Villa) to changes in the second phase, the Hawthorne Effect (Suter & Lindgren, 1989) was controlled.

The program was intended to alter resident and staff behaviours and the communication environment throughout the facility. Therefore, it was not feasible to withhold treatment from a control group at the Villa while the program was being delivered. The participation of residents at a different facility as a control group would have introduced between-subject and between-site variability, and therefore this alternative design was rejected.

The audiologist who administered the evaluation measures (Robertson) was not the same audiologist who delivered the service (Jennings), and each audiologist was blind to the specific activities of and the results obtained by the other. The arms-length relationship between the personnel providing the program and the personnel evaluating the program was required by Health Canada, the agency that funded the project.

Resident Participants

St. Joseph's Villa in Dundas, Ontario, Canada was chosen as the site of the project. All residents were invited to participate in the project except those who were not fluent in English, those known to have communication impairments other than hearing loss, or those receiving high levels of care. Residents were screened by two methods: chart review and a questionnaire given to care nurses regarding their opinion of each resident's potential to benefit from the program. The charts of each of the 362 residents were reviewed by the evaluation audiologist for the following contra-indications to participation in the project: non-fluency in English, severe psychological disorder, aphasia, left-hemisphere stroke, head trauma, severe multiple sclerosis, severe Parkinson's disease, and daily medication sufficient to alter daytime patterns of thought, emotion, or alertness. On the basis of information in the chart, 110 residents were considered to be eligible for the project. These residents were further screened using a questionnaire that was completed by the care nurses. Of the 110 who passed the chart review, 95 were considered by their care nurse to have the potential to benefit from the program. Note that audiometric thresholds were not considered to determine the eligibility of residents for the project for several reasons: (a) the percentage of institutionalised elderly with clinically significant hearing loss has been reported to be as high as 90% (Schow & Nerbonne, 1980); (b) we assumed that even residents with no clinically significant threshold hearing loss would experience difficulty hearing in non-ideal, everyday communication situations (for a review see Willott, 1991); and, (c) in addition to hearing aids, the program offered a wide range of treatment options that could be advantageous regardless of degree of hearing loss.

Consent. The 95 residents who met the eligibility criteria were all invited to participate in the project. An initial contact letter explaining the project was sent to each eligible resident. The evaluation audiologist then visited each of these residents to invite them to participate. Those who were willing to participate in the evaluation were then asked to complete a formal written consent form. In total, 78 residents consented to participate. The reasons given by the other 17 residents for their refusal to participate included the following: ill health, considered self to be too old, considered self to have no handicap, lack of interest, suspicions about associated costs, unwillingness to sign any document, advice of family, and satisfaction with existing hearing services. Any resident could participate in the rehabilitation program; however, only the subset of residents who consented were involved in the formal program evaluation.

Attrition following consent. Of the 78 residents who consented to participate, 48 withdrew by the end of the study, leaving 30 who completed the program evaluation. Almost half (21) of those who dropped out of the evaluation group did so in the first six-month period, with most of the remainder (11 and 13 respectively) dropping out during the second or third six-month period, and with very few (3) dropping out in the final six-month period. About 3/4 of those who dropped out of the study did so for reasons that were unrelated to the project itself (21 had changes for the worse in mental or physical health; 9 died; 3 moved out of the Villa). A little less than 10% dropped out because the evaluation was too demanding. Some who dropped out continued to receive services even though their participation in the formal program evaluation was discontinued. Therefore, those who were evaluated should not be taken to represent the entire population of the Villa, or even the subpopulation to whom audiologic services were delivered. In general, the 30 who completed the evaluation had better and more stable health.

Profile of resident group evaluated. At the outset of the study, the mean age of the evaluated group was 85 years (range 68 to 94 years; *SD* = 6 years). Not surprisingly, the majority of the evaluated group (26 of 30) were women. The length of their residency in the Villa ranged from 0 to 26 years (M = 5 years; *SD* = 6 years), with over half having lived there at least 6 years before the beginning of the project. The fact that many had lived in the Villa for a number of years is consistent with our impression that there was a well-established community of residents at the Villa who knew each other well. According to Lubinski (1984), the prerequisites for successful communication by older adults are that the elderly person must have both the skills and motivation to communicate, and that the external environment must be conducive to communication. We believed that these prerequisites could be satisfied given that there seemed to be a prevailing sense of community at the Villa that fostered and was fostered by communication.

The ability of some residents to engage in activities such as watching a private television, talking on a private telephone, or playing music of their own choice was directly affected by the presence of one or more roommates. The presence of roommates also made interpersonal communication unavoidable. Therefore, the living conditions of the participants must be considered to fully appreciate the possible benefits from the program. About half (14) lived in private rooms, while most of the others (12) had one roommate, and a small number (4) lived with three roommates.

The majority (16) of the evaluated group had no other major health concerns besides hearing loss. Almost a third (9) had a significant visual impairment, and most of those (6) were legally blind. Other chronic health problems that co-existed with hearing loss but that were not considered to be severe enough to interfere with the participation of the affected individuals in the project were: Parkinson's Disease (2), multiple sclerosis (1), anxiety (1), and depression (1). Some members of the evaluated group experienced fluctuations in physical or mental health over the period of the project but these were not sufficient to cause them to withdraw from the study.

The Standardized Mini-mental State Exam (SMMSE) (Molloy, Alemayehu, & Roberts, 1991) was administered to screen for cognitive deficits and to monitor for changes in cognitive function. Overall, the evaluated group were atypical in that they performed very well on the test, with no significant change in performance over the period of the project. The initial mean SMMSE score was 27.4 (max = 30; range 23 to 30; *SD* = 2.1), and mean scores at the E2, E3, and E4 were 27.7, 27.7, and 27.6 respectively, with no increase in the range of scores. In contrast to those who completed the final evaluation, almost 1/4 of the drop-outs had a change in mental health, with almost all (10/11) falling to a score of 21 or less on the SMMSE. It seems that a minimal level of cognitive function, corresponding to a score of about 23/30 on the SMMSE, is sufficient to ensure meaningful participation by the resident in an audiologic rehabilitation program in which complex new skills and self-initiated behaviours must be learned. The present formal methods of program evaluation could not, however, be used to evaluate the benefit that might be realised from an appropriately structured program in those with lower levels of cognitive function (for a discussion see Shultz & Mowry, 1995).

Preprogram audiometric tests were conducted to determine the hearing status of each resident in the evaluated group. Using the rule of thumb that a person with a pure-tone threshold loss of at least 40 dB HL at 2 kHz is likely to benefit from wearing a hearing aid, about half of the evaluated group were found to have a degree of hearing loss that warranted consideration of a hearing aid fitting. The other half of the group also demonstrated hearing loss above 2 kHz consistent with aging (presbycusis). Even when the degree of threshold loss in the elderly is minimal, other subclinical auditory processing deficits likely account for the ubiquitous complaint that they have difficulty understanding speech when there is background noise or multiple talkers (for a review see Willott, 1991). Even when there was no background noise, the best speech discrimination score obtained was fair (below 80%) for about 2/3 of the group (M = 74%; range 16% to 100%; *SD* = 20%). While hearing aids may correct for threshold loss, they are less able to overcome the latter type of auditory deficit that is characteristic of aging (Chmiel & Jerger, 1996; Crandell, Henoch, & Dunkerson, 1991), especially in many of the noisy situations that are encountered in everyday life (Cox & Alexander, 1991). In such cases, and for situations where signal enhancement in noise is required, assistive listening technology may be more useful than hearing aids (Kaplan, 1996; Pichora-Fuller, in press; Sandridge, 1995).

About half (16) of the evaluated group owned hearing aids at the outset of the project. Of those who had hearing aids, 15 used their hearing aid(s) at least some of the time, with most wearing their hearing aids all day long, every day. Note that, in the evaluated group, almost all of those who were considered to be candidates for hearing aids had a hearing aid. Thus, the rate and regularity of preprogram hearing aid use in the evaluated group is much higher than has been reported in previous studies, where use of amplification by seniors living in nursing homes or retirement centres has been found to be as low as 4 to 10% (Schow, 1982; Thibodeau & Schmitt, 1988), and where just over half of those with hearing aids were found to wear them daily (Parving & Phillip, 1991).

Prior to the beginning of the project, some public phones in the Villa were equipped with handset volume controls and four members of the evaluated group reported using them. No other public ALDs were available. Nine residents in the evaluated

group used handset volume controls on private telephones. The only other ALDs in use prior to the program were jack-in earphones for television use that were owned, but seldom used, by two of the residents, and a one-to-one communicator that was owned, but tried only once, by one resident.

Staff Participants

All staff were targeted by the hearing rehabilitation program. A subset of them participated in the formal program evaluation. At the time of each evaluation, the residents who participated in the evaluation identified the staff who were their most regular communication partners in each of the key communication situations. The staff who participated in the evaluation were those identified as regular communication partners. These staff members represented a cross-section of the staff from nursing, dietary, recreation, housekeeping and administration. Nearly 100 workers were evaluated at E1. With the reduction in the number of residents evaluated, there was a corresponding drop by the end of the project in the number of communication partners evaluated. About a third (30) of the staff communication partners participated throughout the duration of the project and it is their results that are described below.

Outcome Measures

We devised a set of outcome measures to determine the impact of intervention on the scope and quality of communication in everyday activities, and to measure the knowledge and skills acquired by the residents and staff that presumably accounted for changes in their communication experiences. In addition to gathering questionnaire data from the residents, we gathered objective measures of skill in use of prostheses from the residents and their regular staff communication partners.

Questionnaire about communication in key situations. Existing questionnaires were too general for our purposes, so we developed a questionnaire that was specific to situations where hearing was considered to be important (see Pichora-Fuller & Robertson, 1994a, 1994b). In a pilot study, two meetings were held, each with 15 participants: 5 residents with known hearing loss, 5 residents who were considered by Villa staff to have good hearing, and 5 staff members. The participants were asked, "In everyday life at the Villa, when is it important for a resident to hear?" The lists of situations generated were later reviewed by four experts (two audiologists, a speech-language pathologist who works with the elderly, and the nurse in charge of the clinic at the Villa). The experts determined a final list of 36 key situations, excluding those that were considered to be duplicates or irrelevant to the project. During period E1, three more situations were dropped because hearing did not seem to be an important or regular feature of the situation. Therefore, 33 situations were retained for the evaluations (Table 1).

Table 1. List of 33 key communication situations.

Situations	
Primary	**Supplementary**
1. Talking to familiar people	1. Talking to strangers
2. Talking to hard-of-hearing people	2. Talking in the lobby
3. Telephone	3. Talking to staff
4. Chapel	4. Talking to nurses about pills
5. Meetings	5. Informal, small-group discussions
6. Exercise class	6. Listening to live music
7. Teas in the solarium	7. Dinners in the Villacourt Lounge
8. Teas in the auditorium	8. Card games
9. Teas in the tuck shop	9. Bingo
10. Dining in the main dining room	10. Bowling
11. Dining in floor-specific dining areas	11. At the beauty parlour
12. Watching TV	12. Outings
13. Radio talk shows	13. Public address system messages
14. Taped books	14. Fire drill
15. Taped music	15. Identifying someone by voice
16. At movies at the Villa	16. Hearing that someone is approaching
17. Art therapy	

The questionnaire (Appendix A) was developed to obtain self-report information from the residents. The questionnaire consisted of nine basic questions: four on scope of communication, three on quality of communication, and two on the use of and benefit from prostheses. The evaluation audiologist asked the questions and recorded the responses during an interview that was held at a time and place that was convenient to the resident, and at a time when the resident was feeling well. All nine questions were asked with respect to 17 of the 33 key situations (primary situations). For the remaining 16 of the 33 key situations (supplementary situations), only the two questions about scope of communication were asked. In the present paper, the responses to the two questions concerning prostheses that were asked with respect to the 17 primary situations are reported. Responses to the other questions have been previously reported (Pichora-Fuller & Robertson, 1994a, 1994b).

Use of and benefit from prostheses were measured using the following two questions in the situation-specific questionnaire (Appendix A): (a) Do you use a prosthesis in this situation?, and (b) Does the prosthesis help you in this situation? Most of the information obtained pertained to hearing aids and little pertained to ALDs because so few residents had any familiarity with ALDs until phase two of the project. Furthermore, because the use of specific ALDs was linked to specific situations, it would not have been reasonable to average responses over situations, as could be done for hearing aid use and benefit. Therefore, only the questionnaire responses concerning hearing aids were analysed statistically.

Test of knowledge and skill with prostheses. Skill with, and handling of prostheses were measured using a hands-on test of skill in operating and caring for hearing aids and ALDs (Appendix B). For ITE (in-the-ear) hearing aids, the ability of

the resident or staff to perform five basic operations was tested: inserting battery, closing battery door, inserting ITE, turning aid on, and adjusting volume. For BTE (behind-the-ear) hearing aids, two additional operations were tested: placing aid over pinna and not twisting the tubing. Responses were scored as "performed correctly and with ease" (4), "performed correctly but with difficulty" (3), "performed with instruction" (2), "could not perform correctly" (1), and "not applicable" (0). For ALDs, responses were scored as: "can use device independently" (6), "can use device with help" (5), "has had hands-on experience but hasn't acquired skill in ALD use" (4), "has seen ALD being used" (3), "knows of ALD and its use" (2), "has not heard of ALD or does not understand its use" (1), "not applicable" (0). Scores on applicable items were averaged.

Residents were evaluated in each of the four evaluation periods (E1, E2, E3, and E4) on their own hearing aids and familiar ALDs. Their staff communication partners were evaluated during the first and final evaluation periods (E1 and E4) on a sample of hearing aids and ALDs that were used by the residents with whom they regularly communicated.

Results

Hearing Aids

Number in use. At E1, nine residents owned BTE and seven owned ITE hearing aids. One owned a BTE as well as a body-worn aid. Note that, in the frail elderly, ability to handle an aid will depend on factors such as dexterity and vision, with such considerations governing the type of aid chosen (Holmes, 1995). ITEs are usually simpler to handle than BTEs (Upfold et al., 1990). ITEs usually have fewer controls and the user need only insert the ITE without having to contend with the more complicated BTE assembly of earmould, tubing, and aid; however, ITEs are also smaller than BTEs and their size may make their controls more difficult for residents to operate. Individuals with poor dexterity, or those who must rely on vision instead of tactile input to adjust the controls, could be candidates for a body aid if an ITE aid is too small and a BTE aid is too complex to handle. All residents in the evaluated group, except one ITE user, wore their hearing aid(s) at least some of the time during the preprogram period. By E2, the aids of two of the ITE users had broken, including one that had not been working since E1. During phase two, the two residents whose ITEs were broken in phase one had them fixed and began wearing them again in phase two, the ITE of another resident broke and he did not want to pay to have it repaired. Two other residents tried alternate fittings. One of them, who had an ITE and a BTE for one ear in phase one, tried a binaural fitting by getting a new earmould and switching the BTE to the other ear; however, ultimately he reverted to wearing a monaural ITE fitting for most occasions and using the BTE with an FM system. The other resident who tried an alternative fitting switched from a BTE to a body aid. Lastly, one person who was unaided in phase one began wearing a body aid. Overall, the pattern of hearing aid use for the evaluated group indicates that the program resulted in new hearing aids being used by very few residents who had not previously been aided. Rather, the main effect of the program was on maintaining hearing aid use by experienced users.

Self-reported benefit. If a resident owned a hearing aid at any time during the period of the project, the amount that the hearing aid was worn (0 = never; 2 = sometimes; 3 = always) and the extent to which the resident reported benefit from the aid (0 = never or not much; 2 = some; 3 = very much) was averaged over all primary situations experienced at least once during the period of the project. Therefore, results were analysed for a fixed number of residents in a fixed number of situations, with "never" being taken as the response at times or in situations when a resident did not use a hearing aid. On average, both use and benefit were stable (average hearing aid use was scored as 2.2, 2.0, 2.2 and 2.1, and average benefit as 2.0, 1.9, 1.9 and 2.0, respectively, at the four evaluations). An examination of each of the situations separately showed that there was no significant change in amount of hearing aid use or benefit in any particular situation.

Residents' knowledge and skill. At E1, on the skills test, 10 of the 16 aided residents could perform all necessary hearing aid operations easily (see Figures 1 and 2). Three ITE users had trouble performing more than one operation, and one had trouble with only one operation. Two BTE users had trouble performing more than one operation. At E2, for the seven residents who had working ITEs, there was no change in ability to perform hearing aid operations. By E2, the two BTE users who had trouble at E1 could no longer perform the operations without assistance. The preprogram abilities of the residents are consistent with the finding of Parving and Phillip (1991) that there were many handling problems amongst both new and experienced elderly hearing aid users.

Between E2 and E3, there was no change in the skills of the ITE users. The BTE users who had come, by E2, to require assistance operating their aid, regained ability to perform some of the skills independently, although they also continued to have some difficulty. Enhanced skill was possible in one case because the resident switched from a BTE to a body-worn hearing aid. By E4, of the group who had begun with BTEs (except one who was too sick to be tested), only the one who switched to the body aid needed assistance with any of the operations, and the other who had had trouble earlier regained ability to perform all operations independently, although with difficulty on some operations. An even more striking result is that by E4, all eight residents who had working ITEs could perform all operations easily except for two who needed help inserting the battery. Overall, these results highlight the importance of the program

Figure 1. Number of residents operating BTE hearing aids with ease at each of the four evaluations.

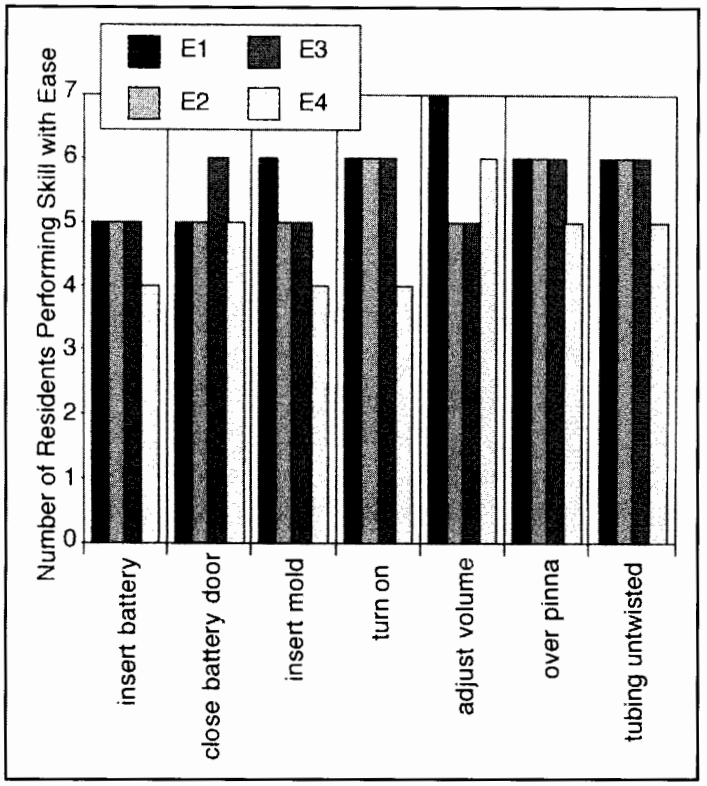
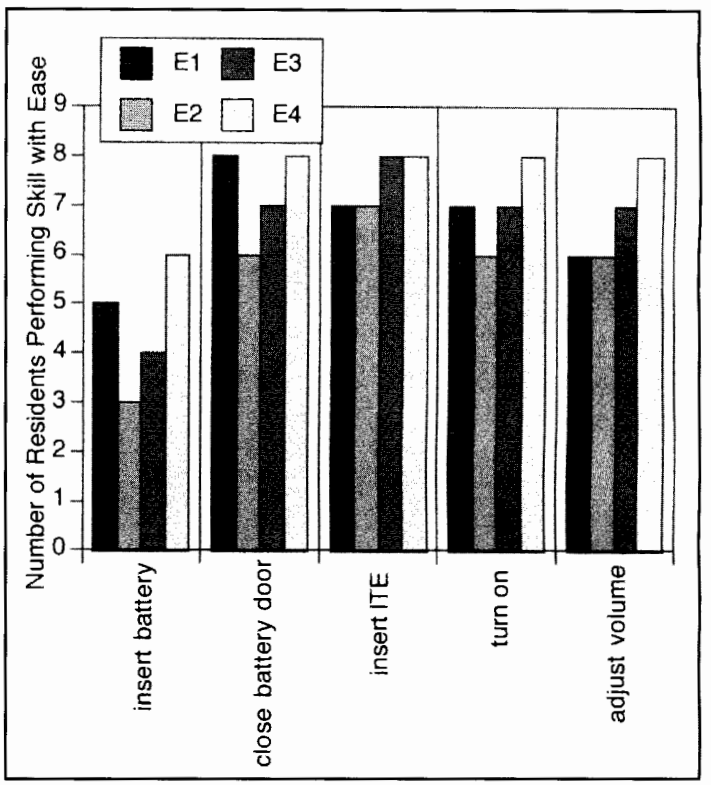


Figure 2. Number of residents operating ITE hearing aids with ease at each of the four evaluations.



in ensuring, on an ongoing basis, that hearing aid fittings are appropriate and that residents maintain their ability to operate them successfully.

Staff knowledge and skill. Especially for residents who require assistance, it is important for staff to be skilled in operating hearing aids and to know if these prostheses are in good working order. Staff skills in operating hearing aids improved from E1 to E4, with significant gains in all of the operations tested except how to turn on a BTE aid and how to insert a battery into a BTE aid (see Figures 3 and 4). The reason for the continuing difficulty of the staff in turning on a BTE aid seems to arise from the way the hearing aid switches are labelled ('m' for 'microphone' means 'on' and 'o' means 'off'); staff members frequently thought that 'o' meant 'on'. The battery was often inserted into the hearing aid rather than being placed in the battery compartment, and it was also often placed with the polarity reversed (upside down). Between E1 and E4, the 30 staff members who completed both evaluations improved significantly in the following BTE skills: closing the battery door [M score 3.1 vs. 3.7; $t(29) = -2.67$, $p < .015$], inserting the earmould [M score 2.0 vs. 3.0; $t(29) = -3.75$, $p < .001$], placing the aid over the pinna [M score 2.6 vs. 3.6; $t(29) = -4.07$, $p < .001$], not twisting the tubing when placing the hearing aid on the pinna [M score 2.8 vs. 3.7; $t(29) = -3.82$, $p < .001$], adjusting the volume [M score 2.2 vs. 3.1; $t(29) = -3.68$, $p < .001$]. For skills required to operate an ITE aid, staff members improved on the following operations: inserting the battery [M score 3.0 vs. 3.6; $t(29) = -3.16$, $p < .005$], closing the battery door [M score 2.9 vs. 3.7; $t(29) = -3.40$, $p < .002$], inserting the aid [M score 2.1 vs. 2.9; $t(29) = -3.31$, $p < .005$], turning the aid on [M score 2.1 vs. 2.9; $t(29) = -3.22$, $p < .005$], and adjusting the volume [M score 2.1 vs. 3.1; $t(29) = -3.97$, $p < .001$]. Overall, the program was clearly effective in increasing staff skill in operating hearing aids. By the final evaluation, on average, the staff were able to perform the skills required to operate a hearing aid and they were able to provide assistance to residents who needed it.

Assistive listening devices

Number with experience using ALDs. As shown in Figure 5, at E1, 10 residents had used their hearing aid with the phone, 9 residents had used a handset amplifier (on public phones), 5 had used TV headsets, and one owned but seldom used a one-to-one communicator. By E2, five more people had used a handset phone amplifier, and one more person had used a number of TV

Figure 3. Average staff score for BTE skills pre and postprogram.

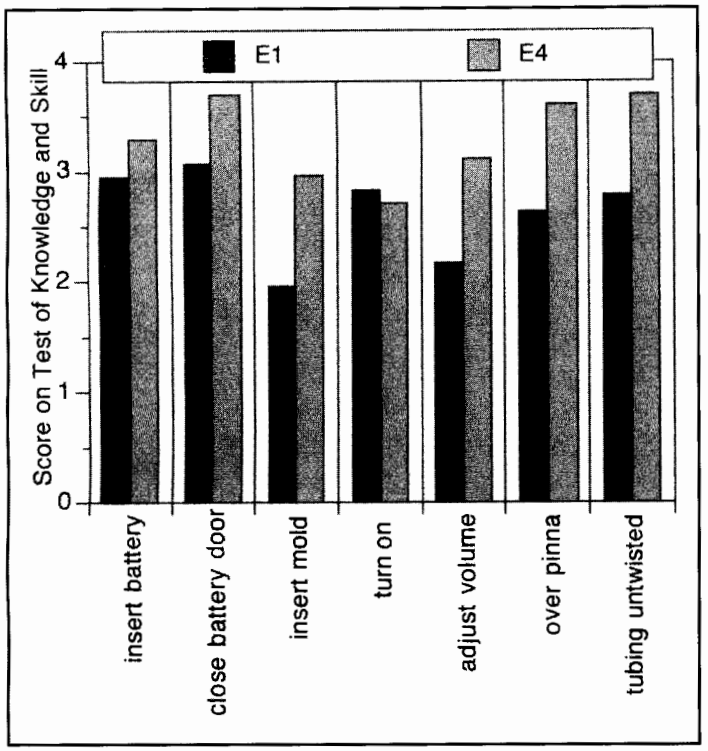
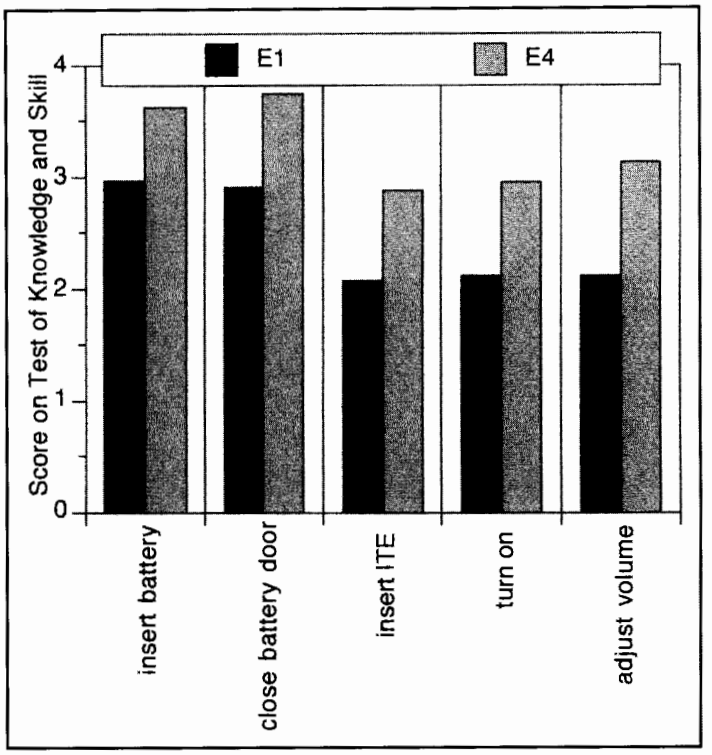


Figure 4. Average staff score for ITE skills pre and postprogram.

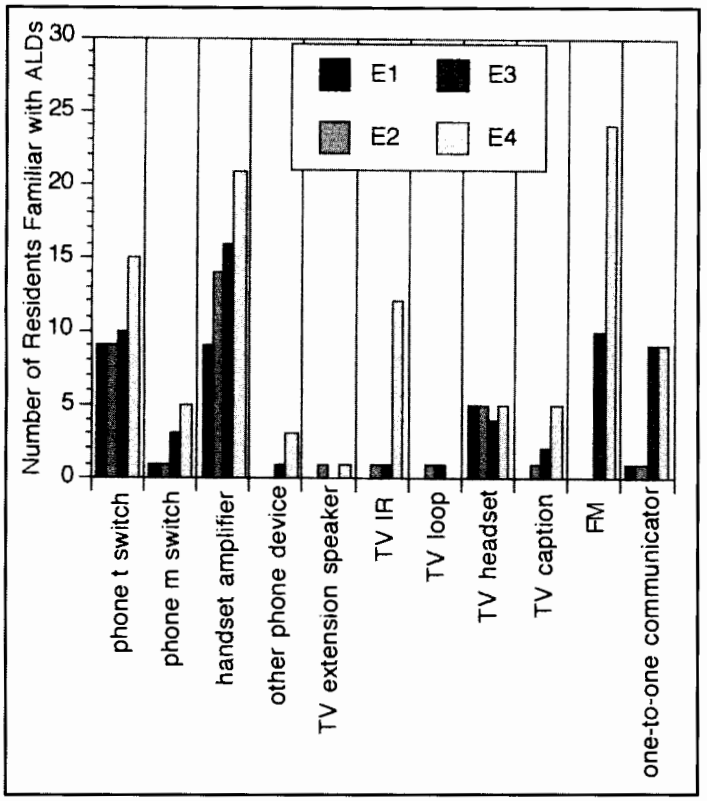


devices (closed caption, extension speaker, TV headset, infrared (IR) and magnetic loop). After the program was implemented, there were further increases in the number of residents who had used their hearing aid with the phone (13 by E3 and 16 by E4), the handset phone amplifier (16 by E3 and 21 by E4), and other types of phone devices (1 by E3 and 3 by E4). More residents also tried TV devices, with the greatest increases being in the number who had used caption TV (2 by E3 and 5 by E4) and a TV IR system (1 by E3 and 12 by E4). The number of residents who had used a one-to-one communicator rose to 9 by E3 and E4. Finally, there was an increase in the use of the FM system (used in the chapel and auditorium), with 10 residents having used it by E3 and 24 by E4. Overall, very few residents were familiar with ALDs prior to the program but by the final evaluation most residents had used ALDs for phone, television, and personal communication. In some cases this use of ALDs was limited to sessions conducted by the program audiologist and in other cases residents became regular users of ALDs. Furthermore, it is noteworthy that many of the residents who did not wear hearing aids became familiar with ALDs.

Residents' knowledge and skill. Prior to the implementation of the program, most of the residents who had attempted to use a prosthesis for the telephone were able to operate either their hearing aid or a handset amplifier effectively for phone use. The one resident who had acquired a television headset was able to operate it effectively. No other ALDs were used effectively by the residents. After the implementation of the program, there were significant improvements in the use of hearing aids with the telephone and in the use of other assistive technology for various purposes. Analyses were conducted for residents who could have used and had been exposed to each type of ALD at any time during the project; for example, blind residents would not have been exposed to television captioning and would not have been included in the analyses for that type of ALD.

All but one resident in the evaluated group used the telephone. As shown in Figure 6, regarding telephone use, residents who did not have a telecoil (t-switch) on their hearing aid became significantly more skilled in placing their hearing aids to the telephone so that the hearing aid could be used (set on 'microphone'). Specifically, they were more skilled in using their hearing aid with the telephone in this way at E4 than they were at either E1 or E2 ($p < .05$; multiple comparisons were evaluated using a Student-Newman-Keuls test), with average scores of 1.2, 1.3, 1.9 and 2.6 respectively for the four evaluations [$F(3,42) = 3.2$, $p < .05$]. Residents also showed significant improvement in their knowledge of, and skill with handset phone amplifiers from E1 (which did not differ from E2, $p > .05$) to E3 ($p < .05$) and to E4 ($p < .01$), with average scores of 3.0,

Figure 5. Number of residents who had used and were familiar with ALDs at each of the four evaluations.



3.4, 3.8 and 4.8 respectively at the four evaluations [$F(3,84) = 10.9$, $p < .01$]. Skill with, and knowledge of other telephone devices also improved significantly ($p < .05$) from E1 (which did not differ significantly from E2 or E3, $p > .05$) to E4, with average scores of 1.1, 1.1, 1.3 and 1.7 respectively [$F(3,84) = 3.97$, $p < .05$].

At E1, 26 residents reported watching television, although only 22 residents watched television at E2, and 23 watched television at E3 and E4. Knowledge of, and skill with infrared devices for television viewing increased significantly ($p < .01$) from E1 (which did not differ significantly from E2 or E3, $p > .05$) to E4, with the average scores being 1.1, 1.2, 1.3 and 3.0 respectively at the four evaluations [$F(3,69) = 21.55$, $p < .01$].

Knowledge and skill also improved significantly ($p < .01$) for one-to-one communicators from E1 (which did not differ from E2, $p > .05$) to E3 (which did not differ from E4, $p > .05$); scores were 1.6, 1.7, 2.8 and 2.3 respectively [$F(3,84) = 5.22$, $p < .01$]. Finally, there was also a significant improvement from E1 (which did not differ from E2, $p > .05$) to E3 ($p < .01$), with a further significant ($p < .01$) increase from E3 to E4 in knowledge of and skill with FM room systems that were used extensively in the chapel and to a lesser extent at meetings and events in the auditorium, with average scores of 1.2, 1.1, 2.6 and 4.6 respectively [$F(3,84) = 84.72$, $p < .01$]. Note that there was an increase in the number of residents participating in activities where FM systems were used. Specifically, by the end of the project, more residents attended chapel; 22 residents attended services in the chapel at E1 but 26 attended by E4. Likewise, there was an increase in the number of residents who attended meetings, with 11 attending at E1 and 18 attending by E4. There was also an increase in attendance at teas in the auditorium, with 6 attending at E1 and 15 attending by E4 (see Pichora-Fuller & Robertson, 1994a, 1994b).

Overall, there were noteworthy gains in the residents' knowledge of and skill with ALDs. Importantly, ALDs were used for situations in which many residents participated, namely, telephone conversations, television viewing, and chapel.

Staff knowledge and skill. As shown in Figure 7, between E1 and E4 there were also significant increases in the staff's knowledge of and skill with various ALDs. Staff members improved in their understanding of how hearing aids are used with telephones, both when the hearing aid is set to its 't-switch' position [M score 2.5 vs. 3.9; $t(29) = -3.48$, $p < .005$], and to its 'm-switch' position [M score 1.0 vs. 1.6; $t(29) = -2.25$, $p < .05$].

Figure 6. Average resident score for knowledge of and skill in operating ALDs at each of the four evaluations.

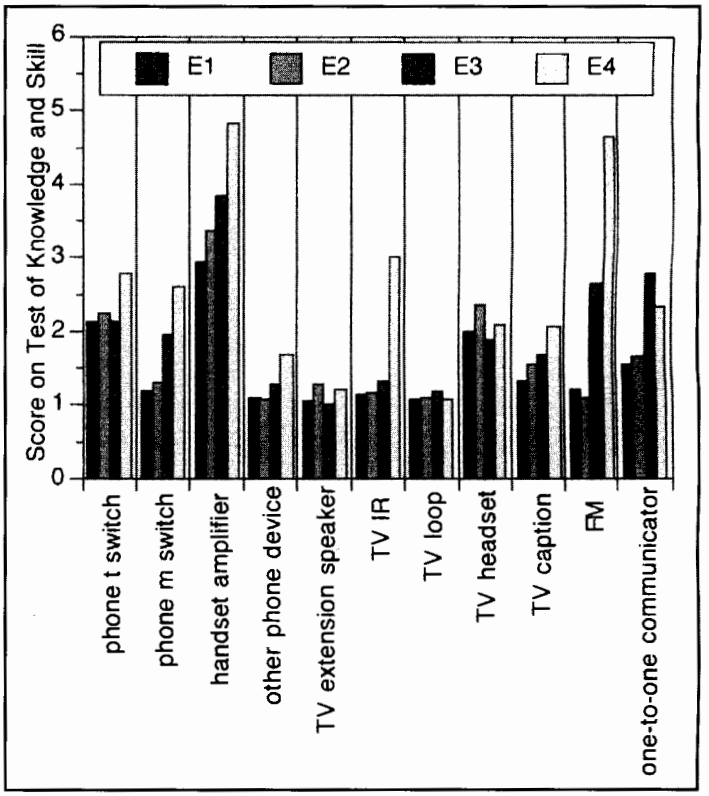
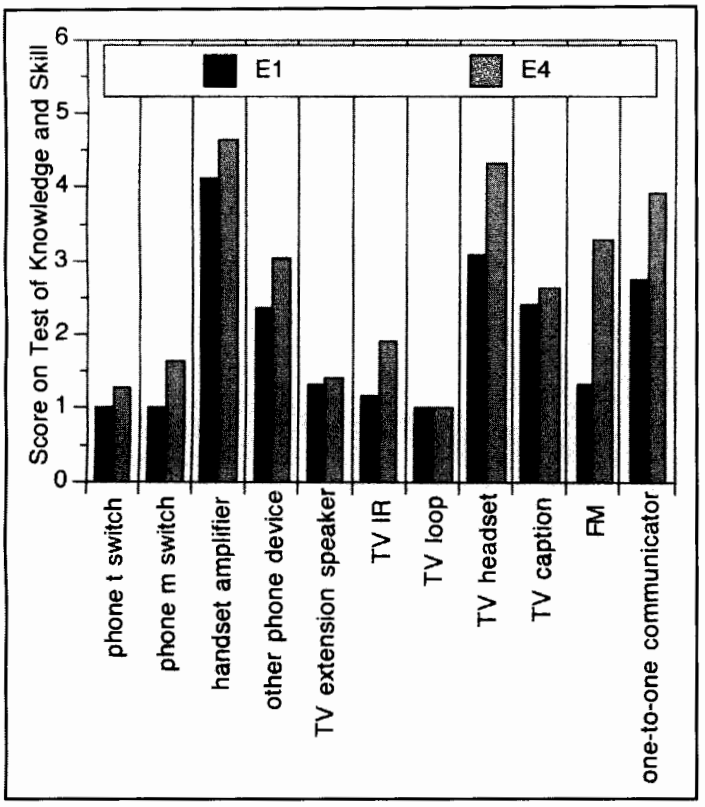


Figure 7. Average staff score for knowledge of and skill in operating ALDs pre and postprogram.



They improved in their understanding of devices that can be used to assist listening to television: IR systems [M score 1.2 vs. 1.9; $t(29) = -3.13$, $p < .005$,] and plug-in television headsets [M score 3.1 vs. 4.2; $t(29) = -2.75$, $p < .01$]. They also improved in their understanding of how to use one-to-one communicators like the PockeTalker from Williams Sound, Eden, MN [M score 2.7 vs. 3.9; $t(29) = -2.81$, $p < .01$]. Finally, they improved in their understanding of the FM system that was used in the chapel, auditorium, and meetings [M score 1.3 vs. 3.3; $t(29) = -5.49$, $p < .001$]. Not surprisingly, the staff acquired more knowledge of and skill with the ALDs that were the most widely used by the residents.

Conclusions

Within the design of this study, there were four different hypothetical patterns of outcomes that might have been observed and interpreted as evidence that the program was effective. The first hypothetical pattern was an increase in performance between the mid- and postprogram evaluations following no change in the preprogram period; this pattern would provide strong evidence that the program was effective. Strong evidence would also be provided by the second hypothetical pattern, which was an increase or rebound in performance between the mid- and postprogram evaluations following a decline in performance during the preprogram period. The third hypothetical pattern was an increase in performance between the mid- and postprogram evaluations following an increase in performance in the preprogram period; this pattern would provide weaker evidence of program effectiveness because improvement would be observed even before the program began. The fourth hypothetical pattern was no change in performance between the mid- and postprogram evaluations following a preliminary improvement during the preprogram period; this pattern would provide very weak evidence of program effectiveness because improvement would only be observed before the program began. Preprogram changes might have resulted from the evaluation itself raising awareness of hearing-related issues. The actual patterns observed that provide evidence of benefit from treatment will be summarised.

Strong evidence of program effectiveness, based on observation of the first pattern, was obtained on the following measures: amount understood in the chapel (see Pichora-Fuller and Robertson 1994a, 1994b); resident skill in operating ITE hearing aids; staff skill in operating hearing aids; and resident and staff knowledge of and skill with ALDs. For both residents and staff there were improvements in knowledge and skill regarding hearing aid use with the telephone, TV IR systems, one-to-one communicators, and FM systems. In addition, residents improved their knowledge of and skill with the phone handset amplifier and other phone devices. Staff members improved their knowledge of and skill with TV headsets. There was also significant improvement in resident knowledge of listener- and environment-related solutions to communication problems (Pichora-Fuller & Robertson, 1994a; Robertson et al., this issue).

Additional, strong evidence of program effectiveness based on observation of the second pattern, rebound in performance after the implementation of the program and following a decline during the preprogram period, was obtained on the following measures: hours per month spent talking to familiar people, hours per month spent in chapel (Pichora-Fuller & Robertson, 1994a, 1994b), and BTE hearing aid operation by residents.

Weaker evidence of program effectiveness based on observation of the third pattern, improved performance after implementation of the program and following a positive change between E1 and E2, was observed for the following measures: number of different activities attended and hours per month spent at meetings (Pichora-Fuller & Robertson, 1994a, 1994b).

The fourth pattern, no change in performance after program implementation and following a positive change between E1 and E2, was observed for the following measures: amount under-

stood on the phone, satisfaction with communication on the phone, and amount understood when talking to a hard-of-hearing person (Pichora-Fuller & Robertson, 1994a, 1994b).

There was no marked increase in the number of residents using hearing aids or in resident satisfaction with communication; performance on these measures was at or near ceiling for the group we evaluated. Residents at other institutions, or more impaired residents, might not be at ceiling on these measures. The fact that performance was at ceiling, however, does not necessarily mean that the residents experienced no difficulties. For example, the high level of satisfaction reported by the residents likely arises from an adaptive attitude whereby the elderly accept limitations in their abilities. Many of the residents with declining cognitive abilities found it very difficult to respond to the more differentiated five-point scale piloted before the beginning of the study; therefore, a three-point scale was used for this item. This decision was probably premature, given that the ultimate group of residents in the evaluated group did not suffer from cognitive declines that would have precluded use of a five-point scale. In the decision to simplify the response choice set, the ability to discriminate between differences in level of satisfaction or change in level of satisfaction may have been sacrificed (Pichora-Fuller & Robertson, 1994).

Overall, benefit from treatment was found with respect to the residents' scope of communication, resident and staff knowledge of and skill with hearing aids, the number of residents with experience using ALDs (especially the FM), and resident knowledge of strategies for solving communication problems (see also Pichora-Fuller & Robertson, 1994; Robertson et al., this issue). Within the ecologically oriented rehabilitation program that was provided, these changes likely were realised because the conditions were established to predispose, enable, and reinforce changes in the behaviours of the residents and staff (for a discussion of these factors in program planning for seniors living in care facilities, see Carson & Pichora-Fuller, 1997; Pichora-Fuller, in press). The services delivered by the program audiologist enabled the continuing use of hearing aids by those who already owned them and the new use of ALDs by many residents. For several reasons, the residents and staff were likely predisposed to adopt new behaviours required for the use of ALDs. First, as already mentioned, the residents of the Villa seemed motivated to communicate and the environment was conducive to communication even before the program was implemented and this no doubt provided a solid base on which positive changes could be built. Second, ALDs are useful in situations where many residents participate regularly but where benefit from hearing aids is limited (e.g., holding telephone conversations, watching television, or attending services in the chapel). Third, the very fact that many residents could take advantage of ALDs in these frequently experienced situations probably reinforced the efforts of residents and staff as they acquired knowledge of, and skill with ALDs. Fourth, there was consistent support provided by the program audiologist. The constellation of benefits that are attributable to the program seem to be interlocked in a positive feedback cycle that promotes program success.

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Appendix A

Key Communication Questionnaire

Situation: _____
Regular Communication Partner(s): _____

A. Scope

1. How often are you ever in this situation?
a. regularly ____ hours/week ____ days/week ____ weeks/month
b. less regularly range: _____
2. How often does a hearing problem prevent you from being in this situation?
never sometimes comment: _____
3. When were you last in this situation? _____
4. How many people do you have conversations with in this situation?
NA Number: _____ Regular Partners: _____

B. Communication Handicap

1. Is it important for you to hear well/understand in this situation?
no sometimes yes comment:_____
2. How much do you hear/understand in this situation?
less than half half most or all comment: _____
3. Are you satisfied with how well you hear/understand in this situation?
no sometimes yes comment: _____

C. Usage and Benefit from Prostheses

1. How often do you use a hearing aid or other device in this situation?
never sometimes always
2. How much does the hearing aid or other device improve your hearing/understanding in this situation?
not much so-so very much comment: _____

Appendix B

Test of Basic Operation of a Hearing Aid*

Examiner sets the hearing aid to 'off', minimum volume, and removes the battery.

The resident is asked to put the hearing aid on and adjust it.

A staff member is asked to put the hearing aid on someone else and to adjust it.

The examiner observes and scores performance (score for response is given in brackets).

Prompts may be used if necessary.

Hearing Aid Test Score Sheet

1. Inserts battery
(4) easily (3) with difficulty (2) with instruction (1) incorrectly
2. Closes battery compartment
(4) easily (3) with difficulty (2) with instruction (1) incorrectly
3. Inserts ITE or earmould of BTE
(4) easily (3) with difficulty (2) with instruction (1) incorrectly
4. Keeps tubing untwisted
(4) easily (3) with difficulty (2) with instruction (1) incorrectly
(0) NA if not BTE
5. Places aid correctly over pinna
(4) easily (3) with difficulty (2) with instruction (1) incorrectly
(0) NA if not BTE
6. Turns aid on
(4) easily (3) with difficulty (2) with instruction (1) incorrectly
(0) NA if no 'on' switch
7. Adjusts volume
(4) easily (3) with difficulty (2) with instruction (1) incorrectly
(0) NA if no volume control

*adapted from the Mount Sinai Hospital Skill Evaluation, Thurier & Pichora-Fuller, 1986.

Assistive Listening Devices Test (Abbreviated Version)

A. Telephone Devices

1. Hearing Aid T-switch
(6) can use device independently
(5) can use device with help
(4) has had hands-on experience but hasn't acquired skill in ALD use
(3) has seen the ALD being used
(2) knows of ALD and its use
(1) has not heard of device or does not understand its use
(0) not applicable — no potential to use ALD

2. Hearing Aid M-switch	(6)	(5)	(4)	(3)	(2)	(1)	(0)
3. Handset Amplifier	(6)	(5)	(4)	(3)	(2)	(1)	(0)
4. Other Telephone Device	(6)	(5)	(4)	(3)	(2)	(1)	(0)

B. Television Devices

1. Extension Speaker	(6)	(5)	(4)	(3)	(2)	(1)	(0)
2. Infra-red	(6)	(5)	(4)	(3)	(2)	(1)	(0)
3. Magnetic Loop	(6)	(5)	(4)	(3)	(2)	(1)	(0)
4. Plug-in Headset	(6)	(5)	(4)	(3)	(2)	(1)	(0)
5. Caption	(6)	(5)	(4)	(3)	(2)	(1)	(0)

C. Personal Communication

1. FM	(6)	(5)	(4)	(3)	(2)	(1)	(0)
2. One-to-one Communicator	(6)	(5)	(4)	(3)	(2)	(1)	(0)