Effectiveness of Supplemental Parent Training in Hearing Aid Checks

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Frequent hearing aid checks are recommended to ensure that children's hearing aids are functioning appropriately. In this study, the effectiveness of parent training in establishing appropriate listening check behaviors was investigated. A single subject, alternating treatments design was implemented with parents of hearing-impaired children to determine which of two training methods was superior: (a) conventional parent training, versus (b) conventional parent training combined with supplemental videotape training. The results indicated that parent training is effective in improving listening checks and detecting defective hearing aids. While videotaped supplements did not consistently facilitate learning when coupled with direct training, the access to videotaped supplements did augment learning for the parents who could not receive the conventional parent training.

A major concern among professionals who work with hearing-impaired infants and children is ensuring that hearing aids worn by these children are functioning properly. Proper fit and maintenance of hearing aids are essential elements in any child's aural (re)habilitation program, yet several studies have reported unreliable performance of hearing aids used in the classroom (Bess, 1977; Gaeth & Lounsbury, 1966; Porter, 1973; Zink, 1972). These studies have estimated that as many as 40 to 50% of children's hearing aids in the educational setting perform unsatisfactorily.

While hearing aids can be routinely analyzed electroacoustically, daily hearing

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aid checks including both visual and listening assessments have been routinely recommended. A visual assessment involves the inspection of each visible component of the hearing aid for defects, for example, dead batteries, brittle tubing, frayed cords, and poorly fitting earmolds (Kemker, McConnell, Logan, & Green, 1979). A listening assessment involves listening to the sound output from the hearing aid with the sound controls in various positions allowing identification of defective or broken controls and distortion. Bess and McConnell (1981) indicated that up to 48% of the hearing aids which were found to be defective in the classroom setting were defective due to electroacoustical malfunctions. These defects presumably would only be identified by an electroacoustic analysis or by an extensive listening check of the hearing aid's performance.

Several studies have indicated that the operating status of hearing aids used in the classroom have not improved in recent history and suggested that listening checks have been far from adequate (Busenbark & Jenison, 1986). This may be due to confusion as to who actually takes on the responsibility to ensure that the hearing aids are functioning appropriately. The responsibility of monitoring a child's hearing aids has typically been placed upon the child's parents, the classroom teacher, the speech-language pathologist, and/or the educational audiologist. Elfenbein, Bentler, Davis, and Niebuhr (1986) found that a large number of children's hearing aids were rarely or never checked by any school personnel including the school based speech-language pathologists. With these statistics and the varying frequency of professional contact, Niswander (1989) suggested that the actual task of monitoring the hearing aids should fall to the parents. In addition, habilitation programs designed to train parents of hearing-impaired children often recommend that parents perform a daily hearing aid check (Clark & Watkins, 1985; Thompson, Atcheson, & Pious, 1985).

Data are not readily available regarding the effectiveness of parent training in the area of hearing aid monitoring. Many parents become solely responsible for monitoring their children's amplification due to their infrequent contact with hearing-health professionals. Other parents become solely responsible for monitoring hearing aid performance as this is often a goal in many home-based AR programs (Niswander, 1989). Training in hearing aid monitoring should serve to familiarize parents with the function of hearing aids and help them to become comfortable with their daily use. Unfortunately, most parents do not receive adequate training in visual and listening checks of hearing aids.

The purpose of this study was to investigate the effectiveness of a parent training program in establishing the behaviors necessary to perform appropriate hearing aid checks. Specifically, this investigation addressed whether or not supplemental videotape training would improve learning in parents who perform checks on their hearing-impaired children's hearing aids.

METHOD

A single subject design, similar to the alternating treatments design described by Barlow and Hayes (1979), was used to determine the effectiveness of two different training programs in teaching the behaviors necessary to perform visual and listening checks on postauricular hearing aids. As an alternating treatments design involves training behaviors under two or more conditions, the two different treatments were administered during the treatment phase. The purpose of this design was to determine which treatment condition was more effective in changing behavior. In this study, the alternating treatments design was used to compare the effectiveness of the following training procedures: (a) direct parent training in hearing aid monitoring, and (b) direct parent training combined with videotaped training. These treatments were alternated and counterbalanced across two subject groups to control for any order effects as well as to replicate the influence of the independent variables on subjects' behaviors.

Subjects

Two sets of parents of preschool hearing-impaired children participated in the study. Parent group A consisted of spouses A_1 and A_2, while parent group B consisted of spouses B_1 and B_2. The subjects were matched on as many relevant characteristics as possible in order to alleviate sources of variability. These characteristics were determined from an analysis of candidates' responses to a questionnaire and are summarized as follows: (a) the subjects' children had been aided for more than one month, but no more than three months during the period of data collection; (b) the subjects have no other family members who wore hearing aids, including siblings or parents; (c) the subjects' hearing-impaired children were no older than three years of age; (d) each subject's hearing-impaired child was fit binaurally with behind-the-ear hearing aids; and (e) the subjects shared similar education backgrounds. There were no parents who had received previous course work in respect to hearing aids or amplification issues.

Materials

Two Phonic Ear 860 PPCL postauricular hearing aids were used during the baseline and training phases. An electroacoustic analysis and listening check by an ASHA certified audiologist indicated normal functioning for both hearing aids. An additional ten postauricular hearing aids, six with confirmed defects or electroacoustic malfunctions, were used during the extra-therapy measures. These ten hearing aids were used to collect data on the accuracy of each subject's ability to identify the defects or malfunctions. Two of the hearing aids exhibited gross harmonic distortion (THD $> 10\%$). An additional two hearing aids were judged to have inappropriate or nonlinear volume control tapers. The last two hearing aids exhibited clearly visible cracks running the width of each hearing aid. Four hearing aids were judged to be functioning within the manufacturer's specifications and did not appear to be defective.

A hearing aid stethoscope and a battery tester were provided to each subject prior to the initiation of the listening check tasks. Each subject recorded their results in writing on a standardized form regarding their listening checks on the experimental hearing aids. The subjects were videotaped as they performed the listening checks during the treatment phase. These recorded data were then used for interobserver scoring.

The "Visual and Listening Checks for Hearing Aids" protocol developed by Tourné and Wynne (1988) was used for the subject training in one treatment condition. The listening check portion from the "Listening in the Classroom" videotape (Berg, 1988) was used for supplemental training in the other treatment condition. This section of the videotape was developed for training naive classroom personnel in how to conduct a thorough listening/visual assessment of a BTE hearing aid.

Procedures

Baseline Procedures. The target behaviors are presented in Table 1. They consisted of five visual and five listening behaviors required to perform an adequate listening and visual inspection of a hearing aid. The scores consisted of the observed number of appropriate behaviors occurring out of a possible ten total behaviors. During the baseline phase, the performance of each subject met the stability criterion within three trials: the number of behaviors exhibited between trials did not vary by more than 2 out of a possible ten (20%). Baseline data points were collected over a period of one and a half weeks. During baseline trials, subjects were instructed to check the presented hearing aid just as if it were their child's own personal hearing aid.

Table 1

Training Steps for Hearing Aid Checks

Visual Inspection

1. Assessing battery voltage (utilizing a volt meter)
2. Proper battery insertion
3. Inspect casing for cracks, dirt and debris
4. Hearing aid controls set on proper settings
5. Inspecting microphone for damage or debris

Listening Check

1. Volume control – listening for linearity, scratchiness or dead spots
2. Sound quality – listening for distortion, static or reduced gain
3. Ling Five Sound Test /u, a, i, ʃ, s/ – using the Ling Five Sound Test as input
4. Hearing aid switches and controls – turning the hearing aid off and on while listening for static, intermittent sound, loose contacts
5. Earmold tubing – removing the receiver from the ear and covering the opening of the earmold while turning the volume control to maximum and listening for feedback

Treatment Procedures. Once the stability criteria had been met, treatment was initiated. Following baseline, parent A_1 and parent B_1 received training. Parent A_1 received direct parent training only, whereas parent B_1 received direct parent training and received access to the training videotape. Their spouses (A_2 and B_2) were probed for generalization data to determine the extent of carry over of training in the home. After three sessions of the initial treatment conditions for both sets of parents, the treatment conditions were alternated such that parent A_1 now received direct parent training and videotaped supplemental training whereas parent B_1 only received the direct parent training.

Direct parent training consisted solely of clinician directed, parent training following the "Visual and Listening Checks for Hearing Aids" protocol by Tourné and Wynne (1988). This training was provided only in the clinic environment. Direct parent training and videotape supplemental training consisted of the training protocol described above combined with videotaped training implemented in the home environment. Both parents receiving the direct parent training were instructed to share the information/training they received with their spouses (parents A_2 and B_2 respectively) after each session.

The direct (live) training sessions in both treatment conditions were administered three times per treatment condition for a total of six treatment sessions over a two week period of time. Parents A_1 and B_1 were instructed simultaneously, for each of the six training sessions in order to avoid any possible differences or biases in training. Each session lasted approximately ten minutes.

The videotaped training portion in the second treatment condition consisted of having the subjects view the videotaped training program at home three times during the corresponding treatment phase. Each viewing was documented on a form signed by the spouses (A_2 and B_2) in each parent group. Again, the subjects (A_2 and B_2) not receiving direct treatment were instructed to view the videotape in the home during this treatment condition with their respective spouse to control for learning effects across all four subjects.

Data were collected at the end of each treatment session for each parent in direct treatment (parents A_1 and B_1) and consisted of having the subject perform a listening check on the hearing aids used in training. The subjects were instructed to keep a log of each item that they inspected on the hearing aids as they proceeded through the inspection in order to assist with observation/data collection.

While parents A_2 and B_2 did not receive direct clinician training, probe data were collected two times during each respective treatment phase. Probe data were obtained by having each subject perform a listening check on the hearing aid used in the baseline phase and recording the target behaviors exhibited during the listening check.

Extra-Therapy Measures. Extra-therapy measures consisted of collecting accuracy data (correct identification of any malfunction of the hearing aid) during each phase of the study. These data were collected from both partners in each parent group. The subjects were asked to evaluate the performance of five hearing aids, two of which were within the manufacturer's specifications, the third with excessive harmonic distortion, the fourth with an inappropriate volume taper and the fifth with cracked casing. A total of ten different hearing aids were used in the above combinations in order to minimize memory effects. Each hearing aid was marked with an identification number. The identification number was randomly assigned during each trial.

Reliability. Scores recorded by a second observer were compared with the original data to provide interobserver reliability of the dependent measures in both the probe and independent treatment conditions. Interjudge reliability was determined for the baseline and generalization probe data by calculating the percentage agreement index (Suen & Ary, 1989). The percentage agreement index is computed by dividing the number of scoring agreements (between the two observers) by the total number of target forms scored (hearing aid monitoring behaviors and correct identification of malfunctions).

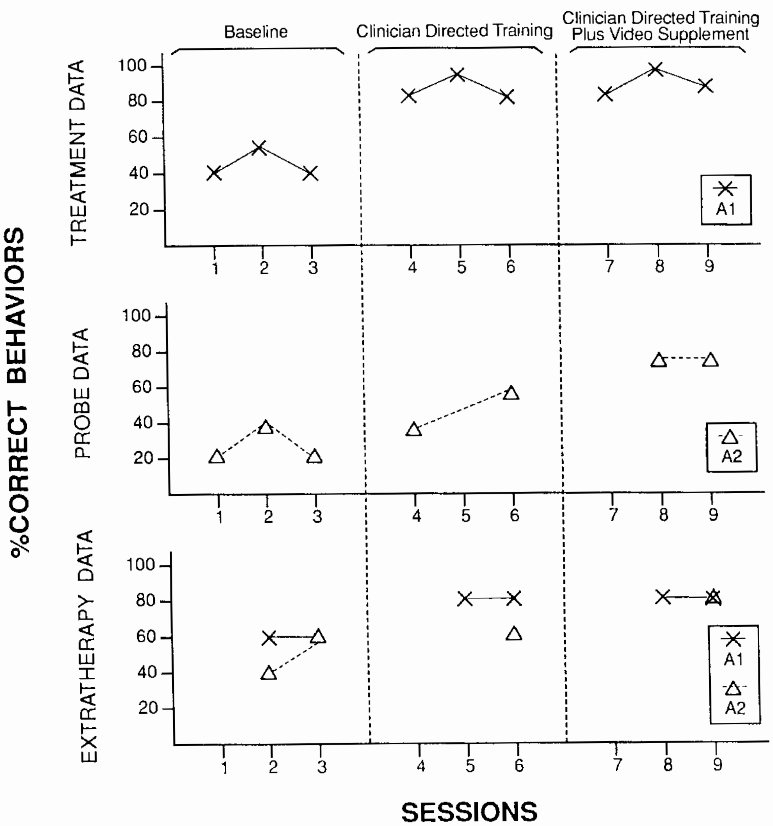

Figure 1. Listening check performance for parent group A.

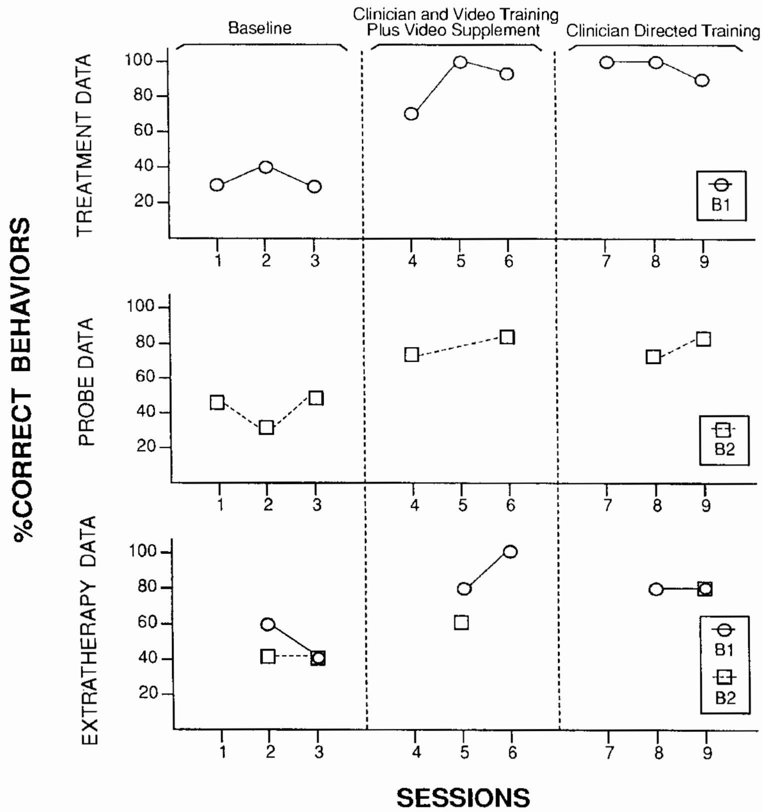

Figure 2. Listening check performance for parent group B.

RESULTS

The performance data obtained during baseline and treatment sessions for parent group A are presented in Figure 1. The performance data obtained during the same phases for parent group B are presented in Figure 2.

Baseline. Baseline measurements of each subject's performance of listening checks on behind-the-ear (BTE) hearing aids were obtained before treatment began. A stable baseline was defined as no more than an average variation of two data points (20%) within the basal period and showing no consistent improvement in performance. Each subject achieved baseline stability within three sessions. Baseline measures ranged from 20% to a high of 50% of the measured behaviors across all four subjects. Visual inspection of the data indicates a relatively stable performance during the baseline phase across subjects.

Treatment. Visual inspection of the data during the treatment phases indicates a sharp increase in the frequency of the target behaviors for both parents receiving clinician directed treatment (parents A_1 and B_1) above previously obtained baseline levels, regardless of their access to the videotape supplement. The frequency of behaviors increased from a baseline average of 43% up to an average of 83% for parent A_1 and from a baseline average of 36% to an average of 87% for parent B_1. Due to the rapid increase of the subjects' performances during the first treatment phase, the performance of both of these subjects plateaued during their second treatment phase, showing relatively no change in performance with a change in treatment. Furthermore, subjects A_1 and B_1 demonstrated essentially equivocal performance across all treatment conditions. Thus, both direct parent training only and direct parent training combined with supplemental videotaped training appeared to be equally effective in increasing listening check behaviors.

Data collected on parents A_2 and B_2 (the parents who did not receive direct clinician training) are also presented in Figures 1 and 2. The baseline measures appear relatively stable (within one data point) for both subjects. A visual inspection of the learning curves indicates an upward trend or increase in the measured behaviors for each subject during the treatment phase. Parent A_2 increased from a baseline average of 25% to an average of 40% during parent directed treatment condition. Parent B_2 increased from a baseline average of 39% to an average of 75% during the parent directed and videotaped training treatment condition. The degree of slope or the learning curve was sharper for parent B_2, whose spouse initially received the treatment condition which combined the direct clinician training with the videotaped supplemental training.

Extra-Therapy Data. Generalization probe data (measures of subject accuracy in detecting actual hearing aid malfunctions) are presented in Figures 1 and 2. Both parent groups (all four subjects) demonstrated an improvement in their ability to detect the defective characteristics in the hearing aids. However, all four subjects failed to correctly identify the hearing aids with excessive harmonic distortion. In the large majority of cases, they indicated that these hearing aids were functioning appropriately.

Reliability. The subjects were videotaped as they performed the listening checks during the treatment phase. The videotapes were viewed by two observers who recorded the listening check behaviors exhibited during their assessment of the hearing aids. The two judges agreed across 94% of the observations recorded.

DISCUSSION

This study addressed the effectiveness of clinician/parent training and supplemental videotaped training in improving the performance of listening checks on BTE hearing aids. The results of this study indicated that parent training was effective in increasing the behaviors necessary to perform an adequate listening check on behind-the-ear hearing aids. As a result of parent training, the subjects' ability to correctly identify hearing aid defects increased. The data also indicated that supplemental videotaped training appeared to facilitate learning in a parent who was not receiving direct parent training from a clinician.

The current results support previous research (Diefendorf & Arthur, 1987; Gaeth & Lounsbury, 1966) indicating that parents are not typically highly trained in performing listening checks. There was no pronounced slope among the baseline measures for any one subject. Apparently, the baseline behaviors presented in this study were representative of those behaviors developed and habitually used prior to the participation in the current treatment program.

During the baseline measures, not one subject manipulated the microphone-telephone-off (MTO) switches of the hearing aids other than to initially turn the hearing aid on. None of the subjects was observed to use the Ling Five Sound Test (Ling & Ling, 1988) during baseline. Instead, the subjects used the following vocal input: counting, "one, two, three, one, two, three," "testing, testing," and "ba, ba, ba." In addition, the subjects did not comment on the sound quality of any of the hearing aids during the baseline measures.

The increases noted in the trends and slopes support the conclusion that the treatment phase was responsible for the improvements noted in listening check behaviors. The trend demonstrated an increase in the behaviors for both parents

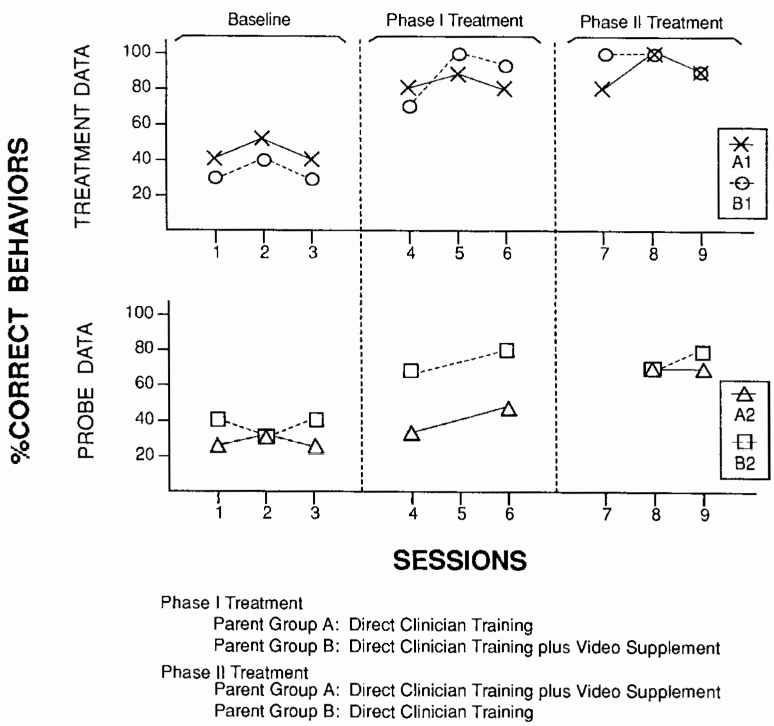

Figure 3. A comparison of listening check performance between the two parent groups.

receiving direct parent training (parents A_1 and B_1). The frequency of appropriate listening check behaviors increased from a baseline average of 43% to an average of 83% for parent A_1 (clinician only initially) and from a baseline average of 36% to an average of 86% for parent B_1 (combined clinician and videotaped training initially) during the initial treatment conditions. Both treatment conditions appeared to have equivocal results as is illustrated in Figure 3.

In addition, data collected on parents A_2 and B_2 (who did not receive any direct clinician training) indicated an upward trend or increase in the measured behaviors during the initial treatment phase. The frequency of parent A_2's listening check behaviors increased from a baseline average of 25% to an average of 40% (no direct treatment) whereas the frequency of parent B_2's listening check behaviors increased from a baseline average of 39% to an average of 75% (videotaped viewing only). It should be noted that the learning curve was not as sharp for the parent (A_2) who did not have access to the supplemental videotaped training.

The dependent variable was generalized to untrained probes of identifying malfunctions in the ten hearing aids. The ability of all subjects to identify the hearing aid defects increased, even though parents A_2 and B_2 did not receive any direct clinician training. This finding may have been due to information sharing. As the parents who received the direct parent training were instructed to share the information they received with their spouse and both parents showed performance increases, the data suggest that information sharing may be beneficial as well as cost effective. This is particularly true in the case of B_2 who demonstrated better than 20% improvement in his ability to provide appropriate listening check behaviors when he had no access to clinician directed or videotaped instruction regarding these behaviors.

Parents A_1 and B_1 (those who received direct parent training) were asked at the end of the study how they shared the clinician training information with their spouses and if they could estimate how much of this information was truly shared. Both subjects indicated that they passed the information along verbally, with parent B_1 reporting that she physically sat down with her spouse and demonstrated the training following the initial training session. Both subjects revealed that they did not continue to share detailed information after the initial training session as they felt that no new information was provided. However, they did perform listening checks on their children's hearing aids in the presence of their spouse.

While the subjects' ability to identify defective hearing aids did not improve as much as expected, they were able to correctly identify the adequately functioning hearing aids consistently throughout the study. Still, they were unable to consistently identify those hearing aids with inappropriate volume controls, those with cracked casing, and those with harmonic distortion. Apparently, these parents needed more experience listening to defective hearing aids. Busenbark and Jenison (1986) cautioned, however, that experience and expertise in the proper functioning of hearing aids could not be equated. If inappropriate behaviors are initially learned and then reinforced through experience, the examiner may never perform an appropriate visual and listen hearing aid check. Furthermore, these inappropriate behaviors may offer some additional resistance to learning appropriate visual and listening check behaviors.

Single or within-subject designs, such as the one presented in the current study, offer clinicians and researchers the opportunity to explore questions regarding the very nature of the aural (re)habilitation process itself. The validity of within-subject designs is sometimes questioned relative to the control of extraneous variables and the generalization of the data to other subjects or subject groups. It is not within the scope of this paper to thoroughly discuss the issues of treatment efficacy research. Several excellent resources are available which address these issues (Hersen & Barlow, 1976; McReynolds & Kearns, 1983; Olswang, Thompson, Warren, & Minghetti, 1990; Suen & Ary, 1989). This paper, however, does demonstrate that the subjects' behaviors were brought under experimental control. This finding is illustrated by their change in behavior when treatment was initiated and again when the nature of the treatment changed. The functional relationship between the dependent and independent behaviors is further demonstrated by the replication of the effects of treatment across two sets of parents within the study itself. Extraneous variables such as history and subject effects could have confounded the results of this study using a within-subject design just as readily as the results of a study using group design. Still, the probability that these effects occur simultaneously with the introduction and withdrawal of the independent variable and across a replication of the treatment design is relatively low and, consequently, reduces the possibilities of having a Type I error. Furthermore, recent research in serial dependent behavior has provided researchers with additional means to quantify behavioral observation data obtained after the introduction of the independent variable (Suen & Ary, 1989).

Finally, the findings of this study highlight the need to carefully examine the treatment goals in an aural (re)habilitation program. For example, while this study demonstrates that parents of hearing-impaired children can rapidly learn and demonstrate appropriate listening check behaviors, these findings can not support or refute suggestions that parents of hearing-impaired children should assume the responsibility for the daily monitoring of their children's hearing aids (Clark & Watkins, 1978; Ling & Ling, 1978; Thompson et al., 1985). Training the parents to perform these activities and having the parents assume the responsibility for these activities may actually involve establishing two relatively independent program objectives. Simply training the listening check behaviors may not be adequate to ensure that these behaviors are practiced routinely.

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