Development of a Video for Pure Tone Hearing Screening Training in Schools

Diana C. Emanuel, Ph.D.
Towson University
Towson, Maryland

Merrill Alterman, M.A.
Former Coordinator of OT/PT/Audiology Services for Baltimore City Public Schools
Baltimore, Maryland

Michelle Betner, Au.D.
Sound Audiology,
St. Louis, Missouri

Rebecca Book, Au.D.
Hearing Specialty Group, Ltd.
Pasadena, Maryland

Towson University (TU), in collaboration with Baltimore City Public Schools (BCPS) and Baltimore City Health Department (BCHD), created a video training program for pure tone hearing screening in schools based upon ASHA (1997) guidelines and BCPS training materials. The video was distributed for educational purposes to 128 graduate programs in Communication Sciences and Disorders and was posted on-line. This manuscript describes the creation of the video, two studies comparing video hearing screening training to traditional training, and the results of a national survey used to elicit feedback from educational audiologists regarding the usefulness of the video nationally. The first study on the effectiveness of the video indicated there were no significant differences between written test scores for live versus video training for 154 BCHD employees trained in the BCPS. The second study indicated there were no significant differences on written scores or practical skills between live versus video training for 23 volunteers trained at TU. Participant ratings of training were significantly higher when training included hands-on practice of screening techniques. The national survey indicated the majority of educational audiologists would use the program as a supplement to their current hearing screening training protocols. This video is recommended for use in conjunction with hands-on practice conducted under the supervision of an audiologist. It is hoped that this training program will assist educational audiologists in providing more consistent training for hearing screeners.

Introduction

Hearing loss can have a detrimental impact on many aspects of children's lives, including their academic performance, expressive language, reading and writing skills, social, emotional, and behavioral development (ASHA, 2002). Studies have shown that if hearing loss is identified and treated early these negative impacts may be lessened (e.g., Yoshinaga-Itano, Sedey, Coulter & Mehl, 1998). The first step in the process of hearing loss identification is the implementation of an effective hearing screening program. The effectiveness of this program relies on appropriate training and supervision of hearing screeners. Currently, there are no national standards regarding either the way hearing screening should be conducted or the qualifications/training requirements for hearing screeners; instead, these issues are specified by state regulations and regional school system/health department policies. However, the American Speech-Language-Hearing Association (ASHA) Panel on Audiologic Assessment, consisting of a group of experts in the area of pediatric audiology, developed guidelines for hearing screening from birth to 18 years of age using a peer-reviewed process (ASHA, 1997). These guidelines are available on ASHA's website (www.asha.org).

In order for hearing screening to be effective, hearing screeners must be adequately trained. Without appropriate training, the result is likely to be an unusually high false negative and/or false positive rate. In addition, it is imperative that adequate record keeping and follow-up procedures ensure that the long term goal of the screening (i.e., identifying and treating children with hearing loss) is actualized by the mass school screening process. Richburg and Imhoff (2008) surveyed hearing screeners in two school districts in the state of Missouri and found huge variability in the procedures used for hearing screening and in the training of school nurses. They also found that more consistent training was seen among contractual hearing screeners, who they presumed had received uniform training from a supervising educational audiologist. The ASHA (1997) audiologic screening guidelines specify that hearing screenings for school-age children (5 – 18 years) should be conducted by an audiologist, speech-

language pathologist, or support personnel under the supervision of an audiologist. The role of a hearing screener falls within the guidelines for support personnel published by both ASHA (ASHA, 2004) and the American Academy of Audiology (AAA, 1997), with both specifying that audiologists should be responsible for directing and supervising these personnel. Regarding training, AAA (1997) specifically states, "Supervising audiologists will provide appropriate training that is competency-based and specific to job performance." Richburg and Imhoff's 2008 study indicates that a method to improve the consistency of hearing screening training for support personnel is needed. One cost-effective way to improve the consistency of training across school systems is to use video training to deliver content and to demonstrate techniques consistent with ASHA (1997) screening guidelines. If this video were used, individual states could then provide ancillary materials to address protocols specific to their state and, in addition, provide necessary hands-on practice.

Video materials, including DVDs and streaming video, are becoming a standard format for instruction. The advantages of video materials include cost effectiveness, consistency of content, availability of graphic animations, use of "real life" scenarios to enhance clarity, flexibility, and the opportunity for repetition. In addition, students can engage in learning from a site at a distance from the training center. Studies have shown that video instruction may be used without sacrificing student test performance (e.g., Kline et al., 1986; McAlpine, 1996; Mir, Marshall, Evans, Hall, & Duthie, 1984). In addition, several researchers have found videos to be well received by students when used as ancillary teaching tools in conjunction with other teaching methods (Lewis, 1995; McAlpine, 1996). It is not suggested that the use of a video can replace the need for a live instructor because skills-based training should always include hands-on practice. Furthermore, students in studies of video versus lecture instruction often report preferring the interaction of a standard lecture, even when tests scores are equal to or poorer than scores from video lecture (Bazyk & Jeziorowski, 1989; Davis, 1987; Kline et al., 1986; Leff, 1988; Paulsen, Higgins, Miller, Strawser, & Boone, 1998; Spitzer, Bauwens, & Quast, 1989). Paulsen et al. (1998) compared group instruction via traditional lecture, interactive television (ITV), and video lecture. Their results indicated students achieved equal success on tests, but students in the video groups were not satisfied with the instruction. Furthermore, students in the ITV and video groups did not perceive the instructor took an active role in the course. To address student preference for interaction during learning, but preserve the efficiency of resources offered by video instruction, McAlpine (1996) studied Tutored Video Instruction (TVI) for a basic hemodynamic monitoring course for nurses as an alternative to independent video viewing. A tutor who was familiar with the material proctored the video presentation. The tutor was able to stop the video and respond to student requests for clarification, thereby providing personal interaction during learning, but maintaining consistency of content from the video. McAlpine (1996) found no significant differences in student preference for TVI compared with standard lecture. Students also respond well to the use of video instruction prior to hands-on instruction. For example, Lewis (1995) incorporated a series of 10-minute instructional videos at the beginning of physics laboratories. Via video, the professor of the physics course introduced the material necessary to perform the laboratory, rather than having a teaching assistant perform this function. The laboratory was then conducted in the traditional manner with a live instructor. Students' evaluations of this teaching format indicated the videos had a positive effect on their learning.

In 2001, Towson University, in collaboration with the Baltimore City Public Schools (BCPS) and the Baltimore City Health Department (BCHD), developed a pure tone hearing screening video in order to teach content and demonstrate hearing screening techniques for school-age children (Alterman & Emanuel, 2004). The BCPS serves approximately 83,000 students in the public school system. Hearing screening is conducted within this school system at school entry (Pre-K, K, or 1st grade), late elementary school (4th, 5th, or 6th grade), and high school (9th grade) according to state mandate (Code of Maryland Annotated Regulations [COMAR], §7-404) to identify children with previously unidentified hearing loss. The hearing screening procedures used by the BCPS are based upon American Speech-Language-Hearing Association (ASHA, 1997) and COMAR guidelines, which describe a 3-frequency (1000, 2000, 4000) pure tone screening.

Described here are three studies used to examine the efficacy of the video used as an ancillary tool in hearing screening training, including two studies used to examine "proof of concept" (i.e., that the video supplemented program was at least as effective as the current training used in Baltimore City) and responses to a national survey of educational audiologists used to obtain input as to whether the video would be useful nationally and to solicit suggestions for future modifications.

Method

Development of the Video

A 15-minute, professional quality video was produced by the Center for Instructional Advancement and Teaching (CIAT) at Towson University. The creation of the digital recording began with the creation of a storyboard and script and the planning of appropriate still and live action photography, narration, props,

and graphics. Filming took place at a Baltimore City elementary school with permission of school administrators, parents, students, and teachers. CIAT provided the film crew, photographers, professional quality digital recording, audio/video editors, and editing equipment.

A rough draft of the video was shown to 50 graduate students and five clinical supervisors during new student orientation at Towson University. The graduate students had undergraduate degrees in Communication Sciences and Disorders, but had not previously conducted hearing screenings. The clinical supervisors all had experience supervising hearing screenings and training students to do hearing screenings. Thus, the audience included both untrained and trained participants. Participants were asked to provide written comments regarding the clarity of the video as a teaching tool. Based on feedback from these participants, the video underwent final editing. The final version was distributed to audiologists in the BCPS and to 128 graduate programs in Communication Sciences and Disorders for educational purposes. The recorded program was subsequently posted on-line in streaming video format and is available at http://www.towson.edu/asld/emanuel.asp.

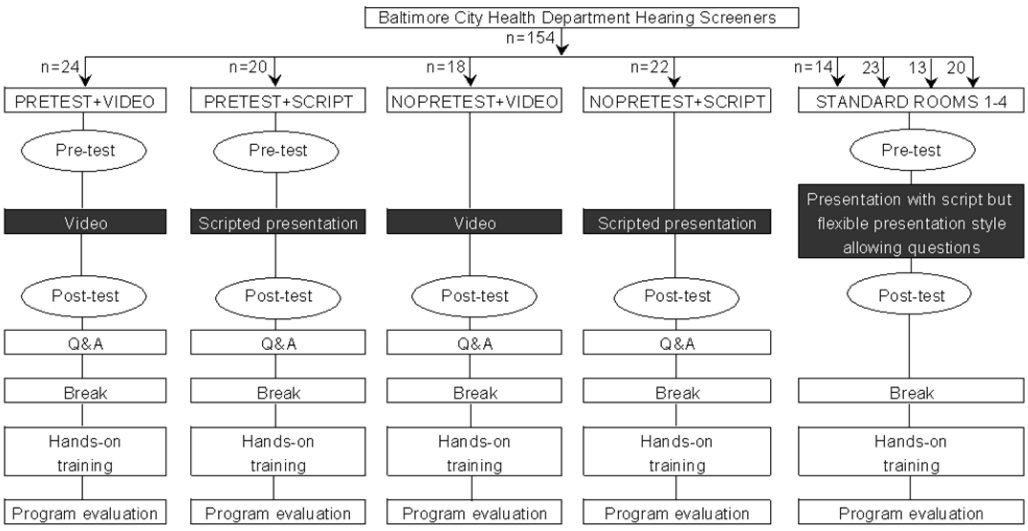
Study 1: Health Department Screener Training with Written Assessment

Every year, BCHD employees assigned to conduct school hearing screenings report to a designated elementary school for training. BCPS audiologists (usually eight) are assigned to provide didactic instruction, hearing screening demonstration, and hands-on instruction. This first study was conducted during one of these training sessions to see if using the video was as effective as their traditional live lecture, with a pre- and post-test format using the BCPS written assessment tool. The test consisted of 20, 4-response, multiple-choice questions. One version of the test is available on-line at: http://www.towson.edu/asld/emanuel/.

One hundred fifty four BCHD hearing screeners reported for the annual training. Figure 1 provides a flow chart to show the design of the study. Randomization of individual participants to experimental conditions was not possible because the BCHD employees had to be grouped by region for training; however, the rooms were randomly selected for each of the educational formats. Four of the rooms (STANDARD 1-4) used the traditional BCPS training format. The audiologists were provided with a script from the video, which was developed from the BCHD training topics (i.e., the content was the same as in prior trainings), but the audiologists were allowed the flexibility of answering questions and allowing spontaneous discussion generated by participant questions, as would usually be the case for in-service training. Two of the other four rooms were assigned as "video" rooms and two were assigned as "script" rooms. In the "video" rooms, training was conducted via video only. In the "script" rooms, the script of the video was carefully followed to control for content as much as possible. To control for the variability of information associated with question and answer periods, participants in the "script" and "video" rooms were not allowed to ask questions until after the post-test was administered. To examine the effect of using the same instrument for the pre- and post-test (current BCPS procedure), two rooms (one "video," one "script") were selected to receive a post-test only, to examine pre-test sensitization. In summary, there were 8 groups: NOPRETEST+VIDEO (n=18), PRETEST+VIDEO (n=24), NOPRETEST+SCRIPT (n=22), PRETEST+SCRIPT (n=20), and STANDARD 1-4 (n = 14, 23, 13, 20).

Following a short break, all participants completed hands-on training and then completed a program evaluation. Thus, for all eight groups, the program evaluation included the participant's evaluation of the entire didactic, question and answer, and hands-on portions of the training. Two of the items from the program evaluation were pertinent to the current study and were analyzed (the other items were not applicable, e.g., questions regarding

Figure 1. Sample size and procedures for eight hearing screening training rooms for Baltimore City Health Department hearing screening training at a public school site (Study 1).

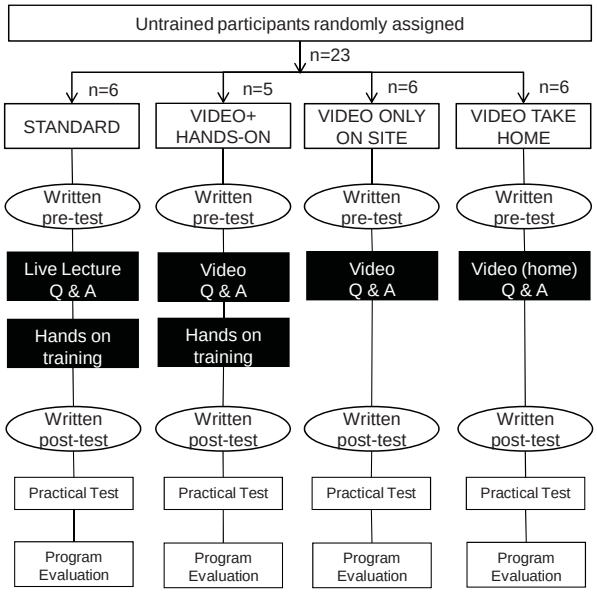


location and facilities). Specifically, the two rated items were: "the materials helped to reinforce concepts presented" and "the training will enable me to improve my job performance." The items were rated on a five-point scale from 1 (poor) to 5 (excellent).

Study 2: Volunteer Training with Written and Practical Assessments

Twenty-three adult volunteers (15 females, 8 males; 21-57 years of age) with no previous training in hearing screening participated in the second pilot study. The design of the study is shown in Figure 2. Participants were randomly assigned to one of four training groups: STANDARD (n=6; 5F, 1M; 26-51 years), which was the same as in Study 1; VIDEO + HANDS-ON (n=5; 2F, 3M; 25-52 years), which was the same as in Study 1 except there was a question and answer period prior to the written test; VIDEO ONLY ON SITE (n=6; 3F, 3M; 24 - 57 years), which used video training but no hands-on training; and VIDEO TAKE HOME (n=6; 5F, 1M, 21-36), in which participants took home the video, were told they could watch it as often as needed, and were allowed to ask questions when they returned to complete the study. This group did not receive hands-on training.

Figure 2. Sample size and procedures for four hearing screening training groups for adult volunteers trained at Towson University (Study 2).



All groups took the same written pre-test used for Study 1. Prior to instruction, participants were given handouts that paralleled the content of the video. They were not allowed to utilize the handouts while taking the tests, but could look at them during instruction. Following training, each participant completed the written post-test (identical to the pre-test), took a practical examination (described below) and completed a program evaluation, which asked participants to rate on a scale of 1-5 (1=strongly agree; 5=strongly disagree) the following statements: (1) Information presented was clear and easy to understand, (2) This training was effective in teaching me how to conduct a hearing screening, and (3) I would recommend this type of training for others who will be conducting hearing screenings.

The practical examination was conducted using a 10-item checklist (Table 1) created based on input from BCPS audiologists. These items represent necessary components of the screening and/or areas in which mistakes are often made by new screeners. Each participant was given a portable audiometer and asked to set up the room for screening, to screen two people, and to document the results. For all participants, two audiologists with normal hearing served as mock patients; one followed the directions of the examiner and the result of the screening should have been "pass;" the other feigned a hearing loss at 4000 Hz in the left ear and the result of the screening should have been "fail." Each mock patient also kept a log of the procedures used by each participant. The order in which the "pass" and "fail" audiologists were tested by each participant was randomized. Note that the ultimate goal of this video is to assist in the training of hearing screening for children; however, in this pilot study adult mock patients were used to control for the variability that is encountered in difficult-to-test children and to assess basic screening skills that are expected to be learned in a one-day training.

Table 1. The 10-item practical evaluation checklist used for Study 2.

Practical Evaluation Checklist		
Participant:	Pass	Fail
1. Appropriately indicates why the room is suitable for conducting a hearing screening.	□	□
2. Appropriately sets up equipment to avoid a tripping hazard.	□	□
3. Appropriately performs a visual and listening check.	□	□
4. Appropriately positions mock patient so as not to see the examiner presenting stimuli.	□	□
5. Appropriately gives instructions for the test.	□	□
6. Appropriately demonstrates tone and task to mock patient.	□	□
7. Appropriately places earphones on mock patient	□	□
8. Correctly follows procedures for screening.	□	□
9. Appropriately re-instructs mock patients if they fail the screening.	□	□
10. Correctly documents results.	□	□

All of the practical examinations were recorded by videotape, and each participant's performance was rated independently by two audiologists as either "pass" or "fail" for each of the 10 items. For cases in which the raters scored the participants differently, both raters reviewed the examination together and came to consensus on the "pass" or "fail" rating. The practical examination contained 10 items; however, item 9 ("appropriately re-instructs mock patient if they fail the screening") was not applicable because participants were trained to re-instruct the patient only if the patient seemed to not understand the directions, which was not the case in this study. Therefore, only the remaining 9 items were considered in the analysis.

Study 3: National Survey

A survey entitled "Revision of a Hearing Screening Training Video" was created to obtain educational audiologists' opinions of the content and usefulness of the video as a training tool. An original survey was created and piloted with 10 educational audiologists from Maryland and Pennsylvania via convenience sample. Respondents received the survey as a printed document and were asked to complete the survey and include written comments regarding the clarity and completeness of the questions. Revisions to the survey were made based on this feedback, and a revised survey was formatted electronically and posted on SurveyMonkey.com. The final survey consisted of 26 questions, including demographic questions, questions regarding the video, and questions about the written materials. A link to the survey was provided in an e-mail distributed on the Educational Audiology Association (EAA) listserv and the ASHA listserv.

Results

Study 1: Health Department Screener Training with Written Assessment

Since random assignment of individuals to experimental groups was not possible, an analysis was conducted to determine if the groups were "matched by accident." A one-way analysis of variance was conducted for the six groups that took a pre-test. Results indicated the pre-test scores were not significantly different across the groups ($F(5, 110) = 0.929$, $p = .465$), suggesting that the groups were similar in terms of prior knowledge.

The mean scores for each of the groups on the 20-item multiple-choice test are illustrated in Figure 3. This figure indicates post-test scores were lower for the "video" and "script" groups who did not take a pre-test, compared to the groups with identical training who received a pre-test; this suggests a pre-test sensitization. A 2x2 analysis of variance (pre-test [yes, no] x training [video, script]) showed a significant main effect for pre-test status (F (1, 80) = 9.056, p = 0.004), but no significant difference for training (F (1, 80) = 1.301, p = 0.258) or the interaction between pre-test status and training (F (1, 80) = 1.405, p = 0.239). This analysis confirmed that a pre-test sensitization did occur for this sample, using the protocol described here.

Figure 3 shows an improvement in mean scores between the pre- and post-test for all groups who took both tests. To determine if there were significant differences among the three training models, a 2 x 3 mixed model analysis of variance for all groups with a pre- and post-test was completed. This analysis indicated a significant main effect for test score (F (1, 111) = 103.262, $p < 0.001$), but not for training (F (2, 111) = 0.987, p = 0.376) or the interaction between test score and training (F (2, 111) = 0.953, p = 0.389). This indicates all of the groups improved significantly and no one method was superior to any other, when using the BCPS multiple-choice test.

Figure 4 illustrates the mean responses from the program evaluation. The highest mean ratings were seen for the video training, followed by the standard training, in the areas of reinforcing concepts and anticipated improvements in job performance. An analysis of variance indicated a significant difference among the groups (F (2, 149) = 14.363, $p < 0.001$). A Tukey post hoc analysis indicated a significant difference between the video training method and the scripted method ($p < 0.001$) and between the standard training method and the scripted method ($p < 0.001$), but not between the standard training method and the

Figure 3. Mean pre- and post-test scores for all training groups for Study 1. Note that two of the groups did not take a pre-test by design in order to examine pre-test sensitivity.

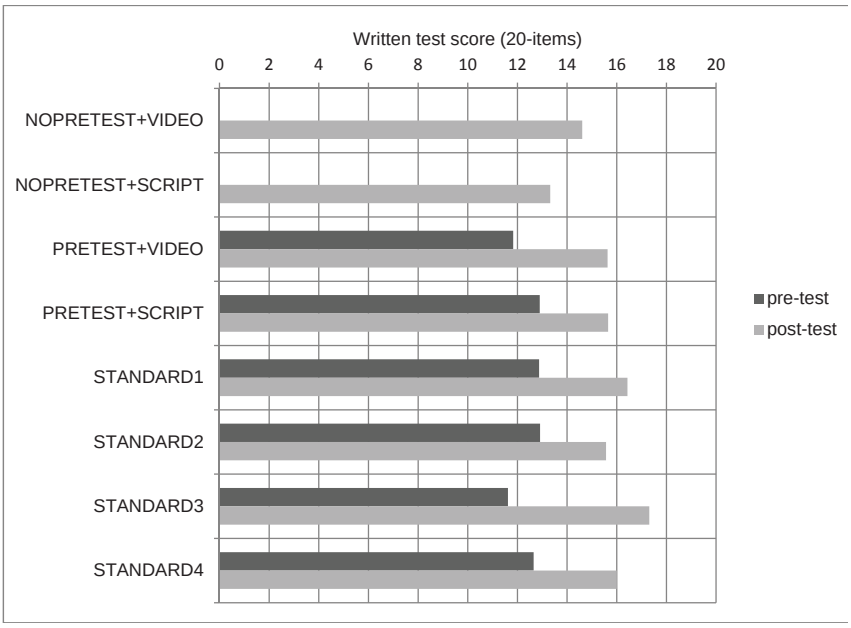


Figure 4. Program evaluation ratings by participants in Study 1 for video, script, and standard groups Regarding whether the training reinforced concepts and if the participant predicted the training would improve job performance.

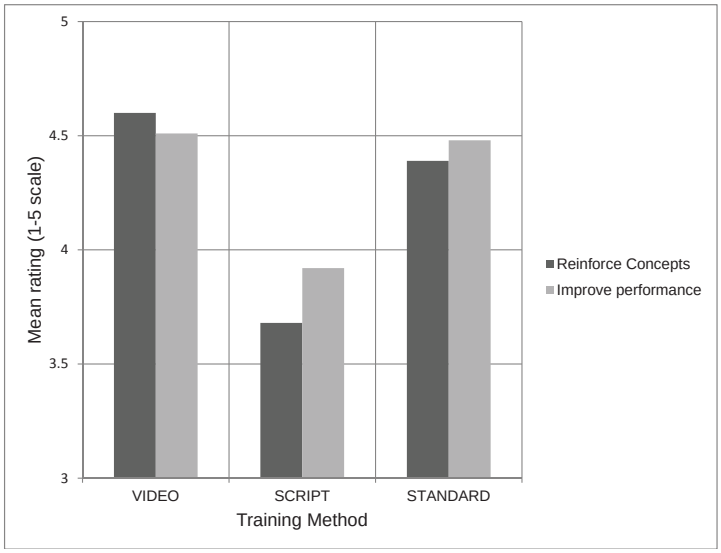


Figure 5. Mean pre- and post-test scores for all training groups in Study 2 for a multiple-choice written assessment.

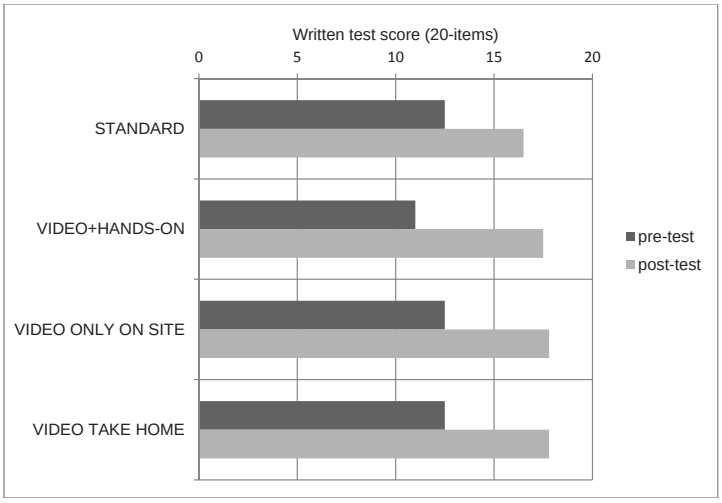
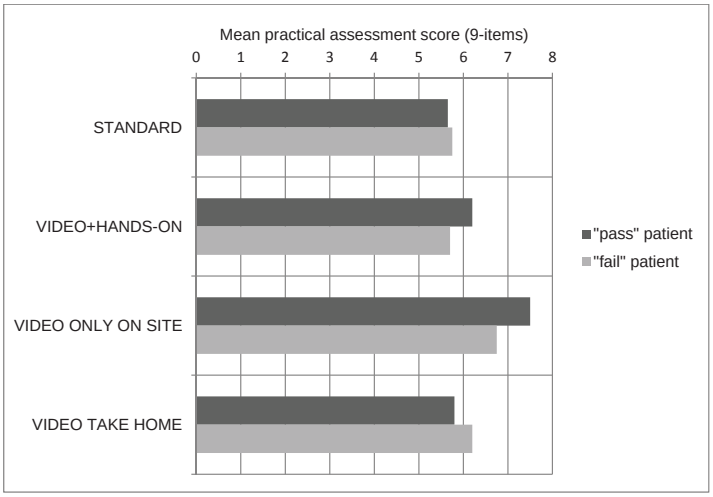


Figure 6. Mean pre- and post-test scores for all training groups in Study 2 for a practical assessment.



video method ($p = 0.414$). This indicates that both the standard and video training were well received by participants.

Study 2: Volunteer Training with Written and Practical Assessments

Figure 5 illustrates the results of the written assessment for the four groups of volunteers included in the second study. This figure shows that mean written test scores improved from pre- to post-test for all four groups. A 2 x 4 mixed model analysis of variance indicated a significant main effect for test (F (1, 19) = 85.250, $p < 0.001$); however, no significant differences were found for training (F (3, 19) = 0.288, $p = 0.833$) or for the interaction between test and training (F (3, 19) = 0.728, $p = 0.548$). This indicates there was a significant improvement in written test score from pre- to post-test, but no one method was superior to another in causing this improvement.

Figure 6 shows that the mean practical scores were similar for the "pass" versus "fail" mock patients for each training method. The VIDEO ONLY ON SITE group had a slightly higher mean score compared with the other groups; however, an analysis of variance indicated no significant differences among the training groups for either the "pass" patient (F (3, 19) = 3.013, $p = 0.056$) or for the "fail" patient (F (3, 19) = 0.582, $p = 0.634$). This indicates that no one method was superior to another based on the results of the practical assessment, keeping in mind that the sample size was small for each group.

Participant responses to the program evaluation are listed in Table 2. This table indicates all of the participants, regardless of training, agreed the information was clear and easy to understand (Q1) and that the training was effective (Q2). The responses were slightly more variable for the question regarding recommending the training (Q3) and this was the only question in which the chi square analysis indicated significant differences (Q3 (χ^2 (3) = 9.6, $p < 0.5$) across the four groups. Although this table suggests VIDEO + HANDS ON was the training method most likely to be recommended by participants, the cell sizes were too small to make a definitive conclusion regarding training preference across all of the groups. To examine preference for a method that used hands-on training (STANDARD combined with VIDEO+HANDS ON) versus no hands-on training (VIDEO ONLY ON SITE combined with VIDEO TAKE HOME), the data were collapsed into two groups and chi-square analyses were conducted for all three questions. There were no significant findings for Q1; however, there were significant differences for Q2 (χ^2 (1) = 6.1, $p < 0.5$) and Q3 (χ^2 (2) = 8.9, $p < 0.5$). This indicates participants who had hands-on training had significantly higher ratings in the areas of perceived training effectiveness and their tendency to recommend the training to others compared with participants who did not have hands-on training.

Table 2. Participant ratings on the program evaluation for Study 2.

Training evaluation question	Group	Number of respondents selecting each rating				
		Strongly Agree 1	Agree 2	Neutral 3	Disagree 4	Strongly Disagree 5
Q1. Information presented was clear and easy to understand.	STANDARD TRAINING	4	2			
	VIDEO+ HANDS-ON	4	1			
	VIDEO ONLY ON SITE	4	2			
	VIDEO TAKE HOME	4	2			
Q2. This training was effective in teaching me how to conduct a hearing screening.	STANDARD TRAINING	5	1			
	VIDEO+ HANDS-ON	5				
	VIDEO ONLY ON SITE	2	4			
	VIDEO TAKE HOME	3	3			
Q3. I would recommend this type of training for others who will be conducting hearing screenings.	STANDARD TRAINING	5			1	
	VIDEO+ HANDS-ON	5				
	VIDEO ONLY ON SITE	2	3		1	
	VIDEO TAKE HOME	2	3		1	

Review of the recorded program. Respondents were asked about the appropriateness of the length of the video (15 minutes). The majority of participants (79%) indicated the length was about right, 21% felt it was too long, and 2% (1 person) said it was too short (note: 1 person selected two answers). The majority of respondents indicated they would access the recorded program in DVD format (83%) or online (62%). Respondents were asked to indicate the circumstances in which they would consider using the video. The majority of participants indicated they would use it as part of a hearing screening program (76%), only if accompanied by hands-on training (66%), and as refresher training for people who have conducted hearing screening in the past (64%). About one-third would use the video for students in a university speech-language-hearing program (36%) and a few indicated they would use it as a temporary training tool if other training options were not available at the time the hearing screener was hired (14%).

For the purposes of the review, the video program was divided into 17 sections including: (1) statistics regarding hearing loss, (2) characteristics of hearing loss, (3) how sound travels, (4) types of hearing loss, (5) frequency, (6) intensity, (7) audiogram, (8) speech banana, (9) audiometer, (10) selecting a screening room, (11) preparing the equipment, (12) audiometer malfunction, (13) calibration, (14) getting the child ready, (15) procedures for screening, (16) record keeping, and (17) purpose for screening. Respondents were asked to indicate if they would keep, modify, or delete each section. The majority of respondents indicated each section should be kept (60-100%, depending on the section). Very few people (n= 1 – 3; i.e., 2-5%) indicated that any section should be deleted, but a number of respondents selected modify and 35 respondents provided suggestions for modification.

Respondents were asked if any of the information was inaccurate and the majority of respondents (77%) selected "no;" several respondents provided specific corrections (e.g., they use a different screening technique; there was a typographical error in the video). Respondents were asked if they felt any topics were missing and 39% said "yes" and most provided comments (e.g., how to test young children; avoidance of cueing). Respondents were asked the most frequent mistakes they saw with new hearing screeners. Comments were provided by 44 participants (e.g., screeners will attempt to find thresholds, incorrect placement of the earphones, failure to conduct a listening check). Comments from respondents were collapsed across common items, organized by video section, and summarized (see Appendix, first column) in order to serve as the basis for the revision of the video script.

Study 3: National Survey

Demographics of the sample. Fifty eight participants completed the national online survey. All of the respondents were audiologists and the majority of respondents (85%) indicated their primary work setting was in pediatric audiology (0-21, K-12, or Pre-K). The majority of respondents (81%) had ten or more years of experience with only three respondents indicating they had worked less than five years. The vast majority of the respondents (91%) reported that they personally administer hearing screenings and most respondents supervise (86%) and train (83%) hearing screeners. Of the respondents who reportedly train hearing screeners, the type of person they were training included audiology/speech-language pathology students (59%), school nurses (45%), parent/community volunteers (38%), audiology technicians (28%), speech-language pathologists (19%) and health department hearing screeners (6%). The majority of respondents who train hearing screeners reportedly use hands-on training (92%), handouts (75%), and instructional lectures (64%). Only four respondents (8%) reportedly used a recorded program and one reported using a pre-packaged training system, but these respondents did not indicate the programs they used. The majority of respondents who train hearing screeners assess learning outcomes with an oral/practical examination (54%) and fewer than half reported using a written test (22% pre- and post test; 24% post-test only). In summary, the respondents represented precisely the target audience that was desired for the survey. Overall, they were experienced educational audiologists who had conducted, supervised, and/or provided training for hearing screening.

Discussion

The Pure Tone Hearing Screening in Schools video, developed at Towson University in collaboration with the BCPS and BCHD, was created to enhance the consistency of hearing screening training and to decrease training costs. The video was found to be as effective as live lecture for content delivery and screening demonstration, when assessed with written and practical tests. In addition, both live- and video-delivery methods were well received by trainees according to the program evaluation ratings, and a national survey indicated it would be useful for hearing screening programs nationally.

For the large-scale BCHD study, program evaluations were completed at the end of both the didactic and hands-on training, so they indicated participants' evaluation of the entire program, suggesting that both live lecture and video lecture were well received as part of the overall training program. The program evaluation was conducted at the end of the training day with the assumption that the video would not be used to replace a comprehensive hearing screening training program. As Kline et al. (1986) stated, "The use of videotape as a 'substitute teacher,'…is an abuse of a method that should be used to improve, not eliminate, faculty-student contact." Previous research has indicated students prefer the interaction of standard lecture to video lecture, even when tests scores are equal to or poorer than scores from video lecture (Bazyk & Jeziorowski, 1989; Davis, 1987; Kline et al., 1986; Leff, 1988; Paulsen et al., 1998; Spitzer, Bauwens, & Quast, 1989); however, when video is used in conjunction with traditional interactive instruction, studies have reported no differences in student preference between this format and a standard lecture (Lewis, 1995; McAlpine, 1996). Therefore, it was never the authors' intention to replace all of the necessary training with a video. The current study's findings were similar to those of McAlpine (1996) and Lewis (1995); specifically, there were no significant differences in test score, practical skills performance, or performance ratings between the standard lecture format and the video-enhanced training format when the program evaluation was conducted at the end of a training day for health department hearing screeners. The script method (live presentation that followed the video content, but did not allow for questions), which was used as a direct comparison between video and lecture without the normal interaction associated with a lecture, was not well received; however, this condition was an artificial construct to control for content, and it appears that the participants did not appreciate having to wait to ask questions until after the post-test. This provides further support for the need for interaction between students and teachers in the training process. In the current study, it appears participants in the video groups were tolerant of the delay in asking questions until after the video, either because they were focused on the video, the graphics/demonstrations in the video enhanced learning to the point that participants had few questions, the video was short, and/or because it is a traditionally accepted protocol (habit) to watch a video without asking questions. For the smaller study with volunteers, the participants who had hands-on training had significantly higher ratings for their perception of training effectiveness and their tendency to recommend the training to others. This supports our assertion that training programs should include both didactic and hands-on training.

The national survey of educational audiologists indicated the majority would consider using the video as part of a hearing screening training program in conjunction with hands-on training and over half of the respondents provided suggested modifications. This indicates that the creation and wide-scale dissemination of a revised video may be widely used, which may improve the consistency of hearing screening training across multiple states and school systems. The original video is currently available on-line along with accompanying notes, an example of a written test, and the skills checklist used in this study (Table 1). Support materials for the revised video will be developed following completion and posting of the video (projected completion date: December 2011). The national survey indicated just over half (54%) of the respondents reported that they conduct a practical assessment and only about 25% conduct a written assessment following training. It is hoped that the provision of assessment instruments that accompany training materials will encourage programs that are not conducting assessments to establish and assess learning outcomes. This study showed that the use of a written pre-test will elevate post-test scores if the same assessment is used for both. If this is a desired outcome, (perhaps to alert trainees of important items or to document the efficacy of training), then the pre-test should be included in a training assessment protocol.

Almost all of the comments provided by respondents were compiled, collapsed across common topic, used to develop a revision plan for the video (see Appendix, second column), and incorporated into the script for the revision of the video. However, a few suggested revisions were considered to be beyond the scope of this video (e.g., tympanometry and otoacoustic emissions). The national survey of educational audiologists indicated the majority of educational audiologists would keep all of the topics in the current version of the video, but would make changes and additions; therefore, the basic outline of the video will remain the same. However, all portions will be modified and enhanced, and the video will include two new additions: "common mistakes" and "frequently asked questions" sections. One common problem stressed by many respondents that was addressed briefly in the original video was background noise. Specifically, hearing screeners did not know how to tell if a room was too loud and/

or hearing screeners often increased the intensity to account for background noise. Because this was a consistent theme in the responses, background noise will be addressed in three sections of the revised video, including an emphasis on keeping the screening level constant and a discussion of how to check the background noise level. Specifically, the procedures for assessing ambient noise level using psychoacoustic procedures, as described in ANSI S3.1 (1999), will be included. This procedure was selected instead of a tutorial on the use of a sound level meter because sound level meters capable of octave or 1/3 octave band filtering with a noise floor capable of measuring the lowest levels specified by ANSI S 3.1 standards was considered to be unrealistic for the use of mass hearing screening. The equipment is both prohibitively expensive and sometimes difficult to operate without adequate training in calibration procedures.

A few respondents indicated that their screening procedures differed from the guidelines presented in the video. The video is based on ASHA (1997) guidelines, which are nationally recognized audiological screening guidelines developed via a peer-review process with a panel of experts in pediatric audiology. In absence of a national standard, efforts should be made by audiologists to have their local school system or health department follow these established guidelines for consistency and best practices and to avoid practices that are not optimal for screening. For example, a few respondents indicated they test 500 Hz in order to identify cases of otitis media. However, the use of 500 Hz in the pure tone screening in rooms that are not sound treated will increase the false positive rate, due to the effects of background noise at lower test frequencies (Robinson, 1992). If more hearing screening training programs included the use of video training based on ASHA (1997) methods, it could result in more consistent procedures nationally.

Future Research

To our knowledge, although recorded training programs have been shown to be effective across a number of disciplines, this is the first study to examine the effectiveness of a video used for hearing screening training. Because only about half of the respondents indicated they conduct a written assessment following hearing screening training, it is unknown if learning outcomes are assessed in another manner, such as an examination of the accuracy of the overall screening program. More research should be conducted into the efficacy of hearing screening training in order to optimize identification of children with hearing loss. Once the revised version of the video is available, further testing of the efficacy of video training can be conducted using outcomes based assessments, such as written and skills-based assessment with adults and children and an examination of overall program accuracy.

Conclusions

The Pure Tone Hearing Screening in Schools video was found to be effective for training based on the results of written and skills-based tests. Video training and standard training were both well received by hearing screeners; however, hearing screeners preferred to participate in a training program that included hands-on instruction in addition to didactic instruction and demonstration. The national survey indicated educational audiologists would use a video as part of their hearing screening training and many respondents provided suggestions for the revision of the video. The revised video is currently in production, including two new sections: frequently asked questions and common mistakes. The use of a hearing screening video could reduce training costs and improve consistency of instruction for the didactic and demonstration portions of a hearing screening program; however, the video is intended to be used in conjunction with hands-on training within a program that is supervised by an audiologist.

Appendix

Pure tone hearing screenings in schools video revision plan	
Issue	Action
General Items	
• Current DVD is in standard (low definition) format • Some respondents only wanted to use selected portions • There was no mention of Audiology and Audiologists and the Audiologist's role as the expert on diagnostic testing and remediation. • Respondents wanted to include tests that are outside the scope of this video (e.g., tympanometry, otoacoustic emissions). • All of the children and teachers in the video are black. Respondents wanted the video to be more multi-cultural.	• Filming/editing scheduled in high resolution. • Have video available as a whole and also divided into sections, so educators can select topics. • Add a discussion of audiologists in the introduction (definition; role in the screening process). • Indicate at the end of the video that some school systems include other tests, such as tympanometry and otoacoustic emissions, but that these tests are outside the scope of this video. • Include more diversity in video.
Opening credits	
• Opening credits are out of date (e.g., plaque on the wall indicates prior mayor)	• Update all credits. • Video will be completely re-filmed.
Statistics related to hearing loss	
• Section most often rated as "least useful" by respondents. • Voice is monotone • Need to update statistics especially regarding noise (e.g., Ipod, MP 3 player) • Too many stills of the same kids • No references provided for statistics • The narrator said "they" when talking about one child.	• Shorten the statistics section to essential items. Highlight with text overlay. • Record with more dynamic voice. • Update statistics. • Include a reference/information list (e.g., ASHA) • Omit duplicate pictures of the same children. • Add pictures of children wearing IPods. • Double check grammar in script.
Characteristics of hearing loss	
• Statistics and characteristics are merged and overlap the visual showing the hearing screening demonstration.	• Merge statistics and characteristics of hearing loss sections. • Omit screening procedure clips from this part of the video.
How sound travels to the brain	
• When the word "cochlea" appears, the line is not pointing to the cochlea - it is pointing to the vestibule. • The lightning bolt meant to represent electrical energy is not located on cochlear part of the nerve.	• Revise all graphics and carefully edit.
Types of hearing loss	
• Sensori-neural hearing loss is said to be "not medically treatable" but hearing aids are considered medical treatment • Need to update hearing loss examples for SNHL.	• Revise to include medical and audiological treatment such as hearing aids and cochlear implants. • Update SNHL list; remove presbycusis.
Characteristics of sound	
• The transition appears rushed between the end of types of hearing loss and the beginning of the characteristics of sound portion. • Need more emphasis on the difference between frequency and intensity	• Create headers for each part to signal the transition between sections. • Use text overlays to emphasize frequency (in Hz) - perceived as pitch and intensity (in dB) - perceived as loudness. Add musical scale after description of frequency/pitch.
Audiogram	
• Need to improve the usefulness of this section as a teaching tool	• Emphasize axes with graphic (arrow) overlay on audiogram (fade in and out).

• Provide more detailed description of the audiogram, such as x-axis is frequency from low to high and y-axis is intensity from 0-120dB, and the higher the threshold the more severe the hearing loss etc. • Provide an imitation of how speech may sound with a hearing loss.	• Include audio sample of high-pass filtered speech with text emphasizing the missing sounds. Then play the unfiltered speech and fad in the missing letters of the text.
Locating a screening room	
• Transition is very quick between audiogram and audiologist looking for a room. • A lot of information with no text support • Respondents didn't like the audiologist wandering down the hall looking for a screening room. • Respondents wanted much more emphasis on the fact that screeners should not turn up the level to compensate for a noisy test environment. • Respondents wanted the school to be involved in helping the screener find a quiet room.	• More defined transitions between sections. • Add more text emphasis to supplement narration. • Add a section showing the hearing screening working with school staff to locate a room. Make sure audiologist does not appear to be "searching" for a room as she walks down the hall. • Emphasize the problems with turning up the level to account from background noise in multiple sections – here and in common mistakes and frequently asked questions sections. • Add discussion of why one cannot turn up the level. Discuss ANSI procedures for assessing background noise level.
New section: Setting up a group hearing screening	
• Respondents wanted the video to show the set up for multiple screeners in a room and to discuss how to manage the flow of children, how to test more than one child at a time, and how to use volunteers to monitor children waiting to be tested.	• Show multiple room set ups including 1:1; 1:3 (2 children waiting); students lined up in a hallway with a monitor; 3:3 (3 screenings taking place at one time).
Listening check	
• There is a typo on the bulleted list, "cusions" should be "cushions". • This assumes normal hearing, which may not be the case. • Respondents indicated the video should show moving the cords and listening for a short and checking the entire length for fraying. • Make sure they don't drop the audiometer	• Make sure "cushions" is spelled correctly on the revised video. Do a careful edit of all overlaid text for spelling. • Indicate what to do for a listening check if the screener does not have normal hearing and demonstrate partner listening check. • Add check for frayed cords and moving the cords when doing the listening check. • Add "don't drop the audiometer" to the list of things to avoid. Illustrate if possible.
New section: Pre-screening	
• Have screeners check for anything in the ear canal - some children have cotton in their ears from ear aches or ITEs that are not obvious and not known to the screener. • Add information about children with lesions on the pinna, discharge from the ear, skin conditions, and lice. • Include the need for screeners to use hand sanitizer between children to help protect the screener and later children from infectious conditions. • Add information about using an otoscope. • The audiologist does not do a listening check when she takes out the audiometer. • The audiologist does not sanitize her hands (nor is it mentioned). • The audiologist does not clean the earphone cushions.	• Include what to do if the child has a documented hearing loss or wears hearing aids. • Include the need to sanitize hands prior to starting the screening and between each child. • Show the screener cleaning the earphone cushions and headset. • Add an item about the need to check the ears prior to screening (note: otoscopy is outside the scope of the video). Referral to the school nurse for pain, discharge, head lice, and so forth.

New section: audiometers	
• Respondents wanted the video to show updated/multiple audiometers.	• Include 3 different portable audiometers • Highlight the frequency and intensity dials on each model. • Highlight the need to switch between ears with a toggle on some models.
Instructions for screening	
• The demonstration for the student is done with the headset on the table at 100 dB. This is a concern because if the audiologist forgets to re-set the intensity dial before the test, the student will get 100 dB in their ear. • The audiologist places the earphones from behind the student. They should be placed from the front. • Respondents indicated “fail” should be changed to “refer” • One respondent did not like the item: “If you have any doubt about results or child’s responses, please ask an audiologist or refer the child” Sometimes an audiologist is not available.	• Show several ways of instruction, including group instruction. Keep the one from current video, but also include others. Be sure to emphasize the danger of the loud sound if they use that instructional method (text highlight) • Show proper earphone placement (from the front). • Change “fail” to “refer” in all instances (including response forms). • Remove the sentence (If you have any doubts …) and include the importance of follow up and the fact that individual school systems set up follow up procedures (list a few, such as referral to the school audiologist).
Closing summary	
• One person didn't like seeing Martin O'Malley's listed as the mayor on the school plaque because it dated the video.	• Re-film the closing summary. Add information about audiologists here and/or in the introduction. Avoid having printed items that will become dated in the background.
New section: Commonly asked questions	
• What if my school system uses a different screening procedure than the one shown here?	• Include in script the fact that the video is based on ASHA (1997) guidelines; school systems can supplement if their protocols are different; including 500 Hz will increase the false positive rate.
• How do I screen special needs or difficult to test students?	• Include suggestions for difficult to test children.
• What if I am testing a very young child and they do not want to raise their hand?	• Show an example of CPA audiometry.
• What should I do if I am not sure if the student heard the tone or they don't understand the instructions	• Re-instruct. Try hand over hand demonstration if needed. Ask if they understand. If the child still doesn’t respond, they should be referred for further testing.
• What do I do if they only fail one frequency?	• If the child fails only one frequency, then they fail the screening.
• What is the difference between frequency and intensity?	• Make this section clearer with text/graphic emphasis.
• What do the screening results mean? If they fail, does it mean they have a hearing loss?	• Explain what a screening result means and the need for further audiological testing.
• What should I do if the equipment doesn't work?	• Demonstrate a systems check (outlet, plug, cords, mode button, etc.)
• How are the parents notified if their child fails the screening?	• Notification for the parents varies based on the procedure in effect in the specific school system. Check with your school system to see if you need to contact the parents or if that is done by someone else.

• Can earwax cause a hearing problem? What should I do if I see a lot of wax?	• Discuss earwax. Add a check for earwax in the pre-screening section of the video.
• How do I know if the screening room is too loud?	• Explain ANSI procedure to check the background level.
• If the student fails, what do I do next?	• Explain that they need to follow school system/health department procedures for referrals. The child should be seen by an audiologist for a failed screening and referred to the school nurse for issues concerning head lice, pain, drainage, redness, swelling, etc.
• What do I do if the child doesn't speak English?	• Have the child watch other children during their screening test. Teach using gestures.
• Can I hurt the child if I mess up and give a tone that is too loud?	• A short sound will most likely not cause any damage, but it is uncomfortable and it may make the child difficult to screen.
• If the room is too loud, can I just make the tone louder?	• Emphasize that under no circumstances should the intensity level be adjusted above 20.
• What do I do about students with hearing aids?	• Do not screen children who wear hearing aids. They have already been identified as having hearing loss.
• What should I do if I see head lice?	• Refer the child to the school nurse.
• Do I need parental permission to test a student?	• Usually, all students in public schools are required to undergo periodic health screenings. If a parent refuses to have his or her child screened for reasons that are supported by the school, this information should be on file with the school system. As for a list from the school nurse of any children who cannot be screened for this reason.
• Am I ready to go after watching this video?	• Hands-on practice with an audiologist should follow this video. If that is not possible, watch the demonstration portion several times and practice with several adults prior to testing children.
	<u>New section: Common mistakes</u>
• Collapsed ear canals	• Explain what collapsed ear canals are, how it affects the test, and what to do about it.
• Presenting tones in a predictable pattern	• Demonstrate patterning and how to avoid it.
• Improperly placed headphones	• Show how to check fit • Do not let the child place the headphones • Be sure the earphones are on the correct ears. Consider labeling them "right" and "left" • Check for skewed placement and hair under the earphone.
• Providing visual cues	• Show problems with the child facing the examiner, mirrors/reflective glass, and other visual cues
• Not switching from left to right	• Show left to right switch on several machines. • Make it part of the routine
• Not performing listening checks	• Emphasize: Perform a listening check whenever an audiometer is turned on.
• Using a noisy room	• Include reminder about the room.
• Increasing the intensity	• Do not raise the intensity of the tone. • If the room is noisy, find another room or re-schedule the screening. • Don't raise the tone to see how 'bad' the hearing is. Keep the tone at 20 dB. When the child comes back for a full hearing test the audiologist will find out the status of the hearing.
• Not wanting the child to fail	• Explain that it is human nature to want everyone to pass but it is not in the best interests of the child to pass them when they did not hear all of the tones.

• Not cleaning the earphones	• Clean the earphones and the headset between students.
• Not feeling confident as a screener	• Explain this is natural. Be sure to check the equipment and follow the protocol. If unsure of skills, practice on a few adults before screening children. Arrange to have your supervisor watch you screening.
• Equipment failure in the middle of the test	• If several children in a row have the same pattern (they all just fail 1000 Hz), check the equipment and do a listening check. • If the lights blink on and off check the power cord - it may have come away from the wall or the audiometer. • If the child reports “strange noises” do a listening check. • If the equipment is faulty and you don't have a backup then you will need to re-schedule the screening.
• Wanting to counsel the child/parent about results	• Follow the procedures in place at your school for follow up. Have resources ready to give to parents. Do not tell them the child has a hearing loss – further testing is needed.
• Talking in the room	• Make sure others in the room know they cannot talk. • For multiple children, a room monitor may be needed.
• Screening children with hearing aids	• Don't place headphones on top of hearing aids, cochlear implants, or other listening devices. • Students with known hearing loss do not need a screening.

Acknowledgements

The authors gratefully acknowledge the contributions of the following people: Dr. James Drummond, principal, and the teachers and students of Cecil Elementary School in Baltimore City and Gayle Amos, BCPS Special Education and Student Support Services, for making the filming of the video possible; Ron Santana and Matt Wynd from the Center for Instructional Advancement and Technology (CIAT) at Towson University for filming, editing, and graphics; Stephanie Bronson for starring in the video and assisting with the pilot studies; BCPS audiologists Sandra Abramowitz, Michele Allen, Francine Angert, Cindy Blake, Karen Brock, Tanya Green, Theresa Lechlitner, and Estelle Skinner for assistance with the pilot studies; Kim Benson and Lisa Ross for assistance with data collection; and Lisette Osborne from the BCHD for assistance with the pilot study and coordination with the health department.

References

Alterman, M., & Emanuel, D. C. (2004, Summer). School hearing screening and training program in Baltimore, Maryland. *Educational Audiology Review*, 12-13.

American Academy of Audiology (1997) *Position Statement & Guidelines of the Consensus Panel on Support Personnel in Audiology*. Available from www.audiology.org.

American National Standards Institute. (1999). Maximum permissible ambient noise levels for audiometric test rooms [ANSI S3.1-1999]. *Acoustical Society of America.* New York.

American Speech-Language-Hearing Association. (1997). *Guidelines for Audiologic Screening* [Guidelines]. Available from www.asha.org/policy.

American Speech-Language-Hearing Association. (2002). *Guidelines for Audiology Service Provision in and for Schools* [Guidelines]. Available from www.asha.org/policy. American Speech-Language-Hearing Association. (2004). Support Personnel [Issues in Ethics]. Available from www.asha.org/policy.

Bazyk, S., & Jeziorowski, J. (1989). Videotape versus live instruction in demonstrating evaluation skills to occupational therapy students. *The American Journal of Occupational Therapy, 43*(7), 465-468.

Davis, A. (1987). Comparing the effectiveness of two teaching methods for neurological assessment. *Journal of Nursing Staff Development, 3*(3), 138-140.

Hearing and Vision Screening Tests. Code of Maryland Annotated Regulations (COMAR): Education, Title 7, Subtitle 4, § 7-404. Available from http://198.187.128.12/maryland/lpext.dll?f=templates&fn=fs-main.htm&2.0.

Kline, P., Shesser, R., Smith, M., Turbiak, T., Rosenthal, R., Chen, H., & Walls, R. (1986). Comparison of a videotape instructional program with a traditional lecture series for medial student emergency medicine teaching. *Annals of Emergency Medicine, 15*(1), 16-18.

Leff, E. (1988). Comparison of the effectiveness of videotape versus live group infant care classes. *Journal of Obstetrical, Gynecological, and Neonatal Nursing, 17*(5), 338-344.

Lewis, R.A. (1995). Video introductions to laboratory: Students positive, grades unchanged. *American Journal of Physics, 63*(5), 468-470.

McAlpine, L. (1996). Comparison of the effectiveness of tutored videotape instruction versus traditional lecture for a basic hemodynamic monitoring course. *Journal of Nursing Staff Development, 13*(3), 119-125.

Mir, A. M., Marshall, R. J., Evans, R. W., Hall, R., & Duthie, H. L (1984). Comparison between videotape and personal teaching as methods of communicating clinical skills to medical students. *British Medical Journal, 289*, 31-34.

Paulsen, K.J., Higgins, K., Miller, S.P., Strawser, S., & Boone, R. (1998). Delivering instruction via interactive television and videotape: Student achievement and satisfaction. *Journal of Special Education Technology,13*(4), 59-77.

Richburg, C., & Imhoff, L. (2008). Survey of hearing screeners: Training and protocols used in two distinct school systems. *Journal of Educational Audiology, 14*, 31-46.

Robinson, D. W. (1992). Background noise in rooms used for pure-tone audiometry in disability assessment. *British Journal of Audiology, 26*, 43-54.

Spitzer, D.R., Bauwens, J., & Quast, S. (1989, May). Extending education using video: Lessons learned. *Educational Technology*, 28-30.

Yoshinaga-Itano, C., Sedey, A. L., Coulter, D. K., & Mehl, A. L. (1998). Language of early- and later- identified children with hearing loss. *Pediatrics, 102*, 1161-1171.