

The Ardent Hearing Conservationist

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ABSTRACT

In spite of a hearing conservationist's best intentions, in spite of his or her best efforts at audiometry, and in spite of the best engineering noise controls, often the only thing between an employee and a noise-induced hearing loss is a hearing protector. We all know that hearing protectors can work; we also know that many times they fail to work. The difference between success and failure is obvious – getting worker buy in, and also, making sure workers know how to “buy in” once they are ready. Experience suggests this often fails to occur. It is all too common for less than 50% of employees who should be wearing hearing protection to actually be wearing it at all, let alone wearing it properly. Intervention can include a more appropriate selection of hearing protectors, individual fitting of the devices, and stronger enforcement. An additional factor is proper motivational techniques to personalize hearing conservation so that employees can make the connection between abstract concepts and personal outcomes. Techniques include sharing stories and testimonials, developing interactive sessions, and creating listening exercises and auditory demonstrations, all with the intent of sharing a passion for the wonder of hearing, and the tragedy of noise-induced hearing loss with its concomitant, tinnitus.

INTRODUCTION

It all seems pretty straightforward. Noise damages hearing. Hearing protectors block sound. Select devices with high, or at least adequate Noise Reduction Ratings (NRRs). Hand them out. Tell people they need to wear them. Require they be worn. Job done. Well, not exactly ...

So what does it take? The difference between success and failure in hearing conservation is clear – get worker buy in, and also, make sure the workers know how to “buy in” once they are convinced to participate. Unfortunately, this often fails to occur. For example, Berger (2000a) reviewed 112 studies from 1981 – 1999 that provided quantitative data on the use rates of hearing protection in both occupational and non-occupational settings. Although he did find some success stories, and although a few of the reports suggested an increase in usage over the past two decades, he found that those wearing hearing protection generally amounted to less than 50% of those who should be doing so. What's a hearing conservationist to do?

The answer is a comprehensive hearing conservation program (HCP, or as some call it today, hearing loss prevention program). Whatever you call it, the components are well known, although they vary slightly between authors. They include the 5 fundamental phases: noise surveys, education and motivation, noise control, hearing protection devices (HPDs), and audiometric monitoring (Stewart, 2000). Other associated elements include management and professional supervision, recordkeeping for each phase, and ongoing program evaluation. The presence of these elements is necessary for a program to function effectively, but is not sufficient to guarantee its success. As Stewart argues, management commitment, enthusiasm and competence on the part of the occupational hearing conservationist (OHC), and the “motivation of each worker to protector his or her own hearing,” are the vital aspects that assure achievement of the goals. It is this need for *an ardent hearing conservationist* and hence the possibility to truly motivate workers to protect their own hearing, that is the focus of this paper.

In the process of preparing this work, 139 hearing protection articles dealing wholly or in part with motivation were reviewed. That complete list is available upon request; a subset appears in the references provided at the end of this report. The articles varied from the deeply theoretical to exceedingly straightforward. Although a few aspects of theory will be touched upon herein, few data will be presented, since the emphasis will instead be directed towards specific examples along the line of a motivational cookbook, i.e., here are 42 ideas, try them, they work. If you need more facts, consult the cited references.

BACKGROUND AND A WEE BIT OF THEORY

A review of motivational techniques seems to uncover one universally accepted factor: to effectively motivate, you must discover the basis of and appeal to self-interest (Bellanca, 1982; Gasaway, 1985), i.e. you must personalize the message. The worker wants to know, "What's in it for me?" Company policy and enforcement are certainly an important part of the mix, but without grabbing the employee his or her ossicles, as it were, success cannot be assured.

Because noise-induced hearing loss is such an abstract concept with no immediately observable effects in most instances, the "reward" for practicing safe hearing is not palpable. In many cases it may be viewed as avoidance of a negative situation as opposed to a positive outcome. Often the required behavior, wearing hearing protection, is annoying (at least initially) in and of itself, or otherwise problematic. So the goals of the HCP must be structured to remove obstacles to HPD use, and provide rewards, or at the very least create awareness of the very positive aspects of possessing and retaining a pair of finely functioning ears (Royster and Royster, 2000).

Researchers have developed various models to describe the motivational problem, such as the Behavioral-Diagnostic Model (Dejoy, 1986) which emphasizes predisposing factors (personal beliefs), enabling factors (characteristics that promote or block safe behavior) and reinforcing factors (reward or punishment), and the Health Promotion Model (Lusk et al., 1994) which looks at modifying factors (such as interpersonal influences and behavioral characteristics) and cognitive-perceptual factors (such as perceived benefits and perceived self-efficacy). Important insights for hearing conservation that can be gleaned from these models are that for HCPs to be effective, workers must believe they are susceptible to noise-induced hearing loss (NIHL), that it will seriously affect their lives, and that they can do something about it. Furthermore, barriers to compliance such as uncomfortable HPDs, inconvenient HPDs, interference with communications, and a culture that denigrates hearing safety, must be removed (Merry, 1995).

Additional factors that have been shown to be beneficial are highlighting immediate tangible benefits such as reduced fatigue and headaches (Berger, 2000b), providing rewards through, for example, creation of token economies (Lofgreen et al., 1982; Zohar, 1980), and establishing strong positive role models such as foremen, managers, and other leaders (Luz et al., 1973).

With the forgoing in mind, the remainder of this paper will provide the best suggestions that I have been able to discover to get the job done. Emphasis will be solely on motivational issues. Other aspects of program management and enforcement, as well as details of training in hearing protector use have been covered elsewhere. An excellent manuscript reviewing all aspects of education and motivation is Royster and Royster (2000), and for information in training on use of HPDs see Berger (2000c).

INFLUENCING PERSONAL BELIEFS

A common place to begin in the effort to alter personal beliefs about hearing is with a discussion of how the ear works and how noise damages the ear. This need only be brief; just enough to set the stage. A useful aspect can be to highlight the intricacies of the auditory system with unusual facts and figures. “Gee wow” sorts of stuff that might be recalled later, or become the topic of a casual conversation, can help to keep hearing in the forefront of a person’s consciousness. But it is much better to go beyond the techie facts as do many of the suggestions that follow.

Your Best Shot: The Annual Audiogram

The contact between the audiometric technician and the employee during the annual audiogram is the best single opportunity to influence behavior regarding the HCP. You have available valuable one-on-one time in which to craft a message specifically for the individual in question. Don’t waste the annual audiometric experience by simply measuring hearing and filing the results away for next year. In fact, use the opportunity as an HPD training/retraining opportunity as well, by requiring employees to bring their HPDs with them to the test. Check the condition of the devices and ask them to fit them. Skill, or lack thereof, in fitting the device will be immediately apparent.

The employee’s interest is high at this time since this is a personal medical test and they will want to know the outcome. Provide them some immediate feedback on hearing trends that are observed, comparing for example their thresholds to expected age-related values. Graphic displays comparing the employee’s hearing to age norms or to degrees of hearing loss, can be helpful (Ohlin, 2000a). Or superimpose their audiogram on a “count-the-dots” representation of an audibility index, which immediately can demonstrate, by the number of dots that are below the audibility line, the amount of hearing that has been lost (Mueller and Killion, 1990; Royster, 2000). Be sure to provide praise if hearing levels are being preserved, or questions, concern, and words of caution if hearing shifts are observed.

Another possibility is to conduct a real-time demonstration for each individual employee using their audiogram and the audiometer. So often an employee denies any awareness of hearing loss, although their audiogram indicates noticeable effects. Harris (1996) describes for both symmetric and asymmetric hearing losses how to set the audiometer to a constant level which will be subthreshold at some frequencies, and suprathreshold at others, and then as the employee selects the various test tones to point out how some are audible whereas others are not. This can be more convincing than what the employee normally experiences while taking the audiogram since in that case the ability to change the gain during the test assures that all the tones will eventually become audible.

Prerecorded Auditory Demonstrations

Auditory demonstrations are an excellent way to present in a tangible manner what listening can be like for someone with a hearing loss. Today there are available a number of demonstrations that are fun and easy to use. In the E?A?R *Audio Demonstration Series* workers can experience a representative noise-and-age-effect hearing loss as they listen to a forest brook, a soda pop can being opened, music, and speech. The presentations are casual and fast paced. For a slower paced, more technical and formal demonstration, illustrating ranges of hearing loss, one can turn to NASA’s *Auditory Demonstrations in Acoustics and Hearing Conservation* (uses speech and classical music), or the University of Wisconsin’s *Hearing Loss Sampler* (uses only speech, but also includes speech in noise demos).

The E?A?R <<http://www.aearo.com/html/industrial/tech01.asp#audio demo>> and NASA <<http://acousticaltest.grc.nasa.gov/>> demonstrations can be sampled over the web, but are best listened

to from CDs which are available upon request. The University of Wisconsin demonstration can be downloaded as an executable file from <http://facstaff.uww.edu/bradleys/ohc/home.html#software>.

Tinnitus

Getting employees to realize that their hearing is at risk is important, but often equally as dramatic is the awareness someone has when they learn hearing loss doesn't necessarily leave one in silence, but may well rob one of hearing and replace it with an annoying and constant sound over which the listener has no control, tinnitus. Although there are many causes of tinnitus, epidemiologic studies have revealed that hearing loss is one of the most significant causes of this affliction. The E?A?R audio demonstration disk also includes a simulation of tinnitus. One perspective on the criticality of being able to experience quiet, both internally and externally, was voiced by Slouka (1999):

I wish not to define silence but to inquire about its absence, and I ask the question not to restate the obvious – that silence, in its way, is fundamental to life, the emotional equivalent of carbon – but because everywhere I turn I see a culture willing to deny that essential truth.

Testimonials

Search your audiometric data base to find examples of permanent and temporary NIHL from on-the-job and off-the-job exposures. These audiograms, plus personal comments or “testimonials” from those with hearing loss are excellent fodder for discussion during training sessions. If possible, find an employee with such a loss who is willing to lead the conversation or address the safety meeting. Peer training can be very effective, especially in shifting the safety culture within the company. Use quotes for posters or newsletters that describe the effects of hearing loss, such as:

?? *My daughter no longer seems to speak clearly*

?? *I miss the birds. I miss the whispers. I miss all the good sounds.*

?? *People avoid talking with me because they have to repeat so much.*

?? *You always have this ringing in your ears.*

?? *It kind of puts you away outside the world, kind of leaves you out by yourself. There are people around me. I can see them but I don't hear them.*

Personal Demonstration – Use of the Car Radio

A method of clearly relating an employee's daily temporary hearing losses to his or her own personal noise exposure is to ask him or her to set the volume on the car radio to a *just audible level* upon arriving at work, and to leave the volume unchanged after turning off the ignition. Upon return to the car at the end of the shift, the employee should listen to see if the radio is still audible. If not, this is evidence of a temporary threshold shift (TTS), indicating that his or her ears have been fatigued by the day's noise. Alternatively, some suggest setting the volume when the employee gets home at night and directing them to notice how loud the radio appears in the morning. This can work too, but is an unfair demonstration since listeners get used to sounds after a period of continuous exposure such as listening to the radio during their drive to home, and have a tendency to be startled upon first re-exposure in the morning. Furthermore, the first approach requires a simple determination of audibility, whereas the alternative demonstration relies on a judgement of the relative loudness of sounds presented many hours apart.

Hearing Aids vs. Hearing Protection

Often a reason not to wear HPDs is the discomfort and nuisance of wearing something in the ear. It is useful to mention that failure to wear HPDs can result in hearing loss, and the consequent need to wear hearing aids. But if one presumes that hearing aids can be relied upon it may be shocking to realize that they too fit to the ear with an earplug like device. If the person was averse to wearing an HPD 8 hrs./day,

5 days/week, on the job, won't wearing a hearing aid 16 hrs./day, everyday, for the rest of their lives be even more of a burden and a bother?

Eyeglasses vs. Hearing Aids

Although hearing aid technology has improved dramatically in the past 20 years and although hearing aids should always be considered as an option for those suffering hearing losses of all types, it is important for noise-exposed workers to realize that this should not lead them to take NIHL lightly. Unlike eyeglasses that can in most cases virtually completely correct a vision problem arising from ocular distortion, NIHL is more closely akin to the case of macular degeneration in which nerve cells are dead and no longer present to receive information. Hearing aids can in such cases improve the ability to detect and discriminate sounds to a certain extent, but by no means do they restore "normal" hearing.

Effects on Personal Interactions and the Family

The ability to hear is undeniably a key quality-of-life issue, from communication with coworkers, family, friends, and loved ones, to times of relaxation or appreciation, to hearing warning sounds and other signals. Many of life's joys involve activities that include social interaction. That interplay is generally acoustical and oral in nature —conversing over a meal, playing at the beach, or listening to one's mate, or child, or someone special, whisper "I love you." The impact of hearing loss is often felt as much by the family of the impaired person, as by the person him or herself. Alone time can also be listening time, and this too can be diminished by hearing loss (Berger, 2000b; Hetu and Getty, 1991). It is valuable to share these concepts, and to dialog with employees about the effects hearing loss might have.

Hearing Loss Can Affect Your Ability to do Your Job

Hearing loss can affect one's ability to function on the job, and perhaps one's employability as well. Difficulties can be experienced in talking on the phone, detecting subtle changes in machine sounds that are indicative of production problems, or even something as simple as localizing the sound of the impact of the dropping of a small part in order to be able to quickly find and retrieve it. And in the military, hearing loss can be life threatening when one considers the need to localize snipers, hear the activation of perimeter alarms, detect enemy movement through leaves, grass and twigs, determine enemy locations from the sounds of wildlife, loading of cartridges, or clipping barbed wire, or respond to radio messages and verbal orders (Ohlin, 2000a). Furthermore, let's face it, when companies downsize or experience layoffs it is easier to discharge "problem" employees first, and "problem" employees may be those with hearing and communication problems.

Extra-Auditory Effects

As might be anticipated, the principal effect of sound is upon the organ intended to receive and decode it. However, extra-auditory effects have been observed as well. Daily exposures above 85 dBA may contribute to elevated blood pressure and hypertension. Reduced fatigue and less postwork irritability have been documented both subjectively, and via objective blood tests, for those wearing hearing protection vs. those choosing to go unprotected in a noisy environment. So it is worth indicating to employees that they may experience less stress and feel better after work if they simply choose to wear their HPDs as directed (Berger, 2000b).

ESTABLISHING A FEELING OF SELF-EFFICACY

To induce employees to take action on their behalf, we must show them that their action is meaningful and can make a difference. It is also important to provide cues on when that action should be implemented and the means to help them in doing so. Consider the following.

HPD Training

If employees do not know how to wear their HPDs properly then clearly the devices cannot be effective. Real-world studies have consistently demonstrated that, in practice employees wear HPDs poorly. A large part of the problem can be attributed to lack of motivation to fit them well (which of course this report is intended to overcome), and to attempts to avoid overprotection (Berger, 2000c), but much of it is due to inadequate training. Large group training using slides, videos, or CDs is inadequate. Employees must be trained in small groups of no more than 5 or 6 persons, preferably one on one (Sweeney et al., 2000). And to be effective and convincing the trainer must be intimately familiar with the devices. This was argued convincingly nearly 30 years ago by Maas (1972) who said,

Nothing is quite so valuable as firsthand experience in promoting hearing protection – or in promoting anything! By wearing different types of protectors, you will acquire practical information about the various devices which you can pass on to the employee. It is far more effective to say, “I’ve worn this type and I like it very much,” rather than “I’ve heard that this kind is supposed to be good.”

Fit Testing

Fit testing can serve many purposes such as documenting effectiveness of devices for individuals, auditing a program’s overall compliance, STS follow up, and training the trainer (i.e., teaching fitters how to better fit devices). And with respect to motivation and self-efficacy this tool can directly demonstrate to an employee that a properly used HPD can really make a difference (Merry and Stephenson, 1999). Unless you can do fit testing in a sound field, normally the procedure will be implemented with either specially built large circumaural earphones (Michael, 1999) or even with standard audiometer earphones (Berger, 1984). In the latter case it would appear that a criterion of ≥ 15 dB at 500 Hz can provide reasonable assurance of achieving acceptable sound-field attenuation (Berger, 2000c).

TTS Demonstrations

Another direct way to demonstrate the effectiveness of HPDs is to measure hearing thresholds before and after work on consecutive days and allow/encourage employees to not wear hearing protection on one of those days. In sufficiently high noise levels, greater than 90 to 95 dBA, most employees will experience temporary threshold shifts (TTSs) after a day of unprotected exposures, and thus a convincing with vs. without demonstration can be provided. The audiograms should be reviewed with the employees at the time of testing and for even greater effect, posted (anonymously, if necessary) on department bulletin boards for further group discussion. In one study in an Israeli steel plant Zohar et al. (1980) found this to be a very effective approach with lasting effects after the conclusion of the study, suggesting that department norms, i.e. the safety culture had been permanently affected.

ADBA Results

In a similar way that individual TTS results can be meaningful, group feedback may be useful. This can be achieved by posting the findings of annual audiometric data bases analysis (ADBA) procedures in simple bar graph formats for comparison between departments, or between the company and known acceptable results. These results can also be presented during the annual group educational sessions.

Garner Employee Input and Suggestions

Employees will be much more willing to participate if they feel part of the decision-making process. Their input can be easily integrated into the hearing protection selection part of the HCP. Establish small test panels to evaluate trial HPDs and make recommendations for the devices which will be approved, and as

discussed below, under HPD selection, be sure to provide a variety of devices from which employees can choose. And finally, you must be ready and willing to implement reasonable or helpful ideas.

Establish Behavioral Clues to Damaging Noise

Sure you are going to post noisy areas, but also give employees some tips on how to determine noise hazardous situations on their own. This will be especially helpful for nonoccupational exposures. The two best tips are:

- ?? When you feel the need to shout in order to be heard 3 feet away, the noise levels are probably 85 dBA or more and hearing protectors are recommended.
- ?? If, immediately after a period of high noise exposure, a ringing, buzzing, or whistling is noticed in your ears, called tinnitus, this is a warning sign. It's like a "sunburn" of the hair cells of the inner ear (or you might call it a "soundburn"), indicating that the hair cells have been irritated and overworked. Tinnitus is especially noticeable in quiet place, such as when trying to go to sleep at night. If you don't protect your ears from noise, tinnitus can become a permanent constant annoyance in your life.

Buddy System

Encourage employees to work together to help each other learn how to use hearing protectors, solve problems in hearing protector utilization, and even to check the fit of each other's devices. In this way, they both learn. Sometimes another person may uncover the reason for a fitting problem by watching a coworker trying to insert an earplug, or by looking at the positioning of an already inserted device. In fact, one new foam earplug on the market (E?A?R, 2000) specifically includes a colored stripe in the middle of the plug that a buddy can use to make a quick visual check of the depth of insertion.

REMOVAL OF BARRIERS

The next step in motivation is to remove all of the needless barriers that make it more difficult for a worker to practice safe hearing. Once we have workers motivated, and they want to protect themselves, let's make it a no-brainer.

HPD Selection

One of the most important barriers to overcome is that of uncomfortable or inconvenient HPDs. If the devices are not comfortable and convenient they won't be worn well; perhaps not at all. Be sure to provide a variety from which to choose, and that does not mean 3 different brands of foam earplugs. Although OSHA requires an employer to provide a "variety of suitable" HPDs, which has been interpreted to mean at least one type of plug and one type of muff, a preferable approach that provides more choice and "buy-in" from the employee is to offer a minimum of four devices (as required by the new MSHA noise regulation). Include at least two earplugs and a muff. Involving employees in the selection process will increase the likelihood of obtaining and maintaining their participation in the entire program.

Communication, Part 1: Proper Protection

As far back as 1958 hearing conservationists pointed out that hesitancy to wear hearing protection could often be attributed to employees' fears of missing speech or warning signals (Guild, 1958). Yet for many years hearing protectors were selected primarily based on more protection is better (i.e. bigger NRRs). If the noise levels are in the upper 80s or even lower 90s, what is needed is not an NRR of 30 dB, but a well-fitted and comfortable device that can provide an actual delivered 10 or 15 dB of noise reduction. Those in the know now realize that avoidance of overprotection is beneficial and they will recommend flat

and moderate attenuation passive devices, or even in particular applications, specially designed electronic devices (Casali and Berger, 1996).

Communication, Part 2: Teach the Speaker to Speak Up

When employees wearing proper protection in noise levels greater than about 85 dBA complain of not being able to hear speech in noise, the problem is often due to the speaker. Because of what is sometimes called the earplug effect (and arises due to the occlusion effect), but applies to earmuffs as well, talkers in high noise tend to reduce their voice levels 3 to 4 dB. This has a much larger effect on speech intelligibility than anything the HPD does. In fact, if two people are speaking in noise and can't communicate easily, it would be better for the talker to remove his or her HPD, than for the listener to do so. The moral of the story: teach HPD users that they have to speak more loudly than they think they need to when communicating in noise (Berger, 2000c).

Safety Culture

Peer pressure influences us all, on the job, at home, and at play. Make it work for you in your hearing conservation efforts. As you implement the ideas in this paper, such as peer trainers, testimonials, and sincere management support (an absolute must), and empowering employees to develop safety policies, strive to change the climate from one in which fools and sissies wear hearing protection to one in which it is the "in" thing to do (Merry, 1995). Additional ideas to influence the culture follow.

Role Models and Leader Behavior

Those in authority and those we admire can strongly influence our behavior (Luz et al., 1973; Lipscomb, 1988; Maas, 1972). If they talk the talk, but don't walk the walk, the message will be contradictory and unconvincing. An important place to begin walking the walk is whenever supervisors and managers enter noise posted areas. Regardless of how short a period of time they spend in the noise, they *must* wear their hearing protection in order to reinforce the value and importance of doing so. In fact, management should ask workers to require individuals entering noise hazard areas unprotected to leave until they obtain and don HPDs, even to the extent of applying that rule to supervisors and guests (Royster and Royster, 2000).

Another role model idea is to recruit a "hearing protection champion." This is an employee, not necessarily a supervisor, who strongly embraces the value of hearing and the importance of the HCP and is willing to be vocal and visible in supporting the program and demonstrating its value to him or her. See also the prior section on testimonials.

Reward Supervisors

To encourage supervisors to be good role models and supportive hearing conservationists include measures of hearing conservation effectiveness for their departments (such as percentage of people wearing HPDs, or ADBA results) in their personal goals against which they will be evaluated for job performance.

Token Economies

Since the benefits of HPDs in terms of hearing loss prevention are long term and not immediately apparent, some authors have suggested that instantaneous rewards might induce more employees to wear hearing protection and if enough of them do so, to permanently change the company culture so that use of protection becomes the accepted norm. Studies by Lofgreen et al. (1982) and Zohar (1980) support such ideas. Between them they tested rewards in three different HCPs, providing either lottery tickets or tokens that could be exchanged for consumer products, to those found wearing HPDs. In one

variant, the value of the tokens was adjusted based on how many in the department were found wearing hearing protection, with the intention of ratcheting up the potential influence of peer pressure. All approaches worked and had lasting effects after the reward programs terminated. However, some have cautioned the rewards may sometimes fail because workers perceive that they are being manipulated (Merry and Franks, 1995).

ADDITIONAL IDEAS

In this section you will find some additional ideas that have been found useful, but don't easily fit into the preceding categories.

Encourage Employees to Take Home Hearing Protection

Provide free hearing protection for employees to take home. The small cost to the company is easily offset by the good will it cultivates and the fact that this reinforces the habit of using protection whenever noise is present. In fact, be sure to provide "noise thermometers" to indicate the types of noises that are likely to be encountered that can be harmfully loud, and in the presence of which, HPDs should be worn. Use community events such as auto races, concerts, air shows, and tractor pulls as opportunities to encourage employees to use hearing protection off the job.

Offer Free Hearing Testing

As a special health benefit to promote the HCP, perhaps in conjunction with International Noise Awareness Day, which occurs each April <<http://www.lhh.org/noise/inad/>>, offer free hearing screenings to non-noise-exposed plant personnel and especially the children and spouses of employees. Do this on weekends or at annual picnics or other events. If you find a few employees or children of employees with hearing losses that require referral, this is a corporate mitzvah and something that will dramatically elevate the appreciation of hearing and the company's own HCP (Meinke and Hackel, 2000).

Use Training Videos Judiciously

HCP training films can be a useful adjunct to the annual training program, but don't make them the only part of the program. Don't show the same film year after year. You can use sources such as Berger and Kladden (1998) or the regular movie reviews that appear in the National Hearing Conservation Association (NHCA) *Spectrum* as a guide for selection. View the video in advance of showing it to your workers to make sure it is appropriate and so you can alert employees to watch for specific scenes that may be particularly applicable.

Post or Distribute Question-and-Answer Documents

Well-informed employees are more likely to be willing participants in an HCP. Make sure they don't have unfounded fears involving fitting hearing protection. After all, we all know that mother told us never to put anything smaller than our elbow in our ear. Resources are available which can provide a basis to prepare fact sheets that can be posted or circulated with pay checks, or distributed in conjunction with hearing conservation training (Berger et al., 2000). Alternatively you can turn to already available materials that can be adapted (Berger, 1982).

Positive Practice Overcorrection

An interesting approach that was validated in a military setting was reported in one paper (Sadler and Montgomery, 1982). Individuals who agreed to participate in the study were subject to positive practice overcorrection – whenever they were caught not wearing their hearing protection, they were made to stop their work, turn off or otherwise get out of the noise, and insert and remove earplugs five times before

continuing work. The gains in usage were modest, and were greatest for those groups in which the leaders participated and were also subject to the same overcorrection scenario. It is important to obtain employee and supervisor buy in before commencing this technique, otherwise it will likely be viewed as a punitive managerial measure.

Keep it New, Different, Relevant, and Up to Date

There are many suggestions in this paper. Don't use them all in any one year (which of course would be impossible), but choose among them and keep things changing. OSHA requires an annual educational program. Don't waste that time or engender employee malcontent by presenting the same old boring material year after year. If you see news clips on noise, or hear of other relevant acoustical events, be sure to include such materials.

Training Program Do's and Don'ts

- ?? DO be passionate about your material. If it doesn't appear to workers as though this is important to you, it becomes very difficult to make it seem important to them.
- ?? DO keep the program short (no more than 45 mins.).
- ?? DO use a variety of speakers, and if possible, arrange for upper-level management (as high a level as possible) to introduce the program, and by so doing demonstrate full management support.
- ?? DO use a variety of materials – slides, films, sound clips, posters, speakers, and show and tell.
- ?? DON'T simply read to the audience from documents you have given them, such as a policy manual.
- ?? DON'T begin by saying "OSHA requires that we do this each year, so here we go ...". You need to believe, and convince others you believe in this program, and that you're not just complying with a regulatory edict.

FUN STUFF – GAMES, STORIES, INTERACTIVE SESSIONS

The following exercises all help develop an awareness of the magnificence of the auditory experience and how precious hearing is. They can redirect awareness from the many sensory inputs that overwhelm us, often visual in nature, to those that are auditory in nature. Any exercise that causes the participants to think about, talk about, wonder about, and appreciate the miracle of hearing and the impact of sound, will help foster behaviors conducive to hearing conservation.

Sound is Unique

Sound by its nature is evanescent - it ceases to exist even as it is produced; by the time the last syllable of a word is uttered, its initial sounds have faded. Another unique characteristic of sound as compared to the other principal sense, vision, is that sounds pour into the hearer's ears whereas sight places the observer on the outside looking at, or looking in. Vision comes to the viewer from one direction whereas sound confronts us from all directions and places us in the center of an auditory space (Schafer, 1993), enveloping us and hence often greatly affecting our emotions.

Favorite Sounds

It is common for people to have favorite colors, but how often do they talk about their favorite sounds? Meinke (2000) has been exploring this question and has thus far collected over 750 favorite sounds from various groups. Pose this question in a group training session and observe what happens. Related questions can also be discussed such as "what sound would you miss most if you lost your hearing," and even more to the point, "why do you or why don't you wear your hearing protection." The responses will be varied, but regardless, they are bound to stimulate thought and discussion, and maybe even some problem solving.

Hearing is Precious

Hearing is precious to me, so I particularly like to demonstrate that to others. I treasure good hearing and the ability to perceive and enjoy natural quiet (which of course would be impossible with a noise-deafened ear that is plagued by tinnitus). I describe some of my exciting listening experiences in the wilderness, when my ears and what they beheld were an incredible source of excitement, joy, and spiritual wonder (Berger, 2000b).

Another story I like to share is a recollection told by National Public Radio's Susan Stamberg when she marked the observance of Fathers Day in 1999. She dusted off some old 78-rpm recordings made in 1940 and later, by her father -- who had been deceased for over 30 years. She never had the heart to listen before, having up till then felt his loss was still too near to deal with. She was surprised to find the records included her own voice and that of her dad, Robert Levant, illustrating his professional oratory style of speaking. Near the conclusion of her story she remarked,

I believe that we reside most in our voice, that the voice conveys the absolute essence of who we are, that it puts you in the presence of a person even more than photographs.

A related demonstration is simply to discuss what is and what is not precious. For example take a \$50 bill and casually wave it in one hand as you play with a lit flame in the other hand, as though you are about to incinerate the greenback. Watch the audience squirm and develop an immediate and felt sense of "preciousness." Then relate that to something even more precious – the ability to hear (Wells, 2000).

Sound Games

Show people how important their ears are, how much they can aurally discern, how much fun it is to listen, and give them something to think about. Here are some suggestions from Murray Schafer (1992). If you try one of these games in a training session be sure to allow sufficient time to explore the audience response and not rush the process.

- ?? Ask the audience to write down every sound they can currently hear. Have them share their responses. Note the differences.
- ?? Solicit an assistant, and then while both of you continuously talk or make other sounds, independently walk slowly around the room. Ask the audience, with eyes shut, to use one hand to point to one of you and the remaining hand to follow the other. When you stop moving, ask them to open their eyes. Discuss how easily most of them were able to use their ears to accomplish such a technically intricate task.
- ?? Talk about the sound of feet. People wear different shoes and walk differently, or stuff jingles in their pockets. Ask the audience to close their eyes and pick people, one at a time, to walk across the front of the room. Have the audience describe what they hear, or even try to guess who is walking simply from the sounds they make.
- ?? Solicit responses to the following: What was the first sound you heard this morning on waking, the last sound you heard last night before sleep, the loudest sound you heard today, the most beautiful sound you heard today?
- ?? Ask if anyone would like to share the most memorable sound experience they have ever had?
- ?? Collect keys from 10 people in the audience. Have everyone listen, eyes closed, as you shake each set of keys in turn. Ask people to raise their hands if they hear their own keys being jangled.
- ?? Hearing gets to places where sight cannot. Ears see through walls and around corners. Ask the audience to help make a list of sounds that are made by objects that are never seen or that come from hidden places. (Ex.: water in a drain pipe, squirrels on the roof, an echo, mice in a wall, and a stomach growling.)

Sound in the Movies, Part 1: Excitement

An exciting component of film, perhaps the most exciting, is sound and it is often overlooked by the audience. Film reviewer David Ansen (*Newsweek*) wrote in 1994 about the movie *Blink*,

But the secret ingredient of this adrenaline-pumper is the sound mix, supervised by Chris Newman, who also happened to work on the Exorcist, The French Connection, and The Silence of the Lambs, tense movies all. We're rarely conscious of it, but what really frightens us in the movies is often not what we see but what we hear. Not the guy with the knife but the man at the dials, splicing in an electronic "boo!"

Sound in the Movies, Part 2: Sound Tracks

Sounds convey so much information in a film, and also so much of the emotional content. Play snippets (10 secs. or so) of the theme songs from blockbuster films like *Star Wars*, *Jurassic Park*, *Silence of the Lambs*, and others, and have fun while the audience tries to identify the films. Include a few toughies as well and see who you can stump.

Sound in the Movies, Part 3: Jack Foley

Jack Foley is a Hollywood legend---he did his job best by not letting anyone know he existed. But Foley's legacy lives on in every film and television program we watch---it's there in the footsteps of the star walking down a street, in the rustle of a dress, in the pounding of horse-hoofs. Foley made these sounds and many more on his stage at Universal studios. Foley was there on the studio's maiden voyage into sound pictures in 1927 with the production of *Show Boat*, which was originally planned as a silent film, but then had to compete with the *Jazz Singer* that had just been released. At first, he and his team of sound men had only one chance to get all the sound right, and later they would splice in effects painstakingly added from previously recorded materials, one piece at a time. Subsequently, Foley figured out that by projecting the film and recording the sound effects in sync, he would get the best effect---and he would do each effect one at a time, till the various sounds were all put together with the film--a method today called Foley. Foley's stage looked more like a garage than a recording studio---dirt, gravel, and lots of junk everywhere. Foley's voice was never recorded, and he never received an on-screen credit ---but he is remembered by those who worked with him.

Among Jack's other incredible talents was his ability to create actor's footsteps. Actors would specifically request him. In an interview he said each actor had unique footsteps: Rock Hudson – solid stepper, Tony Curtis – brisk foot, Audie Murphy – springy, James Cagney – clipped, Marlon Brando - soft, John Saxon – nervous, and women's steps are quicker and tough for Foley to copy with his 250-lb. body.

He saved Stanley Kubrik's *Spartacus* (1960) having to return to Italy to reshoot just to get the sound of the Roman army marching into battle, which was not properly recorded the first time. Foley used a key ring from his pickup truck to simulate the sound. This was his last film because Universal was then bought, and Foley retired after 33 years.

Listen to the full story at <<http://search.npr.org/cf/cmn/cmnpd01fm.cfm?PrgDate=03/24/2000&PrgID=2>>

Cerumen and Art

So often employees are grossed out when a wax-coated earplug is removed from their ears. It may help to remind them that cerumen is an important protective substance in the ear, but furthermore, cerumen even has had a place in the creative arts. It was commonly used by artists during the Middle Ages in the making of illuminated manuscripts (i.e., highlighted by color and gilding). "Glaire" was used by artists to

apply the colors. Its base was beaten egg albumin that tended to froth unless a little earwax was added. Avoidance of bubbles was necessary for a good color application (Petrakis, 2000).

How Does Your Eardrum Grow?

It grows out. This is one of the self-cleansing mechanisms of the ear. It is also one of the reasons that it is so difficult to keep tubes in the ears of children suffering from middle ear infections. The eardrum grows radially out from its center and then the growth continues along the canal walls at a rate of migration of about 1.5 mm/month.

Earology

Earology, also called otomorphology is the study of the physiognomy of the pinna, which varies enough from person to person that it is possible to read earprints like we are used to reading fingerprints, a fact not generally known among ENT specialists. This highly specialized knowledge has been developed as a distinctive branch of forensic medicine. Criminals are generally careful to wipe their fingerprints but rarely think of earprints remaining in places they may have pressed their ears while eavesdropping. Burglaries and even a homicide in Britain have been solved by the introduction of earprints into testimony, and comparison of those prints to suspects led to convictions (Feenstra and Lugt, 2000).

Share Some Quotes

At our company hearing conservation is more than a priority; it is a value. That is an important distinction, because although priorities may change, values never do. Charles Robinson

Words mean more than what is set down on paper. It takes the human voice to infuse them with shades of deeper meaning. Maya Angelou

Hearing is a way of touching at a distance. R. Murray Schafer

Blindness cuts people off from things, deafness cuts people off from people. Hellen Keller

Quiet places are the think tank of the soul. Gordon Hempton

Hearing pure nature is a striking experience no less grand than staring at the Milky Way. It jerks us right out of our daily lives. Without it we are diminished, as individuals and as a civilization. Gordon Hempton

"I love a wide margin to my life," Thoreau remarked, quaintly, referring to the space – the silence – requisite for contemplation, or, more quaintly, the forming of a self. A century and a half later, aural text covers the psychic page, spills over; the margin is gone. Walking to work, we pass over rumbling pipes and humming cables, beneath airplane flight corridors and satellite broadcasts, through radio and television transmissions whose sounds reconstituted from binary code, mix and mingle, overlap and clash, and everywhere drifts the aural refuse of our age. Mark Slouka

Like the telltale lesion that appears only on those who are desperately ill, value, even outrageous value, often blossoms on things just before they leave us, and if the analogy is an ugly one, it is also appropriate; the sudden spasm of love for the thing we're killing, after all, is as obscene as it is human. As we continue to pave the world with sound, we will continue to crave what little silence escapes us, an emptiness made audible by its disappearance. Mark Slouka

REFERENCES

1. Bellanca, J. J. (1982). "Motivating Managers and Workers," *Occup. Health Saf.* 51(4), p. 15-16 and 55.
2. Berger, E. H. (1981). "EARLog #7 - Motivating Employees to Wear Hearing Protection Devices," *Sound and Vibration* 15(6), 10-11.
3. Berger, E. H. (1982 – 1983). "EARLog #8 – #10 – Responses to Questions and Complaints Regarding Hearing and Hearing Protection (Parts 1, II, and III), E?A?R / Aearo Company, Indianapolis, IN, <http://www.aearo.com/html/industrial/earlog.htm>.
4. Berger, E. H. (1984). "Assessment of the Performance of Hearing Protectors for Hearing Conservation Purposes," *Noise & Vib. Control Worldwide* 15(3), 75-81.
5. Berger, E. H. (2000a). "Hearing Protection Device Utilization Around the World," *Spectrum Suppl.* 1, 17, p. 18.
6. Berger, E. H. (2000b). "Noise Control and Hearing Conservation: Why Do It?," in *The Noise Manual, 5th Edition*, edited by E. H. Berger, L. H. Royster, J. D. Royster, D. P. Driscoll, and M. Layne, Am. Ind. Hyg. Assoc., Fairfax, VA, 1-17.
7. Berger, E. H. (2000c). "Hearing Protection Devices," in *The Noise Manual, 5th Edition*, edited by E. H. Berger, L. H. Royster, J. D. Royster, D. P. Driscoll, and M. Layne, Am. Ind. Hyg. Assoc., Fairfax, VA, 379-454.
8. Berger, E. H., Royster, L. H., Royster, J. D., Driscoll, D. P., and Layne, M. (eds.) (2000). *The Noise Manual, 5th Edition*, Am. Ind. Hyg. Assoc., Fairfax, VA.
9. Berger, E. H. and Kladden, C. A. (1998). "Noise and Hearing Conservation Films and Videotapes: Reviews and Availability," Rept. E?A?R 82-10/HP, Indianapolis, IN.
10. Casali, J. G. and Berger, E. H. (1996). "Technology Advancements in Hearing Protection Circa 1995: Active Noise Reduction, Frequency/Amplitude-Sensitivity, and Uniform Attenuation," *Am. Ind. Hyg. Assoc. J.* 57(2), 175-185.
11. DeJoy, D. M. (1986). "A Behavioral-Diagnostic Model for Fostering Self-Protective Behavior in the Workplace," in *Trends in Ergonomics/Human Factors III*, edited by W. Karwowski, Elsevier Science Publishers B.V., North-Holland, 907-917.
12. E?A?R (2000). E?A?R® Classic SuperFit 30™ and 33™ foam earplugs with colored fitting indicators.
13. Esler, A. (1978). "Attitude Change in an Industrial Hearing Conservation Program," *Occup. Health Nurs.* 26(12), 15-20.
14. Feenstra, L. and Van Der Lugt, C. (2000). "Ear Witness," *J. Laryngol. Otol.* 114, 497-500.
15. Foster, A. (1983). "Hearing Protection and the Role of Health Education," *Occup. Health* 35(4), 155-158.
16. Franks, J. R., Stephenson, M. R., and Merry, C. J. (1996). "Preventing Occupational Hearing Loss - A Practical Guide," US. Dept. of HHS (NIOSH), Pub. No. 96-110, Cincinnati, OH.
17. Gasaway, D. C. (1984). "Motivating Employees to Comply with Hearing Conservation Policy," *Occup. Health Saf.* 53(6), 62-67.
18. Gasaway, D. C. (1985). *Hearing Conservation - A Practical Manual and Guide*, Prentice-Hall, Inc., Englewood Cliffs, NJ.
19. Gasaway, D. C. (1996). "To Prevent Noise-Induced Hearing Loss – Aim Between the Ears," *Spectrum Suppl.* 1, 13, p. 28.
20. Guild, E. (1958). "Ears Can Be Protected," *Noise Control* 4, 33-35 and 58.
21. Harris, G. (1996). "The Persuasive Power of Hearing Loss Demonstrations," *Occup. Health Saf.* 65(3), 26-27.
22. Hetu, R. and Getty, L. (1991). "The Nature of the Handicaps Associated with Occupational Hearing Loss: Implications for Prevention," in *Proceedings, National Seminar Series on Occupational Noise-Induced Hearing Loss, Prevention and Rehabilitation*, edited by L. Getty, R. Hetu, W. G. Noble, and R. Waugh, Natl. Occup. Health and Saf. Comm., Sydney, Australia, 64-85.
23. Karmy, S. J. and Martin, A. M. (1982). "Employee Attitudes Towards Hearing Protection as Affected by Serial Audiometry," in *Personal Hearing Protection in Industry*, edited by P. W. Alberti, Raven Press, New York, NY, 491-509.

24. Muller, H. G. and Killion, M. C. (1990). "An Easy Method for Calculating the Articulation Index," *Hearing J.* 43(9), 14-17.
25. Lipscomb, D. M. (1988). "The Employee Education Program," in *Hearing Conservation in Industry, Schools, and the Military*, edited by D. M. Lipscomb, College-Hill Press, Boston, MA, 193-202.
26. Lofgreen, H., Holm, M., and Tengling, R. (1982). "How to Motivate People in the Use of Their Hearing Protectors," in *Personal Hearing Protection in Industry*, edited by P. W. Alberti, Raven Press, New York, NY, 485-490.
27. Lusk, S. L. (1999). "Translating Research into Training: Motivating Construction Workers to Use Hearing Protection Devices," *Spectrum Suppl.* 1, 16, p. 21.
28. Lusk, S. L., Ronis, D. L., Kerr, M. J., and Atwood, J. R. (1994). "Test of the Health Promotion Model as a Causal Model of Workers' Use of Hearing Protection," *Nurs. Res.* 43(3), 151-157.
29. Luz, G. A., Decatur, R. A., and Thompson, R. L. (1973). "Psychological Factors Related to the Voluntary Use of Hearing Protection in Hazardous Noise Environments," U.S. Army Med. Res. Laboratory Report No. AD-777 520, Fort Knox, KY.
30. Maas, R. B. (1970). "The Challenge of Hearing Protection," *Ind. Med.* 39(3), 29-33.
31. Maas, R. B. (1972). "Industrial Noise and Hearing Conservation," in *Handbook of Clinical Audiology*, edited by J. Katz, Williams and Wilkins Co., Baltimore, MD, 772-818.
32. Meinke, D. (2000). Personal communication.
33. Meinke, D. and Hackel, S. (2000). "Hearing Loss Prevention as Part of a Wellness Program," *Spectrum Suppl.* 1, 17, p. 22.
34. Merry, C. J. (1995). "Instilling a Safety Culture in the Workplace," in *Proceedings Hearing Conservation Conference III/XX*, edited by J. Franks and J. Casali, Natl. Hearing Conservation Assoc., Des Moines, IA, 86-92.
35. Merry, C. J. and Franks, J. R. (1995). "Historical Assessment and Future Directions in the Prevention of Occupational Hearing Loss," in *Occupational Medicine: State of the Art Reviews - Vol. 10, No. 3*, edited by T. C. Morata and D. E. Dunn, Hanley & Belfus, Inc., Philadelphia, PA, 669-681.
36. Merry, C. J. and Stephenson, M. R. (1999). "Reliability and Feasibility of Earplug Fit-Testing in the Real World," *Spectrum Suppl.* 1, 16, p. 21.
37. Michael, K. (1999). "Measurement of Insert-Type Hearing Protector Attenuation on the End-User: A Practical Alternative to Relying on the NRR," *Spectrum* 16(4), 13-17.
38. Nelson, D. A. and Cooper, B. A. (1998). "Auditory Demonstrations in Acoustics and Hearing Conservation," in *Proceedings of Noise-Con 98*, edited by J. S. Bolton and L. Mongeau, Noise Control Foundation, Poughkeepsie, NY, 45-48.
39. Niswender, M. E. (1980). "Making Good 'Cents' Out of Hearing Conservation," *Occup. Health Saf.*, March, 57-60.
40. Ohlin, D. (2000a). Personal communication re examples in military pamphlets.
41. Ohlin, D. (2000b). "Behavioral Obstacles to Marketing Hearing Conservation Programs," *Spectrum Suppl.* 1, 17, p. 17.
42. Petrakis, N. L. (2000). "Earmarks of Art History: Cerumen and Medieval Art," *Am. J. Otol.* 21(1), 5-8.
43. Royster, J. D. (2000). "Audiometric Monitoring Phase of the HCP," in *The Noise Manual, 5th Edition*, edited by E. H. Berger, L. H. Royster, J. D. Royster, D. P. Driscoll, and M. Layne, Am. Ind. Hyg. Assoc., Fairfax, VA, 455-516.
44. Royster, L. H. and Royster, J. D. (2000). "Education and Motivation," in *The Noise Manual, 5th Edition*, edited by E. H. Berger, L. H. Royster, J. D. Royster, D. P. Driscoll, and M. Layne, Am. Ind. Hyg. Assoc., Fairfax, VA, 245-278.
45. Sadler, O. W. and Montgomery, G. M. (1982). "The Application of Positive Practice Overcorrection to the Use of Hearing Protection," *Am. Ind. Hyg. Assoc. J.* 43(6), 451-454.
46. Schaefer, M. R. (1992). *A Sound Education, 100 Exercises in Listening and Sound-Making*, Arcana Editions, Indian River, Canada.
47. Schafer, R. M. (1993). *Voices of Tyranny, Temples of Silence*, Arcana Editions, Ontario, Canada.

48. Shaw, S. (1988). "Use of Workers as Educators in an Occupational Hearing Conservation Programme for a Heterogeneous Workforce," Proceedings of the Int. Conf. on Ergonomics Occup. Saf. and Health and the Environment, Chinese Society of Metals, Beijing, China, 1023-1035.
49. Slouka, M. (1999). "Listening for Silence, Notes on the Aural Life," *Harper's* 298(1787), 63-68.
50. Stapleton, L. and Royster, L. H. (1981). "Educational Programs for Hearing Conservation," in *Proceedings of Noise-Con 81*, edited by L. H. Royster, F. D. Hart, and N. D. Stewart, Noise Control Foundation, Poughkeepsie, NY, 153-156.
51. Stapleton, L. and Royster, L. H. (1985). "The Education Phase of the Hearing Conservation Program," *Sound and Vibration* 19(2), 29-31.
52. Stewart, A. P. (1985). "Protecting Workers from Noise-Induced Hearing Problems," *PIMA* 67(11), 32-35.
53. Stewart, A. P. (2000). "Program Overview and Administration" in *The Noise Manual, 5th Edition*, edited by E. H. Berger, L. H. Royster, J. D. Royster, D. P. Driscoll, and M. Layne, Am. Ind. Hyg. Assoc., Fairfax, VA, 149-164.
54. Sweeney, M. H., Fosbroke, D., Goldenhar, L. M., Jackson, L. L., Linch, K., Lushniak, B. D., Merry, C., Schneider, S., and Stephenson, M. (2000). "Health Consequences of Working in Construction - Noise-Induced Hearing Loss," in *Construction Safety and Health Management*, edited by R. Coble, J. Hinze, and T. C. Haupt, Prentice-Hall, Inc., Upper Saddle River, NJ, 219-222.
55. Wells, L. (2000). Personal communication.
56. Zohar, D. (1980). "Promoting the Use of Personal Protective Equipment by Behavior Modification Techniques," *J. Saf. Res.* 12(2), 78-85.
57. Zohar, D., Cohen, A., and Azar, N. (1980). "Promoting Increased Use of Ear Protectors in Noise Through Information Feedback," *Human Factors* 22(1), 69-79.