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Do auditory simulations of noise-induced hearing loss change young adults' attitudes towards noise exposure?

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USE OF THESIS

Do Auditory Simulations of Noise-Induced Hearing Loss Change Young Adults' Attitudes Towards Noise Exposure?

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Auditory Simulations of Noise-Induced Hearing Loss and Attitudes Towards Noise Exposure: A Review of the Literature

Claire Roockley

Abstract

Noise-induced hearing loss (NIHL), or hearing damage from regular exposure to loud noise, can profoundly affect a person's hearing capabilities and overall well-being. Many individuals continue to expose themselves to hazardous levels of noise, and, in turn, put themselves at risk of developing a NIHL. This review critically examines the existing literature presented on NIHL. Emphasis is placed on the increasing prevalence of NIHL in young adults from exposure to loud recreational noise. The effectiveness of current educational strategies that have been employed to reduce or prevent the occurrence of NIHL in this cohort is also examined. Research indicates that hearing conservation programs have generally been ineffective in encouraging healthier attitudes and behaviours towards the prevention of NIHL in young adults. Perhaps this is because most strategies have not allowed people to experience what a hearing loss feels and sounds like. A preliminary study by Brew (2005) investigated the effectiveness of audio simulations of hearing loss and tinnitus as a way to enhance the efficacy of an educational hearing campaign in young adults. Several methodological problems in the Brew (2005) study may have mitigated any significant improvements in participants' attitudes and behaviours. Given the potential benefits for audio simulations to convey a realistic experience of the dangers inherent with prolonged noise exposure, implications for future research are discussed.

Keywords: noise-induced hearing loss, young adults, hearing conservation programs, audio simulations.

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Introduction

Exposure to occupational and recreational noise can adversely affect a person's hearing, particularly if the exposure is prolonged and intense (Rabinowitz, 2000). Under these conditions, noise-induced hearing loss (NIHL), or hearing damage from regular exposure to loud noise, may develop, and can seriously affect a person's well-being (Clarke, 1992; Clarke & Bohne, 1999). NIHL is also frequently accompanied by the debilitating symptom of tinnitus, commonly described by sufferers as a persistent ringing, hissing, or buzzing sound in the ears (Rabinowitz, 2000; WorkCover, 1989).

Despite the dangers associated with excessive noise exposure, increasing numbers of people (particularly young adults) are sustaining NIHL from repeated exposure to loud recreational noise (Bistrup et al., 2002; Chung, Des Roches, Meunier, & Eavey, 2005; Folmer, Griest, & Martin, 2002). Unfortunately, educational hearing campaigns have generally been ineffective in encouraging attitudinal and behavioural changes towards the adoption of safer hearing practices amongst young adults (Crandell, Mills, & Gauthier, 2004; Dalton et al., 2001). This is because many hearing programs generally provide information that just describes the consequences of chronic noise exposure without allowing a person to actually "hear" what it would sound like to have a hearing loss.

An alternative approach that is only just beginning to be investigated as a way to augment the effectiveness of hearing campaigns are fear appeals. Fear appeals present information about health issues in a threatening manner to motivate people to engage in health protective behaviours (Beck & Frankel, 1981). One way information about the dangers of NIHL and tinnitus can be presented within a fear appeal context is via audio simulations of hearing loss and tinnitus. By presenting individuals with audio simulations, people may be more likely to experience a vivid, fearful, and real experience of what a hearing loss actually feels and sounds like compared to just

viewing visual information via a presentation that describes what a hearing loss sounds like (Crookall & Saunders, 1989; Munro, 1993).

This review critically examines the currently available literature on NIHL. Particular focus is placed upon the increasing prevalence of NIHL in the younger generation from exposure to sources of loud recreational noise, as well as an evaluation of the educational strategies that have been employed in attempts to reduce the prevalence of NIHL in this cohort. This review begins by defining NIHL, along with the many ways in which excessive noise exposure can deleteriously affect an individual's health and well-being. Following this, sources of loud noise (with particular emphasis on leisure sources of noise) capable of producing NIHL, are explored, with justification as to why the younger population is at increased risk of sustaining hearing damage. An evaluation of the effectiveness of educational hearing campaigns promoting safer hearing practices is presented, followed by a discussion of how fear appeals are often employed as a means to promote attitudinal and behavioural changes towards safer health practices. Finally, the use of audio simulations based on a fear appeal as an alternative approach for augmenting the effectiveness of hearing conservation messages is addressed.

What is Noise-Induced Hearing Loss?

The ear can be damaged by noise in two different ways, with the type of sensorineural damage caused being dependent upon the intensity and duration of the noise exposure (Bahadori & Bohne, 1993; Rabinowitz, 2000). High-intensity, short-duration noise levels exceeding 140 decibels (dB, a measure of a sound's intensity or loudness) can stretch and tear sensitive inner ear tissues and damage delicate ear structures within the cochlea, the hearing organ (Clarke, 1992; Clarke & Bohne, 1999). This damage is referred to as acoustic trauma, and occurs instantaneously following exposure to extremely loud noise (Rabinowitz, 2000). This, in turn, results in

individuals sustaining an immediate and permanent hearing loss (Clarke & Bohne, 1999).

Alternatively, hearing loss can also develop as a result of chronic exposure to less intense, yet still potentially hazardous noise levels ranging from 90-140 dB (Clarke, 1992). This type of damage is commonly referred to as NIHL. In contrast to acoustic trauma, NIHL evolves gradually over several years from regular exposure to loud noise equal to, or in excess of, 90 dB (Bahadori & Bohne, 1993; Rabinowitz, 2000). NIHL is also often accompanied by symptoms of tinnitus, commonly described as a persistent ringing, hissing, or buzzing sound in the ears (Rabinowitz, 2000; WorkCover, 1989). Due to the slow progression of this hearing disorder, NIHL proceeds in three successive stages. First, sensory hair cells lining the basilar membrane of the cochlea are damaged and eventually killed from prolonged exposure to excessive noise (Clarke, 1992; Clarke & Bohne, 1999). Second, following years of loud noise exposure, hearing loss in the high frequency range emerges, comparable to the sound produced by the pitch of a ringing telephone (Clarke & Bohne, 1999; Rabinowitz, 2000). Because this deficit does not directly affect speech comprehension, however, hearing loss at this stage often remains unnoticed (Clarke, 1992). With continued exposure, however, hearing loss eventually includes the lower frequencies vital for comprehending speech (Clarke & Bohne, 1999). It is only at this third and final stage, where more overt symptoms (such as communication problems) begin to emerge, that most individuals become aware of their condition along with the severity of the hearing loss that has been sustained (Clarke, 1992). By this stage, however, which is when medical intervention is usually sought, most of the damage caused is irreversible and beyond medical or surgical remedy (Dobie, 1995).

NIHL is defined as an insidious health condition (Meyer-Bisch, 1996). In other words, this type of hearing loss is characterized by an absence of overt short-term

symptoms like bleeding or pain to make sufferers aware of the damage that has been caused (Clarke & Bohne, 1999; Meyer-Bisch, 1996). Unfortunately, it is only until the condition has sufficiently evolved following several years of exposure that sufferers only begin to realize how prolonged exposure to loud noise has impacted upon their hearing and health. NIHL, therefore, is a concerning health issue that can adversely impact upon an individual's well-being in a number of profound ways. The specific ways in which prolonged exposure to loud noise can deleteriously affect one's hearing and functioning is considered next.

Effects of Noise-Induced Hearing Loss on Hearing and Well-Being

Repeated exposure to excessive noise has been found to contribute to a wide variety of health complications for individuals suffering from a NIHL (Bahadori & Bohne, 1993; Crandell et al., 2004). For example, because loud noise stresses the body, this can lead to a number of physiological alterations in bodily functioning (Patel, Witte, Zuckerman, & Murray-Johnson, 2001). Common physiological complaints that have been associated with a NIHL include increased heart rate and blood pressure, vertigo, hypertension, headaches, and muscular tension (Henderson, 2001; WorkCover, 1989). Loud noise exposure can also result in hearing complications from progressive damage to the delicate hearing structures located in the cochlea. For example, individuals with a hearing loss may experience tinnitus, hypersensitivity to sound, a feeling of "fullness" in the ears, or the perception of others speech as being muffled and far away (Bahadori & Bohne, 1993; WorkCover, 1989). Finally, NIHL can also profoundly accelerate the ear's natural ageing process (WorkCover, 1989). Hearing levels that would normally be experienced later on in life may actually occur 20-30 years earlier.

Impact of noise-induced hearing loss on adults. Hearing loss from loud noise exposure can also deleteriously affect an individual's psychological well-being and

emotional state of mind. A study investigating the prevalence of psychiatric disorders amongst a group of tinnitus patients reported that a significant proportion exhibited depressive (62%) or anxiety (45%) disorders as a side effect of persistent tinnitus (Zoger, Svedlund, & Holgers, 2001). Other psychological issues that can emerge as a result of NIHL include anger, irritability, reduced self-esteem, lack of confidence, and poor self-image (Henderson, 2001).

Research further indicates that a NIHL can significantly impair an individual's psychosocial functioning skills and their ability to interact with others. Hetu, Lalonde, and Getty (1987) identified several psychosocial disadvantages experienced within the family unit and in broader social contexts as a result of individuals having sustained occupational NIHL. Family tension caused by a loud TV, radio or voice, difficulties following conversations, pretending to understand or guessing the content of conversations, and constantly asking the speaker to repeat what was said were some of the most pertinent social difficulties reported by the hearing impaired (Hetu et al., 1987). NIHL, therefore, not only effects people suffering from a hearing loss, but can also create a source of frustration and conflict for those continuously interacting with the hearing impaired. Moreover, many people with a hearing loss report high incidences of isolation and withdrawal from social activities due to difficulties engaging in, and maintaining conversations with others (Hallberg & Barrenas, 1995; Patel et al., 2001).

Finally, hearing loss has been shown to impair an employee's work-related performance (Henderson, 2001). Research demonstrates that a NIHL can significantly reduce productivity levels and job satisfaction, increases absenteeism rates and work-related accidents, impairs accuracy and precision skills, and increases fatigue (Henderson, 2001; WorkCover, 1989). On a cognitive level, short-term memory deficits, difficulties recalling the order of events, and an inability to focus on a number

of simultaneous tasks have also been associated with a NIHL, as well as contributing towards reduced workplace performance (Henderson, 2001).

Impact of noise-induced hearing loss on children. NIHL can adversely affect the health and functioning of children and adolescents exposed to excessive noise levels. Specifically, hearing loss has been found to impact upon children's cognitive, attentional, and motivational processing abilities (Bistrup et al., 2002). For example, young children exposed to dangerous noise levels can exhibit delays in the acquisition of reading skills and poor language development (Bistrup et al., 2002; Haller & Montgomery, 2004). Hearing loss can also significantly impair a child's memory, particularly long-term memory for complex, semantic material, which is memory for general knowledge and information (Bistrup et al., 2002; Reed, 2004). Associations between excessive noise exposure and attentional deficits, including poor visual search performance and impaired functioning on auditory discrimination tasks requiring children to detect differences between similar sounding words have also been recognized (Bistrup et al., 2002). Finally, children with a NIHL are more likely to be less motivated and task oriented in achievement situations where task performance requires high levels of persistence and attentional control (Bistrup et al., 2002).

Such potentially widespread impairments in cognitive functioning can profoundly affect a child's education and their ability to interact with others (Haller & Montgomery, 2004). Bess, Dodd-Murphy, and Parker (1998) found that children with minimal sensorineural hearing loss exhibited significantly lower scores on tests of basic academic and communication skills compared to their normal hearing peers. Furthermore, the children with a hearing loss displayed more behavioural problems, difficulties socializing, and lower self-esteem compared to classmates with normal hearing (Bess et al., 1998). As a consequence, employment prospects for young people with hearing impairments are often limited due to underdeveloped scholarly and

communication skills (Furlonger, 1998; Punch, Hyde, & Creed, 2004). Furlonger (1998) reported that young high school adolescents with a hearing loss tended to show lower levels of career maturity, career awareness, and career decision-making skills compared to normal hearing adolescents. Unfortunately, this tends to result in many hearing impaired individuals being employed in unskilled or semiskilled jobs, placing them at increased risk of unemployment or underemployment (Punch et al., 2004).

Despite the many adverse effects excessive noise exposure can have on an individual's health, NIHL is virtually 100% preventable through the use of appropriate hearing protection, eliminating or lowering chronic noise levels, and reducing one's exposure time to loud noise (Clarke & Bohne, 1999; Dobie, 1995; Rabinowitz, 2000). Irrespective of this, many people are still hazardously exposing themselves to dangerous levels of noise, particularly as a result of engaging in recreational activities capable of excessive noise. The following section provides an exploration of the sources of recreational noise capable of producing a NIHL.

Sources of Excessive Noise Capable of Noise-Induced Hearing Loss

For centuries, hearing loss from prolonged exposure to loud noise has long been associated with industrial or occupational activities (Clarke & Bohne, 1999; Dalton et al., 2001; Mostafapour, Lahargoue, & Gates, 1998). It is well documented that many workers employed in manufacturing, mining, construction, and agriculture are exposed on a daily basis to sound levels in excess of 100dB (Bahadori & Bohne, 1993; Patel et al., 2001). In turn, this places these individuals at significant risk of a NIHL if appropriate hearing protection devices are not used (Patel et al., 2001). The potential for hearing damage, however, is not only limited to excessive noise exposure within the industrial sector. In recent years, increasing attention is now beginning to focus on sources of non occupational or leisure noise from recreational activities and devices capable of producing hazardous noise levels equivalent to, and sometimes in excess of

those experienced in the workplace (Bahadori & Bohne, 1993; Dalton et al., 2001; Mostafapour et al., 1998; Niskar et al., 2001).

Sources of recreational noise that have been identified as being capable of producing dangerous levels of noise include amplified music, firearms, recreational vehicles, power tools, and various children's toys (Haller & Montgomery, 2004). For example, sound levels from listening to music through personal stereos such as Walkmans, iPods, car stereos, and CD players can reach in excess of 100 dB, especially with the use of in-the-ear earphones that pump sound directly to the eardrum of the wearer (Brookhouser, Worthington, & Kelly, 1992; Clarke, 1992). Similarly, sound exposures at nightclubs, discos, and rock concerts have been found to average between 100-115 dB, with peak sound levels of up to 124 dB being measured (Bray, Szymanski, & Mills, 2004; Meyer-Bisch, 1996). Studies of temporary threshold shifts (or changes in the threshold at which a person hears sound) indicate that, following attendance at a concert, many listeners sustain temporary threshold shifts equivalent to a 30 dB hearing loss (Clarke & Bohne, 1999). For a person with normal hearing, a 30 dB hearing loss is equivalent to trying to hear sound with earplugs in the ears. Consequently, it can take hours to days for a person's hearing to fully recover following such a significant change in one's hearing threshold (Clarke, 1992). Recreational vehicles like motorcycles, motorboats and racing cars, as well as power tools including lawnmowers and chainsaws are also capable of producing hazardous noise levels ranging from 90-110 dB (Brookhouser et al., 1992). Alarmingly, firearms and various children's toys have been found to produce the most dangerous exposure levels. Gunfire from rifles and shotguns can range from 132-170 dB, whilst children's squeaky toys, toy weapons, and firecrackers situated within close proximity to a child's ear can produce sound levels up to 150 dB (Brookhouser et al., 1992; Chung et al., 2005; Clarke, 1992). This consequently places individuals regularly exposed to excessive levels of leisure noise at

significant risk of a NIHL, particularly as recent advancements in technology are making recreational activities and devices more appealing, stimulating, and therefore, increasingly popular.

Why the Younger Population is at Increased Risk of Noise-Induced Hearing Loss

Given that exposure to these sources of recreational noise has significantly increased in prevalence within the younger population over the last few decades, these cohorts are at an increased risk of sustaining hearing damage (Bistrup et al., 2002). Research by Bistrup et al. (2002), Chung et al. (2005) and Niskar et al. (2001) provide evidence that the number of children, adolescents, and young adults diagnosed with a NIHL has increased profoundly over the last 20-30 years. Furthermore, hearing impairments in these cohorts have been directly attributable to excessive noise exposure from participation in noisy leisure activities (Bistrup et al., 2002; Chung et al., 2005).

The danger of recreational noise impacting upon the hearing of young adults has been extensively investigated. Meyer-Bisch (1996) evaluated the hearing damage sustained by 1364 young individuals as a result of exposure to loud amplified music. It was found that subjects who regularly and intensively listened to personal cassette players for more than seven hours a week exhibited significantly greater signs of auditory suffering (e.g., tinnitus and hearing fatigue), as well as higher rates of hearing loss compared to matched controls (Meyer-Bisch, 1996). Similar results were obtained for subjects who attended rock concerts at least twice a month, with those having attended discos at least once a month demonstrating significantly more signs of auditory suffering compared to matched controls (Meyer-Bisch, 1996). In a study investigating the association between leisure noise exposure and hearing loss, Dalton et al. (2001) discovered significantly higher rates of hearing loss amongst individuals who regularly engaged in noisy recreational activities such as woodworking, driving a noisy

recreational vehicle, and doing yard work with power tools compared to individuals who did not engage in noisy leisure activities. Brookhouser et al. (1992) also found that amongst a sample of 114 children and adolescents diagnosed with a NIHL, the most frequently cited sources of noise that contributed towards this sample's hearing loss were from riding with a parent on a recreational vehicle, accompanying parents to shooting ranges, listening to loud music, and assisting parents in the home workshop.

Although prolonged exposure to loud amplified music has been identified as a noise source capable of NIHL, coupled with music listening becoming the most popular noise intensive leisure activity engaged in by young people, studies investigating listening habits have generally found that most listeners select safe sound levels below 90 dB (Bistrup et al., 2002; Brookhouser et al., 1992; Clarke, 1992; Meyer-Bisch, 1996). Only a minority (approximately 5-10%) prefer to listen to music at dangerous levels above 100 dB over extended periods of time (Clarke, 1992; Meyer-Bisch, 1996). Although the risk of developing a NIHL from exposure to loud music appears to be limited to a small proportion of individuals, many other young people who listen to music within safe limits can still be at risk of hearing damage if exposed to other multiple sources of noise. Given that a substantial proportion of the younger population participate in multiple noisy leisure activities supplementary to exposure to loud music, the side effects of such repeated exposures progressively accumulate over time. This consequently places a significant proportion of young people at heightened risk of developing permanent hearing damage.

Taken together, these findings indicate that regular exposure to loud leisure noise significantly enhances an individual's risk of sustaining a NIHL. This is particularly evident in regards to the younger population, as exposure to noisy leisure activities has substantially increased in prevalence over the decades. The detrimental effects of a NIHL and ways to protect one's hearing, therefore, are issues that need to

be brought to the forefront of this cohort's attention. One way this has been addressed is through the development of educational hearing programs, designed to inform the public about the dangers of excessive noise exposure as well as strategies to encourage the adoption of safer hearing practices (Dalton et al., 2001; Haller & Montgomery, 2004). The effectiveness of these programs is examined next.

Effectiveness of Hearing Conservation Programs

Increasing people's knowledge about the health risks associated with engaging in health-threatening behaviours is regarded as a vital strategy among health care professionals in encouraging people to adopt more health protective behaviours (Caltabiano & Sarafino, 2002). Given the increasing rates of NIHL within the younger population, these individuals need to be provided with educational information that emphasizes the dangers chronic noise exposure can have on one's hearing and health. The most frequently used and well-recognized strategy for achieving this has been through the use of hearing conservation programs, designed to reduce and prevent the incidence of NIHL in the wider community (Crandell et al., 2004; Folmer et al., 2002). Typically, hearing conservation messages are presented in the form of lectures, handouts, brochures, or slide-show presentations, with high emphasis placed upon presenting information via a visual format. Hearing programs generally provide information about how the auditory system works and how vulnerable hearing mechanisms are to damage from loud noise (Folmer et al., 2002). Hearing programs also educate people about the dangers of prolonged exposure to loud noise, as well as specific sources of loud noise capable of potential hearing damage (Crandell et al., 2004). Noise safe strategies further constitute a central component to any hearing campaign, and often include encouraging people to eliminate or reduce noise levels; reducing exposure times to noise; suggesting that people attending concerts or any other loud leisure activity avoid exposure to other sources of noise on the same day;

and where noise cannot be avoided, wearing appropriate hearing protection such as earplugs or earmuffs (Clarke & Bohne, 1999). These strategies are based on research indicating that avoiding or minimizing exposure to excessive noise, as well as following episodes of loud noise exposure with periods of rest to allow hearing mechanisms to recover can significantly reduce the onset of a NIHL, or prevent damage that has already occurred progressing any further (Bahadori & Bohne, 1993; Clarke & Bohne, 1999; Rabinowitz, 2000).

In attempts to reduce and prevent the incidence of NIHL within the younger population, the effectiveness of hearing conservation programs being able to enhance people's knowledge about NIHL and encourage the adoption of safer hearing practices has been extensively explored. Despite such efforts, hearing campaigns have generally been unable to encourage safer listening habits in young adults. For example, Crandell et al. (2004) explored the knowledge, behaviours, and attitudes of 200 university students aged 18-29 years in relation to hearing loss, noise, and use of hearing protection. It was found that irrespective of considerable knowledge about the effects noise can have on the auditory system (e.g., 85% knew that there was no cure for a hearing loss, and 95% were aware that excessive noise exposure at any age can lead to hearing damage), the majority of students surveyed indicated a lack of the use of safe hearing practices when exposed to loud noise (Crandell et al., 2004). Remarkably, although 70% of students correctly indicated that the best way to protect one's hearing is through the use of hearing protection devices, 72% reported that they never wore hearing protection when exposed to loud noise (Crandell et al., 2004). Research conducted on high school students has also raised similar findings. Lass et al. (1987) and Lewis (1989) found that after students participated in an educational hearing conservation program, knowledge pertaining to the effects noise exposure can have on one's hearing significantly improved compared to pre-test responses. Yet, despite the

students' increased awareness about NIHL following a hearing campaign, only a minority (19.5% from the Lewis, (1989) study and 24% from the Lass et al., (1987) study) indicated they would use hearing protection against loud noise in the future. Finally, research by Bray et al. (2004) revealed that of a group of 23 young disc jockeys (DJs), only 13% indicated the use of appropriate hearing protection during work despite the majority of the DJs sampled indicating concerns about the risk of sustaining hearing damage from exposure to loud noise. Overall, it appears that regardless of many young adults demonstrating an improved knowledge base of noise and hearing loss following a hearing campaign, this is failing to translate into the adoption of appropriate hearing conservation strategies. Reasons for these somewhat paradoxical findings are addressed in the following section.

Explaining Attitudes Towards Noise-Induced Hearing Loss

Several explanations have been proposed to account for why young people continue to exhibit unsafe hearing practices and negative attitudes towards hearing conservation despite demonstrating considerable knowledge about the effects noise can have on one's hearing. First, it has been suggested that these health trends may be partially accounted for by the insidious nature underlying NIHL (Clarke & Bohne, 1999). In most cases, NIHL involves no overt short-term symptoms like bleeding or pain to make people aware of the damage that can be caused from ongoing exposure to loud noise (Clarke & Bohne, 1999). Where early warning signs do occur, such as temporary threshold shifts, tinnitus, or "fullness" in the ears, these symptoms usually subside within a few hours to a few days following a period of rest from loud noise (Bahadori & Bohne, 1993). Yet, even if an individual repeatedly experiences these temporary symptoms, the detrimental affects of these warning signs often do not manifest and become evident until several years later (Chung et al., 2005; Meyer-Bisch, 1996). These insidious characteristics underlying NIHL may have inadvertently

instilled the misperception that the transient warning signs that arise in response to excessive noise exposure are somewhat less severe and serious compared to other health issues with more immediate and life-threatening consequences (Chung et al., 2005; Crandell et al., 2004). It may be, therefore, that people tend not to take these warning signs seriously as they usually disappear within a short period of time. This, in turn, may account for why hearing conservation programs have been ineffective in fostering safer hearing practices within the younger population.

Another explanation that has been posited centres on the beliefs and values shared amongst many adolescents and young adults. Geller (2003) suggested that within the younger population, there is the general belief that injury or disease only occurs to older people or to other young adults besides themselves. These perceptions of invincibility, invulnerability, and the belief that "it will never happen to me" may have instilled in this cohort the belief that loud noise exposure will have few (if any) long-term personal consequences on their hearing and health due to a perceived lack of risk and susceptibility. These values, which are strongest amongst the youth, may further help explain a reduced need to use hearing protection and a general non adoption of safer listening habits amongst the younger population.

Lastly, though perhaps most importantly, it has been proposed that the ineffectiveness of current hearing campaigns may be associated with the way that information is typically provided, usually via brochures or presentations that contain visual and verbal information that just *describes* what a hearing loss is and sounds like. A reliance on such strategies has subsequently meant that individuals have generally not been provided with the opportunity to *experience* first hand what a hearing loss actually sounds like or fully appreciate the impact a hearing loss can have on one's health and well-being (Chung et al., 2005). Moreover, many people may not actually know what tinnitus is or sounds like. Without these experiences, as well as the fact that

a NIHL is an auditory disorder, it appears that current hearing campaigns may not be presenting information about the dangers prolonged noise exposure can have on one's hearing in the most effective manner. This, therefore, may provide another possible explanation as to why hearing conservation programs have been ineffective in fostering attitudinal and behavioural changes towards the prevention of NIHL in young adults.

Limitations of Hearing Conservation Programs

In light of the findings that have been presented in regards to the efficacy of hearing conservation programs, it seems apparent that these campaigns have only been effective to a certain degree. This is because although hearing campaigns have demonstrated the ability to enhance people's knowledge and awareness about a NIHL, it seems that this increased knowledge is generally not translating into behavioural changes towards the adoption of safer hearing practices or more positive attitudes towards the prevention of NIHL (Crandell et al., 2004; Lass et al., 1987; Lewis, 1989). This is of concern given the dangerous recreational noise levels young people are increasingly exposing themselves to, as well as the inconsistent use of appropriate hearing protection. Given the reliance on the use of visual and verbal information to educate people about a NIHL, along with the potential limitations these strategies present, it is clear that other strategies need to be implemented as a way to augment the persuasiveness and saliency of hearing campaigns encouraging safer hearing practices amongst the younger population. One such strategy that has been suggested for achieving this within the persuasive communication literature is through fear appeals.

Use of Fear Appeals to Promote Attitude and Behaviour Change

When designing health promotion messages, there are several ways in which information about a health issue can be presented in a persuasive and influential manner (Hale & Dillard, 1995). One of the most popular and widespread persuasive communication strategies that has been used in health promotion programs are fear-

arousing communication messages, or fear appeals (Hale & Dillard, 1995; Witte, 1998). This is because one of the primary goals of any health promotion campaign being able to influence and persuade changes in people's health-related behaviours is to present information depicting the threatening and adverse consequences that are likely to arise if recommended health protective behaviours are not followed (Beck & Frankel, 1981).

Fear appeals have been extensively used throughout history as a medium for influencing people's health-related attitudes and behaviours (Green & Witte, 2006). Specifically, fear appeals are persuasive messages that present information about a particular health issue in a threatening manner to make susceptible individuals more aware of the harmful health outcomes that are likely to occur if message recommendations are not followed (Geller, 2003; Witte & Allen, 2000). When a person is informed about a threat, this usually evokes feelings of fear and apprehension in response to that threat. As a result of feeling fearful, people tend to become motivated to engage in behaviours that will eliminate the possibility of a threat occurring. It has been argued that in absence of knowledge pertaining to the fearful health risks associated with engaging in detrimental health behaviours, the potential dangers posed to one's health often go unnoticed or ignored, thereby resulting in individuals failing to take appropriate action (Beck & Frankel, 1981; Smalec & Klingle, 2000).

Extensive research has been conducted on fear appeals. This has primarily focused on the development of several theories and models to help explain people's responses and reactions to threatening information, the effectiveness of fear appeals as a medium for influencing changes in people's health-related behaviours, as well as the amount of fear required to motivate individuals to comply with recommended health messages (Beck & Frankel, 1981; Witte, 1998). Unfortunately, a comprehensive review of the fear appeal literature is beyond the purpose of this literature review. Instead,

readers are referred to Beck and Frankel (1981), Higbee (1969), Witte (1998), and Witte and Allen (2000) for detailed discussions on the effectiveness of fear appeals. To summarize, a broad investigation of the fear appeal research consistently indicates that fear-arousing messages are powerful and persuasive mediums for facilitating attitudinal and behavioural change across a variety of public health issues, especially when such messages incorporate two key components (Caltabiano & Sarafino, 2002; Green & Witte, 2006; Witte & Allen, 2000). The first is a threat component, primarily intended to arouse the emotion of fear as a way to motivate people to adopt more health protective behaviours and attitudes (Geller, 2003; Hale & Dillard, 1995). To achieve this motivational state, threat components typically emphasize the seriousness and severity of the harmful consequences that are likely to occur if individuals fail to adhere to message recommendations, and also personalize the risk and harm associated with a threat to make individuals feel personally vulnerable and susceptible to the negative health consequences that are being presented in the health message (Geller, 2003; Hale & Dillard, 1995; Witte, 1998). The second main component that defines an effective fear appeal is an action component, designed to convince people that actively following message recommendations are easily achievable and worthwhile (Geller, 2003; Hale & Dillard, 1995). To achieve such beliefs, action components tend to instill perceptions of self-efficacy, which is a person's belief that he or she is capable of performing the recommended responses being advocated in the health message, as well as perceptions of response-efficacy, which refer to a person's beliefs about the effectiveness of a health messages' recommendations being able to successfully avert a threat occurring (Geller, 2003; Hale & Dillard, 1995; Witte, 1998).

The efficacy of fear appeals incorporating threat and action components has been investigated by Witte and Allen (2000), who conducted an extensive meta-analysis on approximately 100 fear appeal studies. As a result of this research, it was

found that the stronger the fear aroused by a fear appeal, the more persuasive the fear appeal was in fostering greater attitudinal, intentional, and behavioural changes (Witte & Allen, 2000). Furthermore, fear appeals that utilized stronger threat components reported greater attitude, intention, and behaviour change, but only when accompanied by strong action components (Witte & Allen, 2000). In other words, fear appeals that instilled higher perceived susceptibility and severity perceptions towards a threat were found to greatly increase people's motivation to process and adopt message recommendations, though only when perceptions of self-efficacy and response-efficacy were high. This is because when individuals feel highly susceptible to a serious threat, people are more likely to demonstrate attitude and behaviour change when they perceive message recommendations to be personally achievable as well as being effective in averting a threat occurring (Green & Witte, 2006). Conversely, fear appeals that arouse high levels of fear but low perceived efficacy expectations tend to evoke maladaptive responses such as defense avoidance or denial, particularly when individuals perceive message recommendations as being non effective and personally unachievable (Witte & Allen, 2000). Similar results have also been replicated in other meta-analyses conducted by Witte (1993), thereby reinforcing the important role fear appeals have in influencing changes in people's health-related attitudes and behaviours when perceptions of severity, vulnerability, and efficacy are high.

Examples of fear appeals promoting safer health practices. In light of these findings, fear appeals have been extensively used as a medium for encouraging safer health practices towards a variety of public health issues (Witte & Allen, 2000). For example, persuasive communication messages have been employed to encourage smoking cessation (Hill & Carroll, 2003; White, Tan, Wakefield, & Hill, 2003), skin cancer prevention (Kubiak, 2003; Mahler, Kulik, Gerrard, & Gibbons, 2007), and safer driving habits (Griffeth & Rogers, 1976; Sutton & Hallett, 1989) to name but a few.

Outcomes obtained by these studies indicate that among individuals exposed to highly threatening information pertaining to the health risks associated with engaging in detrimental health behaviours, greater attitudinal and behavioural change towards the adoption of recommended health strategies were demonstrated compared to those presented with non fearful information (Griffeth & Rogers, 1976; Kubiak, 2003; Mahler et al., 2007; White et al., 2003). To achieve these reactions, researchers typically present graphic visual information in the form of pictures or film clips in conjunction with an educational message to enhance perceptions of severity and vulnerability. This is ultimately intended to arouse and elicit a strong, negative visceral response towards a particular threat. For example, QUIT smoking campaigns such as the Australian National Tobacco Campaign initiated in 1997-2000 used a series of graphic television advertisements to illustrate the damage smoking causes to the human body (Hill & Carroll, 2003). Similarly, safer driving campaigns have aroused fear towards the risks associated with dangerous driving by presenting target audiences with graphic visual imagery of car wrecks and injuries sustained by road trauma victims (Griffeth & Rogers, 1976). Finally, recent studies on skin cancer prevention have used vivid photoaging images (photographs that show the cumulative effects of sun exposure, like wrinkles and age spots, not normally visible with the naked eye) as a way of illustrating the dangers associated with prolonged exposure to excessive ultraviolet radiation (Kubiak, 2003; Mahler et al., 2007).

It is apparent that in these as well as many other fear appeal studies, placing high emphasis on the use of fearful visual and graphic imagery to supplement educational health messages has shown to be an appropriate and persuasive medium for emphasizing the negative health outcomes associated with a variety of detrimental health behaviours. With regards to a hearing loss, however, which is an auditory disorder, presenting individuals with a fearful visual experience of a hearing loss to

increase the persuasiveness of a hearing message may not provide the most effective means for fostering attitude and behaviour change. This is because people are unlikely to fully experience what a hearing loss is along with the effects it can have on one's hearing and health when presented via a visual medium, such as an audiogram (a graph that shows a person's level of hearing loss for different sounds at specific frequencies), or photographs showing microscopic damage to the cochlea. Unfortunately, there has been an over reliance on the use of these strategies in hearing conservation programs, which may help account for why current hearing campaigns have been unable to encourage safer hearing practices and more positive attitudes towards NIHL in young adults. As such, an investigation of alternative fear-arousing methods to the use of visual media as a means to increase the effectiveness of educational hearing messages is of paramount importance. One alternative strategy that has been suggested as a way to potentially address this issue is to present individuals with fear-arousing audio simulations of hearing loss and tinnitus.

Use of Audio Simulations of Noise-Induced Hearing Loss in a Hearing Campaign

Over the years, increasing attention has been directed towards the use of simulation as an innovative and powerful tool in the study of a range of phenomena including conflict management, inter-group relations, decision making, and cultural values (Crookall & Saunders, 1989). Simulations have also become highly recognized as an important component in the fields of education (e.g., as an experiential study aid), training (e.g., as a professional training instrument), and research (Crookall & Saunders, 1989). Simulations can be broadly defined as being representations of some 'real world' event or system, and are frequently demonstrated in the form of simulated games, role plays, or computer models (Crookall & Saunders, 1989). Importantly, although simulations are primarily intended to recreate and imitate some real world event, simulations often provide participants with a very 'real' and vivid experience of

a somewhat unreal event. As such, several advantages have been posited in regards to the use of simulations as a medium for encouraging effective and purposive learning. For example, simulations have been found to be highly motivating; they can enhance performance and retention of material; they can foster a greater understanding of complex issues by broadening and deepening individuals' experiences, perceptions, and interpretations of real world events; and they can allow events that can not be immediately experienced in the real world to be made more readily experienced through the aid of simulation (Crookall & Saunders, 1989; Munro, 1993).

One way simulations can be used as a strategy to augment the persuasiveness of a hearing campaign is to present individuals with fear-arousing audio simulations of hearing loss and tinnitus. Audio simulations consist of audio samples of common sounds, such as music and dialogue, digitally altered to simulate a hearing loss (Moore, 1997). This can be demonstrated by playing a short segment of music or dialogue at a normal decibel range (i.e., approximately 65 dB, which is the level of a typical conservation without background noise), followed immediately by another short segment of music or dialogue but with a simulated 30 dB reduction in volume. Niskar et al. (2001) indicated that a 16 to 25 dB hearing loss represents slight hearing damage, a 26 to 40 dB hearing loss represents mild hearing damage, and a 40 dB or higher hearing loss represents moderate to severe hearing damage. By contrasting differences between the intensity of sound at a normal decibel range versus a simulated 30 dB hearing loss, for example, individuals would be able to directly experience and appreciate what their hearing would sound like with no hearing damage versus how their hearing would be affected if they suffered from a mild hearing loss. Likewise, tinnitus can be simulated by playing short segments of various tinnitus sounds (e.g., filtered pure-tone signals) found to be frequently associated with a hearing loss.

A number of advantages are apparent in regards to the use of fear-arousing audio simulations as an alternative strategy to enhance the effectiveness of hearing campaigns. First, NIHL simulations can provide individuals with a more vivid, fearful, and most importantly 'real' experience of what a hearing loss actually feels and sounds like, along with a greater appreciation of the devastating affects loud noise exposure can have on a person's hearing (Moore, 1997). Second, Bistrup et al. (2002) suggested that because audio media (e.g., audio simulations) have the capacity to deliver sound, they provide an excellent medium for illustrating to people what they would actually be hearing (or not hearing) if they suffered from a hearing loss. Third, given that NIHL is an insidious condition that takes several years to manifest and surface, simulations can help people experience the effects of a hearing loss more immediately, thereby making individuals more aware of the potentially devastating affects surrounding this hearing disorder. Taken together, it is reasonable to conclude that a hearing campaign incorporating fearful audio simulations has the potential to provide target audiences with a more motivating and persuasive learning experience regarding the dangers associated with loud noise exposure.

Preliminary Evidence of Audio Simulations as a Strategy to Enhance a Hearing Campaign

Despite the effectiveness of fear appeals as a medium for facilitating attitude and behaviour change, coupled with the potential for audio simulations providing an innovative and interesting means for educating people about a NIHL, only one study has attempted to explore the efficacy of audio simulations as a strategy for encouraging safer hearing practices in young people. A preliminary study of a fear appeal as an alternative medium for enhancing the efficacy of a hearing conservation message was conducted by Brew (2005) on young university students. Brew (2005) investigated the effectiveness of an educational hearing message augmented by a fear appeal consisting

of audio simulations of hearing loss and tinnitus. Brew (2005) hypothesized that fear-arousing simulations in conjunction with an educational hearing campaign would enhance the effectiveness and persuasiveness of an educational hearing message by broadening and deepening participants' experiences and interpretations of what a hearing loss actually sounds like along with the adverse effects loud noise exposure can have on a person's hearing. It was anticipated that this would result in greater improvements in participants' intentions to change listen habits, motivations to protect against excessive noise, attitudes towards loud noise exposure, and fears regarding exposure to loud noise compared to an educational hearing message without simulations. The overall results indicated that the inclusion of audio simulations with a hearing conservation message did not have any significant effects on enhancing participants' behaviours and attitudes towards NIHL compared to an educational hearing message without simulations. Only significant improvements for the Simulation-Plus-Education group were found for the dependent variable measuring intentions to change listening habits compared to the Education-Only group. No other significant differences were found between the Simulation-Plus-Education group compared to the Education-Only group for the other three dependent variables.

Unfortunately, Brew's (2005) nonsignificant findings were most likely attributed to several methodological flaws inherent within the study's design. First, the settings in which testing took place may have severely compromised attainment of the anticipated outcomes. Because the audio simulations were presented to participants in a large lecture theatre, the sound acoustics of the auditorium may have dissipated the persuasive impact of the simulations throughout the room. Furthermore, as testing was conducted in a large auditorium, this allowed the opportunity for large groups of students ranging in size from 30-70 to be tested at any one time. Although the benefits of recruiting a significant sample size abound from such a testing method, factors

inherent within group settings such as talking amongst individuals along with the subsequent distractions and ambient noise generated may have masked the intended effects of the audio simulations.

Second, the delivery method of the simulations may have also profoundly impacted upon the results obtained. In particular, the audio simulations were presented to large groups of participants via free-field audio equipment (i.e., an amplifier and speakers) situated within a lecture theatre. Given that audio simulations are most effective and optimally heard when presented directly to individuals one at a time under conditions free of distractions (i.e., through headphones), a lack of the use of such strategies may also help account for why the simulations may not have been presented in the most optimal manner, and hence had little impact on altering participants' behaviours and attitudes.

Third, the fact that the presentations were visually and graphically over stimulating and engaging may have further contributed towards Brew's (2005) non significant findings. Considerable effort was invested into making each of the presentations highly interesting and appealing through the use of strong contrasting colours, flashing words, fade-in and fade-outs, blinking arrows, high quality pictures, and comical cartoon caricatures. While slide-show presentations often incorporate some degree of creativity and novelty to engage their target audiences, the overuse of these techniques may have inadvertently distracted people's attention away from the intended persuasive effects of the audio simulations. Altogether, these uncontrolled extraneous factors meant that the simulations of hearing loss and tinnitus could not be heard clearly, and, as such, may not have provided an ideal environment conducive to testing. It is likely, therefore, that these factors (and not limitations in the actual audio simulations as an educational medium per se) may have mitigated the effectiveness of

the fear appeal enhancing participants' attitudes towards NIHL and behaviours regarding the adoption of safer hearing practices.

Summary and Future Research Directions

In light of the literature reviewed, large numbers of young adults are at significant risk of NIHL from exposure to loud recreational noise. As a result, many attempts have been made by educational programs to encourage safer listening habits in young people. Unfortunately, hearing campaigns have generally been ineffective in promoting attitude and behaviour change towards the prevention of NIHL in this cohort. Similar outcomes were also obtained by Brew (2005), though mainly as a result of methodological limitations. Given the potential for audio simulations providing an innovative and influential means for augmenting the effectiveness of educational hearing messages, considerable potential awaits for future research in this area. In particular, if Brew's (2005) design limitations can be addressed, such as testing individuals on a one-to-one basis, or perhaps presenting the audio simulations in a more direct and uninterrupted manner (i.e., via headphones), these design improvements may enhance the efficacy of the audio simulations fostering greater improvements in young adults' attitudes and behaviours towards NIHL. Also, a qualitative design that more specifically explores young people's attitudes, experiences, perceptions, and feelings regarding noise and hearing loss could shed valuable insight into understanding current attitudes and behaviours in this cohort, as well as providing directions for areas of improvement. Ultimately, enhancing the effectiveness of hearing campaigns via an auditory medium that allows individuals to better appreciate what a hearing loss actually feels and sounds like may provide the critical step necessary towards reducing the prevalence of NIHL in the community.

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Do Auditory Simulations of Noise-Induced Hearing Loss Change Young Adults' Attitudes Towards Noise Exposure?

Claire Roockley

Abstract

Brew (2005) investigated the effectiveness of audio simulations of hearing loss and tinnitus as a strategy for promoting healthier attitudes and behaviours towards noise-induced hearing loss (NIHL) in young adults. Several methodological problems in Brew's (2005) study may have mitigated any significant improvements being found in participants' attitudes and behaviours. This study addressed these limitations to examine whether audio simulations together with an educational hearing message are more effective in improving young adults' attitudes, motivations, intentions, and fears towards NIHL compared to an education-only message without simulations. In Experiment 1, forty-five participants were randomly assigned to a Simulation, Education, or Control presentation. Participants completed a survey exploring their attitudes and behaviours towards NIHL pre- and post-presentation. An ANOVA conducted on the data revealed no significant improvements in the Simulation groups' motivations, attitudes, intentions, and fears towards NIHL compared to the Education group, though the results were in the anticipated direction. However, potential limitations regarding the insensitivity of the Likert scale used to measure changes in people's responses may have mitigated any significant effects being found. The purpose of Experiment 2 was to employ a more sensitive measurement procedure for directly comparing the effectiveness of the Simulation versus the Education group. Ten different participants viewed both the Simulation and Education presentations, followed by completing a survey asking which presentation was more effective. Chi-square analyses conducted on the data found that a significant proportion (90%) of participants selected the Simulation presentation as being more effective in improving their motivations, attitudes, intentions, and fears towards NIHL compared to the Education presentation. The results confirmed the effectiveness of including audio simulations as an alternative educational strategy for significantly augmenting the persuasiveness of a hearing conservation message.

Keywords: noise-induced hearing loss, young adults, hearing conservation programs, audio simulations.

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Introduction

Exposure to noise can adversely affect a person's hearing, especially if the exposure is prolonged and intense (Rabinowitz, 2000). Noise-induced hearing loss (NIHL), or hearing damage from regular exposure to loud noise, can also seriously affect a person's well-being (Clarke, 1992; Clarke & Bohne, 1999). NIHL is frequently accompanied by the debilitating symptom of tinnitus, described as a persistent ringing, hissing, or buzzing sound in the ears (Rabinowitz, 2000; WorkCover, 1989).

Despite the dangers associated with excessive noise exposure, large numbers of young adults sustain NIHL from repeated exposure to loud recreational noise (Bistrup et al., 2002; Chung, Des Roches, Meunier, & Eavey, 2005; Folmer, Griest, & Martin, 2002). Unfortunately, educational hearing campaigns have generally been ineffective in encouraging safer hearing practices and attitudes amongst young adults (Crandell, Mills, & Gauthier, 2004; Dalton et al., 2001). This is because many hearing programs generally provide information that just describes the consequences of chronic noise exposure without allowing a person to actually "hear" what it would sound like to have a hearing loss.

An alternative approach, which augments the effectiveness of hearing campaigns, is through the inclusion of fear-arousing audio simulations of hearing loss and tinnitus. Audio simulations consist of samples of common sounds, such as music and dialogue, digitally altered to simulate a hearing loss (Moore, 1997). By presenting individuals with audio simulations, people may be more likely to experience a vivid, fearful, and real experience of what a hearing loss actually feels and sounds like compared to just viewing materials from an information-based campaign (Crookall & Saunders, 1989; Munro, 1993).

The aim of the present study was to test the effectiveness of audio simulations of hearing loss and tinnitus based on a fear appeal as an alternative method for

augmenting the efficacy of an educational hearing program. By combining audio simulations with an educational hearing message, it is anticipated that participants who experience the combined presentation will demonstrate greater attitudinal and behavioural changes towards the adoption of safer hearing practices compared to control groups who do not listen to the audio simulations. The report briefly reviews the literature that has been presented on NIHL. Particular emphasis is placed on the increasing prevalence of NIHL in young adults from exposure to loud leisure noise, as well as an evaluation of the educational strategies that have been employed in attempts to reduce the occurrence of NIHL in this cohort. The use of audio simulations as an innovative and persuasive means for augmenting the effectiveness of educational hearing programs is also examined.

What is Noise-Induced Hearing Loss?

NIHL is a specific type of hearing damage that evolves gradually over several years from regular exposure to loud noise in excess of 90 decibels (dB, a measure of a sounds intensity) (Bahadori & Bohne, 1993; Rabinowitz, 2000). NIHL is often accompanied by symptoms of tinnitus, commonly described as a persistent ringing, hissing, or buzzing sound in the ears (WorkCover, 1989). The development of NIHL proceeds in three successive stages. First, sensory hair cells in the cochlea are progressively damaged from prolonged noise exposure (Clarke, 1992). Second, following years of loud noise exposure, hearing loss in the high frequency range emerges, though usually remains unnoticed as this deficit does not directly affect speech comprehension (Clarke, 1992). With continued exposure, hearing loss eventually includes the lower frequencies vital for comprehending speech (Clarke & Bohne, 1999). It is only at this final stage, where more overt symptoms such as communication problems begin to emerge, that individuals become aware of their condition (Clarke, 1992). NIHL, therefore, is defined as an insidious health condition

as it is characterized by an absence of overt short-term symptoms like bleeding or pain to make sufferers aware of the damage that has been caused (Clarke & Bohne, 1999; Meyer-Bisch, 1996). By the time people become aware of their condition, most of the damage caused is irreversible and beyond medical or surgical remedy (Dobie, 1995).

General Effects of Noise-Induced Hearing Loss on Hearing and Well-Being

Repeated exposure to excessive noise can contribute to a variety of health complications (Bahadori & Bohne, 1993; Crandell et al., 2004). For example, because loud noise stresses the body, this can lead to several physiological issues such as increased heart rate and blood pressure, vertigo, hypertension, headaches, and muscular tension (Henderson, 2001; Patel, Witte, Zuckerman, & Murray-Johnson, 2001). Chronic exposure to loud noise can also result in hearing complications, resulting from damage to the delicate hearing structures in the cochlea. For example, individuals with a hearing loss may experience tinnitus, hypersensitivity to sound, or a feeling of "fullness" in the ears (Bahadori & Bohne, 1993).

Impact of noise-induced hearing loss on adults. NIHL can deleteriously affect an individual's psychological well-being. It has been found that individuals suffering from a NIHL can experience depression, anxiety, anger, irritability, reduced self-esteem, and poor self-image (Henderson, 2001; Zoger, Svedlund, & Holgers, 2001). NIHL can also impair an individual's psychosocial functioning skills. Family tension caused by a loud TV or voice, difficulties engaging in and following conversations with others, social isolation, and withdrawal have been identified as some of the most commonly experienced social difficulties reported by the hearing impaired (Hallberg & Barrenas, 1995; Hetu, Lalonde, & Getty, 1987; Patel et al., 2001). Research also demonstrates that a NIHL can impair an employee's work-related performance by reducing productivity levels, increasing work-related accidents, impairing accuracy and precision skills, and increasing fatigue (Henderson, 2001). Finally, NIHL can also

profoundly accelerate the ear's natural ageing process. Hearing levels that would normally be experienced later on in life may actually occur 20-30 years earlier (WorkCover, 1989).

Despite the many adverse effects excessive noise exposure can have on an individual's health, many people are still exposing themselves to dangerous levels of noise. This is particularly as a result of engaging in recreational activities capable of excessive noise levels. The following section briefly provides an exploration of the sources of recreational noise capable of producing a NIHL.

Sources of Excessive Noise Capable of Noise-Induced Hearing Loss

For centuries, hearing loss from exposure to loud noise has long been associated with industrial or occupational activities (Clarke & Bohne, 1999; Dalton et al., 2001; Mostafapour, Lahargoue, & Gates, 1998). A more alarming concern in recent years now centres on sources of hazardous noise levels from everyday recreational activities (Dalton et al., 2001; Mostafapour et al., 1998; Niskar et al., 2001). For example, music from personal stereos (e.g., iPods and Walkmans), CD players, nightclubs and concerts, as well as recreational vehicles like motorboats and motorcycles, power tools, firearms, and various children's toys are all capable of producing noise exposure levels in excess of 100dB (Bray, Szymanski, & Mills, 2004; Brookhouser, Worthington, & Kelly, 1992; Clarke, 1992; Haller & Montgomery, 2004; Sataloff & Sataloff, 2006).

Why the Younger Population is at Increased Risk of Noise-Induced Hearing Loss

Given that exposure to these sources of recreational noise has increased in prevalence within the younger population over the last few decades, these cohorts are at an increased risk of sustaining hearing damage (Bistrup et al., 2002). Research by Bistrup et al. (2002), Chung et al. (2005) and Niskar et al. (2001) provide evidence that the number of children, adolescents, and young adults diagnosed with a NIHL has increased profoundly over the last 20-30 years. Furthermore, hearing impairments in

these cohorts have been directly attributable to excessive noise exposure from participation in noisy leisure activities (Bistrup et al., 2002; Chung et al., 2005). For example, Meyer-Bisch (1996) found that among young individuals who regularly and intensively listened to personal cassette players for more than seven hours a week, or attended discos at least once a month, higher rates of hearing loss were found compared to matched controls. Similarly, Dalton et al. (2001) discovered higher rates of hearing loss among individuals who regularly engaged in woodworking, driving a noisy recreational vehicle, and using power tools compared to individuals who did not engage in such noisy leisure activities. Brookhouser et al. (1992) also found that the most frequently cited sources of noise engaged in by a group of young children with a NIHL were from riding a recreational vehicle, accompanying parents to shooting ranges, and listening to loud music.

Given that a substantial proportion of the younger population participates in multiple noisy leisure activities, many young adults are at risk of developing hearing damage. The detrimental effects of a NIHL and ways to protect one's hearing, therefore, are issues that need to be brought to the forefront of this cohort's attention in an informative and meaningful way. One way this has been addressed is through the development of education-based hearing conservation programs (Dalton et al., 2001; Haller & Montgomery, 2004).

Effectiveness of Hearing Conservation Programs

A widely recognized strategy for educating the public about the dangers of a NIHL has been through the use of hearing conservation programs (Crandell et al., 2004; Folmer et al., 2002). Hearing programs provide information about how the auditory system works and how vulnerable hearing mechanisms are to damage from loud noise (Folmer et al., 2002). Hearing programs also educate people about the dangers of loud noise exposure, as well as sources of noise capable of hearing damage

(Crandell et al., 2004). Hearing conservation strategies are also addressed, and often include encouraging people to eliminate or lower noise levels; reducing exposure times to noise; and, where noise cannot be avoided, wearing appropriate hearing protection (Clarke & Bohne, 1999).

The effectiveness of hearing programs encouraging healthier attitudes and behaviours has been extensively evaluated. Despite such efforts, hearing campaigns have generally been unable to encourage safer listening habits in young adults. For example, Crandell et al. (2004) discovered that despite young university students demonstrating considerable knowledge about noise and hearing loss, the majority indicated that they failed to use hearing protection when exposed to loud noise. Similarly, research on high school students found that only a minority intended to use hearing protection against loud noise in the future despite demonstrating an improved knowledge base about NIHL following a hearing program (Lass et al., 1987; Lewis, 1989). Finally, Bray et al. (2004) revealed that many young disc jockeys did not use hearing protection during work despite many indicating concerns about the risk of sustaining hearing damage from loud noise exposure.

Explaining Attitudes Towards Noise-Induced Hearing Loss

Several explanations have been proposed to account for why young people continue to exhibit unsafe hearing practices and negative attitudes towards hearing conservation despite demonstrating considerable knowledge about NIHL. First, the insidious nature of a NIHL means that there are no overt short-term symptoms to make people aware of the damage that can be caused from exposure to loud noise (Clarke & Bohne, 1999). Where early warning signs do occur, such as tinnitus or “fullness” in the ears, these symptoms usually subside within hours to days (Bahadori & Bohne, 1993). Furthermore, the detrimental effect of persistent tinnitus often does not manifest until several years later (Chung et al., 2005). These insidious characteristics may have

inadvertently instilled the misperception that the transient warning signs that arise in response to excessive noise exposure are somewhat less severe and serious compared to other health issues with more immediate and life threatening consequences (Chung et al., 2005; Crandell et al., 2004).

Another explanation centres on the beliefs and values shared amongst younger adults. Geller (2003) suggested that within the younger population, there is the general belief that injury or disease only occurs to older people or to other young adults besides themselves. These perceptions of invincibility and invulnerability may have instilled in this cohort the belief that loud noise exposure will have few (if any) long-term personal consequences on their hearing and health due to a perceived lack of risk and susceptibility.

Lastly, it has been proposed that the ineffectiveness of hearing campaigns may be associated with the way that the information is typically provided, usually via brochures or presentations that contain visual and verbal information that just *describes* what a hearing loss is and sounds like. A reliance on such strategies has meant that individuals have generally not been provided with the opportunity to *experience* first hand what a hearing loss actually feels and sounds like (Chung et al., 2005). Without these experiences, it appears that current hearing campaigns may not be presenting information about the dangers noise exposure can have on one's hearing in the most effective manner.

Limitations of Hearing Conservation Programs

Although hearing campaigns have demonstrated the ability to enhance people's knowledge about NIHL, it seems that this increased knowledge is not translating into attitudinal and behavioural changes towards the adoption of safer hearing practices (Crandell et al., 2004; Lass et al., 1987; Lewis, 1989). This is of concern given the dangerous recreational noise levels young people are increasingly exposing themselves

to, as well as the inconsistent use of hearing protection. It is clear that other strategies need to be implemented to augment the effectiveness of educational hearing campaigns encouraging safer hearing practices and more positive attitudes towards hearing conservation within the younger population. One strategy that has been suggested for achieving this is through fear appeals.

Use of Fear Appeals to Promote Attitude and Behaviour Change

Fear appeals have been extensively used throughout history as a medium for influencing appropriate changes in people's health-related attitudes and behaviours (Green & Witte, 2006; Witte, 1993). This is because one of the primary goals of any health promotion campaign that is able to foster changes in people's health-related behaviours is to present information depicting the adverse consequences that are likely to arise if recommended health protective behaviours are not followed (Beck & Frankel, 1981). Fear appeals are persuasive messages that present information about a health issue in a threatening manner to motivate people to engage in health protective behaviours (Caltabiano & Sarafino, 2002). It has been argued that in absence of knowledge pertaining to the health risks associated with detrimental health behaviours, the potential dangers posed to one's health often go unnoticed or ignored, thus resulting in individuals failing to take appropriate action (Beck & Frankel, 1981; Smalec & Klingle, 2000).

Extensive research has been conducted on the effectiveness of fear appeals. Readers are referred to Beck and Frankel (1981), Higbee (1969), Witte (1998), and Witte and Allen (2000) for a detailed discussion of the fear appeal literature. To summarise, a broad investigation of the fear appeal research consistently indicates that fear-arousing messages are powerful and persuasive mediums for facilitating attitudinal and behavioural change across a variety of public health issues (Caltabiano & Sarafino, 2002; Green & Witte, 2006; Witte & Allen, 2000). Research indicates that the stronger

the fear aroused by a fear appeal, the more persuasive the fear appeal was in fostering greater attitudinal, intentional, and behavioural change (Witte & Allen, 2000). Furthermore, fear appeals that instilled higher perceived susceptibility and severity perceptions reported greater attitude, intention, and behaviour change, but only when accompanied by strong perceptions of self-efficacy and response-efficacy (Witte & Allen, 2000). This is because when individuals feel highly susceptible to a serious threat, people are more likely to demonstrate attitude and behaviour change when they perceive message recommendations to be personally achievable, as well as being effective in averting a threat (Green & Witte, 2006).

Examples of fear appeals promoting safer health practices. Fear appeals have been widely used to encourage safer health practices towards a variety of public health issues including smoking cessation (Hill & Carroll, 2003; White, Tan, Wakefield, & Hill, 2003), skin cancer prevention (Kubiak, 2003; Mahler, Kulik, Gerrard, & Gibbons, 2007), and safer driving habits (Griffeth & Rogers, 1976; Sutton & Hallett, 1989) to name but a few. To achieve behavioural and attitudinal change, researchers typically present graphic visual information in conjunction with an educational message to elicit a strong, negative visceral response towards a threat. Australian QUIT smoking campaigns used a series of graphic television advertisements to illustrate the damage smoking causes to the human body (Hill & Carroll, 2003). Safer driving campaigns have aroused fear towards dangerous driving by presenting audiences with graphic imagery of car wrecks and injuries sustained by road trauma victims (Griffeth & Rogers, 1976). Finally, studies on skin cancer prevention have used vivid photoaging images (photographs that show the cumulative effects of sun exposure, like wrinkles and age spots) to illustrate the dangers associated with prolonged exposure to ultraviolet radiation (Kubiak, 2003; Mahler et al., 2007).

On the basis of the fear appeal research, fear-arousing messages can provide a powerful and effective means for promoting appropriate changes in people's health-related attitudes and behaviours. In particular, placing high emphasis on the use of fearful visual imagery to supplement educational health messages has shown to be a persuasive medium for emphasizing the negative outcomes associated with a variety of detrimental health behaviours. With regards to a hearing loss, however, presenting individuals with a fearful visual experience of a hearing loss to increase the persuasiveness of a hearing message may not provide the most effective means for fostering attitude and behaviour change. This is because people are unlikely to fully experience what a hearing loss is and sounds like when presented via a visual medium, such as an audiogram (a graph that shows a person's level of hearing loss for different sounds at specific frequencies), or photographs showing microscopic damage to the cochlea. Unfortunately, there has been an over reliance on the use of these strategies in hearing conservation programs, which may account for why hearing campaigns have been unable to encourage healthier attitudes and behaviours towards NIHL in the younger population. An investigation of alternative fear-arousing methods to the use of visual media to increase the effectiveness of educational hearing messages is of paramount importance. One strategy that has been suggested to potentially address this issue is to present individuals with fear-arousing audio simulations of hearing loss and tinnitus.

Use of Audio Simulations of Noise-Induced Hearing Loss in a Hearing Campaign

Over the years, increasing attention has been directed towards the use of simulation as an innovative and powerful tool in the study of a diverse range of phenomena (Crookall & Saunders, 1989). Simulations can be broadly defined as being representations of some real world event (Crookall & Saunders, 1989). Several advantages have been posited in regards to the use of simulations as a medium for

encouraging effective and purposive learning. For example, simulations can be highly motivating; they can broaden and deepen an individuals' experiences and interpretations of real world events; they can provide participants with a very 'real' experience of a somewhat unreal event; and they can allow events that cannot be immediately experienced in the real world to be made more readily experienced through the aid of simulation (Crookall & Saunders, 1989; Munro, 1993).

One way simulations can be used as a strategy to augment the persuasiveness of a hearing campaign is to present individuals with fear-arousing audio simulations of hearing loss and tinnitus. Audio simulations consist of samples of common sounds, such as music and dialogue, digitally altered to simulate a hearing loss (Moore, 1997). This can be demonstrated by playing a short segment of music or dialogue at a normal decibel range (i.e., approximately 65 dB, which is the level of a typical conversation without background noise), followed by another short segment of music or dialogue but with a simulated reduction in volume. By contrasting differences between the intensity of sound at a normal decibel range versus a simulated hearing loss, individuals would be able to directly experience and appreciate what their hearing would sound like with no hearing damage versus how their hearing would be affected if they suffered from a hearing loss. Likewise, tinnitus can be simulated by playing short segments of tinnitus sounds (e.g., filtered pure-tone signals) found to be frequently associated with a hearing loss.

Several advantages are apparent in regards to the use of audio simulations as an alternative strategy for enhancing the effectiveness of hearing campaigns. First, NIHL simulations can provide individuals with a more vivid, fearful, and 'real' experience of what a hearing loss feels and sounds like, along with a greater appreciation of the devastating effects loud noise exposure can have on a person's hearing (Moore, 1997). Second, Bistrup et al. (2002) suggested that audio simulations can provide an excellent

medium for illustrating to people what they would actually be hearing (or not hearing) if they suffered from a hearing loss. Third, given that NIHL is an insidious condition that takes several years to manifest, simulations can help people experience a NIHL more immediately. Finally, presenting individuals with fearful simulations of a NIHL can disabuse individuals of the misperceived idea that the transient warning signs that arise as a result of prolonged exposure to loud noise (e.g., tinnitus) are harmless and not as severe as other health conditions with more life threatening consequences.

Preliminary Evidence of Audio Simulations as a Strategy to Enhance a Hearing Campaign

Despite the potential for audio simulations providing an innovative and interesting means for educating people about a NIHL, only one study has attempted to explore the efficacy of audio simulations as an alternative strategy for enhancing a hearing conservation message. Brew (2005) investigated the effectiveness of an educational hearing message augmented by a fear appeal consisting of audio simulations of hearing loss and tinnitus among young university students. Brew hypothesized that fear-arousing simulations in conjunction with an educational hearing campaign would enhance the effectiveness and persuasiveness of an educational hearing message by allowing people to hear what a hearing loss actually feels and sounds like. It was anticipated that this would result in greater improvements in participants' intentions to change listen habits, motivations to protect against excessive noise, attitudes towards loud noise exposure, and fears regarding exposure to loud noise compared to an educational hearing message without simulations. The overall results indicated that the inclusion of audio simulations with a hearing message did not have any significant effects on enhancing participants' behaviours and attitudes towards NIHL compared to an educational hearing message without simulations.

Unfortunately, Brew's (2005) nonsignificant findings can most likely be attributed to several methodological flaws inherent within the study's design. First, the settings in which testing took place may have severely compromised attainment of the anticipated outcomes. Sataloff and Sataloff (2006) suggested that presenting audio-based simulations in a large room can negatively impact upon a simulation's sound properties. For example, reflection, reverberation, and absorption properties of a room (which are a pronounced feature of lecture theatres), the dimensions of a room, as well as the distances between the sound source and listeners can profoundly affect the volume (and, hence, the effectiveness) of the simulations (Sataloff & Sataloff, 2006). Given, therefore, that the audio simulations were presented to participants in a large lecture theatre, the sound acoustics of the auditorium coupled with the displacement of participants throughout the theatre may have dissipated and altered the persuasive impact of the simulations throughout the room. Furthermore, as testing was conducted in a large auditorium, this allowed the opportunity for large groups of students ranging in size from 30-70 to be tested at any one time. Although the benefits of recruiting a significant sample size abound from such a testing method, factors characteristic of group settings such as talking amongst individuals along with the subsequent distractions and ambient noise generated may have masked the intended effects of the audio simulations.

Second, the delivery method of the simulations may have also profoundly impacted upon Brew's (2005) results. In particular, the audio simulations were presented to large groups of participants via free-field audio equipment (i.e., an amplifier and speakers) situated within a lecture theatre. Given that audio simulations are more optimally heard when presented directly to individuals one at a time under conditions free of distractions (i.e., through headphones in a quiet room), a lack of the

use of such strategies in Brew's (2005) study may help account for why the simulations had little impact on altering participants' behaviours and attitudes.

Third, the fact that the presentations were visually and graphically over stimulating and engaging may have further contributed towards Brew's (2005) nonsignificant findings. Considerable effort was invested into making each presentation highly interesting and appealing through the use of strong contrasting colours, flashing words, fade-in and fade-outs, high quality pictures, and comical cartoon caricatures. While slide-show presentations often incorporate some degree of creativity and novelty to engage their target audiences, the overuse of these techniques may have inadvertently distracted people's attention away from the intended persuasive effects of the audio simulations. Altogether, these uncontrolled extraneous factors meant that the simulations of hearing loss and tinnitus could not be heard clearly, and, as such, may not have provided an ideal environment conducive to testing (Sataloff & Sataloff, 2006). It is likely, therefore, that these factors (and not limitations in the actual audio simulations as an educational medium per se) may have mitigated the effectiveness of the fear appeal enhancing participants' attitudes and behaviours towards the adoption of safer hearing practices.

Purpose of the Study and Hypothesis

Many young adults are at significant risk of developing a NIHL from exposure to loud recreational noise. To little avail, educational hearing campaigns have generally been ineffective in encouraging healthier attitudes and behaviours towards the prevention of NIHL in this cohort. Brew (2005) attempted to address this issue by investigating the use of audio simulations of hearing loss and tinnitus as an alternative strategy to augment the effectiveness of an educational hearing campaign. Unfortunately, several methodological limitations in Brew's (2005) study may have mitigated the effectiveness of the simulations enhancing participants' attitudes and

behaviours towards NIHL. Despite Brew's (2005) nonsignificant findings, it is still highly probable that a hearing campaign incorporating fearful audio simulations has the potential to provide audiences with a more motivating and persuasive learning experience about NIHL compared to an educational hearing message that just describes what a hearing loss is and sounds like. This is particularly likely if the shortcomings associated with the design and testing procedures used in Brew's (2005) study can be addressed to optimize the potentiality of the simulations having a more persuasive and influential impact on individuals' attitudes and behaviours towards the prevention of NIHL.

This study was designed to replicate Brew's (2005) research to examine whether audio simulations based on a fear appeal in conjunction with a hearing conservation message was more effective in improving young adults' attitudes and behaviours towards NIHL compared to an educational hearing message without simulations, though with particular attention to addressing the methodological limitations inherent within Brew's study. To enhance the effectiveness of an educational hearing campaign incorporating audio simulations of hearing loss and tinnitus, simulations were presented directly to each relevant participant on an individual basis in a quiet, distraction-free testing environment via headphones. This methodology was based on the idea that audio simulations are optimally heard and more fully appreciated when delivered to individuals under conditions free of distractions. Headphones also provide a direct means for presenting the simulations to participants, and also aid in blocking out any ambient sound. It was hypothesized that an educational hearing campaign that incorporated audio simulations of hearing loss and tinnitus would enhance the persuasiveness of the hearing conservation message, thereby resulting in greater improvements in participants' intentions to change listening habits, attitudes towards excessive noise exposure, motivations to protect against loud

noise, and fears regarding overexposure to loud noise compared to an educational hearing message without simulations.

Experiment 1

Method

Participants

Forty-five young adults participated in the study. The sample comprised 8 males and 37 females, all with self-reported normal hearing. Participants' ages ranged from 18 to 27 years ($M = 22.29$, $SD = 2.55$). Participants were randomly assigned to one of three conditions: a Simulation-Plus-Education (Simulation) group (n = 21), an Education-Only (Education) group (n = 19), or a Control group (n = 5).

Design

The study involved a pre- versus post-test randomized control trial. The between groups independent variable ('Presentation Group') consisted of three levels: a Simulation group, an Education group, and a Control group. Four primary dependent variables were measured: 'Intention to change listening habits,' 'Attitude towards excessive noise exposure,' 'Motivation to protect against excessive noise,' and 'Fear regarding overexposure to loud noise.' Each dependent variable was measured pre-presentation (Time-1) and post-presentation (Time-2).

Materials

Powerpoint slide-show presentations. Three PowerPoint slide-show presentations were developed. Information presented in the Simulation and Education presentations were designed to provide participants with information relating to hearing loss, noise, and tinnitus. A slide-show was also developed for the Control group, which provided general health information. As a way of making the presentations less stimulating and engaging (an issue previously identified as a potential methodological flaw in Brew's (2005) study), several alterations to the presentations were made. This

involved the removal of all pictures, graphics, and technical slide-show effects including flashing words, fading, and dissolving visual effects inherent in Brew's (2005) PowerPoint presentations. Text, when used, was presented on neutral background colours. The PowerPoint presentations are appended in the CD-ROM in Appendix A.

The Simulation presentation consisted of a health-based message focusing on the issues of noise and hearing loss. This information was presented visually using text. Specific issues addressed throughout the presentation included an introduction of noise as a normal aspect of daily functioning; common sources of noise capable of hazardous sound levels; epidemiological facts on NIHL; an explanation of how loud noise has to be to be regarded as hazardous; the effects noise can have on a person's physical, psychological, social, and occupational functioning; common warning signs that indicate excessive noise exposure has occurred; and recommendations people are advised to follow in order to preserve their hearing. In addition to this information, the Simulation presentation also included a series of audio simulations delivered via headphones interspersed at relevant times throughout the presentation to illustrate the harmful effects a NIHL and tinnitus can have on a person's hearing. A total of 14 audio simulations were used, ranging in duration from 10 to 20 seconds each (lasting 2 minutes and 40 seconds in total). Ten of the audio simulations illustrated a NIHL, and four simulations represented symptoms of tinnitus (see Appendix B for a list of the audio simulations included in the Simulation presentation). The NIHL simulations consisted of a series of audio tracks containing samples of male dialogue, female dialogue, and popular music. Two tracks depicted what a person's hearing would sound like with normal (undamaged) hearing, three tracks illustrated how a person's hearing would be affected if they had a hearing loss, and five tracks juxtaposed normal hearing followed by a hearing loss. The hearing loss audio tracks were filtered at 30 and 40 dB,

representing a mild hearing loss. The tinnitus simulations consisted of samples of different tinnitus sounds with narrowband noise at 2 kHz and 4 kHz, broadband high frequency noise, and a 4 kHz tone. The Simulation presentation lasted 9 minutes, and contained 57 slides.

The Education presentation consisted of the same health-based educational message on noise and hearing loss as the Simulation presentation. However, no audio simulations were included in the Education presentation. The Education presentation lasted 5 minutes and 30 seconds, and contained 38 slides.

The Control presentation provided general health information regarding how to live a happy and healthy lifestyle. Emphasis was placed on good lifestyle habits as a way of extending overall well-being, youthfulness, and vitality. For example, a segment on maintaining physical well-being suggested the importance of a balanced diet, regular sleep, and regular exercise. The importance of psychological well-being focused on limiting stress, controlling anger and anxiety, encouraged mental stimulation, and intellectual growth. Limiting excess consumption of alcohol, drugs, and food was also addressed. Only one slide referred to the dangers of noise with the message "In order to maintain good health, it is important to avoid loud noises." No audio simulations were included in the Control presentation, which lasted 6 minutes, and contained 47 slides.

Questionnaires and measure of dependent variables. Four dependent variables were used to measure participants' responses towards a NIHL. These dependent variables measured participants' intentions to modify engaging in a risky behaviour, attitudes towards a threat, level of motivation to avoid a threat, and level of fear relating to a threat. To assess participants' current attitudes, motivations, intentions, and fears towards NIHL prior to viewing their respective slide-show (Time-1), a pre-presentation survey (Noise Survey-1) was administered. Participants were

asked to respond to a series of statements using a 5-point Likert scale (see Appendix C). To measure 'Intention to change listening habits,' participants were asked "At this present time, how strong is your intention to change your current noise exposure habits?" Responses ranged from *Not at all strong* (1) to *Very strong* (5). To measure 'Attitudes towards excessive noise exposure,' participants were asked to respond to the statement "At this present time, how strongly do you feel that reducing your exposure to noise is a sensible thing to do?" Responses ranged from *Not at all strong* (1) to *Very strong* (5). To measure 'Motivation to protect against excessive noise,' participants were asked "At this present time, how strongly do you feel the need to reduce the amount of noise you are exposed to?" Responses ranged from *No need at all* (1) to *A very strong need* (5). To measure level of 'Fear regarding overexposure to loud noise,' participants were asked to respond to the statement "At this present time, how fearful do you feel about being overexposed to loud noise?" Responses ranged from *Not fearful at all* (1) to *Extremely fearful* (5).

To assess the effects of the three presentations on participants' attitudes, intentions, motivations, and fears towards NIHL (Time-2), a post-presentation survey (Noise Survey-2) was administered. Participants were asked to respond to a series of statements using a 5-point Likert scale (see Appendix D). To measure 'Intention to change listening habits,' participants were asked "After viewing the presentation, how strong is your intention to change your current noise exposure habits?" Responses ranged from *Not at all strong* (1) to *Very strong* (5). To measure 'Attitudes towards excessive noise exposure,' participants were asked to respond to the statement "After viewing the presentation, how strongly do you feel that reducing your exposure to noise is a sensible thing to do?" Responses ranged from *Not at all strong* (1) to *Very strong* (5). To measure 'Motivation to protect against excessive noise,' participants were asked "After viewing the presentation, how strongly do you feel the need to reduce the

amount of noise you are exposed to?" Responses ranged from *No need at all* (1) to *A very strong need* (5). To measure level of 'Fear regarding overexposure to loud noise,' participants were asked to respond to the statement "After viewing the presentation, how fearful do you feel about being overexposed to loud noise?" Responses ranged from *Not fearful at all* (1) to *Extremely fearful* (5). After completing these questions, participants were then asked to complete four demographic questions pertaining to date of birth, gender, main language spoken at home, and highest level of education completed.

Stimuli and Apparatus

The slide-show presentations were viewed by participants on an IBM PC. The audio simulations were presented via Sennheiser HD 260 headphones. The level of volume used was approximately 60-65 dB SPL, equal to the level of a typical conservation without background noise.

Procedure

Each participant was randomly assigned to one of three slide-show presentation groups: a Simulation group, an Education group, or a Control group. Participants were provided with an information sheet outlining the details of the study, as well as a consent form (see Appendix E). Participants were then asked to complete the Noise Survey-1 prior to viewing their respective slide-show. Following completion of the first survey, participants then viewed their respective slide-show presentation one at a time on an allocated computer in a small, quiet, computer laboratory. All participants (including those in the Education and Control groups) were required to wear headphones throughout their presentation as a means to block out ambient sound, and to minimize any background distractions. This aided in maintaining consistency and comparability between the three presentation groups. For participants who viewed the Simulation presentation, the audio simulations were presented directly to each

participant individually at relevant times throughout the slide-show via headphones. The use of headphones provided a direct and uninterrupted means for presenting the simulations to participants. These testing procedures were adopted to maximize the clarity and persuasiveness of the audio simulations, designed as methodological improvements upon the testing procedures used by Brew (2005). After viewing their respective slide-show, participants were then asked to complete the Noise Survey-2.

Results

Baseline Information

A one-way between groups analysis of variance (ANOVA) was conducted on the pre-scores obtained for each dependent variable ('Motivation to protect against excessive noise,' 'Attitudes towards excessive noise exposure,' 'Intention to change listening habits,' and 'Fears regarding overexposure to loud noise') measured at Time-1 for the Simulation, Education, and Control groups. This analysis was performed to identify whether any significant differences existed between the three presentation groups on each of the dependent variables prior to viewing the slide-show presentations. The raw data for each participant upon which analyses in Experiment 1 are based are appended in Appendix F. Data screening indicated normally distributed samples with no outliers. The scores for one case from the Simulation group were removed as responses to some questions were incomplete. Assumption testing for each ANOVA was deemed satisfactory, with the alpha level set at .05. Mean scores for Time-1 are presented in Table 1. Results of the analyses conducted on each dependent variable are provided in the following section (statistical output is appended in the CD-ROM in Appendix A).

Table 1

Mean Scores and Standard Deviations for the Four Dependent Variables Measured Pre-Presentation (Time-1) For the Three Presentation Groups

Dependent Variable		Simulation Group	Education Group	Control Group
Motivation				
	M	1.99	2.38	1.73
	SD	0.82	1.04	0.41
Attitude				
	M	2.72	3.04	2.54
	SD	0.93	1.18	0.98
Intention				
	M	1.75	1.81	1.52
	SD	0.55	0.73	0.69
Fear				
	M	2.08	2.17	1.87
	SD	0.66	0.99	0.83

Note. The range of values for Motivation, Attitude, Intention, and Fear is between 1-5.

Motivation to protect against excessive noise. In response to the statement "At this present time, how strongly do you feel the need to reduce the amount of noise you are exposed to?," results at Time-1 indicated no significant differences between the three presentation groups, $F(2, 41) = 1.45, p > .05$.

Attitude towards excessive noise exposure. In response to the statement "At this present time, how strongly do you feel that reducing your exposure to noise is a sensible thing to do?," results at Time-1 indicated no significant differences between the three presentation groups, $F(2, 41) = 0.69, p > .05$.

Intention to change listening habits. In response to the statement "At this present time, how strong is your intention to change your current noise exposure habits?," results at Time-1 indicated no significant differences between the three presentation groups, $F(2, 41) = 0.38, p > .05$.

Fear regarding overexposure to loud noise. In response to the statement "At this present time, how fearful do you feel about being overexposed to loud noise?,"

results at Time-1 indicated no significant differences between the three presentation groups, $F(2, 41) = 0.26, p > .05$.

Taken together, these baseline results indicate that there were no statistically significant differences between the Simulation, Education, and Control groups on any of the dependent variables prior to the slide-show presentations. This indicates that the presentation groups did not differ significantly in their pre-scores measuring motivations, attitudes, intentions, and fears towards NIHL.

Experimental Effects of 'Presentation Group' on Dependent Variables

To determine whether the three levels of the independent variable ('Presentation Group') had a significant effect on altering participants' responses, mean-difference scores (*Md*) between Time-1 (pre-presentation scores) and Time-2 (post-presentation scores) were calculated. Individuals' Noise Survey-1 (Time-1) scores were subtracted from the Noise Survey-2 (Time-2) scores to create four new dependent variables (Motivation difference score, Attitude difference score, Intention difference score, and Fear difference score) that represented the experimental effects of the independent variable. Data screening of the pre- and post-scores upon which the mean-difference scores were calculated indicated non-normal distributions with outliers. Outlying cases were replaced with respective group means. Re-analysis of the results indicated that the transformed data had no significant effect on the outcomes obtained compared to the initial analysis performed on the original data. All of the original data was, therefore, retained except for one case from the Simulation group that had to be removed due to incomplete responses on some questions.

A one-way between groups ANOVA was conducted on the mean-difference scores calculated for each new dependent variable (Motivation difference score, Attitude difference score, Intention difference score, and Fear difference score) for the

Simulation, Education, and Control groups [1]. Assumption testing for each ANOVA was deemed satisfactory, with the alpha level set at .05. Mean-difference scores are presented in Table 2. The results of the analyses performed on each dependent variable are discussed in the following section (statistical output is appended in the CD-ROM in Appendix A).

Table 2

Mean-Difference Scores and Standard Deviations for the Four Dependent Variables Obtained for the Three Presentation Groups Post-Presentation (Time-2)

Dependent Variable		Simulation Group	Education Group	Control Group
Motivation				
Difference	*M*	1.41	1.22	0.58
	SD	0.56	0.92	0.61
Attitude				
Difference	*M*	1.33	1.01	0.10
	SD	0.80	1.16	1.28
Intention				
Difference	*M*	1.53	1.13	0.37
	SD	0.72	0.71	0.48
Fear				
Difference	*M*	1.34	0.94	0.32
	SD	0.95	0.69	0.40

Motivation to protect against excessive noise. An ANOVA conducted on the mean-difference scores for the dependent variable measuring motivations indicated no statistically significant differences between the three presentation groups, $F(2, 41)$ =

[1] A Multivariate Analysis of Variance (MANOVA) performed on the dependent variables revealed similar results to those produced by the ANOVA (see Appendix A).

2.47, $p > .05$. The highest mean motivation difference score was obtained for the Simulation group ($Md = 1.41$), followed by the Education group ($Md = 1.22$), and finally the Control group ($Md = 0.58$).

Attitude towards excessive noise exposure. An ANOVA performed on the mean-difference scores for the dependent variable measuring attitudes indicated no statistically significant differences between the three presentation groups, $F(2, 41) = 2.89$, $p > .05$. The highest mean attitude difference score was obtained for the Simulation group ($Md = 1.33$), followed by the Education group ($Md = 1.01$), and finally the Control group ($Md = 0.10$).

Intention to change listening habits. An ANOVA conducted on the mean-difference scores for the dependent variable measuring intentions indicated statistically significant differences between the three presentation groups, $F(2, 41) = 5.85$, $p < .05$. Post hoc pairwise comparisons revealed that the Simulation groups' intentions to change current noise exposure habits increased significantly more from Time-1 to Time-2 ($Md = 1.53$) compared to the Control group ($Md = 0.37$), (Tukey's HSD, $p < .05$). No other significant differences were found between the Simulation and the Education groups, or the Education and Control groups (Tukey's HSD, $ps > .05$). The Simulation groups' mean intention difference score was higher ($Md = 1.53$) compared to the Education group ($Md = 1.13$).

Fear regarding overexposure to loud noise. An ANOVA performed on the mean-difference scores for the dependent variable measuring fear indicated statistically significant differences between the three presentation groups, $F(2, 41) = 3.52$, $p < .05$. Post hoc pairwise comparisons revealed that the Simulation groups' fears concerning loud noise exposure increased significantly more from Time-1 to Time-2 ($Md = 1.34$) compared to the Control group ($Md = 0.32$), (Tukey's HSD, $p < .05$). No other significant differences were found between the Simulation and Education groups, or the

Education and Control groups (Tukey's HSD, *ps* > .05). The Simulation groups' mean fear difference score was higher (*Md* = 1.34) compared to the Education group (*Md* = 0.94).

Taken together, these results indicate that for the dependent variables measuring 'Motivation to protect against excessive noise,' 'Attitude towards excessive noise exposure,' 'Intention to change listening habits,' and 'Fear regarding overexposure to loud noise,' no significant differences were found between the Simulation group compared to the Education group. The results for each dependent variable, however, were all in the anticipated direction, with the Simulation groups' mean motivation, attitude, intention, and fear difference scores increasing more compared to the Education group.

Introduction

Experiment 2

The purpose of Experiment 1 was to test the hypothesis that an educational hearing campaign that incorporated audio simulations of hearing loss and tinnitus would be more effective in fostering greater improvements in participants' motivations, attitudes, intentions, and fears towards NIHL compared to a hearing conservation message without simulations. The results of Experiment 1, using Likert scale measures of attitude, motivation, intention, and fear, did not support this hypothesis as no significant improvements in the Simulation groups' measures towards the adoption of safer hearing practices were found compared to the Education group. Despite these findings, the results for each dependent variable were all in the anticipated direction, as the Simulation group demonstrated enhanced attitudes, motivations, intentions, and fears towards NIHL compared to the Education group.

Limitations of Experiment 1

One possible explanation for the nonsignificant results of Experiment 1 concerns the relative insensitivity of Likert scales to accurately measure changes in people's responses (Elmes, Kantowitz, & Roediger, 2006). This may be because Likert scales generally require participants basing their responses on a limited number of descriptors (or anchor points) provided by a scale, or by simply marking a section of a line that best corresponds to an individual's response that is later converted into a more quantifiable measure (Elmes et al., 2006; Kowalchuk & Endler, 1985). To a large extent, these measurement techniques may not have provided the most sensitive or direct means to detect significant differences between the groups on each dependent measure (Elmes et al., 2006).

Purpose of Experiment 2 and Hypothesis

Based on the potential insensitivity of Likert scales, as well as the fact that the results obtained for each dependent variable were all in the anticipated direction, it was still considered that the simulations were indeed having a greater effect on participants' responses, though were mitigated by the type of scale used. To examine this notion, a second experiment was conducted to more directly investigate whether a hearing campaign that incorporated audio simulations of hearing loss and tinnitus was significantly more effective than an educational hearing message without simulations. Given that a between groups pre- versus post-test design was unable to detect significant differences, a repeated measures design was used for this direct comparison between the effectiveness of the Simulation presentation against the Education presentation. This involved a different group of participants who were not tested in Experiment 1 viewing both the Simulation and Education presentations consecutively after one another (the order of the presentations was randomly determined), and then simply selecting which presentation they felt was more effective. These participants,

therefore, had no prior knowledge of the purpose and expectations of the study prior to viewing the presentations. It was anticipated that the majority of participants would select the Simulation presentation over the Education presentation as being more effective in enhancing their motivations, attitudes, intentions, and fears towards NIHL. This, in turn, would confirm the effectiveness of including audio simulations as an alternative strategy for significantly augmenting the persuasiveness and effectiveness of an educational hearing campaign.

Method

Participants

Ten young adults who did not participate in, or had any prior awareness of Experiment 1, participated in the study. The sample comprised six females and four males, all with self-reported normal hearing. Participants' ages ranged from 19 to 27 years, ($M = 23.10$, $SD = 2.68$). Participants were randomly assigned to one of two conditions: the Simulation presentation followed by the Education presentation ($n = 5$), or the Education presentation followed by the Simulation presentation ($n = 5$).

Design

The study involved a within-subjects design. Although the same between groups independent variable ('Presentation Group') was used as in Experiment 1, only two levels were required (the Simulation and Education groups) to compare the experimental effects of the two treatment conditions. Participants were completely unaware prior to the experiment that they would be viewing two contrasting presentations and later evaluating which one was more effective. The order of the presentations was counter-balanced to control for order effects. Five participants viewed the Simulation presentation first followed by the Education presentation, with the other five participants viewing the Education presentation first followed by the

Simulation presentation. The same four dependent variables were measured as in Experiment 1.

Materials

Powerpoint slide-show presentations. The same (Simulation and Education) presentations were used as in Experiment 1.

Questionnaires and measure of dependent variables. The same four dependent variables examined in Experiment 1 were examined here to maintain consistency and comparability between the two experiments. To assess which presentation was more effective in improving participants' attitudes, motivations, intentions, and fears towards NIHL, a short survey (Noise Survey-3) was administered. Participants were asked to respond to a series of statements regarding which presentation was more effective by selecting from two possible responses, *The Simulation Presentation* or *The Education Presentation* (see Appendix G). To measure 'Intention to change listening habits,' participants were asked "Which presentation (the first or the second) do you think was more effective in encouraging you to change your current noise exposure habits?" To measure 'Attitudes towards excessive noise exposure,' participants were asked to respond to the statement "Which presentation (the first or the second) do you think was more effective in encouraging you to see that reducing your exposure to noise is a sensible thing to do?" To measure 'Motivation to protect against excessive noise,' participants were asked "Which presentation (the first or the second) do you think was more effective in encouraging you to reduce the amount of noise you are exposed to?" To measure level of 'Fear regarding overexposure to loud noise,' participants were asked to respond to the statement "Which presentation (the first or the second) do you think was more effective in increasing your fears about being overexposed to loud noise?" After completing these questions, participants were then asked to complete four demographic questions

pertaining to date of birth, gender, main language spoken at home, and highest level of education completed.

Stimuli and Apparatus

The slide-show presentations were viewed by participants on an IBM PC. The audio simulations were presented via Sennheiser HD 260 headphones. The level of volume used was the same as in Experiment 1.

Procedure

Each participant was randomly assigned to one of two conditions: the Simulation presentation followed by the Education presentation, or the Education presentation followed by the Simulation presentation. Participants were provided with the same information sheet and consent form as in Experiment 1, but were informed that this experiment would require them to view two consecutive presentations instead of one. Importantly, although participants were made aware that they would be viewing two presentations, they had no idea *prior* to taking part in the experiment that the presentations were different, or the content of each presentation (i.e., that one had sound and the other did not). Participants were simply told that they would be viewing two presentations, followed by answering a short survey. These design procedures were adopted so that the researcher's intentions and expectations were not obvious to the participants in order to minimise the influence of possible demand characteristics. Participants were then presented with both slide-shows, viewed consecutively after one another. The same testing procedures were used as in Experiment 1. This involved testing individuals one at a time in a quiet computer laboratory, with all participants required to wear headphones to minimise distractions as well as to deliver the audio simulations to each participant individually in a direct and uninterrupted manner. After viewing the slide-show presentations, participants were then asked to complete the Noise Survey-3.

Results

Experimental Effects of 'Presentation Group' on Dependent Variables

Given that the results for Experiment 2 represented frequencies observed across two possible response categories (i.e., Simulation presentation effective, or Education presentation effective), a non-parametric data analysis technique was used. A Chi-square test for goodness of fit was conducted on each dependent variable ('Motivation to protect against excessive noise,' 'Intention to change listening habits,' 'Attitude towards excessive noise exposure,' and 'Fear regarding overexposure to loud noise') to determine whether significant differences existed in the frequencies within which participants selected either the Simulation presentation or the Education presentation as being more effective in enhancing their motivations, attitudes, intentions, and fears towards NIHL. The results for each participant upon which the analysis is based are appended in Appendix H. Assumption testing for each Chi-square analysis was deemed satisfactory, with the alpha level set at .05. Observed frequency counts for the Simulation and Education presentations are presented in Table 3. Results of the analyses performed on each dependent variable are discussed in the following section (statistical output is appended in the CD-ROM in Appendix A).

Table 3

Observed Frequencies Measuring the Effectiveness of the Simulation and Education Presentations for the Four Dependent Variables

Dependent Variable	Frequency of Response	
	Simulation Presentation Effective	Education Presentation Effective
Motivation	9	1
Attitude	9	1
Intention	9	1
Fear	9	1

For the dependent variables measuring 'Motivation to protect against excessive noise,' 'Attitude towards excessive noise exposure,' 'Intention to change listening habits,' and 'Fear regarding overexposure to loud noise,' statistically significant differences in the frequencies obtained between the Simulation and Education presentations were found, $\chi^2(1) = 6.40$, $ps < .05$. These results indicate that when participants viewed both presentations, a significant proportion (90%) of individuals selected the Simulation presentation over the Education presentation as being more effective in improving their motivations, attitudes, intentions, and fears towards NIHL.

Discussion

Overview of Experiment 1 Results

The purpose of this study was to investigate the hypothesis that an educational hearing campaign that incorporated fear-arousing audio simulations of hearing loss and tinnitus would enhance the persuasiveness and effectiveness of a hearing conservation message, and thus result in significantly greater improvements in young adults' motivations, attitudes, intentions, and fears towards NIHL compared to an educational hearing message without simulations.

The results of Experiment 1 did not support this hypothesis. No significant improvements in the Simulation group's 'Motivations to protect against loud noise,' 'Attitudes towards excessive noise exposure,' 'Intentions to change listening habits,' and 'Fears regarding overexposure to loud noise' were found compared to the Education group. Nevertheless, examination of the mean-difference scores between the Simulation and Education groups indicated trends in the anticipated direction for all dependent variables. The inclusion of audio simulations with an educational hearing message was demonstrated to be a relatively effective method for improving participants' motivations, attitudes, intentions, and fears towards NIHL compared to an

educational hearing campaign without simulations, though these improvements did not reach statistical significance.

Accounting for Experiment 1 Results

Several explanations can be postulated to account for why the inclusion of audio simulations with a hearing conservation program were unable to foster significant improvements in individuals' attitudes, behaviours, and fears towards NIHL compared to individuals presented with an educational hearing message alone. In regards to 'Attitudes toward excessive noise exposure,' the results obtained may be explained by what Clarke and Bohne (1999) and Meyer-Bisch (1996) referred to as the insidious nature underlying NIHL. Characteristically, NIHL is associated with an absence of overt short-term symptoms like bleeding and pain to make people aware of the progressive damage that can arise as a result of chronic exposure to loud noise. Moreover, early warning signs like persistent tinnitus, hypersensitivity to sound, or "fullness" in the ears typically subside within a few hours to days, with the cumulative effects of these transient symptoms taking several years to manifest (Bahadori & Bohne, 1993; Chung et al., 2005). When participants viewed this information during their presentation, this may have dissipated the intended fear-arousing effects of the audio simulations as the simulated long-term damage depicted may have been perceived as an issue not worth considerable attention (nor important enough to modify existing attitudes) given the time span over which such effects typically arise. It can be argued, therefore, that the insidious nature of NIHL may have inadvertently contributed towards the ineffectiveness of the audio simulations to significantly enhance the Simulation group's 'Attitudes towards loud noise exposure' (and, as a consequence, 'Motivations to protect against loud noise' and 'Intentions to change listening habits') above the effects found for the Education group.

Second, Geller (2003) suggested that within the younger population, beliefs regarding disease or injury only occurring to older adults or to other people besides themselves are widely held perceptions within this cohort. Such notions of invincibility and invulnerability may have instilled the misperception that the adverse effects associated with loud noise exposure as depicted by the audio simulations would have few (if indeed any) serious consequences on the health and well-being of the younger adults sampled. It is possible, therefore, that these attitudes were strong enough to override the intended persuasive effects of the audio simulations significantly enhancing the Simulation group's attitudes towards NIHL (and, likewise, motivations and intentions to adopt safer hearing practices) over the improvements made by the Education group.

In accordance with the fear appeal literature, the addition of fear-arousing audio simulations with an educational hearing message was designed to present a greater level of threat, and elicit a stronger, negative visceral response for the Simulation group towards the dangers associated with excessive noise exposure compared to the Education group who did not experience fearful simulations of a NIHL. Green and Witte (2006) indicated that persuasive fear-arousing messages have been extensively used over time as a medium for facilitating attitude and behaviour change across many public health issues. Furthermore, research has consistently found that higher levels of fear aroused by a fear appeal tend to promote greater attitudinal, behavioural, and intentional change through the instilment of greater susceptibility and severity perceptions towards a threat (Witte & Allen, 2000). In regards to accounting for the nonsignificant results obtained for the dependent variable measuring 'Fear regarding overexposure to loud noise,' it is possible that the level of fear aroused by the audio simulations was inadequate in fostering a significantly stronger negative emotional response for the Simulation group above the level of fear experienced by the Education

group. Niskar et al. (2001) indicated that a 16 to 25 dB hearing loss represents slight hearing damage, a 26 to 40 dB hearing loss represents mild hearing damage, and a 41 dB or greater hearing loss represents moderate to severe hearing damage. The audio simulations used in this study simulated a 30 to 40 dB hearing loss, and can thus be described as representing a mild hearing loss. Participants, therefore, may not have perceived the simulated damage associated with a mild hearing loss to be threatening enough to warrant considerable attention. This may further account for why the inclusion of audio simulations with an educational hearing message was ineffective in significantly enhancing the Simulation group's fear levels concerning exposure to loud noise (and, subsequently, motivations, intentions, and attitudes towards NIHL) above the effects found for the Education group.

In light of the findings obtained, it appears that the results of Experiment 1 did not demonstrate any significant advantages to the use of audio simulations as a medium for augmenting the efficacy of a hearing campaign fostering enhanced attitudes, safer hearing practices, and higher levels of fear towards NIHL in young adults compared to an educational hearing message without simulations. These outcomes were surprising, especially given the rigorous attention devoted to addressing Brew's (2005) methodological limitations. Nonetheless, the results for each dependent variable were all in the anticipated direction, suggesting that the addition of audio simulations with an educational hearing campaign was effective in improving young adults' motivations, attitudes, intentions, and fears towards NIHL, though that these effects were not strong enough to reach statistical significance. Interestingly, Brew (2005) found similar results to those obtained in Experiment 1, with no significant improvements in the Simulation groups' attitudes, behaviours, and fears towards NIHL being observed compared to the Education group.

Considering, however, that similar findings were reported by Lass et al. (1987) and Lewis (1989) in respect to those obtained in Experiment 1 and by Brew (2005), it is possible that the medium used to educate people about NIHL may not be the primary contributing factor influencing young adults' lack of commitment towards the adoption of safer hearing practices. Given that a variety of media have been investigated to educate young people about a NIHL (predominantly visual media with its associated limitations, and now more recently audio simulations together with visual information), it may be that other underlying factors such as the insidious nature of NIHL, attitudes emphasizing invincibility and invulnerability, or insensitive or inaccurate measurement techniques are inadvertently compromising the effectiveness of educational hearing programs (and thus the efficacy of the audio simulations in this study) fostering significant attitude and behaviour change towards the prevention of NIHL in young adults. This line of thinking was the impetus for Experiment 2.

Rationale for Experiment 2

Given that the results for each dependent variable were all in the anticipated direction, it was still considered that the audio simulations were indeed having a greater (perhaps even a significant) effect on participants' responses, but that this effect was mitigated or masked by the insensitivity of the Likert scale used in Experiment 1. Elmes et al. (2006) and Kowalchuk and Endler (1985) suggested that how people respond to Likert scales can be influenced by a number of variables, including individuals' responses being restricted by a limited number of descriptors provided by a scale; potential inaccuracies converting subjective responses recorded by a scale into a quantifiable measure; and participants' misunderstanding the requirements of a scale, especially those based on a pre- versus post-test design (as evidenced by one case in Experiment 1 having to be removed due to incomplete scores). It is possible that one or more of these factors may have influenced the nonsignificant results of Experiment 1,

and, importantly, may not have been a reflection of the ineffectiveness of the actual audio simulations as an educational medium per se.

The purpose for Experiment 2, therefore, was to employ a more sensitive measurement technique for assessing the effectiveness of the Simulation presentation fostering greater improvements in participants' attitudes, behaviours, and fears towards NIHL compared to the Education presentation. This required individuals viewing both the Simulation and Education presentations, and then simply selecting which presentation they felt was more effective in enhancing their motivations, attitudes, intentions, and fears towards NIHL. It was anticipated that the majority of participants would select the Simulation presentation over the Education presentation as being more effective in improving their motivations, attitudes, intentions, and fears towards NIHL. This, in turn, would confirm the effectiveness of including audio simulations as an alternative strategy for significantly augmenting the persuasiveness and effectiveness of an educational hearing campaign.

Overview of Experiment 2 Results

The results of Experiment 2 demonstrated support for this hypothesis across all dependent variables. A significant proportion of individuals (90%) selected the Simulation presentation as being more effective in improving their 'Attitudes towards excessive noise exposure,' 'Motivation to protect against loud noise,' 'Intention to change listening habits,' and 'Fears regarding overexposure to loud noise' than the Education presentation without simulations. Furthermore, spontaneous anecdotal comments provided by some participants following the presentations also supported the effectiveness of the Simulation presentation. For example, one participant said "Yes, the one with sound was more effective because you could actually hear a hearing loss." Several others commented on the effects of the tinnitus simulations, saying "Those tinnitus sounds were horrible........ I'd hate to hear that for the rest of my life," and "I

now understand what those buzzing sounds in my ears are........ Perhaps I should do something about it." Taken together, these findings provide conclusive evidence supporting the use of audio simulations of hearing loss and tinnitus as a medium for significantly augmenting the effectiveness and persuasiveness of a hearing conservation program fostering enhanced attitudes, safer hearing practices, and higher levels of fear towards NIHL in young adults compared to an educational hearing message without simulations.

Accounting for Experiment 2 Results

Several reasons can be posited to explain why an educational hearing program that incorporated audio simulations was significantly more effective in Experiment 2 than the same simulation-based hearing campaign used in Experiment 1, as well as in comparison to an educational hearing message without simulations. The first regards the modifications made to the experimental design and measurement procedure used in Experiment 2. The repeated-measures design underlying Experiment 2 was designed to expose each participant to two successive hearing conservation programs, one that provided the opportunity for individuals to experience first hand what a hearing loss actually feels and sounds like together with educational information on NIHL, and another that provided educational information only on NIHL. By juxtaposing the differing levels of threat emphasized in each presentation against one another, it is likely that a significant proportion of participants selected the Simulation presentation as being more effective in improving their attitudes, intentions, motivations, and fears towards NIHL as they gained a deeper appreciation of, and felt more threatened by the adverse health consequences illustrated by the audio simulations more so than the information provided in Education presentation which just described what a hearing loss feels and sounds like. This, in turn, may partially account for the nonsignificant results of Experiment 1 as participants were only exposed to one particular

presentation, and, as such, did not have a frame of reference upon which to compare the effectiveness of their respective presentation against.

Second, an indirect and insensitive assessment procedure was used in Experiment 1, which involved participants marking a section of a Likert scale to best represent their response to each of the four dependent variables. In light of the potential validity issues associated with Likert-type scales as proposed by Elmes et al. (2006) and Kowalchuk and Endler (1985) discussed beforehand, the rationale for Experiment 2 was to employ a more direct and sensitive measurement technique that required participants to simply select from two possible responses as to which presentation they felt was more effective in regards to each dependent variable. Given that the same dependent measures and questions pertaining to each dependent variable were used, as well as the fact that no changes to the slide-show presentations were made between the two experiments (thus maintaining consistency and comparability), it is highly likely that the improvements made to the measurement procedure used in Experiment 2 was an important contributing factor towards the significant results obtained. This also supports the contention that the audio simulations were most likely having a greater effect on participants in Experiment 1, but that this effect was mitigated by the insensitivity and inaccuracy of the Likert scale used. Importantly, modifications made to the experimental design and measurement procedure used in Experiment 2 may have enhanced the likelihood of other factors such as improvements made to the delivery method of the simulations, advantages pertaining to the use of simulation as a medium for enhancing learning, and the influential power of fear appeals (all discussed in greater detail below) having a more profound bearing on the significant results obtained.

Considerable improvements made to the testing procedures used in Brew's (2005) study may have contributed towards the effectiveness of the Simulation

presentation in Experiment 2 encouraging enhanced attitudes, safer hearing practices, and higher levels of fear towards NIHL in young adults compared to the Education presentation. First, one of the main objectives of this study was to investigate a more influential and persuasive method for delivering the audio simulations to individuals in lieu of the procedures used by Brew (2005). This involved presenting the simulations directly to each participant individually via headphones in a quiet, distraction-free testing environment. This method was based on the idea that audio simulations are optimally heard and more fully appreciated when presented under conditions free of distractions. Headphones also provided a more direct means for presenting the simulations to participants, and also aided in blocking out any surrounding noise. These testing procedures were in marked contrast to those used by Brew (2005), which involved testing large groups of individuals at a time in a noisy lecture theatre, and presenting the simulations via free-field audio equipment. Thus, by presenting the audio simulations to participants in a more optimal format, this most likely enhanced the persuasiveness and influential power of the audio simulations, and, in turn, helped reinforce the educational information supplied.

Second, considerable effort was invested into making each presentation less visually stimulating and engaging, an issue previously identified as a potential flaw contributing towards Brew's (2005) nonsignificant results. This involved the removal of all pictures, graphics, and technical slide-show effects, as well as the presentation of text on neutral background colours in attempts to direct people's attention towards the audio simulations and educational information supplied. This most likely limited people's attention being inadvertently distracted away from the intended persuasive effects of the audio simulations, and thus provides another possible explanation as to why the Simulation presentation was preferred as being more effective than the

Education presentation in improving participants' attitudes, motivations, intentions, and fears towards excessive noise exposure.

Advantages pertaining to the use of simulation as an innovative and novel medium for encouraging effective and purposive learning may have been another factor influencing the significant results obtained. Crookall and Saunders (1989) and Munro (1993) indicated that simulations can provide participants with a very 'real' experience of a recreated real world event, they allow events that cannot be immediately experienced in the real world to be made more readily experienced through the aid of simulation, and they can broaden and deepen people's experiences and interpretations of real world events. Thus, by illustrating the adverse consequences chronic noise exposure can have on a person's hearing and health via the aid of audio simulations of hearing loss and tinnitus, the Simulation presentation was able to provide participants with a vivid and 'real' first hand experience of what a hearing loss actually feels and sounds like. Moreover, given that NIHL is an insidious condition in which the long-term effects of noise exposure take several years to manifest (Meyer-Bisch, 1996), the audio simulations allowed participants to experience the devastating effects of a NIHL more immediately. It is reasonable to conclude, therefore, that the Simulation presentation was preferred as being more effective than the Education presentation in improving attitudes, intentions, motivations, and fears towards NIHL as participants gained a deeper (and importantly 'real') appreciation of, and increased awareness about the detrimental health consequences loud noise exposure can have on one's health following hearing the audio simulations. The audio simulations may have also aided in disabusing individuals of the misperceived idea that the transient warning signs that arise as a result of prolonged exposure to loud noise (e.g., tinnitus) are harmless and not as severe as other health conditions with more life threatening consequences. In addition, providing participants with a 'real' encounter of how their hearing may be

affected if they suffered from a hearing loss helped reinforce the educational information supplied, thereby enhancing the persuasiveness of the overall Simulation presentation. This is contrasted to the less motivating and persuasive learning experience provided by the Education presentation, which just described what a hearing loss feels and sounds like. This, in turn, most likely explains why the Education presentation was not preferred over the Simulation presentation as being more effective in enhancing participants' attitudes, behaviours, and fears towards NIHL.

Finally, given that another main objective of this study was to investigate the effectiveness of a fear appeal as a method for enhancing a hearing campaign, an appropriate level of fear aroused by the audio simulations may further explain why the Simulation presentation was selected as being more effective than the Education presentation in fostering more positive attitudes, safer hearing practices, and higher levels of fear towards NIHL. Witte and Allen (2000) indicated that higher levels of fear aroused by a fear appeal tend to promote greater attitudinal, behavioural, and intentional change through the instilment of greater vulnerability and severity perceptions towards a threat. Although the audio simulations used in this study represented a mild hearing loss, it is clear that the level of fear aroused by the Simulation presentation was sufficient to evoke a stronger, negative visceral response towards loud noise exposure more so than the Education presentation which did not incorporate fearful audio simulations. Participants most likely felt threatened by how their hearing would be adversely affected following hearing the fearful and vivid audio simulations (which in turn translated into appropriate attitudinal, motivational, and intentional changes) more so than when they were presented with less arousing visual information in the Education presentation which just described what a hearing loss feels and sounds like. Although these findings appear to contradict the ineffectiveness of the Simulation presentation eliciting significantly higher fear levels in comparison to

the Education presentation in Experiment 1, the outcomes of Experiment 2 clearly suggest that the fear appeal was most likely having a stronger influence on individuals' responses, but was mitigated by the measurement procedure used.

Despite the likelihood of the improvements made to the design and measurement procedures incorporated into Experiment 2 having a significant bearing on the results obtained, another possible explanation may account for why a significant proportion of participants selected the Simulation presentation as being more effective. Participants may have responded in favour of the Simulation presentation in light of *perceived* (though not intended) demand characteristics of the study (i.e., participants may have perceived that a response in favour of the Simulation presentation was in some way "demanded" or cued). Although this is a possibility, every attempt was made to not prime or prompt participants to the expectations of the study. For example, although participants were clearly informed that they would be viewing two presentations, the participants who heard the simulations first had no idea that they were not going to hear simulations again. Likewise, participants who did not hear the simulations first had no idea that they were going to hear simulations in the subsequent presentation. As such, even though participants may have determined for themselves that the difference between the two presentations was the inclusion of audio simulations, it was only until *after* they viewed the two presentations consecutively that it would have been obvious that the presentations were indeed different. On this basis, it can be surmised that the results obtained, were, most likely attributable to the experimental effects of the audio simulations as no obvious demand characteristics were "built in" to the study's design and procedure to lead participants (either before or during the experiment) to respond in favour of the Simulation presentation, or reveal (implicitly) the experimenter's perceived expectations. Moreover, the fact that Experiment 2 was designed to mitigate the effects of any potential demand

characteristics influencing participants' responses further suggests that the significant results obtained, to a large extent, were attributable to the experimental effects of the audio simulations.

Nonetheless, it must still be acknowledged that demand characteristics may still have played a role in accounting for the results of Experiment 2. The nature of the repeated measures design, as well as the fact that participants only had two possible responses to choose from may have inadvertently primed participants into believing that one presentation was expected to be more effective than the other. Participants, therefore, may have responded favourably towards the Simulation presentation not because of its "true" persuasive and influential qualities, but simply because the presentation with sound was perceived to be the expected or "right" answer.

Limitations

An important feature of this study was the attempt to conduct a second experiment to more comprehensively investigate the primary hypothesis examining the efficacy of the inclusion of audio simulations with a hearing conservation program in light of the tentative results obtained in Experiment 1. One limitation of this study, however, involved the utilization of a relatively indirect and insensitive measurement scale in Experiment 1, which ultimately compromised (though only to a certain degree) the validity of the initial results obtained. Although this issue was recognised and addressed in Experiment 2, had a more direct and sensitive measurement technique been initially incorporated into Experiment 1, perhaps a significant effect of the Simulation presentation would have been found without the need to conduct subsequent investigation and analyses. Furthermore, the possibility of potential demand characteristics having influenced participants to respond favourably towards the Simulation presentation cannot be totally dismissed as an alternative explanation for the significant results of Experiment 2. Nevertheless, support for the inclusion of audio

simulations with an educational hearing message as a medium for improving individuals' attitudes and behaviours towards NIHL was ultimately attained, and may provide the step necessary towards reducing the prevalence of NIHL in the community.

Future Directions for Research

With the outcomes of this study in mind, many directions for potential future research exist. First, considering that this study explored young adults' attitudes and behaviours towards NIHL aged 18 to 27 years, perhaps the effectiveness of a combined simulation and educational hearing campaign targeting improvements in children's attitudes and behaviours towards NIHL would be of worthwhile interest and importance. This is especially so given that younger children are at just as much risk of developing hearing damage as a consequence of exposure to loud recreational noise as are adolescents and young adults exposed to excessive noise levels. Second, a qualitative design that more specifically explores young people's attitudes, experiences, perceptions, and feelings regarding noise and hearing loss may shed valuable insight into understanding current attitudes and behaviours in this cohort. Similar to this study, participants could be presented with both the Simulation and Education presentations, and interviewed about the effectiveness of each presentation and how this may impact upon their motivations, attitudes, intentions, and fears towards NIHL.

Research Implications

In light of the findings supporting the use of audio simulations of hearing loss as an educational strategy for augmenting the persuasiveness of a hearing campaign in young adults, the practical implications for this study, as well as future research are considerable. First, advantages associated with providing susceptible individuals with an auditory medium such as simulations of a NIHL that more effectively encapsulates and illustrates the consequences inherent with prolonged noise exposure supplementary to educational information may lead to the development of more efficient hearing

conservation programs. This technique could also be disseminated within school curricula to educate primary and high school students about hearing loss, as well as the value and importance placed upon protecting one's hearing. Ultimately, conserving the hearing of the younger population is of paramount importance, particularly given the profound ramifications a NIHL can have on virtually all aspects of an individual's functioning, as well as the ever increasing advancement of today's society into a more technologically driven (and thereby increasingly noisy) world.

Conclusion

The results of the present study demonstrated support for the use of fear-arousing audio simulations of hearing loss and tinnitus as a medium for significantly augmenting a hearing campaign fostering improvements in young adults' motivations, attitudes, intentions, and fears towards NIHL compared to an educational hearing message without simulations. Although the significant results of Experiment 2 appeared to contradict the nonsignificant results of Experiment 1, they clearly suggested that the insensitivity and inaccuracy of the Likert scale used was, to a large extent, a key factor contributing towards the initial ineffectiveness of the Simulation presentation, and, importantly, was not a reflection of the ineffectiveness of the actual audio simulations as an educational medium per se. Given that increasing numbers of young adults are sustaining a NIHL from repeated exposure to loud recreational noise, the development of more effective and influential hearing conservation programs is of paramount importance. Therefore, augmenting the persuasiveness of future hearing campaigns via an auditory medium that allows susceptible individuals to more fully appreciate what a hearing loss actually feels and sounds like in lieu of just being presented with visual information describing the adverse effects of chronic noise exposure may provide the initial critical step necessary towards reducing the prevalence of NIHL in the community.

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Appendix A

CD-ROM Containing Reproductions of Slide-Show Presentations and Statistical Output for Experiments 1 and 2

1. Simulation Slide-Show Presentation
2. Education Slide-Show Presentation
3. Control Slide-Show Presentation
4. One-Way ANOVA for Pre-Scores (Experiment 1)
5. One-Way ANOVA for Mean-Difference Scores (Experiment 1)
6. MANOVA on Mean-Difference Scores (Experiment 1)
7. Chi-square Analyses on Observed Frequencies (Experiment 2)

Appendix B

List of Audio Simulations Included in the Simulation Presentation

Slide 22: Normal male discourse

Slide 24: Male discourse with a flat 40 dB loss

Slide 26: Male discourse normal to 1 kHz, then a 30 dB per octave loss

Slide 28: Normal female discourse with background conversation

Slide 31: Female discourse with background conservation normal to 2 kHz, then a 30 dB per octave loss

Slide 34: Popular music samples that changed from normal to a simulated hearing loss

1. ABBA (Dancing Queen)

   Normal, then a 30 dB per octave loss

2. The Beatles (Can't Buy Me Love)

   Normal, then a 30 dB per octave loss

3. Creedence (Proud Mary)

   Normal, then a 30 dB per octave loss

4. Eminem (Without Me)

   Normal, then a 30 dB per octave loss

5. Nirvana (Smells Like Teen Spirit)

   Normal, then a 30 dB per octave loss

Slide 52: Examples of Tinnitus Simulations

1. Simulated Tinnitus, 4 kHz tone
2. Simulated Tinnitus, 4 kHz narrowband noise, pulsed
3. Simulated Tinnitus, broadband high frequency noise
4. Simulated Tinnitus, 2 kHz narrowband noise

Appendix C

Noise Survey-1

SURVEY

Please indicate your answer to EACH of the following statements by placing a slash (/) anywhere along the line that best represents your response.

1. At this present time, how strongly do you feel the need to reduce the amount of noise you are exposed to?

No need at all	A slight need	A moderately strong need	A strong need	A very strong need

2. At this present time, how strongly do you feel that reducing your exposure to noise is a sensible thing to do?

Not at all strong	Slightly strong	Moderately strong	Strong	Very strong

3. At this present time, how strong is your intention to change your current noise exposure habits?

Not at all strong	Slightly strong	Moderately strong	Strong	Very strong

4. At this present time, how fearful do you feel about being overexposed to loud noise?

Not fearful at all	Slightly fearful	Moderately fearful	Very fearful	Extremely fearful

Appendix D

Noise Survey-2

SURVEY

Please indicate your answer to EACH of the following statements by placing a slash (/) anywhere along the line that best represents your response.

1. After viewing the presentation, how strongly do you feel the need to reduce the amount of noise you are exposed to?

No need at all	**A slight need**	**A moderately strong need**	**A strong need**	**A very strong need**

2. After viewing the presentation, how strongly do you feel that reducing your exposure to noise is a sensible thing to do?

Not at all strong	**Slightly strong**	**Moderately strong**	**Strong**	**Very strong**

3. After viewing the presentation, how strong is your intention to change your current noise exposure habits?

Not at all strong	**Slightly strong**	**Moderately strong**	**Strong**	**Very strong**

4. After viewing the presentation, how fearful do you feel about being overexposed to loud noise?

Not fearful at all	**Slightly fearful**	**Moderately fearful**	**Very fearful**	**Extremely fearful**

QUESTIONS ABOUT YOU

Please fill out the following questions that relate to you

5. **Your date of birth is:** ______________________
   (day / month / year)

6. **Your gender is:** (Circle one)

   a) Male

   b) Female

7. **What is the main language spoken at home?** ______________________

8. **What is the highest level of education that <u>you</u> have completed?** (Circle one)

   a) Primary School
   b) Some High School
   c) Year 12 High School
   d) Trade or technical qualifications
   e) Degree from university, College of Advanced Education or other tertiary institution

Your participation in this research is very important. Your responses, opinions and time are greatly appreciated. Thank you.

Appendix E

Information Sheet and Consent Form

July 2007

Dear Participant,

My name is Claire Roockley and I am an Honours student in Psychology at Edith Cowan University. I am inviting you to participate in a study designed to investigate people's attitudes towards noise. My research conforms to the ethical guidelines produced by the appropriate Ethics sub-committee at ECU.

In my study, I will show you a short slide-show presentation on a computer screen which will last about seven minutes and ask your opinions about the presentation. You will be asked to wear headphones throughout the presentation to minimize any distractions. Participation in my study will take about 15 minutes total. There are no risks to you in participating in this research.

Any information you provide will be held in strict confidence by the researcher. At no stage will your name be reported with your responses or any identifying information be disclosed. All data will be reported as averages only. All information collected will be destroyed upon completion of the study.

Participation in this research is totally voluntary. You are free to withdraw from involvement at any stage during the study without penalty or explanation, including the removal of any data you may have contributed.

I hope that you will consider participating in this research project. Please hold on to this letter for your information. If you have any questions or require further information about this study, please do not hesitate to contact me on (08) 9305 3350 or my supervisor Dr Paul Chang on (08) 6304 5745. Alternatively, if you have any concerns about the project or would like to talk to an independent person, you may contact Dr Dianne McKillop (School of Psychology Fourth Year Coordinator) on 6304 5736.

Your participation in this study will be most greatly appreciated.

Yours sincerely,

Claire Roockley
School of Psychology
Edith Cowan University

Consent form

I have read the information sheet attached and any questions I have asked have been answered to my satisfaction. I agree to participate in this activity, realizing that I may withdraw at any time. I agree that any research data gathered for this study may be published provided I am not identified.

Participant Name: ____

Participant Signature: ____________________________________

Date: ____

Appendix F

Data Set Included in Analyses for Experiment 1

Participant	Presentation Group	Mot. Pre	Att. Pre	Int. Pre	Fear Pre	Mot. Post	Att. Post	Int. Post	Fear Post	Mot. Diff.	Att. Diff.	Int. Diff.	Fear Diff.
1	S	3.00	3.00	1.00	1.00	4.00	4.00	4.00	3.00	1.00	1.00	3.00	2.00
2	S	3.00	3.50	2.00	2.00	4.50	4.50	4.00	4.25	1.50	1.00	2.00	2.25
3	S	1.13	1.93	1.93	2.15	2.13	3.63	2.75	3.00	1.00	1.70	0.82	0.85
4	S	1.81	3.25	2.13	1.75	3.38	4.50	4.00	3.50	1.57	1.25	1.87	1.75
5	S	1.00	1.00	1.00	1.25	2.15	3.50	2.75	3.50	1.15	2.50	1.75	2.25
6	S	2.15	2.81	1.65	1.63	3.81	4.50	4.00	2.00	1.66	1.69	2.35	0.37
7	S	1.25	1.25	1.25	1.75	2.13	2.06	1.63	1.93	0.88	0.81	0.38	0.18
8	S	2.00	2.50	2.50	3.00	4.00	4.00	4.00	4.00	2.00	1.50	1.50	1.00
9	S	1.25	4.09	2.13	1.68	3.81	4.68	2.65	2.21	2.56	0.59	0.52	0.53
10	S	1.13	1.90	1.38	1.84	1.90	1.90	2.34	3.40	0.77	0.00	0.96	1.56
11	S	2.68	3.88	1.18	3.00	3.40	4.00	2.68	3.25	0.72	0.12	1.50	0.25
13	S	3.90	3.00	2.50	1.00	5.00	5.00	5.00	5.00	1.10	2.00	2.50	4.00
14	S	1.00	2.00	1.50	2.50	3.50	4.00	3.50	3.00	2.50	2.00	2.00	0.50
15	S	1.38	2.75	1.00	1.56	2.50	4.75	2.25	3.25	1.12	2.00	1.25	1.69
16	S	3.00	4.00	2.31	3.00	4.00	4.00	3.00	3.50	1.00	0.00	0.69	0.50
17	S	1.90	3.34	2.06	2.50	4.00	4.50	3.25	3.75	2.10	1.16	1.19	1.25
18	S	2.18	1.68	1.68	2.18	3.71	4.68	3.20	3.20	1.53	3.00	1.52	1.02
19	S	2.25	3.93	1.50	2.00	3.00	5.00	3.00	4.50	0.75	1.07	1.50	2.50
20	S	1.50	2.00	1.50	3.00	3.43	3.46	3.96	3.84	1.93	1.46	2.46	0.84
21	S	2.40	2.68	2.88	2.90	3.81	4.38	3.71	4.38	1.41	1.70	0.83	1.48
22	E	1.50	4.00	2.00	2.00	4.00	5.00	3.00	3.50	2.50	1.00	1.00	1.50
23	E	1.00	1.00	2.00	1.00	4.00	5.00	4.00	3.00	3.00	4.00	2.00	2.00
24	E	3.00	4.00	1.00	2.00	4.00	4.50	2.50	3.50	1.00	0.50	1.50	1.50
25	E	1.06	1.90	1.30	4.40	1.40	1.88	1.43	4.40	0.34	-0.02	0.13	0.00
26	E	2.20	1.75	1.63	2.25	3.68	3.68	3.25	3.18	1.48	1.93	1.62	0.93
27	E	1.75	3.00	1.00	1.00	3.00	4.25	3.00	2.25	1.25	1.25	2.00	1.25
28	E	4.40	4.06	3.43	3.06	4.63	4.56	3.93	3.93	0.23	0.50	0.50	0.87
29	E	2.50	3.00	1.43	1.43	3.50	5.00	3.50	3.50	1.00	2.00	2.07	2.07
30	E	1.15	3.60	1.84	3.00	3.85	4.81	3.28	3.90	2.70	1.21	1.44	0.90
31	E	2.50	3.50	2.50	3.00	4.00	4.00	3.50	3.50	1.50	0.50	1.00	0.50
32	E	2.00	3.00	2.00	2.00	4.00	5.00	4.00	4.00	2.00	2.00	2.00	2.00

33	E	2.04	1.31	1.04	1.00	2.06	1.84	1.28	1.20	0.02	0.53	0.24	0.20
34	E	3.56	4.88	2.88	3.59	4.63	4.88	3.59	4.09	1.07	0.00	0.71	0.50
35	E	1.71	3.81	2.31	3.34	4.18	4.25	3.00	3.31	2.47	0.44	0.69	-0.03
36	E	2.00	4.00	1.00	1.50	3.00	4.00	2.50	3.00	1.00	0.00	1.50	1.50
37	E	3.50	4.00	3.00	1.50	4.00	3.50	3.00	1.50	0.50	-0.50	0.00	0.00
38	E	1.53	1.25	1.22	1.59	1.93	1.89	1.81	1.88	0.40	0.64	0.59	0.29
39	E	3.75	4.00	1.31	1.06	4.00	4.00	1.75	2.00	0.25	0.00	0.44	0.94
40	E	4.00	1.81	1.50	2.50	4.50	5.00	3.50	3.50	0.50	3.19	2.00	1.00
41	C	2.00	2.00	1.00	3.00	3.50	3.00	2.00	4.00	1.50	1.00	1.00	1.00
42	C	1.40	3.88	1.75	1.68	1.90	4.13	2.31	2.06	0.50	0.25	0.56	0.38
43	C	1.18	3.25	1.25	1.25	1.25	1.25	1.25	1.25	0.07	-2.00	0.00	0.00
44	C	2.00	2.00	1.00	1.00	2.00	2.00	1.50	1.13	0.00	0.00	0.50	0.13
45	C	2.06	1.56	2.63	2.40	2.90	2.81	2.43	2.50	0.84	1.25	-0.20	0.10

Note. S = Simulation Group; E = Education Group; C = Control Group; Mot. Pre = Motivation Pre-score; Att. Pre = Attitude Pre-score; Int. Pre = Intention Pre-score; Fear Pre = Fear Pre-score; Mot. Post = Motivation Post-score; Att. Post = Attitude Post-score; Int. Post = Intention Post-score; Fear Post = Fear Post-score; Mot. Diff. = Motivation Difference Score; Att. Diff. = Attitude Difference Score; Int. Diff. = Intention Difference Score; Fear Diff. = Fear Difference Score.

Appendix G

Noise Survey-3

SURVEY

Please indicate your answer to EACH of the following statements by circling either (a) or (b) to best represent your response

1. Which presentation (the first or the second) do you think was more effective in encouraging you to reduce the amount of noise you are exposed to?

   a) The Simulation Presentation

   b) The Education Presentation

2. Which presentation (the first or the second) do you think was more effective in encouraging you to see that reducing your exposure to noise is a sensible thing to do?

   a) The Simulation Presentation

   b) The Education Presentation

3. Which presentation (the first or the second) do you think was more effective in encouraging you to change your current noise exposure habits?

   a) The Simulation Presentation

   b) The Education Presentation

4. Which presentation (the first or the second) do you think was more effective in increasing your fears about being overexposed to loud noise?

   a) The Simulation Presentation

   b) The Education Presentation

QUESTIONS ABOUT YOU

Please fill out the following questions that relate to you

1. **Your date of birth is:** ________________________
   (day / month / year)

2. **Your gender is:** (Circle one)

   a) Male

   b) Female

3. **What is the main language spoken at home?** ________________________

4. **What is the highest level of education that <u>you</u> have completed?** (Circle one)

   a) Primary School
   b) Some High School
   c) Year 12 High School
   d) Trade or technical qualifications
   e) Degree from university, College of Advanced Education or other tertiary institution

Your participation in this research is very important. Your responses, opinions and time are greatly appreciated. Thank you.

Appendix H

Data Set Included in Analysis for Experiment 2

Participant	Motivation		Attitude		Intention		Fear	
	Sim. Effect.	Educ. Effect.	Sim. Effect.	Educ. Effect.	Sim. Effect.	Educ. Effect.	Sim. Effect.	Educ. Effect.
1		X		X		X		X
2	X		X		X		X	
3	X		X		X		X	
4	X		X		X		X	
5	X		X		X		X	
6	X		X		X		X	
7	X		X		X		X	
8	X		X		X		X	
9	X		X		X		X	
10	X		X		X		X	

Note. 'X' denotes the presentation participants found more effective; Sim. Effect. = Simulation Presentation Effective; Educ. Effect. = Education Presentation Effective.

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