CHANGING EARPLUG BEHAVIOR:

An Urge for Ongoing Short-Term Hearing Aid Interventions

Isaque Seneda

11844744

Group 1

Research Report

Graduation Project

Persuasive Communication

Word count: 5315 words

Abstract

Noise Induced Hearing Loss (NIHL) is a widely penetrated issue of modern society. This study aims to investigate health intervention campaigns involving earplug (EP) giveaways with the aim of promoting EP use targeted at youngsters who are recreationally exposed to loud noise.

The sample consists of 93 Holland-resident Bachelor students randomly assigned to two intervention conditions (control/treatment) as an independent variable, and six dependent variables measured immediately after the intervention according to the Beliefs About Hearing Protection And Hearing Loss (BAHPHL) scale.

Results show that informational interventions enhanced with EP giveaways return significantly higher behavioral intention scores (that is, a higher intent to engage in protective behavior).

In line with many law enforcement applications throughout the world —obliging nightclubs to provide free EPs, these results show extra support in favor of immediate solution-appealing interventions as effective ways to promote EP use, and demonstrates how ongoing low-cost immediate interventions are a viable alternative to costly and fading long-term aimed interventions.

Introduction

Hearing loss is probably one of the most widely penetrated, yet neglected conditions of modern society. In 2018, around 6.2% of the worldwide population was diagnosed with disabling hearing loss, that is, a loss greater than 40 decibels that might undermine spoken interpersonal communications (Statista, 2018). That number is projected to reach 9.2% of the global population by 2050; an astounding 900 million individuals with hearing impairment.

A strong intensifying factor to that equation causing people to lose their hearing is most likely to be loud noise, a condition known as Noise-Induced Hearing Loss (NIHL). Any exposure to sounds louder than 100dB for more than four hours per week could lead to permanent hearing loss (Hoorstichting, 2012). For instance, out of all adults in the United States who reported having lost their hearing, a staggering 34.2% reported the cause to be exposure to loud noise (Statista, 2014). Tinnitus (a constant ringing in the ears), for example, is a milder subcategory of NIHL caused by exposure to loud noise that affects around 15% of US citizens (NIH, 2016).

Such permanent injuries can be prevented and avoided with effective implementation of Ear Protectors (EPs). However, many individuals still did not adopt the usage of such equipment when exposed to loud noise, or at least not at all times. A recent study by the National Dutch Hearing Foundation performed with over 130.000 clubbers demonstrates alarming rates of misinformation on the causes of NIHL in the Netherlands, which could lead to risky clubbing behavior (Hoorstichting, 2012). Roughly 82% of the night clubbers report trusting in either nightclubs or authorities with taking protective measures to secure the hearing of visitors (Williams, Beach, & Gilliver, 2010), while in fact, nightclubs set decibel limits based on the average noise exposure throughout the night — rather than considering absolute values. DJs also reportedly steadily increase the volume of the music as the night goes by (Le Blanc, 2012).

Concurrently, 54% believe that it is not necessary to wear EPs if their hearing is still good (Hoorstichting, 2012). But the consequences still seem to be present, with 93% of the clubbers reporting ringing in the ear after a night out — an early symptom of what could become a permanent ringing in the ears.

Despite all recent health campaigns from the Dutch government promoting the awareness of NIHL, and the fact that many clubs nowadays feature earplug vending machines, only 4% of the clubbers are reported to be wearing hearing protection in the Netherlands (Hoorstichting, 2012).

Previous studies have shown that one-on-one educational sessions about the risks of exposure to loud noise can significantly increase earplug (EP) use 6 months after the intervention (Keppler, Ingeborg, Sofie, & Bart, 2015). These treatments can return even higher effect sizes when combining different techniques into one intervention (Knobloch & Broste, 1998). Knobloch and Broste's study, for example, featured a 4-year-long educational intervention combined with earplug giveaways, yearly hearing tests, noise meters, and mail reminders which resulted in the EP use to increase from 23.2% to 87.5% in the target population.

However, little is known about the specific effects of earplug giveaways (interventions that give free EP units to the participants accompanied by a hands-on training) on the message processing, and immediate behavior-related beliefs such as attitude towards EP use and attitude towards loud noise, for example. Most studies only address farm working populations, long term effects of the interventions and lack precision in scope by combining multiple interventions at once (Lee, Westaby, & Berg, 2004; McCullagh, 2011; McCullagh, Banerjee, Cohen, & Yang, 2016).

One crucial difference between the young population in comparison to the farm working population is that youngsters' exposure to sound is very often recreational — rather than occupational (Beach, Nielsen, & Gilliver, 2016). That could yield relatively lower effect sizes, since the visitors are at the venues voluntarily, and often consume drinks or other types of soft drugs that can increase their chances of engaging in risky behavior.

The youngster population does not seem to hold earplug giveaway intervention outcomes in the long run, either. A study has shown that providing earplugs to youngsters is an effective way to promote protective behavior, measured after 4 weeks (Beach, Nielsen, & Gilliver, 2016), but the differences between control and treatment seemed to disappear after a longer period of 16 weeks.

Boosters and reminders following an initial intervention with solution appeals submitted throughout time, on the other hand, have shown to be significant tools to maintain the effectivity of an initial intervention after a period of one year (Hong, Chin, Fiola, & Kazanis, 2013). In fact, constant reminders have shown to be successful even after 16 years post to the initial intervention (Marlenga et al., 2011). These results probably indicate that immediate reminders shaped as solution appeals are effective ways to promote behavior change in EP use. One good example of such a reminder would be a constant earplug giveaway intervention at the entrance of a music venue. In Sweden, where music venues provide the visitors with free EPs, the rates of usage are over six times the usage in the United States or Australia, where earplugs are much more scarce or difficult to find at the venues (Beach, Nielsen, & Gilliver, 2016). Public measures have also been adopted in Belgium, both with national campaigns (Gilles & Paul, 2014), and laws enforcing venues to offer free earplugs, with significant short-term results.

Such short-term effectivity insights would be relevant to further develop research about in-discotheque interventions for EP use targeted at youngsters since the effectivity of such interventions seems to be extremely strong in the short term, while fading away after 16 weeks (Beach, Nielsen, & Gilliver, 2016). Indeed, a combination of informational and EP giveaway treatments should increase EP-use related variables about hearing protection.

RQ: What is the immediate influence of an intervention featuring an earplugs giveaway on beliefs about hearing protection as compared to the intervention without a giveaway among Holland-resident youngsters?

Theoretical Framework

The Extended Parallel Process Model

Ear protection interventions have an ultimate goal of changing behavior, and for that reason, they usually feature a fear appeal accompanied by a solution appeal (Gilles & Paul, 2014; Keppler, Ingeborg, Sofie, & Bart, 2015). The Extended Parallel Process Model (EPPM) is a theoretical framework that tries to predict individuals' reactions in face of a fear-induced stimulus (Witter, 1992). It claims that behavioral change is only possible once the health intervention message (containing both a fear appeal and a solution appeal) has successfully convinced the receiver throughout a process involving four requirements. Those are (1.1) susceptibility (how susceptible one perceives to be to the risk communicated), (1.2) intensity (how intense or impactful an eventual consequence of that risk will be to the individual), (2.1) response-efficacy (how effective one believes that the solution provided is in avoiding the risk), and (2.2) self-efficacy (how effective one believes that the solution is in avoiding the risk when applied to their individual context). A successful intervention is able to score high in each of the aforementioned requirements in the target audience's mind, resulting in willingness to engage in danger control — that is, to take the so-desired protective measures. Any interferences in convincing the receiver of high scores related to the first two fear-appeal items (susceptibility and intensity) will result in no further processing. In case the fear-appeals have been both deemed high, the second half is appraised: the solution appeals (response- and self-efficacy). Low scores in any of these two later items can result in willingness to engage in fear control — when the individual decides to initiate thoughts or actions that alleviate the pressure imposed by the fear-appeal items.

Earplug giveaways and informational interventions

Informational interventions are defined as interventions that involve any kind of discussion, lecture, talk or conversation to or with the target audience regarding the risks of being exposed to loud noises in terms of their potential permanent damage to their hearing. They discuss situations that present risk as an attempt to increase the perceived self-scores for the first half of the EPPM model: namely susceptibility and intensity. They can also do that by illustrating the consequences of NIHL and tinnitus through simulations (NIOSH, 2010).

Earplug giveaways are defined as interventions that involve giving the participants access or ownership to EPs for free, as well as providing training experience on how to properly fit the equipment in order to achieve effective protection of the ears, as exemplified in many studies (McCullagh, 2011; McCullagh et al., 2016; Lee, Westaby, & Berg, 2004). They are an attempt to complete the second half of the EPPM (namely response- and self-efficacy) by also offering a solution appeal (free earplugs and online hands-on training).

Previous studies have shown that earplug giveaways are significant enhancers of EP use when featured as a complement to traditional informational interventions (McCullagh, Banerjee, Cohen, & Yang, 2016). One explanation for that would be that earplug giveaways help increase the participants' perception of response- and/or self-efficacy during the fear appraisal phase and therefore more often succeed in leading to behavioral change. That is, while purely informational interventions discuss risks and fear (susceptibility and intensity), interventions with earplug giveaways provide solutions (response- and self-efficacy) and for that reason, tend to be more successful.

Recurring to the literature, we can find many examples substantiating the aforementioned explanation. McCullagh's short study, for example, showed that mailing in free earplugs without any extra information on risks returned an increase of EP use from 23% to 64% among a population of farm workers —measured two months after the intervention (2011). That not only suggests that earplug giveaways are strong predictors of EP use, but it could also demonstrate that intervention efforts put merely into clarifying risks by making use of negative fear messages alone might have reached saturation in the target populations' minds. That is, after being bombarded with fear appeals, solution appeals are deemed necessary to promote change in behavior.

A lean towards solution-focused interventions

A lack of solution appeals —that is, a study involving only informational interventions— has also shown to be inefficient among the population of young nightclubbers (Weichbold & Zorowka, 2003). As opposed to that study, Gilles and Paul have found a significant increase in attitudes about hearing protection for an intervention that instead, emphasized prevention —also among a population of young nightclubbers (2014).

That indicates that informational interventions focusing on solution appeals, such as earplug giveaways, tend to achieve more successful outcomes than informational interventions alone among the young population.

Specific insights on the outcomes of EP giveaways

This study attempts to understand specifically which outcomes are influenced the most by an EP giveaway add-on to an intervention. It consists of a control condition featuring an informational intervention only and a treatment condition featuring both an informational intervention and an EP giveaway. By comparing both conditions, it is possible to know exactly which outcome is influenced by an EP giveaway intervention. Future interventions will be able to benefit from these insights and understand which are the best practices for convincing the target population to take protective measures.

The Beliefs About Hearing Protection And Hearing Loss (BAHPHL) scale

Therefore, in order to measure these outcomes including all four requirements of the EPPM (susceptibility, intensity, response- and self-efficacy) as well as the beliefs about hearing protection of the target population, we decided to adopt the recurring Beliefs About Hearing Protection And Hearing Loss (BAHPHL) scale (Svensson, Morata, Nylén, Krieg, & Johnson, 2004). The scale has also been used in multiple studies in this topic (Gilles & Paul, 2014; Keppler et al., 2015), and has also shown to be reliable in later replications (Degeest, Maes, Leyssens, & Keppler, 2018).

The scale measures the aforementioned four EPPM processes: susceptibility to hearing loss (susceptibility), severity of consequences of hearing loss (intensity), self-efficacy and benefits of preventive action (response-efficacy). It also measures covariates related to feelings of low self-efficacy such as barriers to preventive action (individual difficulties related to the use of the solution) and social norms (individual perception of the normality of the protective behavior). And finally, it measures behavioral intentions (of EP use when exposed to loud noises), which can be interpreted as a predictor of EP use in loud environments.

The BAHPHL scale as a dependent variable is capable of shedding light on differences between control (informational intervention alone) and treatment (informational intervention with EP giveaway), in order for conclusions to be drawn. It is expected that the provision of a solution appeal will result in higher BAHPHL subscores since the message stimulates the participants to go through the entire EPPM process (susceptibility, intensity, response-efficacy, and self-efficacy) finally engaging in danger control (behavioral intention to change). All shown in Figure 1.

H1: An informational intervention with an EP giveaway will result in higher response-efficacy compared to the informational intervention alone among Holland-resident youngsters.

H2: An informational intervention with an EP giveaway will result in higher barriers to protective measure scores compared to the informational intervention alone among Holland-resident youngsters.

H3: An informational intervention with an EP giveaway will result in higher behavioral intention compared to the informational intervention alone among Holland-resident youngsters.

H4: An informational intervention with an EP giveaway will result in higher self-efficacy compared to the informational intervention alone among Holland-resident youngsters.

Higher scores are also expected for susceptibility and intensity because the provision of a solution appeal will in theory cease any intentions to engage in fear control, the process of fear alleviation that would return lower BAHPHL scores. It is important to highlight that barriers to preventive action are also expected to have their scores increased, since they are reverse coded — higher scores mean less barriers. Also shown in Figure 1.

H5: An informational intervention with an EP giveaway will result in higher susceptibility compared to the informational intervention alone among Holland-resident youngsters.

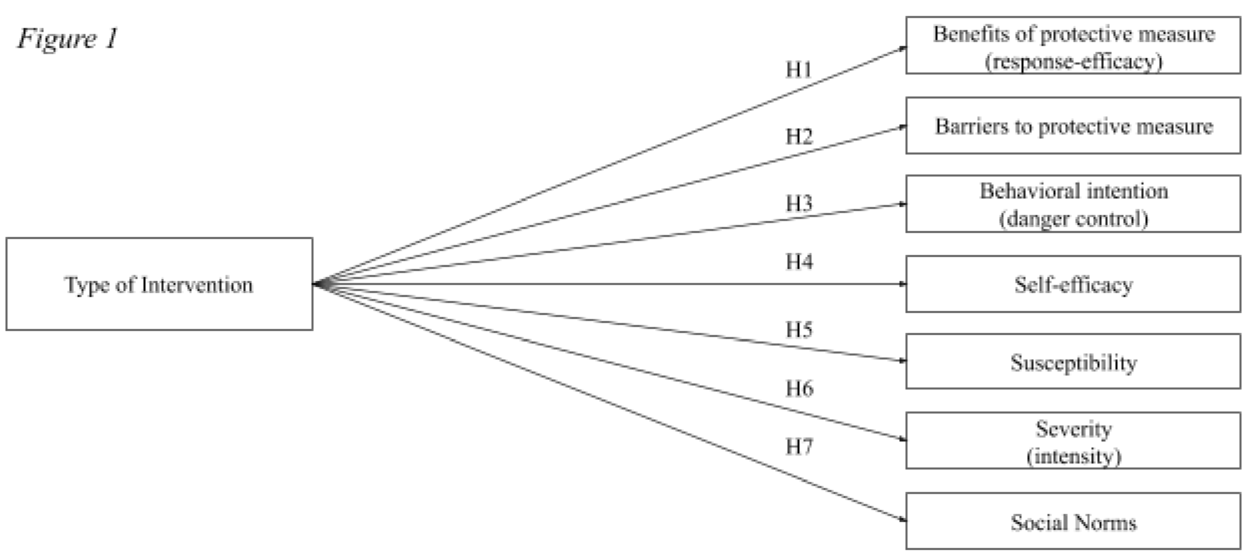
H6: An informational intervention with an EP giveaway will result in higher intensity compared to the informational intervention alone among Holland-resident youngsters.

Finally, social norms are also expected to increase. Social norms can be divided into descriptive and injunctive norms (Cialdini, Reno, & Kallgren, 1990). Descriptive norms represent one's perception of which behaviors are currently being done in society, that is the status quo. Injunctive norms represent the behaviors that are ideally desirable by everyone but are not currently achieved due to certain barriers. As an example, a youngster's perception could —rightfully so— be that EPs are not widely adopted as a means of protection against loud noise (descriptive norm). However, after watching the video, the youngster could perceive the action of wearing EPs as a desirable behavior among the people around them (injunctive norm).

Therefore, it is assumed that due to the participants' perception of the fear appeal as a message of real danger, their perception of wearing earplugs as an injunctive norm can increase their scores of social norms in the BAHPHL scale. Also shown in Figure 1.

H7: An informational intervention with an EP giveaway will result in higher social norms scores compared to the informational intervention alone among Holland-resident youngsters.

Figure 1



Methods

Design & Participants

The design of the study featured a 2-condition [type of intervention: informational/informational with EP giveaway] between-subjects design. There was one manipulated independent variable with 6 dependent variables measured according to the BAHPHL scale. The sample consisted of 93 bachelor students from diverse nationalities ranging from 18 to 33 (M = 21.45, SD = 2.88) enrolled at the University of Amsterdam, of which 57 were female and 36 were male. This sample was chosen due to its representativity of the population investigated: that is, youngster Holland residents. The sample also featured participants from several nationalities.

Procedure & Materials

We conducted an online survey followed by an in-person pickup option. Participants were recruited through posters distributed across the campus with a QR code and the promise that 50% of the participants would obtain a reward —without informing about the earplugs. The participants could then open the online survey on their own phones in order to watch the video and answer the questions. In the survey, they were initially asked for consent in participating in the study, age, gender and whether they "constantly hear a ringing in their ears (a condition also known as Tinnitus)". The following page of the survey included the following message: "you will now be shown a video; please watch and listen to the content carefully (preferably with headphones)". They were then randomly assigned to each condition —treatment or control— in which they watched a video featuring an intervention.

The control condition was shown an informational intervention with the screen capture of a slide presentation about NIHL, featuring a voice narrator discussing an adapted version of a text from the National Institute for Occupational Safety and Health app (NIOSH, 2016). After the presentation, the participants were also exposed to the NIOSH Hearing Loss Simulator (NIOSH, 2010). That simulator generated an audio track that accurately demonstrated to the audience what it sounds like to have acquired permanent hearing loss in two different ways: NIHL and tinnitus. More specifically, the simulator recreated what NIHL sounds like by slowly decreasing higher frequencies from the recording of a man speaking about the risks of hearing loss, causing the recording to sound extremely muffled by the end of the simulation while reaching the equivalent sound of a moderate to severe NIHL with a 40 dB level at 4000 Hz. Concurrently, a high-pitch ringing at around 15000 Hz constantly faded in as the recording got more muffled, illustrating what it would be like to have permanent tinnitus. The goal with the information intervention was to stimulate perceptions of susceptibility and with the simulator, the goal was to stimulate perceptions of intensity.

The treatment condition featured the same stimuli as the above, but with an extended version featuring an excerpt from a training video tutorial on how to properly wear earplugs (3M, 2015). The video features three steps that clarify the fitting of such device: (1) rolling the plug into a smooth cylinder (2) pulling the outer ear outwards and upwards and (3) firmly inserting and holding the plugin for 10 seconds. The video then showed a drawn illustration of what a good fit and what a bad fit look like. The narrator also mentioned that with a good fit, the audience can finally be protected from loud noises. Following the video, the treatment condition was also told that they were given a reward voucher to later pick up one free pair of earplugs at the campus on a specific time within a timespan of one hour (please see the image in the appendix). The goal with the fitting video was to stimulate perceptions of response-efficacy, while the goal with the EP voucher was to stimulate perceptions of self-efficacy. There was no intention in using the vouchers as a way to measure EP use.

The participants then moved on to the final page, where they were presented 24 items measuring EPPM processes and attitudes towards noise and noise protection.

Measures: dependent variable

In order to measure the dependent variables, we used the BAHPHL scale. All 24 items could be evaluated in a scale from 1 to 5, with 1 being "totally disagree" and 5 being "totally agree".

A principal axis factor analysis with direct oblimin rotation was conducted with the 24 items. An inverse coding was applied on items 1, 3, 4, 7, 8, 9, 11, 16, 17, 19 and 21. Those items were originally clustered into 7 subscales (Svensson, Morata, Nylén, Krieg, & Johnson, 2004). 6 of those 7 subscales identified in our factor analysis matched the original.

There six factors were: (1) susceptibility to hearing loss (M = 3.63, SD = 0.97), comprised of 3 items (α = .79), such as "I think I can stay in loud environments without it hurting my hearing"; (2) intensity/severity of consequences of hearing loss (M = 4.55, SD = 0.66), comprised of 3 items (α = .48), such as "losing my hearing would make it hard for people to talk to me"; (3) response-efficacy/benefits of preventive action (M = 4.1, SD = 0.74), comprised of 2 items (α = .46), such as "if I wear hearing protection, I can protect my hearing"; (4) barriers to preventive action (M = 2.55, SD = 0.87), comprised of 3 items (α = .72), such as "hearing protectors are uncomfortable to wear"; (5) behavioral intentions (M = 2.81, SD = 0.95), comprised of 3 items (α = .71), such as "I plan to wear hearing protection when I am in loud environments."; and (6) social norms (M = 2.29, SD = 0.9), comprised of 2 items (α = .51), such as "my friends think it is a good idea to wear hearing protectors in hazardous noise.". The exact questions and dimension reduction procedures can be found in the appendix.

In total, the factors explained 52.98% of the variance in the 24 items, with factor 1 accounting for 18.87% of the variance explained, factor 2 adding 10.1%, factor 4 adding 8.24%, factor 5 adding 5.98%, factor 7 adding 5.07%, and factor 8 adding 4.72%. Overall, items that were targeted at the occupational population did not successfully cluster to the subscales they originally belonged to. The self-efficacy subscale, with items such as "I believe I know how to fit and wear earplugs" was not identified as a factor at all, and therefore was not combined into a variable.

Measures: covariates

In order to ensure the hypothesized effects' internal validity, age, gender, exposure to loud noises, and previously diagnosed tinnitus were controlled for as covariates. We believe that the presence of diagnosed tinnitus might highly correlate with perceptions of susceptibility and intensity since the participants have already experienced the consequences themselves. We also controlled for exposure to loud noises by asking whether the participants believed to be "exposed to loud noise (potentially hazardous/risky noise) at least once a month (for ex. a nightclub)".

Results

In order to measure all seven hypotheses we conducted a MANCOVA with condition as an independent variable, and all six BAHPHL score reduced factors as dependent variables (that is, response-efficacy/benefits of preventive action, barriers to preventive action, behavioral intentions, susceptibility to hearing loss, intensity/severity of consequences of hearing loss, and social norms). Gender, age exposure to loud noises and tinnitus were also included as covariates.

The analysis of variance showed a non-significant main effect of condition on response-efficacy/benefits of preventive action, $F(1,91)=0.21$, $p=0.648$, $\eta^2=.00$. Therefore, H1 is rejected. It also showed a non-significant main effect of condition on barriers to preventive action, $F(1,91)=0.44$, $p=0.507$, $\eta^2=.00$. Therefore, H2 is rejected.

The analysis did show a significant very weak main effect of condition on behavioral intention, $F(1,91)=4.71$, $p=.033$, $\eta^2=.00$. The behavioral intention scores in the treatment condition featuring an informational intervention with an EP giveaway ($M=3.01$, $SD=.99$) were significantly more positive than in the control condition featuring only an informational intervention ($M=2.57$, $SD=.85$). Therefore, H3 was confirmed.

Since the BAHPHL items intended to be used in the variable measuring self-efficacy did not cluster into a factor during our data reduction process, H4 could not be tested.

Further on, the analysis of variance showed a non-significant main effect of condition on susceptibility to hearing loss, $F(1,91)=0.4$, $p=0.528$, $\eta^2=.00$. Therefore, H5 is rejected. It also showed a non-significant main effect of condition on intensity/severity of consequences of hearing loss, $F(1,91)=2.55$, $p=0.114$, $\eta^2=.0.03$. Therefore, H6 is rejected. It also showed a non-significant main effect of condition on social norms, $F(1,91)=2.91$, $p=0.092$, $\eta^2=.0.03$. Therefore, H7 is rejected.

In terms of covariates, the analysis of variance also showed a significant very weak effect of tinnitus on barriers to EP use, $F(1,91)=7.87$, $p=.006$, $\eta^2 = .07$. Participants with tinnitus scored higher in the scale "barriers to EP use". Since this scale is reverse coded, that means that participants who had tinnitus (*M*=2.64, *SD*=0.88) perceived signficantly less barriers to EP use than participants without tinnitus (*M*=1.92, *SD*=0.47).

Table 1

Means, standard deviations and correlations for all variables

	M	SD	1	2	3	4	5	6	7	8	9	10
1. Condition	0.53	0.50	--									
2. Exposure to loud noises	0.77	0.42	0.00	--								
3. Tinnitus	0.18	0.38	0.01	.21*	--							
4. Female	0.63	0.49	0.04	-.23*	-0.05	--						
5. What is your age in years?	22.31	6.07	0.10	-0.16	0.06	-0.04	--					
6. BAHPHL - Behavioral Int.	2.81	0.95	.23*	-.22*	-0.01	0.02	.21*	--				
7. BAHPHL - Susceptibility	3.63	0.97	0.06	-0.11	-0.14	0.08	-0.02	.44***	--			
8. BAHPHL - Barriers EP Use	2.55	0.87	0.05	0.07	-.28**	0.07	-0.11	0.21	.23*	--		
9. BAHPHL - Sever./Intensity	4.55	0.66	-0.16	0.10	-0.10	0.10	-0.04	-0.01	.22*	0.02	--	
10. BAHPHL - Social Norms	2.29	0.90	0.18	0.02	-0.05	-0.14	0.20	.42***	0.20	.23*	-0.10	--
11. BAHPHL - Benefits EP Use	4.10	0.74	0.04	0.13	0.01	-0.17	-0.04	.35**	.28**	.23*	0.04	0.17

Note: *p < .05, **p < .01, ***p < .001, two-tailed. N=91.
For condition 1 = treatment and 0 = control. For exposure to loud noises, female and tinnitus 1 = yes and 0 = no.
M and SD are used to represent mean and standard deviation, respectively.

One of the reasons why the BAHPHL scale was chosen to measure the dependent variables in this study is the fact that its multiple subscales enable specific analyses nuanced in the data. For that reason, we proceeded with the analysis by running a bivariate correlation with all variables in the study, which can be seen in Table 1. That allows for insights within the data that might be useful for future studies. The moderate and significant results are highlighted, in order of strength as follows. The bivariate correlation revealed a significant moderate positive relationship between **behavioral intention** and **susceptibility**, $R=.44$, $p<.001$, a significant moderate positive relationship between **behavioral intention** and **social norms**, $R=.43$, $p<.001$, and a significant moderate positive relationship between **behavioral intention** and **benefits of EP use**, $R=.35$, $p=.001$.

Conclusion and Discussion

This study had the goal of obtaining insights on the immediate impact that an EP giveaway as an add-on to an informational intervention can have on beliefs and behavior-related outcomes. One main finding stands out: that interventions featuring EP giveaways seem to significantly increase the behavioral intention (H3) of wearing EPs in comparison to informational interventions alone, despite the very weak effect size.

The EP giveaway was not enough of an add-on to affect response-efficacy/benefits to preventive action (H1) scores nor barriers to preventive action (H2) scores. It is still unclear as to whether self-efficacy (H4) would have been altered since the data was not available for testing. There were also no differences in terms of susceptibility (H5) and intensity (H6) scores, as opposed to the previous hypotheses. Social norms (H7) also remained equal for both conditions. However, tinnitus was indeed a significant confounder for barriers to preventive action.

Findings and implications

It is unclear as to why there would be a significant increase in behavioral intention without any significant increases in response-efficacy. The answer could lie in the (unavailable) self-efficacy scores. Knowledge prior to this study could have successfully convinced most of the population throughout the EPPM process (susceptibility, intensity, response-efficacy), however stagnating due to low self-efficacy scores. It could be that the EP giveaway, with its fitting training, successfully increased the audience's self-efficacy lifting the final barrier, which allowed the target population's processing of the message to reach full circle culminating in the higher behavioral change scores — significant between conditions. A hypothesized prior knowledge about the effectivity of EPs would explain the lack of differences between the two conditions in terms of response-efficacy. That is, the audience probably already believed in the effectivity of EPs in protecting against noise, but still had problems related to self-efficacy.

In further defense of the EPPM, there seemed to be a moderate correlation between behavioral intention and susceptibility and also between behavioral intention and benefits of EP use/response-efficacy, providing further evidence for the theory that there is no change without going through the established processing steps of the model.

There could be more variables external to the main hypotheses tested. We can not infer that self-efficacy confounders are the same for a large population. There must be many other explanations, varying per individual. For example, the significant moderate correlation found between behavioral intention and social norms could indicate that one of the major barriers to behavioral change is the effect of social norms on self-efficacy. A barrier which does not seem to be fully lifted through EP giveaways.

Referring back to the literature, it could be that descriptive norms also play a very strong role in behavioral change (Cialdini, Reno, & Kallgren, 1990). Variables such as shame or belongingness could be a relevant reason as to why youngsters do not engage in protective behavior.

Tinnitus was also found to be a significant confounder for barriers to preventive action. That could mean that fear appeals can also be very successful as motors for change. That is, implying that audience members with tinnitus have higher susceptibility and intensity scores and that these serve as motivation to engage in actions and training to decrease the barriers to preventive action. However, the sample size for tinnitus in this study was way too small and future studies could develop better ways to assess whether the participants have permanent tinnitus in a clearer way.

Finally, the very weak effects found for H3 do not say much about the effectivity of the intervention, given that a meta-analysis has shown that most interventions obtain small-to-moderate effect sizes (Noar, 2006). That means that immediate interventions are indeed successful in changing behavior. It is important to highlight that this study did not actually give away free EPs. Instead, the mere image of a voucher was enough to yield significant results in the target population. Therefore, in line with the evidence from real life law enforcement applications in Sweden and Belgium that oblige music venues to provide the visitors with free

EPs, making EPs widely available really seems to be an effective way to influence protective behavior.

Limitations and future research

The fact that this study was not able to test self-efficacy hindered very relevant insights that could have been taken away. The main reason why the subscale was not clustered into a factor is probably due to lack of comprehension as to what the items claimed. A few participants that filled up their surveys reported confusion with the wording of items in that subscale.

Future studies could focus on improving this scale by pretesting, adding extra items to measure the same construct, and also constantly readapting the wording to the specific target population investigated.

Another factor that could have omitted very relevant insights is the low ecological validity of this study. Self-reported surveys are known to be flawed due to misperceptions when self-judging and social-desirability biases. Some of the results might have been inaccurate due to survey fatigue, since many participants dropped out, while others might have remained until the end led by interest in the reward provided.

As mentioned above, this study featured the closest methods that could fit in a limited budget. Our version of an EP giveaway required the respondents to redeem the earplugs in campus, in person within a timeframe of one hour during a weekday. Only 2 participants out of the 48 in the treatment condition physically showed up to redeem their earplugs. A replication of this study in an environment with higher ecological validity throughout time would be crucial in finding more solid evidence of the effectivity of ongoing immediate interventions.

Despite the extensive focus on long-term effective interventions due to cost-efficiency motives (Beach, Nielsen, & Gilliver, 2016), short term solution-focused interventions have also shown to be a practical, high-impact and low-cost alternative to significantly increase EP use among youngsters.

References

3M. (2015). *How to fit your 3M roll down earplugs* [Video File]. Retrieved from https://www.youtube.com/watch?v=kMMHudYoQ40

B Svensson, E., Morata, T., Nylén, P., F Krieg, E., & Johnson, A.-C. (2004). *Beliefs and attitudes among Swedish workers regarding the risk of hearing loss*(Vol. 43). https://doi.org/10.1080/14992020400050075

Beach, E., Williams, W., & Gilliver, M. (2010). The contribution of leisure noise to overall noise exposure. *In Proceedings of 20th International Congress on Acoustics, ICA 2010* (Vol. 3, pp. 1985-1989). Sydney, NSW: International Congress on Acoustics (ICA).

Beach, E. F., Nielsen, L., & Gilliver, M. (2016). Providing earplugs to young adults at risk encourages protective behaviour in music venues. *Global Health Promotion, 23*(2), 45–56. https://doi.org/10.1177/1757975914558887

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*(6), 1015-1026. http://dx.doi.org/10.1037/0022-3514.58.6.1015

Degeest, S., Maes, L., Leyssens, L., & Keppler, H. (2018). The test–retest reliability of questionnaires regarding attitudes and beliefs toward noise, hearing loss, and hearing protector devices in young adults. *Noise and Health*, *20*(93), 31–36. https://doi.org/10.4103/nah.NAH_41_17

Gilles, A., & Paul, V. de H. (2014). Effectiveness of a preventive campaign for noise-induced hearing damage in adolescents. *International Journal of Pediatric B Svensson, E., Morata, T., Nylén, P., F Krieg, E., & Johnson, A.-C. (2004). Beliefs and attitudes among Swedish workers regarding the risk of hearing loss(Vol. 43). https://doi.org/10.1080/14992020400050075*

Hong, O., Chin, D. L., Fiola, L. A., & Kazanis, A. S. (2013). The effect of a booster intervention to promote hearing protection behavior in operating engineers. *American Journal of Industrial Medicine*, *56*(2), 258–266. https://doi.org/10.1002/ajim.22091

Hoorstichting. (2012). Rapport 130.000 stappers. *Hoorstichting*. Retrieved from https://www.hoorstichting.nl/publicaties/rapport-gehoorschade-130-000-stappers/

Keppler, H., Ingeborg, D., Sofie, D., & Bart, V. (2015). The effects of a hearing education program on recreational noise exposure, attitudes and beliefs toward noise, hearing loss, and hearing protector devices in young adults. *Noise & Health*, *17*(78), 253–262. https://doi.org/10.4103/1463-1741.165028

Knobloch, M. J., & Broste, S. K. (1998). A Hearing Conservation Program for Wisconsin Youth Working in Agriculture. *Journal of School Health*, *68*(8), 313–318. https://doi.org/10.1111/j.1746-1561.1998.tb00591.x

Le Blanc, V. (2012). '103 decibel is veilig mét oordoppen, niet zonder'. *DJ Broadcast.* Retrieved from https://www.djbroadcast.net/

Lee, B. C., Westaby, J. D., & Berg, R. L. (2004). Impact of a national rural youth health and safety initiative: results from a randomized controlled trial. *American Journal of Public Health*, *94*(10), 1743–1749.

Lusk, S. L., Hong, O. S., Ronis, D. L., Eakin, B. L., Kerr, M. J., & Early, M. R. (1999). Effectiveness of an Intervention to Increase Construction Workers' Use of Hearing Protection. *Human Factors*, *41*(3), 487–494. https://doi.org/10.1518/001872099779610969

Marlenga, B., Linneman, J. G., Pickett, W., Wood, D. J., Kirkhorn, S. R., Broste, S. K., … Berg, R. L. (2011). Randomized Trial of a Hearing Conservation Intervention for Rural Students: Long-term Outcomes. *Pediatrics*, *128*(5), e1139. https://doi.org/10.1542/peds.2011-0770

McCullagh, M. C. (2011). Effects of a low intensity intervention to increase hearing protector use among noise-exposed workers. *American Journal of Industrial Medicine*, *54*(3), 210–215. https://doi.org/10.1002/ajim.20884

McCullagh, M. C., Banerjee, T., Cohen, M. A., & Yang, J. J. (2016). Effects of interventions on use of hearing protectors among farm operators: A randomized controlled trial. *International Journal of Audiology*, *55*(sup1), S3–S12. https://doi.org/10.3109/14992027.2015.1122239

NIOSH. (2010). HLSim - NIOSH Hearing Loss Simulator. *NIOSH*. Retrieved from https://www.cdc.gov/niosh/mining/works/coversheet1820.html

NIOSH. (2016). NIOSH Sound Level Meter. *EA Labs*. Retrieved from https://itunes.apple.com/us/app/niosh-sound-level-meter/id1096545820?mt=8

Noar, S. (2006). *A 10-Year Retrospective of Research in Health Mass Media Campaigns: Where Do We Go from Here?*(Vol. 11). https://doi.org/10.1080/10810730500461059

Statista. (2014). Causes of self-reported hearing loss among U.S. adults who had any trouble hearing without a hearing aid as of 2014, by gender. *Statista - The Statistics Portal*. Retrieved from http://statista.com/

Statista. (2018). Projected number of people with disabling hearing loss worldwide in 2018, 2030, and 2050 (in millions). *Statista - The Statistics Portal*. Retrieved from http://statista.com/

NIH. (2016). Quick Statistics About Hearing. *National Institute of Deafness and Other Communication Disorders.* Retrieved from https://www.nidcd.nih.gov/

Weichbold, V., & Zorowka, P. (2003). Effects of a hearing protection campaign on the discotheque attendance habits of high-school students: Efectos de una campaña de protección auditiva en los hábitos de asistencia a discotecas de estudiantes de educación media. *International Journal of Audiology*, *42*(8), 489–493. https://doi.org/10.3109/14992020309081519

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs, 59*(4), 329-349.

Appendix A - BAHPHL Items

1. I think earmuffs put too much pressure on my ears.
2. I believe I know how to fit and wear earplugs.
3. I do not intend to wear hearing protectors when I am in loud environments.
4. I think I can stay in loud environments without it hurting my hearing.
5. I think wearing hearing protectors every time I am in loud environments is important.
6. I wear hearing protectors whenever I am in loud environments.
7. Hearing protectors are uncomfortable to wear.
8. My friends don’t wear hearing protectors.
9. I am not sure how to tell when earplugs need to be replaced.
10. Losing my hearing would make it hard for people to talk to me.
11. I believe that my ears eventually ‘get toughened’ to noise, so they are less likely to be damaged by it.
12. I know when I should use hearing protectors.
13. I believe exposure to loud noise can hurt my hearing.
14. I am convinced I can prevent hearing loss by wearing hearing protectors whenever I am in loud environments.
15. I think my hearing is being hurt by exposure to loud noise.
16. Hearing protectors limit my ability to communicate with others.
17. I don’t think it would be such a big handicap to lose part of my hearing.
18. If I wear hearing protection, I can protect my hearing.
19. Wearing hearing protectors is annoying.
20. My friends think it is a good idea to wear hearing protectors in hazardous noise.
21. I don’t think I have to wear hearing protectors every time I am in loud environments.
22. I believe that daily exposure to loud noise will eventually damage my hearing.
23. I think it would be a big problem if I lost my hearing.
24. I plan to wear hearing protection when I am in loud environments.

Appendix B - BAHPHL Subscales

*According to previous literature:

1. Susceptibility to hearing loss (items 4, 11, 13, 15, 21 and 22);
2. Severity of consequences of hearing loss (items 10, 17 and 23);
3. Benefits of preventive action/response-efficacy (items 5, 14 and 18);
4. Barriers to preventive action (items 1, 7, 16 and 19);
5. Behavioral intentions (items 3, 6 and 24);
6. Social norms (items 8 and 20);
7. Self-efficacy (items 2, 9 and 12).

*An inverse coding was applied on items 1, 3, 4, 7, 8, 9, 11, 16, 17, 19 and 21

Appendix D - Voucher

VOUCHER

You have been selected
to be part of our earplug giveaway!

Redeem your FREE pair
at the Roeterseiland Campus

On April 29 between 1:30pm and 2:30pm
by the piano in De Brug

Bring a screenshot of this voucher.

Roetersstraat, 1018 WD Amsterdam

Appendix D - Factor Analysis

- Behavioral intentions (items 3, 6 and 24);
  - 5 was clustered but disconsidered
    - .709, perfect, wouldn't go up
- Susceptibility to hearing loss (items 4, 11, 13, 15, 21 and 22);
  - 17 was clustered but disconsidered
  - 13, 15 and 22 were not clustered
  - no clear reason for 22 not to show up
  - 13 (when replaced) 15 (toughened) were specifically targeted at occupational population
    - .786 (no delete needed)
- Barriers to preventive action (items 1, 7, 16 and 19);
  - all clustered
    - excluded item 1, survey traction and confusion as to what the word "earmuffs" meant. from .618 to .719
- Severity of consequences of hearing loss (items 10, 17 and 23);
  - pattern clustered all
    - can't use, .482, couldn't be improved
- Social norms (items 8 and 20);
  - pattern clustered all
    - .509, could not be improved
- Benefits of preventive action (items 5, 14 and 18);
  - 5 was not clustered: every time
    (more targeted at the occupational population)
    - can't use .464, couldn't be improved
- Self-efficacy (~~items 2, 9 and 12~~).
  - not clustered in the factor analysis
  - and furthermore, its reliability was very low .066

Appendix E - Correlations

- Weak correlation between susceptibility and benefits of EP use;
    - .28**
- Weak correlation between tinnitus and barriers to EP use
    - -.28**
- Weak correlation between susceptibility and barriers to EP use;
    - .23*
- Weak correlation between susceptibility and severity;
    - .22*
- Weak correlation between barriers to EP use and social norms
    - .23*
- Weak correlation between barriers to EP use and benefits of EP use
    - .23*