Redesigning Earplugs: Issues Relating to Desirability and Universal Access

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Abstract. Young people growing up with increasing social noises face the risk of hearing damage because of their long term exposure to loud music. Few hearing protection products on the market were designed for this young market. The challenge was to design earplugs that appeal to 18-30 year olds with a focus on desirability. Using personas and scenarios as tools, design students at Brunel University developed a range of creative concepts for aesthetically pleasing earplugs. The project illustrates that by focusing on desirability and key issues of universal access (i.e. diversity of users, tasks and contexts), a medical type of product could become as popular as fashion accessories, thus appealing to the mass market.

1 Introduction

Noise levels in social places in the UK have tripled since the early 1980s. This means that people are prone to the exposure of loud noise in our daily lives more than any generation before us. Exposure to loud noise such as in nightclubs or gigs where loud music is played can cause permanent hearing damage. Over the course of 2002, 15.7 million people visited the UK's 1750 nightclubs to enjoy themselves dancing to their favorite music [3].

Unfortunately, many of the clubbers (who are typically from the 18-30 year olds age group) do not realize that the very thing they love could be causing them harm [2]. Research conducted by RNID, the leading charity for deaf and hard of hearing people, showed that of the 66% of 18-30 year olds who regularly go to clubs and gigs, 73% have experienced ringing in their ears or dullness of hearing – a warning sign of permanent hearing damage. Moreover, the majority of the same group did not know that hearing damage is irreparable or how to look after their hearing [2].

Aiming to raise awareness amongst music fans of the dangers of over exposure to loud music and advise them on how to listen to loud music safely, the RNID launched a campaign 'Don't Lose the Music' (http://www.dontlosethemusic.com/) in May 2003. As part of the campaign, the attitudes of the 18-30 years old towards protecting their hearing were investigated. It was found that only 3% of people wear earplugs in

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a regular/occasional basis. Despite the fact that a range of hearing protection products is available on the market, few were designed for the young (18-30 year olds) at music events.

Based on the experience of an earlier project: Hearwear – the future of hearing (http://www.designboom.com/contemporary/hearwear.html), the RNID believes that a radical change in the design of hearing protection products has to occur, that is, focusing on 'desirability' rather than 'disability'; focusing on 'design innovation' rather than 'medical protection'. With this belief, the RNID created a design brief: redesigning earplugs to suit the 18-30 year olds market. This paper describes how a group of design students at Brunel University answered this challenging design brief, and how the project addresses issues relating to desirability and universal access.

2 Background

A preamble of this design project is Hearwear – a joint effort of the RNID (the UK's leading charity representing 9 million deaf and hard of hearing people), Blueprint magazine (an international commentator on contemporary design), Wolff Olins (a brand consultancy) and the V&A (a museum of art and design). In 2004 the RNID, in partnership with Blueprint and Wolff Olins, commissioned fifteen of the UK's top contemporary designers to design desirable and innovative hearing products, with the aim of making hearwear as acceptable as eyewear. Many interesting design concepts were generated, ranging from jewelry-style hearing unit that can be customized according to the user's outfit or mood to futuristic sound control devices that 'select' pleasant sound and 'mute' unpleasant noise. These concepts were displayed in the V&A from July 2005 to March 2006 and generated a large amount of media and public interest. More information about the Hearwear project can be found from websites (e.g. http://www.vam.ac.uk/hearwear/) The earplug project can be seen as a natural extension of the Hearwear project.

2.1 Related Studies

The RNID had commissioned/conducted several related studies for the earplug project.

The first study was a national survey conducted in October 2002. The aim was to collect information from young people about their social activities, and in particular whether they had ever experienced hearing difficulties, their levels of concern about potential damage to hearing as a result of social activities, and their understanding of hearing damage. 1,400 16 to 30 year olds across the UK were asked to answer questions about their hearing and their social activities. In terms of earplug use and attitudes to it, it was found that:

only 3% of people wear earplugs on a regular/occasional basis
18% of people have never worn earplugs but would consider doing so
34% of people think earplugs look silly and would not consider wearing them
28% of people like loud music so would not wear earplugs
24% of people rarely go clubbing so do not think wearing earplugs is important

It was also found that people who go clubbing more frequently were more likely to show resistance to wearing earplugs.

The second study was a survey of nightclubs across the UK. To get an idea of what noise levels the UK's clubbers are exposed to on an average night out, RNID commissioned a survey of 15 nightclubs around the country. Between December 2003 and March 2004 noise levels were tested in three nightclubs in each of the following cities: Belfast, Cardiff, Edinburgh, London and Manchester. It was found that noise levels were highest on the dance floor – on average between 90-110dB(A). Even in the 'chillout' area, the average noise level ranged from 81-96dB(A), on average 12 decibels higher (or 16 times the sound energy) than the 80dB(A) average recommended by RNID.

The third study was conducted by RNID in April 2006. Six focus groups containing 6 to 10 people aged 16 to 30 were run in London, Glasgow, Birmingham, Manchester and Southampton. It was found that 'lack of knowledge', 'concerns about look', and 'practicalities' were main reasons for not wearing earplugs, for example:

Lack of knowledge:
"…I'm not really aware on what are the best types of earplug to use…"
"People think that if you wear earplugs you can't hear anything at all…"

Concerns about look:
"…I don't wanna walk around with things sticking out my ears…"
"…that looks like an older person's hearing aid or something…It looks like NHS prescription. Horrendous."

Practicalities:
"…it (the earplug) is quite small…I look at it and think 'That's gonna get lost'…"
"…I've just put off getting them (earplugs) for ages cause I keep forgetting…."

2.2 Design Brief

RNID's analysis of earplugs on the market reveals that current earplugs are not designed with aesthetics for fashion in mind, in fact there is no ear protection product on the market that has been directly designed and marketed at the 18-30 year old music loving demographic.

Backed up by the research findings and the market analysis, the RNID created the following design brief:

"The main aim of this project is to turn a medical product into a desirable one.

Your brief is to design a manufacturable concept for an earplug of the future, a product that young people will actually want in their lives.

Your product needs to target 18-30 year olds. Your product needs to protect hearing but not look like a protective 'safety' product.

Packaging and marketing issues should also be considered and they should inter-link with the actual concept to produce a whole product."

3 Method

The brief was given to the first-year design students at Brunel University, as a design project within the 'Design Process' module. It last for five weeks:

- 1st Week: briefing and introduction to relevant research methods: 'personas' and 'scenarios; Hierarchical Task Analysis (HTA), Link and Layout Analysis (LLA)
- 2nd week: Guest lecture (from the RNID Product Development) on hearing loss, hearing protection, basic technical data and the role of product design; group tutorials (personas, scenarios, HTA, LLA)
- 3rd week: Lecture on Detail Design; group tutorial (design concepts)
- 4th week: Further development of the concepts, 2D and 3D sketching
- 5th week: Presentation (Two A3 display boards) and submission of development work.

It was expected that students spend on average six hours per week on the project.

3.1 Research Methods

For this project, students were introduced to two popular design tools, i.e. 'personas' and 'scenarios' and a couple of relevant methods in ergonomics: Hierarchical Task Analysis (HTA), Link and Layout Analysis [6].

Personas are hypothetical archetypes, representing real people throughout the design process. They are defined with significant rigor and precision, backed up by actual user research data [1]. Since the earplug project was focused on the 18-30 year olds market (a diverse market), it would be beneficial for the students to further break down the market through developing 'personas', so that their design concepts can be more focused on a certain type of users within the targeting audience. 'Scenarios' can be used to describe natural, constructed or imagined contexts for user-product interactions [7]. Defining a typical use 'scenario' for the persona will help the students to understand the context of use (the physical, social and cultural environment) and identify a range of issues relating to earplugs (for example, carrying, unpacking, wearing, dealing with 'dropping' or 'missing' situations, purchasing etc) .

Task analysis is a process by which detailed information is gathered from users about what they are required to do, in terms of action and/or cognitive processes, to achieve a task object. More simply, it is used to gain an understanding of what people do in the tasks and jobs they carry out [4]. Using Hierarchical Task Analysis (a technique of task analysis), an instance of the scenario will be further broken down into a hierarchy of goals, operations and plans – this will help the students to identify 'pinch' points – the most challenging part within the hierarchy, and help them to understand the interlinks between the goals and operations. Link and layout analysis are introduced as visual tools to help analyse the eye and hand movement associated with using earplugs.

Many students developed 'personas' based on themselves or their close friends. To emphasize the importance of 'designing for others' rather than 'designing for yourself', a dozen 'personas' were selected, and the students were asked to choose

one of the personas from the list and modify their scenarios based on the chosen persona. Each persona has a title, a text description and a visual expression, and an example is given below:

Title: "Singleton"

Text description: **"**Sophie Palmer, 26. She's a bit like Bridget Jones. She's got a decent job and lots of girl friends. She drinks a lot, for confidence, and goes clubbing to find the perfect man – Jamie Oliver if he's available. Fashion's a big thing. Lots of shoes and completely different looks for work, clubbing and casual."

Visual expression (Fig.1):

Fig. 1. Persona: "Singleton"

4 Results

The students developed a wide range of solutions: in addition to exploring new forms of earplugs, many of them explored state of the art technologies. Three people from the RNID were invited to give independent judgment. The judges from the RNID particularly liked concepts which are simple, manufacturable and marketable. Concepts that make effective use of existing technologies and simple mechanical controls are preferred to those with more complex technologies.

Table 1. Top ten concepts selected by the judges from the RNID

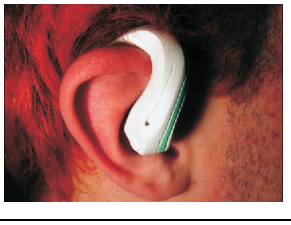
Design concepts	Key features
Trojan Horse 	The idea was to fuse ear protection with entertainment; this was achieved by adding earphones inside the earplugs. To reflect the music playback feature of the earplugs, a row of LEDs was added which reacts to sound in a similar way to how a sound bar graphic reacts to music. The user can select input for the LEDs: the surrounding sound or the music he or she is currently playing through the earphones.

Table 1. (*continued*)

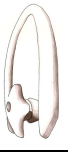
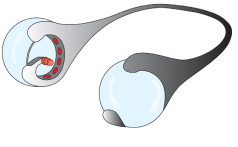
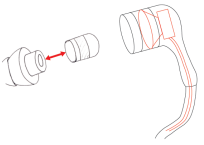
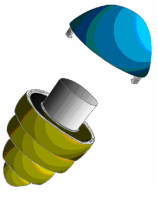
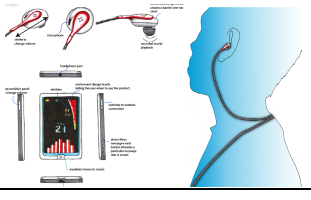
Shutter 	The sound waves are directed through the filter or tunnels by mechanical shutters like in a camera shutter. The level of filtration is adjusted using a Bluetooth connection with a remote bracelet worn on the user's wrist. This is attached to an earphone shape plug that sits inside the ear. The plug is then attached to a wrap around style clip that goes round the back of the ear and connects together at the bottom to keep the earplug secure in the ear.
Speech Marks 	The design is to facilitate the transition between loud music listening, and out of the way conversations. This is achieved via the use a magnetic inner material inside both the ear bud and the bracelet, in which direct contact between the two would be sufficient enough to safely remove the ear bud off the ear and onto the wrist quickly and effectively.
HEAR + 	By wearing the wristband, microphone and headset you are connected to your friends, the bar and the band. Touch your hear + against the receiver pads on the bar and the barman will be able to hear your every word. Being on the same group network you can talk to your friends in crystal clear sound. If music in the venue is too loud simply turn down the volume on your wristband. Touch your band to others to add new friends to your group.
Glow Plug 	Glow Plug could be bought when required and then easily be disposed, like glow sticks. They fit snugly over the ear, incorporating the filter which is placed in the inner ear. When "cracked" it begins to glow, generating atmosphere and excitement for the user and those around them.
Sonic Eardrums 	Bold and brash hearing protection device. The design has two Perspex domes covering the ears which are lit up with a series of LED's inside the head band. There is a simple ear seal to block out the ambient noise; these are fixed into the headband so it isn't fiddly putting them in. The head band wraps around the head creating the main feature of the design, and also keeps the earplugs in the ear.

Table 1. (*continued*)

SOUND bud 	Earphone and hearing protection: two in one solution. Simply clip on the end cap to the bud and put them in your ear. A variety of end caps are available to match your mood. The speaker bud channels the music directly into your ear, blocking out background noise and enhancing the music.
Rock-Ears 	Rock-Ears are ordinary sealed ear plugs, but have a face on the end of the plug. The face of the ear plug is a lot of surface area to look at. That is why the product colours would come in black, orange, red, purple, and many others. The reason is to be proud to wear earplugs by making a fashion statement and support a band. The face offers surface area to brand band names/logos or anything written.
Party Plugs 	The Party Plugs have a built in microphone sensor, continuously monitoring sound/noise levels and sending signals to mobile phones via Bluetooth. The user act on the information by using the volume keys on the phone to increase attenuation. They can also change the covers on the Party Plugs to match the colour of their clothes: keeping up with the latest fashion and look cool!
Valve 	A device that cancels the damaging loud noise from the outside and replaces it with a lower volume of sound. There is also a feature that helps the user communicate in the form of text instead of sound, which is very hard in noisy environment. This can allow the user to display messages such as his name to a new friend, the drink they like to the bar man.

5 An Example

In this section we look at a detailed design example: "Speech Marks" (Table 1, item 3) designed for the persona "Sophie Palmer" (Fig.1)

The student first analysed the persona:

"Lots of girlfriends" – always on the phone to her mates if not MSN, gossiping and chatting about everything!
"Drinks for confidence" – occasionally will drink too much and lose track of things.
"Clubs to find the perfect man" – needs to chat as well as dance, not to mention look good!

"Fashion's big for Sophie" – has good fashion style, and tends to wear top brand names.

Then he applied the Hierarchical Task Analysis (HTA) tool to analyse a typical clubbing experience of the persona, identified the scope and nature of tasks. His creative use of HTA also helped him to identify potential selling points of the earplugs, advertisement points, and chances for recycling the products.

The Link and Layout Analysis (LLA) was used to identify a series of design issues arising from specific scenarios based on the characteristic of the persona:

- "At a nightclub Sophie may need room up to a forearms length in order to insert an earplug. This could be an issue at a nightclub as sometimes the surrounding area and personal space can be limited. Such a problem could make it difficult to use current market earplugs as well as bothering nearby clubbers" – Question: can the product be designed with a minimal of physical movement in order to operate?
- "For most women like Sophie a certain problem arises in using earplugs at particular times. For instance: how would Sophie access her earplugs and use them accordingly if she was holding her handbag and her drink? Could she put them in safely and securely without having to find a table to put things down on? Or perhaps go to the toilet, but then what if she wanted to take them out to chat?" – Question: can the product be designed to be used with minimal effort, or retrieved and equipped with one hand or less?
- "One of many similar situations is stopping to talk or to go to the bar. These earplugs must be easily removable for Sophie in order to tell the bar staff or her friends what she wants to say. After that she can then reuse them and begin dancing once again." – Question: can the product be designed for the period of communication in between – or – while being in use?
- "If Sophie was to use earplugs when clubbing they would need to operate safely and securely while under going various speeds and styles of movement. Due to the size of earplugs, it must be ensured that they would not fall out and end up lost if Sophie was to 'head dance' to her favorite tune, or impress a bloke she likes with her dancing skills" – Question: can the product be designed to withstand varied motion and turbulence?
- "One other thing is that Sophie likes to drink for confidence. If she was to get too drunk would she be able to insert, remove and store her earplugs in an intoxicated state"? – Question: can the product be designed to tolerate unconscious use?

The solution was 'Speech Marks' which has the following key features:

- Safety with style – the product offers a wide variety of colours and accessories just like any other type of clothing – why should safety be limited?
- Wild and vibrant looks – perfectly suit clubbers who enjoy expressing themselves
- Precaution with function – ensures that a user is protecting herself from hearing damage with little change to her normal routine – whether it be ordering drinks, gossiping with mates or flirting with others.
- A premoulded silicon exterior – provides a comfortable fit for the users while its magnetic interior allows it to operate in its unique manner.
- Speech mark shapes – going to clubs is more than about listening to music – chatting is paramount.

- An easy to use interface – simply touch the magnetic bracelet to the ear, and the earwear is safely stored on the bracelet until required later.

A scenario featuring Sophie's use of the 'Speech Marks' is illustrated in Figure 2. The story goes that "Sophie tried out the new earwear. She was able to quickly and confidently remove them using the bracelet on her arm while she was approached by a man and talked to him easily. She did not need to worry about losing track of her earplugs as they were safe on her wrist. When she had finished talking she took the earplugs from her bracelet, quickly snapping them into place. While dancing the rest of the night with her new friend, she could be assured that her ears were safe. "

Fig. 2. Scenario: Sophie Palmer using 'Speech Marks'

6 Discussion and Conclusions

As the design brief emphasized, the redesign of earplugs should focus on desirability. The students' work has largely been focused on visual elements – a key factor to make earplugs appealing to the young 18-30 year olds market. Traditionally earplugs are designed to be discrete, neutral looking. The new approach is to make the earplugs eye-catching and customizable. Using a variety of shapes, colours, materials, advertisements, decorations, earplugs become collectable items. Some form exploration is revolutionary, for example, 'Shutter' (Fig 3, also see Table 1, item 2) has totally changed the image of hearing protection devices which tend to look like barriers/filters between the user and his sound environment; its form gives a fantastic visual representation showing that communication is 'open' – the sound is being 'sucked in' rather than 'blocked out'.

According to the RNID's organizers of Hearwear project, 'form' creation for earplugs was a real challenge for the professional design companies involved in that

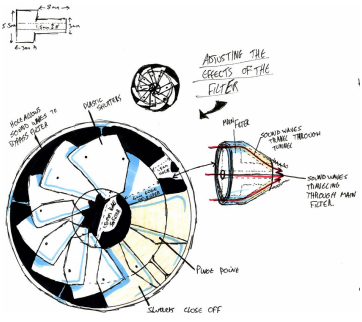


Fig. 3. 'Shutter' – 'sucking in' rather than 'blocking out'

project. The RNID is very satisfied with the wide range of visual ideas Brunel design students came out with in this project.

The RNID project has addressed all the key issues of 'Universal Access', i.e. coping with diversity in (i) the characteristics of the target user population; (ii) the scope and nature of tasks; and (iii) the different contexts of use and the effects of their proliferation into business and social endeavours [5].

Using personas as a tool, the students were able to focus on the specific characteristics of their target user population. HTA and LLA helped the students to understand the scope and nature of tasks and their interlinks; and scenarios were effective in visualizing different contexts of use. These are well illustrated by the example given in Section 5.

In summary, the personas helped the designers to focus on the user characteristics, the HTA and LLA helped identify the tasks involved, and scenarios contributed to the analysis of the context of use. The project illustrates that by focusing on desirability and key issues of universal access (i.e. diversity of users, tasks and contexts), a medical type of product could become as popular as fashion accessories, thus appealing to the mass market.

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