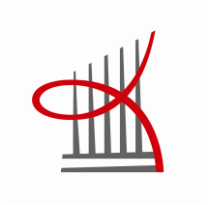

# OPTIMIZING VIDEO GAMES FOR THE HEARING IMPAIRED

## The use of haptic feedback and visual cues in games

Heidi Mäenpää

Bachelor's Thesis
May 2014
Degree Programme in
Media and Arts

TAMPEREEN AMMATTIKORKEAKOULU
Tampere University of Applied Sciences

## ABSTRACT

Tampere University of Applied Sciences
Degree Programme in Media and Arts

HEIDI MÄENPÄÄ:
Optimizing video games for the hearing impaired
The use of haptic feedback and visual cues in games

Bachelor's Thesis 61 pages, appendices 10 pages
May 2014

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The purpose of this thesis was to see how games can be optimized for the hearing impaired users without adding greatly to the development costs. The objective was to collect data on the target group's gaming habits and explore ways haptic feedback and visual cues could be used in games. Based on the findings the aim was to create a sound-based puzzle game and optimize that to the hearing impaired gamers.

The initial research data was collected from 28 people in an online survey. The results were analysed using qualitative methods to visualize the findings and quantitative methods to get specific statistics. The data from game testing was collected in the field from 10 people. The theoretical section of the thesis goes through the definitions of the hearing impaired, video games, sensory information, subtitles and the collected research data. The practical part focuses on the optimization of existing games and the creation of a new game.

The majority of participants believed that current video games were lacking in their use of subtitles and the ways they were optimized for hearing impaired users. At the same time most were also willing to pay for better subtitles. The majority also wanted to have haptic feedback in their games. These results suggest that there is a market for more optimized games if the game developers are willing to answer the consumer demands.

The findings indicate that the video game industry is behind in providing accessibility compared to other entertainment industries. As the game industry grows it is imperative to prevent further inequality between players and start taking measures against ability-based discrimination. Further research is necessary to create unified systems all game developers can use to make sure their games meet the requirements of hearing impaired players and those with other disabilities. Furthermore, developing a universal and mandatory accessibility rating system for all video games would promote gamer equality and raise awareness of the accessibility issues in the industry.

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Key words: video games, haptic feedback, touch, deaf, subtitles

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## ABBREVIATIONS AND TERMS

| | |
|---|---|
| AAA | Triple A, high quality games which have the highest development budgets and levels of promotion |
| AIR | Adobe Integrated Runtime, a cross-platform runtime system, which supports the execution of computer programs |
| CC | Closed captioned subtitles |
| Cinematics | In-game movies where the player has little or no control over the events, used to advance the plot of the game |
| CPU | Central processing unit which carries out the computer's performance |
| DGC | Deaf Gamers' Classification system |
| Flash | Adobe Flash multimedia program. |
| GM | GameMaker: Studio, video game development software |
| iOS | Apple hardware exclusive mobile operating system |
| Mac | Macintosh computers and operating systems made by Apple |
| Niche market | Subset of a market, which a product is focusing on |
| PC | Personal computer, usually referred to as a computer running Windows or Linux operating system |
| Pixelation | Event where pixels become easily visible |
| Retention rate | The rate of gamers who actively come back to the game |
| Sans-serif | A font without small projecting features at the end of strokes |
| SDH | Subtitles for the Dear of Hard-of-Hearing |
| Texture Atlas | A collective file for all 2D graphics used in a video game |

# 1 INTRODUCTION

As the world's population gets older more and more people will suffer from hearing loss. The video game industry also grows every year and gains even more customers. Modern video games seem to be lacking especially in the area of subtitles since no unified guidelines for them exist outside television and film industry. This thesis aims to find out the difficulties hearing impaired players face when playing video games and how those difficulties can be avoided in the future.

The thesis explores how subtitles, haptic feedback and visual effects are used in video games and how those can be edited to enhance the gameplay experience for the target audience. Due to the vast variety of optimization options and budget restrictions, the research focuses on feedback instead of player input. The goal of this thesis is to explain to game developers how video games can be made more accessible towards hearing impaired players and why they should take them into consideration.

The thesis goes through the minimum steps that are required to make a game optimized and demonstrates various ways how this can be accomplished. All optimization examples aim to be low budget options. The thesis also follows the development process of a sound-based puzzle game and explores how taking optimization into consideration from the beginning of the production changes the way a game is designed.

Interviews were conducted to find out the biggest obstacles the target group faces in video games and see if the players would be willing to pay for optimization. The Finnish Association of the Deaf also took part in this thesis and published the online survey on their website.

# 2 THE DEAF AND THE HARD-OF-HEARING

## 2.1 Overview

According to the Free Dictionary, a deaf person is someone who is completely lacking in the sense of hearing, while a hard-of-hearing person has a diminished or defective sense of hearing, but is not completely deaf (Deaf 2009). A collective term for these both is hearing impaired. Accommodation practises for the hearing impaired are visual, such as sign language, lip reading or captioning (Deaf or Hard… 2014, paragraph 1). Sign language uses manual communication with body language to convey meaning instead of acoustically conveyed sound patterns like in spoken languages (Sign language 2014). Ethnologue lists 135 Deaf sign languages currently being used in the world (Language Family 2014).

Statistics published by Professor Frank R. Lin and Professor Sophia E. Kramer (2013, 2—5) show that today nearly 600 million people are suffering from hearing loss globally. Due to the global population growing and aging, this figure is expected to rise to 1.2 billion by 2050. According to the United Nations, the global population will grow from 6.9 billion in 2010 to 9.3 billion by 2050, and people aged 60 or older will reach 21% of the total population, which equals nearly 2 billion people. The number of young people with hearing loss has also risen by over 30% in the last 20 years, mainly due to the increased use of portable music players equipped with headphones and in-ear headphones often used on too loud volumes. Hearing loss caused by diabetes is also on the rise. Adults aged 20-69 with diabetes have a 21% chance of having hearing loss, while adults without diabetes only have a 9% chance. (Kramer, S. & Lin, F. 2013, 2—5.)

The documentary film Sound and Fury (2000) reveals that, despite the increase in people suffering from hearing loss, the amount of completely deaf people is decreasing. This is mainly because of cochlear implants, robotic hearing aids using latest technology, which are surgically inserted inside the brains of children who are suffering from hearing loss at a very young age. (Sound and Fury 2000.)

## 2.2 Prejudice and Audism

The term audism is used to describe prejudice or discrimination towards people with an auditory condition. A non-hearing person is in many situations often only seen as a disabled individual in need of a cure for their condition and regarded as less intelligent than a hearing person. The culture of the hearing is also often seen as superior to the non-hearing culture. (Barth, M. & Manera, C. 2004.) Many parents seem to be afraid that their children will be outcasts in the midst of hearing people, especially if they are hearing themselves (Sound and Fury 2000).

## 2.3 The Non-Hearing and Gaming

According to observations on the discussions on Deaf Gamers Community, AbleGamers Forum, and Deaf Gamers Network Facebook group, the gaming culture of the hearing and the non-hearing do not differ very much. Despite having next-to-no games being made the hearing impaired in mind, it does not seem to discourage them from playing video games. This is most likely related to the fact that they are used to being a minority and, although perhaps entitled to it, do not expect equal treatment from game developers. However, the non-hearing gamers do rank games and send complaints to developers if a game is inaccessible to them.

Many hearing impaired gamer is also using external hardware, such as the ButtKicker products, to boost their gaming experience. ButtKickers are silent subwoofers that use existing audio signal to deliver powerful, musically accurate, inaudible bass through the players' seats which allows them to feel the crashes, racing engines and special effects occurring in games (ButtKicker 2014).

### 2.3.1 Community

There are many different communities for the hearing impaired gamers, most of them formed around specific games. There are also general pages, such as the Deaf Gamers Community and Deaf Gamers Network, which are active and easy places to connect with other hearing impaired gamers. People often promote their guilds, events in games

or share game development news with each other. There is also a vast amount of self-promotion from game streamers and reviewers who use sign language in their videos. Specific social media channels for the hearing impaired can be found for example from Facebook, Twitter, Twitch and YouTube.

### 2.3.2 Game Accessibility Rating Systems

Deafgamers.com uses Deaf Gamers Classification to rate video games based on their subtitles and overall accessibility for the hearing impaired (Deaf Gamers Classification 2014). Currently there is only one game that has gotten the highest grade A. The rating system can be seen below in table 1.

TABLE 1. Deaf Gamers Classification system, DGC.

| Grade | Qualifications | Example Games |
|---|---|---|
| A | -Captions, subtitles and visual clues in every part of the game<br>-Color-coded subtitles<br>-Choice to alternate text speed | Half-Life 2 |
| B | -Subtitles for all important parts of the dialogue<br>-Clear about player's objectives<br>-Player must be able to follow the story<br>-Does not have captioning | Shadow of the Colossus, Alan Wake |
| C | -Playable without any real difficulty<br>-Is not fully subtitled (e.g. cutscenes)<br>-Makes player miss out on the game's story | Dragon Age II, Fable II |
| D | -Huge lack of subtitles either in-game or in cutscenes<br>-General lack of visual feedback<br>-Playing the game through feels more like hard work than enjoyment | Ico, Halo 3 |
| E | -Impossible to play<br>-No way of knowing the game's objectives or story<br>-Games that rely on the ability to hear | Machinarium, The Sly Trilogy |

Unfortunately both deafgamers.com and deafgamers.net have been closed temporarily earlier this year. Copies of already rated games can still be found as archive pages.

Another rating system for video games exists on AbleGamers.com. The AbleGamers Foundation is a non-profit organization which provides support for disabled gamers. They recently raised over 33 thousand dollars from big and small game developers at PAX East 2014, a well-known gaming festival held in Boston, Massachusetts. (AbleGamers raises… 2014.) Due to their site taking into account many disabilities, it is not as comprehensive as the DGC system. It rates the game's accessibility from 0 to 10, ten being the maximum. The site also has an advanced search option where you can find ratings based on certain disability and whether the accessibility of those games is good, mediocre or bad (Game Reviews 2014).

### 2.3.3 Game Developers and Non-Hearing Accessibility

Valve is one of the only big game development companies who are actively trying to improve the gaming experience for the hearing impaired. Clarke (2011) writes that after a series of complaints directed at Valve's Half-Life game for being completely inaccessible by non-hearing gamers they developed their subtitles and visual cues for the following title Half-Life 2. The game was the first and only one to receive the highest DGC score (Half-Life 2 PC… 2014). According to McWhertor (2009), Valve has also begun researching the use of sign language in games. The difficulty comes from there being many sign language variations across the world, hence the cost of developing systems that support it easily rise too high to make profit with it.

The emotion sign language is able to convey to a non-hearing person compared to text is enormous. Utilizing sign language in games would take the hearing impaired player's gaming experience to an entirely new level. Seeing characters move their lips on the screen and waiting for subtitles to appear is far from fully understanding the mindset and emotional state of a character. Madigan (2012) writes about the emotions The Walking Dead (2012) by Telltale Games is able to convey to the players. This is mainly thanks to their ability to animate the faces and body movements in a way that the emotion is mirrored by the player (Madigan, J. 2012). Without sign language the animation of a character's face and its ability to express feelings becomes a crucial

factor in making the game immersive for the hearing impaired users. When a character's voice is desperate a hearing person most likely understands it even if the character's movements and expressions do not completely match that emotion. The emotions are only conveyed to the non-hearing player if the face and body of the character seen in the game displays desperation through its animation. In the screenshots from The Walking Dead (2012, picture 1, picture 2) the game's character Clementine has to shoot her beloved friend Lee by his request before he turns into an undead. Without using words the animation is able to convey a wide range of emotions from the moment Clementine decides to follow up on the request to the moment she takes the shot.

PICTURE 1. Clementine is grudgingly preparing to take the shot. (Source: The Walking Dead Episode 5: No Time Left)

PICTURE 2. Lee is waiting to be shot by Clementine. (Source: The Walking Dead Episode 5: No Time Left)

In the most optimal situation both sign language and excellent animations would be used when optimizing video games. Unfortunately the current state of technology prevents this from becoming the industry standard. The research and development costs are in all probability beyond any game developer's budget for the time being.

# 3 VIDEO GAMES

## 3.1 Overview

Video games can be defined as “any of various games that can be played by using an electronic control to move points of light or graphical symbols on the screen of a visual display unit” (Video Game 2013). A more descriptive definition, according to McCloud (2009), would be saying that video games are pieces of software which display images on a video screen, interact with either one or multiple players and is intended to provide challenge and possibly produce an aesthetic response in the viewer.

## 3.2 Platforms

A platform is something which allows a video game to operate (Video game 2014). This can refer to both hardware and online services, such as Facebook. Video games are often published on more than one platform for increased audience unless it is an exclusive title to a specific platform. A good example is the game Last of Us, one of the most critically acclaimed games of 2013, which only works on Sony’s PlayStation 3 gaming console. According to a poll arranged by the Game Developers Conference 2013, the most used video game development platforms are smartphones and tablets (GDC State of … 2013, figure 1).

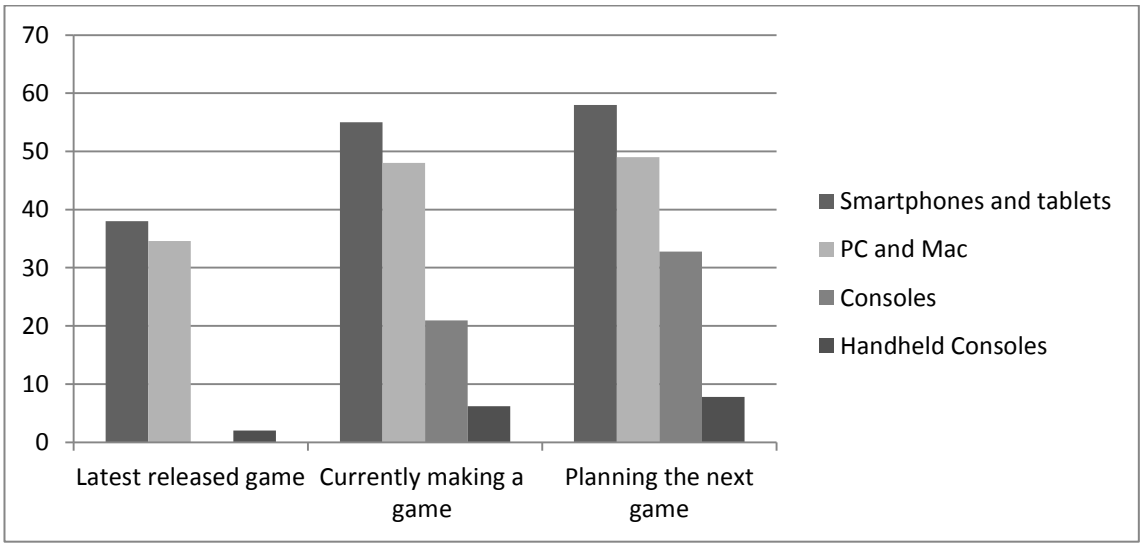



FIGURE 1. Most used game development platforms in percentages.

### 3.3 Sensory Information

Sensory information is very important to consider when wanting to get the players to immerse into the world that has been created for them. The more sensory information the game offers, the less the players' minds have to fill in while playing. For normally hearing people sound is a very important cue, but for the hearing impaired people visual world is the most important, along with the haptic one. This chapter focuses on three senses which are easy to optimize for hearing impaired users: Sight, hearing, and touch. The research also only focuses on feedback and does not include features that require player input, such as voice commands.

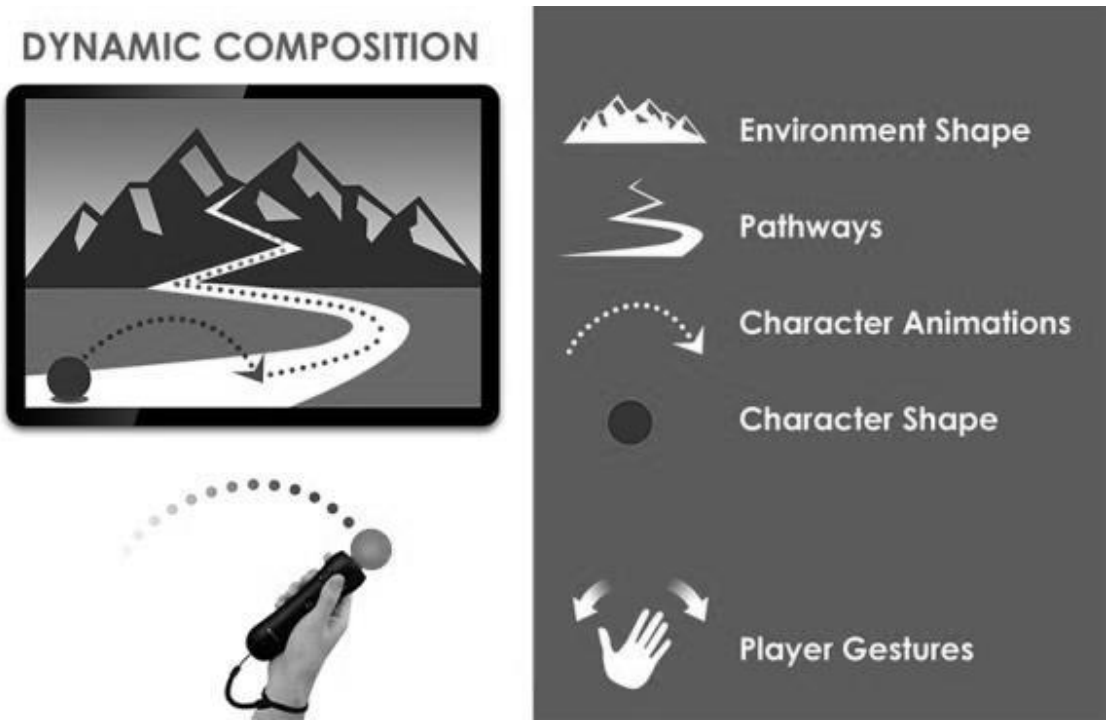
One good example of providing sensory gratification, according to Crawford (1984), is the film industry and their magnificent special effects. The explosive battles, strange places and creatures look so good that we believe and subjectively interpret the fantasy being real. But the effects themselves do not actually make the film, or game, succeed. Crawford writes, "Special effects, graphics, sound, animation – – these factors all help distinguish a good game from a bad game – – however; sensory gratification is a crucial support function, not a central feature." (Crawford, C. 1984, Chapter 2.)

Raph Koster (2005) writes, "If you put a person in a sensory deprivation chamber, they will get very unhappy very quickly. The brain craves stimuli – – This does not necessarily mean it craves new experiences – – mostly, it craves new data." (Koster, R. 2005, 42). Koster explains that an experience might cause a sensory overload, like adding sounds to a part of the game where it is not necessary. An experience, unlike small pieces of data given in the game, lays more than a pattern in front of the brain: a whole new system for it to process. The brain is very disinclined to do more work than it has to, and it might even make the player unable to feel immersed in the game if its sensors receive too much information at once. (Koster, R. 2005, 40 – 42.)

#### 3.3.1 Visuals

Visual sensory information in games refers more to the aesthetics, animations and effects than the actual quality of the graphics. Visual sensory information also includes the user interface elements and visual clues given to the player during gameplay. Weapon selection menus, health bars and indicators of enemy attacks are all encompassed in this category.

The quality of graphics steadily increase with new hardware, but without being combined with great aesthetics the game can lose the players interest very quickly. Solarski (2013) describes aesthetics in games as being composed of four elements: The character's shape, its animations, environment shapes, and pathways. The environment shape also takes into account the secondary characters and enemies. In games you often see elements which can be traced back to primitive shapes. This is because reality is visually so complex that things have to be simplified in order to make the rendering of reality easier, and in this process we are often left with circle, square and triangle shapes. The players feel a sense of connection when the gestures they do echo the shape of the character's movements. (Solarski, C. 2013.)




PICTURE 3. Character's shape and animation are imitated by the character controller. (Source: Solarski, C. 2013)

There are differences in the ways of interpreting a scene if the character and environment's shape are in harmony or in conflict with each other. This effect is often

seen in games where enemies have a sharp silhouette and the main character's features are more round. The difference can also be in the movement of the character and the enemies. Seeing the character and environment in conflict can give the player the feeling of anxiety, because, according to Solarski (2013), the conflict in shapes will make the environment feel threatening. A round object in sharp-edged environment feels more out of place than in round-edged environment, and vice versa (picture 4). To achieve harmony the shapes should complement each other. (Solarski, C. 2013.)


PICTURE 4. Character's shape is either in harmony or in conflict with the environment.

Animations of the character tell us all about how they are feeling and how they observe the world around them. Their movements can be light or heavy, or even change during the game as the story and the character evolve. Recent studies have shown that our ability to empathize with the game characters could be caused by a special mirror neuron system in the brain.

> The mirror neuron system also appears to allow us to decode – – facial expressions. Whether we are observing a specific expression or making it ourselves – – the same regions of our brain become activated – – findings suggest that the mirror neuron system plays a key role in our ability to empathize and socialize with others, for we communicate our emotions mostly through facial expressions. (Perry, S. 2008.)

So far mirror neuron tests have only been conducted on monkeys, so their existence and ways of working in the human brain are still under research (Perry, S. 2008). According to Adaes (2014), despite the controversy surrounding the mirror neurons their discovery has been one of the most important breakthroughs in neuroscience in the last two decades.

The mirror neuron system could explain why games like The Walking Dead (2012) are so emotionally difficult to watch. The characters' facial animations are extremely well done, and according to an interview made by Madigan (2012), the game's Creative Lead Sean Vanaman told that after writing the first episode they listed the emotions characters were going to feel during the game and then started to create isolated facial animations to deliver those feeling and emotions to the player.

Oculus Rift is a great example of wearable cutting-edge technology used to aid visual immersion. The Rift is described to use custom technology to track the user's head in 360°, which allows the user to look around in the virtual world as seamlessly as in the real world. The headset creates a stereoscopic 3D view which imitates the way our eyes perceive images in the real world. (Next-Gen Virtual Reality 2014.) Even though the resolution of the device is not very good due to hardware restrictions, it is a step to the right direction.

### 3.3.2 Sounds

Sounds in video games can be divided into music, sound effects and dialogue. Music in games is usually a loopable melody that has a certain theme. Depending on the size and type of a game it can have one or multiple different themes, for example idle, battle and death themes. The length can vary from minutes to seconds. The music, or the lack of it, is used to set the game's mood and atmosphere.

Sound effects are artificially created or enhanced sounds that emphasize content in games. Hard sound effects are sounds that commonly appear on screen, for instance a weapon firing and a car passing by. Foley effects are sounds that have to be made in real-time so that they are synchronized with the animation, such as footsteps. (Sound effect 2014.) In video games the hard sound effects and Foley sound effects mix since the animations often have a certain speed and it does not change during gameplay. Foley methods are needed when creating cutscenes since those are often not rendered real-time, but are built separately from the rest of the game. Ambient sounds, or background sound effects, are sounds that indicate the setting of the game to the player, for example forest sounds or the buzzing of fluorescent lights (Sound effect 2014).

Journey (2012), developed by Thatgamecompany, is a great example of both background music and sound effects working seamlessly together with the graphics of the game. The game itself is an audio-visual experience which does not contain any dialogue, and yet is able to convey feeling and meaning to the player (picture 5).

PICTURE 5. Journey is a seamlessly working audio-visual experience. (Source: Journey 2012)

The Blind Monks Society (2008) is a Half-Life 2 modification where the player's actions in-game are based only on sounds they hear around them, preferably from headphones. The game can be used on mobile phones to track the movement of the player in 3D space allowing an even more immersive experience.

Dialogue, according to Bridgett (2009), is perhaps the most important aspect of sound in cinematic video games and one of the most often criticized parts in game reviews. The quality of dialogue can easily make or break a game, including the choice of actors selected to read the parts and the synchronization between the picture and audio. In bigger game productions dialogue consists of story dialogue, in-game dialogue and scripted mission dialogue. (Bridgett, R. 2009.)

Modern games often use positional audio, a technique in which the sound source is directly placed in the game and can be heard in 3D space. In Alan Wake (2010) sound

effects and changes in music would be triggered when stepping into invisible areas in the game world. The effect it creates works best when using headphones or surround-sound systems.

### 3.3.3 Haptics

Haptic feedback is information given through mechanical changes in a device, which is observed through the sense of touch as vibrations. It also includes vibrations caused by sound waves in a gaming device or other equipment. Haptic feedback makes it possible to simulate physical features like mass, hardness or texture, and it is also a very effective in making our reaction time shorter (Kortum, P. 2008, 30). There are many immersive features the feeling of touch can bring into games, in addition to using sounds and visuals. The sense of touch is one of humans' most informative senses, so the amount of feedback it is able to process is also vast (Kortum, P. 2008, 25). According to Kortum (2008, 31), the smallest difference a human is able to notice in their finger joint positions is 2,5%. This means that the vibrations have to be strong enough, but not too strong for players to feel overwhelmed by them and lose the feeling of immersion.

According to Immersion Corporation, the immersion is easier to achieve if the audio, visual, and haptic feedback elements of a game are well-synchronized and as realistic as possible Immersion Corporation writes that in order to not overdo the haptic feedback the developers have to consider playing only one effect at the time. (Best Practises for… 2010, 14).

> Just as too many beautiful sounds played simultaneously become a cacophony, too many compelling touch effects played together or too close to each other can overwhelm the player. Each individual sensation will lose its impact, and the gamer will tire of the feature because it has stopped contributing to the experience. – – In some situations – – play one effect – – or one well-synchronized complex effect – – at a time. (Best Practises for… 2010, 14.)

Similar to any other sensory feedback feature in games there also should be an option to turn off haptic effects. Because of the hardware the vibrations often make sounds, which is not always desirable.

### 3.4 Single-Player and Multiplayer Games

Single-player games are probably the most common form of games. In single-player games the player acts on their own, and their decisions are solely theirs. Koster (2013) writes that recently the rise of online-connectivity and more social gameplay has caused the erosion of the pure single-player experience to accelerate. There are increasingly more multiplayer features in single-player games, and sharing gameplay sessions online is becoming more common (Koster, R. 2013). Some single-player gamers are commercializing their gaming and by sharing their videos get publicity and gain money from advertisers.

Multiplayer games can range from two players to thousands of players playing a video game at the same time. This mostly requires a network connection, but some games also give you the opportunity to play with others locally and offline. Multiplayer games vary from working towards a common goal to fighting against everyone playing the same game.

Koster (2013) predicts that in the future single-player games will become more of a service than a product, and might eventually vanish completely. Across the centuries it has always been natural for humans to play together, and as time passes and technology evolves it wouldn’t be a big surprise to see video games turn more into multiplayer games from single-player games.

# 4 SUBTITLES

## 4.1 Overview

Subtitles are textual versions of a monologue, dialogue or commentary seen in television programs, films, or video games and is typically displayed at the bottom of the screen. They can either be foreign language translations, a written rendering of the same language, with or without added information to help viewers who are hearing impaired, or people cannot understand the spoken dialogue or have accent recognition problems. (Subtitle (captioning) 2013.)

## 4.2 Closed Captioned Subtitles

Closed captioned subtitles, often abbreviated CC, are subtitles which include additional of interpretive information to the viewer. These often include descriptions of non-speech elements. (Closed Captioning 2014.) These can include changes in musical themes or sound effects such as explosions happening in the background. Closed captioning is mainly used when the content is aimed for the hearing impaired. In closed captioned subtitles square brackets are used at the beginning and at the end of the information.

## 4.3 SDH

SDH is an abbreviation of Subtitles for the Deaf or Hard-of-Hearing, which refers to normal subtitles where non-dialog information has been added in addition to speaker identification. The one big difference between closed captioning subtitles and SDH subtitles is the visual form they are presented in. SDH subtitles are using the same font and proportions as normal subtitles and closed captions are often displayed as light text on a dark band that blocks some of the content visible on the screen. (Subtitle (captioning) 2013.)

### 4.4 Subtitles in Games

Unlike television and film industry, game industry does not have clear guidelines on how to create subtitles. Assassin's Creed (2007) had no subtitles implemented in the game. The sequels of the game have subtitles provided, but those display nothing but the dialogue in the game. "The other thing to note is that having subtitles in games should not be one of those things which are added in "because everyone else is doing so" or at the "last minute", Griffiths (2009) writes, "but instead as something which can enhance the player experience."

In Valve's Half-Life series the developers took a huge leap forward from their first game Half-Life (1998) to its sequel Half-Life 2 (2004), which was praised by many for its extensive effort to create the best gameplay experience possible for the hearing impaired players (Clarke, S. 2011). The subtitles in the game are extensive and show nearly everything that is spoken within a certain distance from the player. All subtitles are color-coded, according to which character is talking. The game also included closed captioning for all important audible cues (picture 6).


PICTURE 6. In Half-Life 2 the subtitles are closed captioned to indicate important sounds to the player. (Source: Half-Life 2 PC DVD-ROM 2014)

In a discussion had with writer Carita Forsgren, it came apparent that there are also times when playing video games with the sound on is not possible even for the hearing players. Parents with small children often get little time to play and need to be constantly aware of the sounds around them, in case a child has awoken or is hungry. With older children it is also good to be alert, especially if they are left alone in their room to play. In these cases it is important to be able to know what happens in the game without the sounds being on.

### 4.4.1 Modifications

Picking the correct colour for the subtitles is very important. According to Griffiths (2009), the recommended colours are white, yellow, cyan, and green against a solid black background for the best contrast. To make subtitles even more customizable it would be good to let the player decide the colours themselves.

The font has to be readable and should also stay consistent, and preferably use non-capital letters. In some games the fonts are modified to highlight the emotions the character is feeling, for example by using italics, capital letters or by changing the font completely. There should be a way for the player to always identify the speaker, whether by colour or by the game showing the speaker's name before their phrase.

Reading lengthy subtitles in dialogue-heavy games can become straining for the player. The player should be given the option to control the speed of the subtitles, preferably on-the-go. (Griffiths, G. 2009.) If changing the speed becomes too challenging, the players should have the ability to stop the subtitles and move to the next part when they have finished reading the previous one.

### 4.4.2 Translations

Taarluoto (2011) writes that subtitles and other translations in modern games are often based only on text sent to the translator by the developer. This means that the translators are likely to never see the gameplay material before the game is published, which precludes any additional info from being added to the game, such as closed captioned

subtitles. There are also problems with gaming consoles and translations, for example when the Nordic Edition of Assassin's Creed 3 was released in 2012 and played on Xbox360 in Finland with the system language being English, the in-game menus couldn't be changed to anything else than Finnish. Although localization is needed and desirable, the players should always have the option to also use the original language. Additionally at least in Western countries English would also be good to have as a language option.

# 5 MODIFYING EXISTING GAMES

## 5.1 Overview

This chapter summarizes and demonstrates different approaches of hearing impaired optimization for games that are in their post-production phase or already on the market. For published games the modifications could be made available as downloadable content. The aim was to create solutions which wouldn't take much time to create and would be relatively affordable. If a game is impossible to play without using sounds and it cannot be optimized for the player, the description of the game should express this clearly.

The chapter also goes through some of the research results gained from a survey aimed for the hearing impaired gamers (appendix 1). The survey was answered by 28 people, from whom 29% were completely deaf without any hearing aids and 33% were hearing impaired who used some kind of hearing aid. 61% said they were playing games, and most used gaming platforms for them were PC and smartphones.

## 5.2 Visual Changes

Making visual alterations to games is the easiest approach when thinking about optimizing the games. Often these only need subtle changes to the code of the game and the performance should not deteriorate very much. Creating extensive new animations or adding other substantial features to the game were not considered as valid optimization options.

### 5.2.1 Subtitles

In the survey (appendix 1) 50% of the respondents had noticed deficiencies in game subtitles, and 58% said that they might be willing to pay a small amount of money for optimized subtitles. Those who weren't willing to pay argued that optimized subtitles should be there like any other subtitles, and since players usually don't pay for those

they should not have to pay anything extra either. When asked what was the best way to clarify subtitles to the player 22% agreed on closed captioning and sans-serif font (figure 2). Next were the mention of the sound source at the beginning of the text and the use of different colours for different sources. (Appendix 1.)

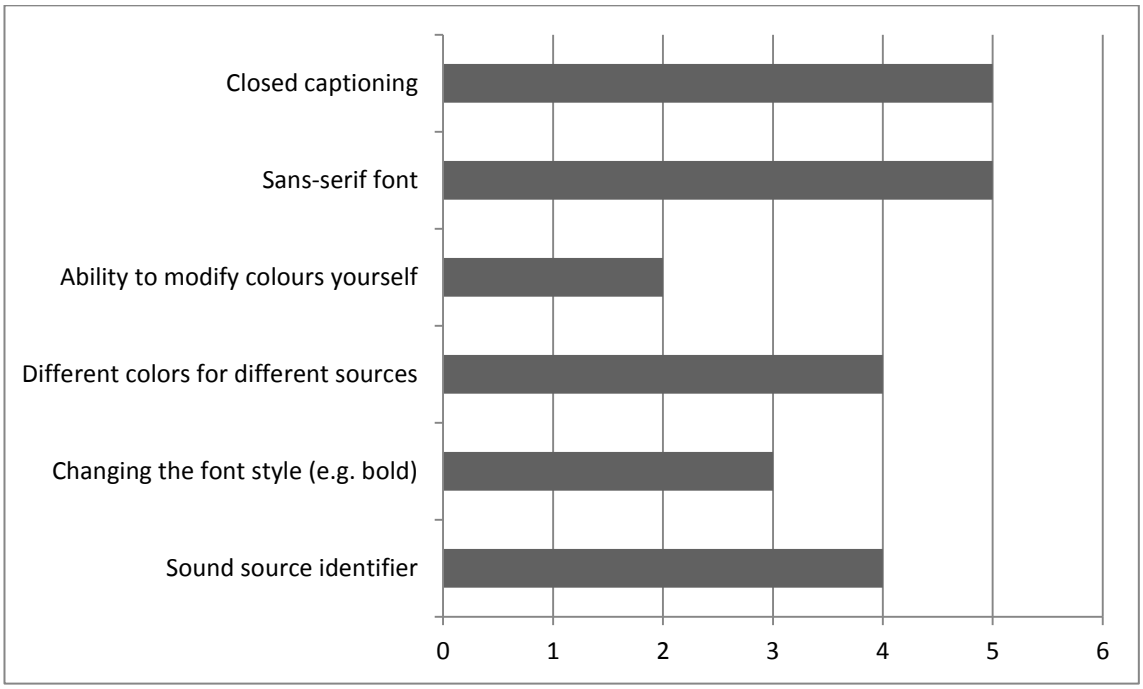
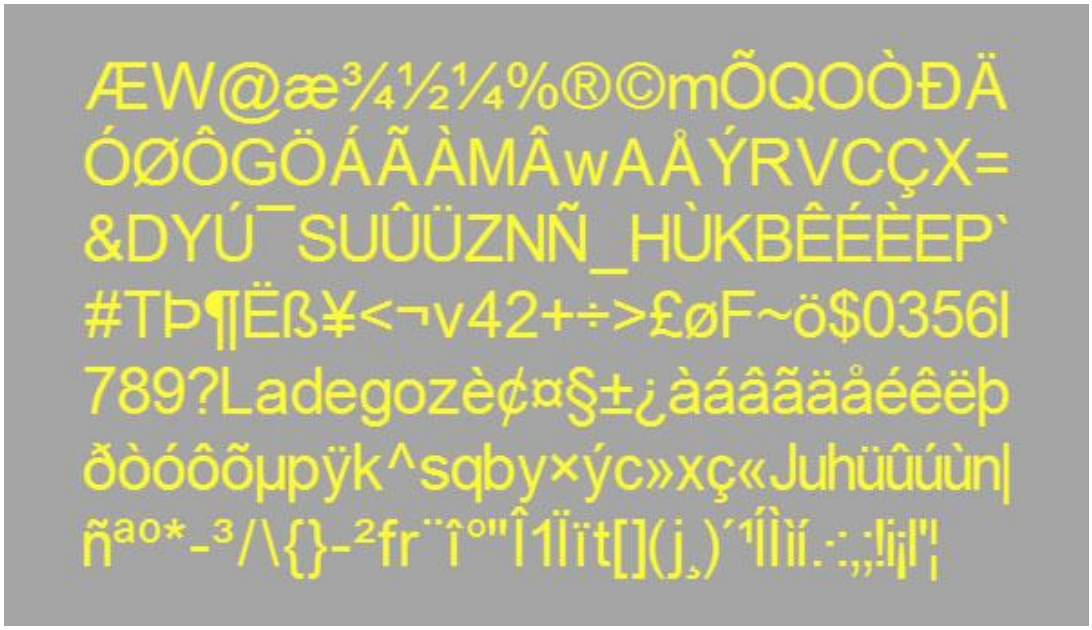



FIGURE 2. The best ways of clarifying subtitles.

Most game companies are aiming to get global attention for their games, and it means that they need to spend time localizing their product. At least for cinematic games this means that the developers have a subtitle script that they send to the translators. Making optimized subtitles for the hearing impaired could be easily done at this phase by simply adding audio source identifiers to the script. To get closed captioning the developers would have to play through the game and select the sounds and music which have an important impact on the story, and then make a separate script out of those. Subtitles and closed captioning should both be properly timed with the speech and events happening on the screen.

To save space in the texture atlas when using more than one colour subtitles one solution would be to create a texture for one colour and later change its lightness and hue values inside the code. For example from yellow text (picture 7) both black and white subtitles are very easy to get. However, if the font style needs to be changed to bold or italics separate textures are needed for each style.




PICTURE 7. To save room in the texture atlas the colour variations could be made using a single font texture.

### 5.2.2 Effects

If a game needs visual effects to be optimized for the hearing impaired players the developers should keep the changes to a minimum, especially if the product has already been released to the market. Every change and additional graphical element should mirror the style of the game, and it should not break the immersion during gameplay. These subtle changes could simply include the edges of the screen changing colour when taking damage or the view starting to blur when the player has very low health.

In case the game has sound-based features like puzzles, there should be a way to solve them without getting stuck in the game. The puzzles should have visual clues on how to get them right, for example by using colour to match a played note, or in the worst case left optional so that the game can still be finished despite failing to finish the puzzle. Adding an option to let the player choose which kind of puzzles they want to do could work in some games, but often this would require more work than it makes sense budget-wise. The optimization of visual effects should be relatively easy and fast if the aforementioned features are skipped.

### 5.3 Haptic changes

According to the survey results, 59% of gamers play with the sound on. 76% wanted to get haptic feedback during their games via sounds, artificial vibrations or both (figure 3). Many also agreed that in war and car games the haptic feedback has been implemented the best. (Appendix 1.) Multiple patent issues between companies are the main problem with making haptic changes, as this means that the effects have to be separately done for every platform the game is published on.

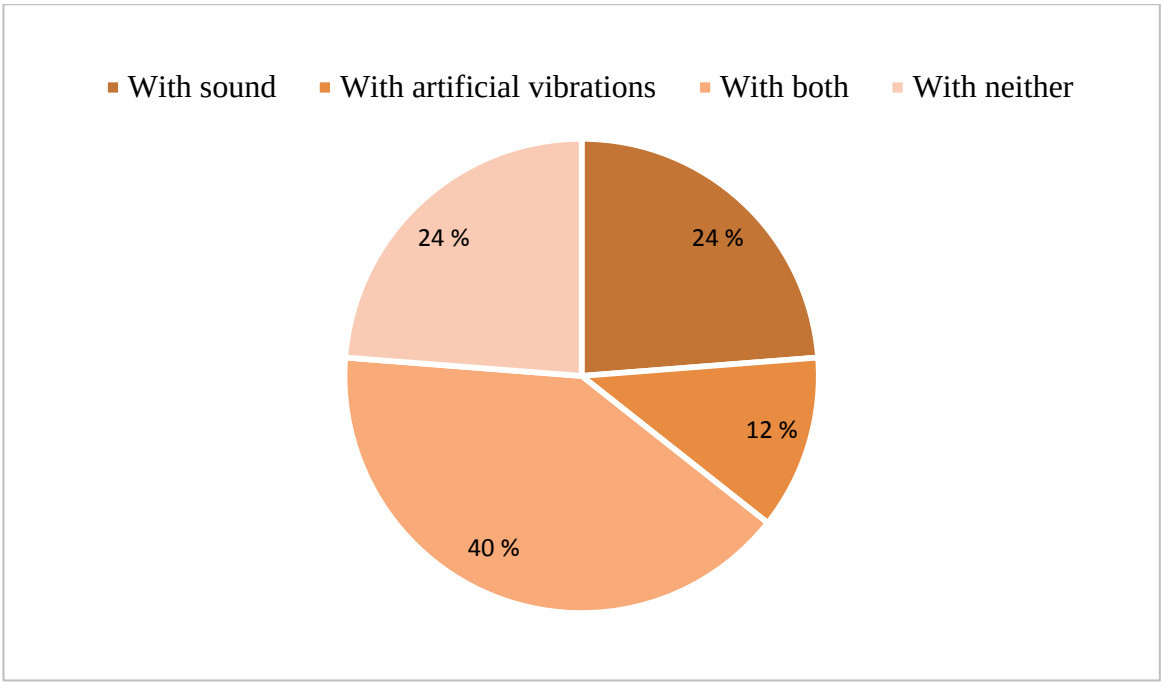



FIGURE 3. Results on how players would like to receive their haptic feedback.

Immersion, one of the leading haptic feedback developers, is offering a free haptic feedback library to mobile developers. The library works with nearly every mobile platform, excluding the iOS products. The Immersion library has been used in games like Max Payne Mobile (Heubel, B. 2012). The library is very easy to use and has more than enough haptic effects for the developers to test in their games.

Adding haptic feedback to console games means coding sequences of vibrations. Even though the feedback is not very precise it can still have a great impact on the immersion. The game controllers shipped with the consoles developed by Sony and Microsoft all support haptic feedback. Nintendo's Wii remote offers quite limited haptic feedback, but has a built-in speaker, which gives the developers different kind of opportunities.

### 5.3.1 Sound Frequencies as Haptic Feedback

If no haptic effects can be used the developers should focus on optimizing the sounds of the game to act as haptic feedback. The low pitched sounds are the easiest to feel and they create the most recognizable patterns. Depending on the quality of playback equipment the sound pressure level can get cut, and that leaves the player with less feedback than intended. Mobile phones, tablets and in-ear headphones often suffer from this problem and therefore this is not the recommended way of creating haptic feedback. However, since for example PC games often don't offer any other solution, the developers are recommended to use varying pitch in their effects to differentiate them from each other.

## 5.4 Case Studies

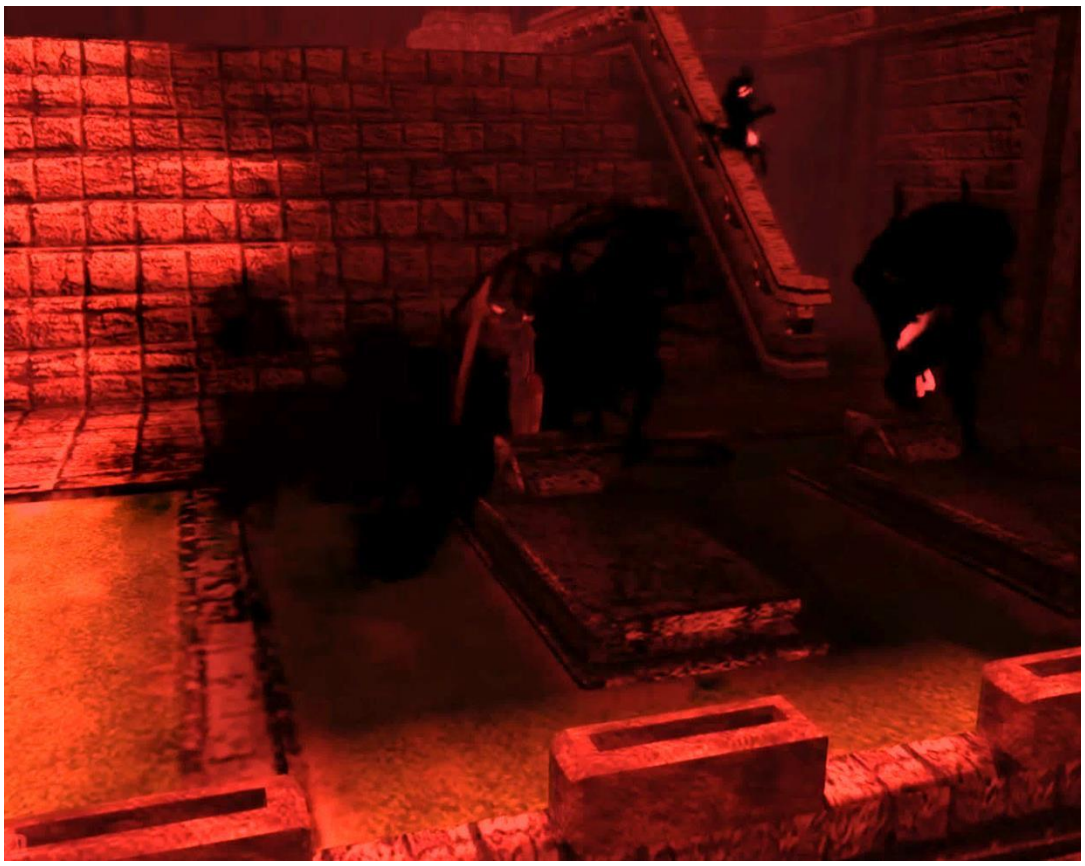
In the following examples on how existing games can be modified the solutions which require minimum effort and resources from game developers are gone through. The examples are chosen based on the Deaf Gamers Classification system (Deaf Gamers Classification 2014), and the scores of the games range from B to E.

### 5.4.1 Ico by Team Ico

In Ico (2011) the gamers play as a horned boy called Ico who is trying to escape a castle with a girl named Yorda. They are hunted by shadow creatures who try to take Yorda back to her evil mother. The main problem with the game is its lack of visual cues when Yorda is being attacked by the shadow creatures and Ico does not see her. The game notifies the player about the attack only with a change in music, which isn't very helpful for the hearing impaired gamers. If Yorda is sucked through the shadow creatures' portal (picture 8), the game shows it, but at that point it is too late to help her and the game is over. (Ico & Shadow… 2014.)

PICTURE 8. Yorda is being sucked through the portal. (Source: Ico 2011)

One solution to the attack problem would be to create a graphical indicator that shows when the shadow creatures grab the girl. The game already has a red overlay for the moment the game is failed, so the same kind of effect could be used to draw attention to Yorda when she is attacked by the shadow creatures (picture 9). The effect could trigger when Ico and Yorda are at a longer distance from each other, so that the screen won't flash constantly during battle scenes. Reusing the same effect also does not require anything to be added to the texture atlas.



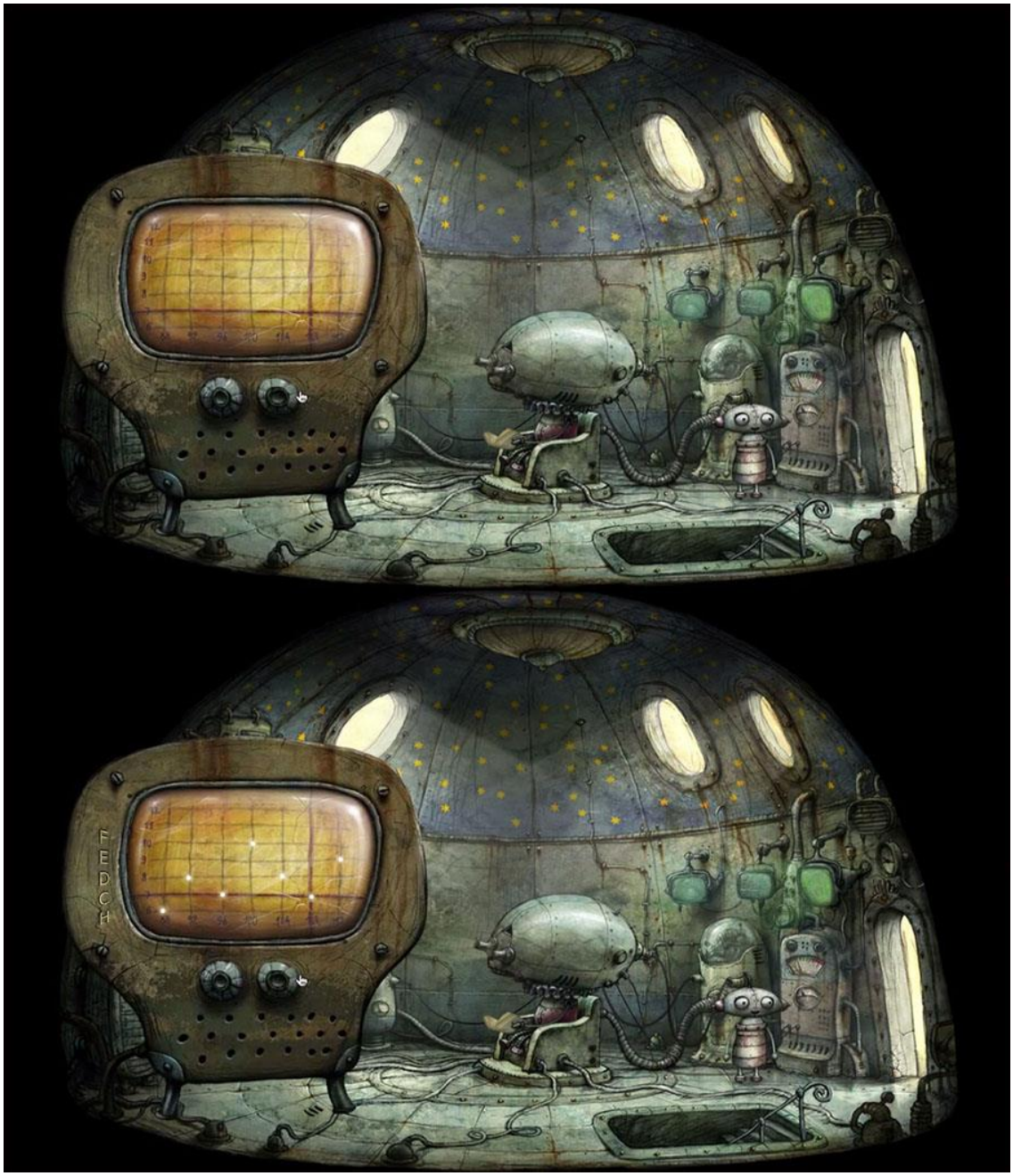
PICTURE 9. The screen could flash red when Yorda is captured by the shadow creatures. (Modified from: Ico 2011)

### 5.4.2 Machinarium by Amanita Design

Machinarium (2009) is a point-and-click puzzle game where you play as a robot called Josef and try to save your girlfriend Berta from an evil gang of robots. According to Deaf Gamers review (Machinarium PC 2014), the game is great up to a puzzle at the end where you have to play a certain tune in order to advance further. There are no other clues except for a tune played by a machine in the previous room, so a hearing impaired person is unable to solve the puzzle unless they look up the solution online. This earned the game the lowest score E based on the Deaf Gamers Classification chart. (Machinarium PC 2014.)

A very simple solution to this would be to name the different tunes with a letter or with any other symbol and then briefly display the tune on the clue screen (picture 10), mimicking the way notes are normally displayed in music sheets. Showing the notes

could be done simultaneously with the sounds, so that the hearing impaired player goes through the same thinking process as the hearing player.




PICTURE 10. Clue screen as seen in the game (upper) and the modified version (lower) displaying visual hints when the notes are being played. (Modified from: Machinarium 2009)

The gadget you play the tune with in the next room (picture 11) would display the same letter or symbols as the clue screen (picture 10). This way the hearing impaired player would be able to memorize the pattern and reproduce it the same way a hearing person reproduces the tune. Neither of these optimizations requires much change in the code

itself, and the clue screen could be either an animated sequence or a static picture depending on how much size is wanted to use for the changes.


PICTURE 11. Musical gadget displaying the same symbols as the clue screen. (Modified from: Machinarium 2009)

### 5.4.3 Alan Wake by Remedy Entertainment

Alan Wake (2010) is a psychological horror game that follows a writer through his journey to undo his wife's death. According to Tefertiller (2010), the main problems with the game are with the subtitles and the way it alerts about enemies nearby. All important dialogue is subtitled, but there is no indicator on who is speaking and it is also missing closed captioning (picture 12). When enemies appear the music changes, which is not enough for hearing impaired player. There is, however, a slow-motion effect often associated with an enemy attacking the main character, so if the effect would happen every time an attack begins it would solve the issue completely.


PICTURE 12. The subtitles show only what is being said and do not tell who or what is speaking at the moment. (Source: Alan Wake 2010)

Optimizing the subtitles requires the most work. In the example (picture 13) inanimate objects' dialogue is shown as yellow with italics font styling, and it also shows the name of the source. Closed captioning is also added to better convey the feeling of the game. Normal character text would remain like the original, but the sound source would be added there as well. This system would require the development and implementation of three different subtitles, but it would also make the game easier to understand. As with normal subtitles the timing should be checked for each three, and preferably tested with hearing impaired users.


PICTURE 13. Closed captioning, sound source and font styles should be added to the game. (Modified from: Alan Wake 2010)

# 6 CREATING A NEW GAME

## 6.1 Initial Decisions

In the beginning of the research it became obvious that the full extent of game optimization could not be gone through with only visualized case studies. A game development team was gathered and, in addition to the author of this thesis, the team included Hermanni Ketonen, Matias Lehtoranta and Jaakko Hautamäki. The initial idea was to make a game for only hearing impaired people, but after some discussions with team members it was decided that the game's target audience was casual gamers who enjoy exploration and puzzles. It was decided that the game would be free of spoken dialogue and that its core feature would be haptic feedback. The team was also quite inexperienced with coding, so Unity 3D was not considered as a development platform, despite its current popularity in the industry. The pictures in this chapter belong to the author unless stated otherwise.

## 6.2 Development

Development of the game started during the last quarter of 2013. There were many versions of game until the idea was finalized in March 2014. The main character has been the same from the very beginning, but the story has periodically changed, along with gameplay mechanics and development platforms.

From the beginning it was decided that the game would be made for Android tablets, due to their ability of giving the player haptic feedback. Apple's tablets were not considered for the time being, because of their complicated publishing and testing methods. Most of the team members were also familiar with developing games for Android. From very early on, it was also decided that the game graphics would be 2D instead of 3D, mainly because of the size, creation time and CPU performance differences.

### 6.2.1 Development Platform

The very first version of the game was made in a bit over a month using AIR with Flash. When doing tests, it was noticed that the performance was very bad on low-end tablets, especially during animated sequences. It was also nearly impossible to program haptic feedback effects with Flash, so the team decided to switch to a platform where the effects were already implemented. However, most graphical elements and the mood of the game stayed similar in the next game as well (picture 14).


PICTURE 14. First main menu for the game done in Flash.

Stencyl was the next development platform the team focused on. It was very easy to use and it featured drag-and-drop programming, so even the most inexperienced team members were able to use it. It was also cheap compared to the more popular GameMaker, which is a similar development platform. Stencyl games also run on multiple platforms just like GM games. The team spent two months trying to finish the game with Stencyl, but eventually had to give up on that as well because the updates were very frequent and unstable, so the game would be broken most of the time. Stencyl is also such a new development platform that getting help or finding tutorials was almost impossible.

Finally the team ended up using GameMaker for the final product. Getting the Professional version of GM and the Android export was quite expensive, but the team

was slowly running out of time and needed the best solution available. GM also had a native support for the Immersion effects library, so adding haptic feedback was very easy. The game came together very efficiently and the haptic feedback effects worked perfectly.

### 6.2.2 Genre and Gameplay Mechanics

Since the game needed to have something challenging to be optimized, the team decided to make a sound-based puzzle game. During the development, it changed from being a point-and-click puzzle game to a platform jumping game with puzzles integrated to the levels. The team tested sounds as haptic feedback, as well as artificial effects, and ended up using a combination of both in the final version. The game has no combat for the time being, but still offers exciting moments in its gameplay.

### 6.2.3 Story

In the first story drafts, the main character was a doll that had missed getting ears when being taken through the assembly line. It is checked by an inspector who throws the doll away as flawed. The doll is then accidentally washed down a drain and finally ends up far away from the doll factory in a scrapyard with sewer waste. The doll starts its journey back towards the town and gains other deaf friends along the way, such as a TV that shows her pictures and clues. In the end, the doll fights the evil manager of the factory and shuts it finally down. However, this story arch did not make the final product because it seemed a bit too radical and excluding. The team wanted the story to be something that the player could relate to, whether they were hearing impaired or not.

In the final version, the game starts with a room full of doll parts and other broken toys. The player has to wake up the doll and then lead her to through a series of jumping puzzles to get out of the basement. Along the way the doll has to find a key to open the basement door, and also solve puzzles to open doors and discover hidden secrets. The demo version of the game ends when the doll opens the basement door and a security robot grabs her.

In the full game, the story continues with the security robot carrying the doll into a prison cell. She escapes the cell and continues exploring the factory. She finds an assembly line where copies of her are being made. The dolls are then sprayed with gas, which seals their thoughts away, and packed into boxes. The doll has to find a way to stop the gas from working and then free the other dolls. She also realizes that the gas has no effect on her, and eventually remembers that it was the reason why her power was switched off and she was dispatched into the cellar in the first place. When the doll finally succeeds in disabling the gas, she continues on to find the engine room to shut down the factory and security robots' power. In the engine room she finds a creature and has to decide its fate, along with her own.

### 6.2.4 Visuals

The visual development began with concepts of the first story draft (picture 15). The team wanted the game have an organic feel to the game, so the first graphics were all drawn by hand.


PICTURE 15. First concept art piece.

The character had to have human-like features, but still look like a doll. The doll had to look fearless and curious about the world around her. A turnaround was created of the doll (picture 16), and the look has stayed the same for the entire duration of the production. A clay model of the character was also created, so that the team could easily compare its proportions to the environment (picture 17).

PICTURE 16. Character turnaround.

PICTURE 17. Character model made out of clay.

When the main character's design was done, the team began thinking about monsters the doll could face in and around the factory (picture 18). The initial idea was to make a monster that would somehow utilize either sound or vibrations in its attack. The team ended up selecting a crab man with shake screen ability for the basement levels of the game. The security guard in the factory levels was decided to be kept as a robot instead of a real monster.


PICTURE 18. Monster development sketches.

The animations for the character were done by dividing it into parts a doll would have and then those were rotated based on the movement (picture 19). The same animation style was kept consistent in other parts of the game as well. In cinematic scenes the team tried to save texture atlas space, so those animations were kept minimalistic.


PICTURE 19. Running animation sheet.

The environment was hand drawn and later textured in Photoshop. This became problematic when the game was tested on multiple tablets, because the Android tablet resolutions differed a lot from each other. The team is in the process of fixing parts that are pixelating and trying to come up with a good solution to the resolution problem before releasing the demo to the market.

### 6.2.5 Sounds

In the first version of the game, the sounds were not used at all, to show how a hearing impaired person perceives the world. When the idea was refined, the team decided to use sounds and music after all, because for hearing players the experience would be better that way. Adding sounds and sound-based puzzles also gave an opportunity to show how those can be optimized in tablet games.

The sound frequencies for effects and music had to be kept separate from each other. The idea was that a hearing impaired player could be able to enjoy the game while playing with the sounds on, and that the sound effects would provide different kind of haptic feedback than the music or artificial vibrations.

### 6.2.6 Haptics

Optimizing the game using haptics was probably one of the easiest things in the entire production. The team used the Immersion plugin for GM and simply added haptic effects from the existing library to each part where sound effects were coded. The effects were tested so that they were not too mild or too powerful, and it was also tested that they could be told apart from haptic feedback received from the music and sound effects. Haptic effects were also used during cinematic scenes to create better immersion. Making the game optimized for the hearing impaired users did not take significant time, nor affect the game design process negatively at all.

## 6.3 Testing

### 6.3.1 Alpha Tests

Alpha tests were conducted by the development team twice per month for the entire duration of the production. The mechanics were first tested as paper prototypes and later on transferred to digital form. The alpha tests were useful in defining what worked and what did not work and to see how much better the team got in designing the game as time passed. After the last alpha test in April 2014, the team started preparing for the first public beta test to get feedback from people who did not know anything about the game.

### 6.3.2 Public Beta Testing

The first public beta test for the game was arranged during the 28th National Culture Days for the Deaf in Tampere on May 17th 2014. A group of 10 participants played through the game and gave feedback in a form of a survey (appendix 3). The majority of the beta testers found the game easy to play, and had little difficulties with the haptic feedback they were receiving from the game. They also seemed to get familiar with the controls quite fast. The most difficult part of the game for the participants was a puzzle in the last room of the game, which required the players to memorize the places of invisible platforms. The team had to help some of the players through that puzzle, so after the beta, more clues were added to the upper level of the jumping puzzle.

According to the survey (appendix 3), the testers liked the main character and the underwater environment the most. Some people disliked the character's clothing colour, but that should not become a big issue since in the full version of the game the player can change the colour of their outfit. Six out of ten people were also willing to buy the game right away. The rest said that they would like to get the game for free, but that they might be willing to buy different kind of clothing as in-game purchases. The next public beta testing is scheduled to happen before the release of the game, the current date being the 30th of May 2014.

### 6.4 Publishing and Future Development

The demo version of the game is scheduled to be published to Google Play Store on 11th of June 2014 with the name Doll: Chapter 1. The Demo is free to play, and it is available both in Finnish and English. The game is designed to work only on Android tablets at the moment. After the second beta the marketing for the demo version will start and gameplay and cinematic trailers for the game will be created. The team will see if the reception is good enough to continue with the production further and create a full scale game out of the demo. Most of the resources for the full game are already done, but external help might be needed to fix the resolution issues.

# 7 CONCLUSIONS AND DISCUSSION

The aim of this thesis was to see what kind of problems the hearing impaired are having with modern video games and how those problems could be solved using the minimum amount of time and money. The goal was to show game developers why they should care about the needs of the hearing impaired and help them with finding an easy approach to game optimization. Other objectives were also finding out how visual cues and haptic feedback are used in video games, and after that creating and optimizing a completely new game and observing if the development process differs from the normal.

The research gathered from the survey and articles indicated that the video game industry seems to be behind in providing accessibility to the hearing impaired. In the case studies, three video games were analysed and the most reasonable optimization option was tried to find out for each. The thinking of optimization options became easier as more video game material was gone through and spotting deficiencies in games has become almost a reflex. The findings also showed that when the hearing impaired are taken into consideration from the beginning of the development process, it does not slow the production down in a mobile title and can actually create additional value to the end product.

Seeing what problems the hearing impaired face in video games and how games can be optimized for the hearing impaired succeeded very well. Creating the sound-based puzzle game and optimizing it worked out also even better than expected. However, the way the optimization can be done in larger games was not researched enough to provide game developers with proper guidelines. The optimization examples work well in mobile titles since their budget is small to begin with, but more extensive research should have been done for the AAA titles. More data would have been needed globally from hearing impaired players to show game developers how much money exactly they are losing when they are disregarding this audience.

One arguable part with the reliability of the research done during this thesis is the fact that many of the references are opinions of only one person, even though they might be experts in their own field. Many of the observations focused on online forums and conversations and those often contain opinions that are nearing extremity instead of

summing up the general consensus. Since there were no previous studies about this subject, it is impossible to compare earlier results and data with the thesis research results. Due to the vast variety of optimization options available and budget restrictions, the research focused more on feedback instead of player input even though input in modern video games also plays a very big role. There is a lot of data that could be added to this thesis to make the results even more reliable, but getting it would require the research to be done in cooperation with big global organizations like AbleGamers.

The research results can be put to use when evaluating a game's potential target group size and how much revenue it is expected to make. The results from optimization options can also be utilized when a game in development wants positive popularity on big sites like Kotaku, because their reporters seem to be reporting everything that has something to do with enhanced accessibility. Since the hearing impaired gamers are a niche market, it can easily begin promoting the game for the developer completely free of charge if it notices that it is being treated especially well. This has happened with Valve's Half-Life 2, although the game already had a lot of popularity before it started releasing information about hearing impaired optimization. Adding haptic feedback effects to video games according to the research guidelines can also give the players a more immersive experience and in best cases could even enhance their retention rate.

Further research is necessary to create unified systems all game developers can use to make sure their games meet the requirements of hearing impaired players and those with other disabilities. Especially a system for adding optimized subtitles to games would be urgently needed, because the current systems are not working very well. Furthermore, developing a universal and mandatory accessibility rating system for all video games would promote gamer equality and raise awareness of the accessibility issues in the industry. Another research topic could be how motion capture software could be used to recognize sign language.

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**APPENDICES**

Appendix 1. Gaming Habits Survey, in Finnish

Pelitottumuskysely: Kysely pelitottumuksista kuuroille, heikosti kuuleville sekä kuuleville. Kyselyn tarkoituksena on luoda konkreettinen pohja lopputyölleni pelien optimoinnista kuuroille sekä heikosti kuuleville. Kyselyn tulokset käsitellään luottamuksellisesti ja tulokset julkaistaan ainoastaan keskiarvoina sekä mediaaneina.

Yleiset tiedot

1. Ikäsi?
    a) 0-10
    b) 11-15
    c) 16-18
    d) 19-25
    e) 26-35
    f) 36-49
    g) 50-100

2. Sukupuolesi?
    a) Nainen
    b) Mies

3. Oletko...?
    a) Kuuleva
    b) Kuuro, jolla on sisäkorvaistute
    c) Kuuro, jolla on jokin muu kuulolaite
    d) Kuuro, jolla ei ole kuulolaitetta
    e) Huonosti kuuleva, jolla on kuulolaite
    f) Huonosti kuuleva, jolla ei ole kuulolaitetta

4. Pelaatko pelejä?
    a) Kyllä
    b) En

continues

c) 5. Jos vastasit edelliseen kysymykseen "En", miksi et?

Pelialustat

6. Millä välineillä pelaat pelejä?

a) Pelikonsolilla (esim. Playstation3, Xbox360, Wii)
b) Käsikonsolilla (esim. Nintendo DS, Playstation Vita)
c) Tablettitietokoneella (esim. Samsung Galaxy Tab, iPad)
d) Älypuhelimella
e) Pöytätietokoneella
f) Kannettavalla tietokoneella
g) Manuaalisesti (esim. pelikortit, lautapelit)
h) Jollain muulla:

7. Millä välineellä pelaat eniten?

a) Pelikonsolilla
b) Käsikonsolilla
c) Tablettitietokoneella
d) Älypuhelimella
e) Pöytätietokoneella
f) Kannettavalla tietokoneella
g) Manuaalisesti
h) Muu:

Pelit

8. Mikä on mielestäsi paras pelaamasi peli?

9. Miksi se oli paras?

10. Mikä on mielestäsi huonoin pelaamasi peli?

11. Miksi se oli huonoin?

12. Pelaatko pelejä tekstitykset päällä?
    a) Kyllä
    b) En
    c) Joskus

Tekstitykset peleissä

13. Oletko huomannut puutteita pelien tekstityksissä?
    a) Kyllä
    b) En

14. Jos vastasit edelliseen kysymykseen "Kyllä", kuvaile puutteita muutamalla sanalla:

15. Jos vastasit ensimmäiseen kysymykseen "Kyllä", luettele pelejä joissa puutteita olet huomannut:

16. Valitse mielestäsi paras/parhaat selkeyttäjät tekstityksille:
    a) Äänen lähteen maininta tekstityksen alussa (esim. Matti: Mitä sanoit? Minna: En mitään...)
    b) Tekstin tyylittelyt (esim. kursivointi, lihavointi)
    c) Tekstin värit (esim. ympäristön äänet sinisellä, päähenkilön puhe keltainen…)
    d) Tekstin värien räätälöinti omien mieltymysten mukaan
    e) Selkeä, koristelematon teksti (sans-serif)
    f) Suljettu kuvatekstitys / ääniteksti (esim. [iloista musiikkia])
    g) Jokin muu:

17. Paras tapa tarjota tekstityksiä peleissä:
    a) Pelkät alkuperäiskieliset tekstitykset ja/tai käännökset alkuperäiskielestä kohdekielelle
    b) Pelkät erikoistekstitykset kuuroille & huonokuuloisille
    c) Molemmat yllämainitut
    d) Jokin muu:

18. Olisitko valmis maksamaan erikoistekstityksistä?

Jos peleihin voisi ostaa pienellä hinnalla (esim. 0,20 - 1€) ladattavana sisältönä paremmat tekstitykset, joissa on kiinnitetty huomiota pelaajien erityistarpeisiin, voisitko kuvitella ostavasi ne?

a) Kyllä
b) En
c) Ehkä

19. Jos vastasit edelliseen kysymykseen "Kyllä" tai "Ehkä", mikä olisi korkein hinta jonka voisit teksteistä maksaa?
Käytä vastauksessasi desimaalimuotoa, esim. 0,20 €

20. Jos vastasit "Ei", miksi et?

Peliäänet ja värähtelyt

21. Pelaatko pelejä äänet päällä?

a) Kyllä
b) En

22. Kuinka hyvin tunnet äänen värähtelyt kehossasi?
1 2 3 4 5 6 7 8 9 10
(1= Erittäin huonosti, 10= Erittäin hyvin)

23. Onko jossain pelissä mielestäsi käytetty erilaisia värähtelyefektejä erittäin hyvin? Jos on, niin missä?
Esimerkiksi konsolipelien ohjainten värähtelyt, puhelimen tärähtely mobiilipeleissä yms.

24. Jos saisit valita, pelaisitko mieluummin...

a) Äänten kanssa, jolloin värähtelyn tuntee kehossa
b) Keinotekoisten värähtelyefektien kanssa
c) Molempien kanssa
d) Ilman ääniä tai värähtelyjä
e) Jokin muu:

Appendix 2. Gaming Habits Survey, English translation

Gaming Habits Survey: This survey is meant for deaf, hard-of-hearing and hearing players. The aim of this survey is to create a concrete base for a Bachelor's Thesis about optimizing games for the deaf and hard-of-hearing. The results will be treated confidentially and the results will be published only as averages and medians.

Background Information

1. Your age?
    a) 0-10
    b) 11-15
    c) 16-18
    d) 19-25
    e) 26-35
    f) 36-49
    g) 50-100

2. Your gender?
    a) Female
    b) Male

3. Are you...?
    a) Hearing
    b) Deaf with a cochlear implant
    c) Deaf with some other hearing aid
    d) Deaf with no hearing aid
    e) Hard-of-hearing with a hearing aid
    f) Hard-of-hearing with no hearing aid

4. Do you play games?
    a) Yes
    b) No

5. If you answered "No" to the previous question, why not?

continues

Gaming Platforms

6. What do you play with?

a) Console (e.g. Playstation3, Xbox360, Wii)
b) Handheld console (e.g. Nintendo DS, Playstation Vita)
c) Tablet (e.g. Samsung Galaxy Tab, iPad)
d) Smartphone
e) Desktop computer
f) Laptop
g) Manually (e.g. card games, board games)
h) Other:

7. What do you play most with?

a) Console
b) Handheld console
c) Tablet
d) Smartphone
e) Desktop computer
f) Laptop
g) Manually
h) Other:

Games

8. Best game you have ever played?

9. Why was it the best?

10. Worst game you've ever played?

11. Why was it the worst?

12. Do you play games with subtitles on?

a) Yes

b) No
c) Sometimes

Subtitles in Games

13. Have you noticed deficiencies in game subtitles?
a) Yes
b) No

14. If you answered "Yes", describe shortly how:

15. If you answered "Yes", name games which you have noticed these issues in:

16. The best way/ways to clarify subtitles is/are:
a) Sound source / speaker identifier at the beginning of the subtitle
b) Font style variations (bold, italics)
c) Different colours (environmental sounds different from normal dialogue etc.)
d) Ability to customize colours of the subtitles
e) Sans-serif font
f) Closed captioning
g) Other:

17. Best way to offer subtitles in games:
a) Subtitles in the original language and translations
b) Subtitles optimized for the deaf and hard-of-hearing
c) Both
d) Other:

18. Would you be willing to pay for special/additional subtitles?
If you could buy better subtitles for a small price (e.g. 0,20 - 1€) as downloadable content, would you be willing to buy them?
a) Yes
b) No
c) Maybe

19. If you answered "Yes" or "Maybe", what would be the highest amount you'd be willing to pay?
Please use the decimal form in your answer (e.g. 0,20 €)

20. If you answered "No", why not?

Game Sounds and Rumble Effects

21. Do you play games with the sound on?

a) Yes
b) No

22. How well do you feel sound vibrations in your body?
1 2 3 4 5 6 7 8 9 10
(1= Not at all, 10= Very well)

23. Do you remember a game where haptic feedback was very well used? If yes, please write down these games.
E.g. controller vibrations or phone vibrations.

24. If you could choose, would you play...?

a) With sound, so you feel the vibrations in your body
b) With artificial vibration effects
c) With both
d) Without sound or vibrations
e) Other:

Appendix 3. Beta Test Survey, in Finnish

1. Oliko peliä helppo pelata?
    a) Kyllä
    b) Ei

2. Jos vastasit ei, miksi?

3. Vaikein kohta pelissä?

4. Helpoin kohta pelissä?

5. Mistä pidit eniten pelissä?

6. Mistä pidit vähiten?

7. Voisitko kuvitella ostavasi pelin? Anna myös lyhyt selitys miksi.

Appendix 4. Beta Test Survey, English translation

1. Was the game easy to play?
    a) Yes
    b) No

2. If you answered no, why not?

3. Most difficult part of the game?

4. Easiest part of the game?

5. What did you like the most about the game?

6. What did you like the least?

7. Can you see yourself buying the game? Please also give a short explanation why.