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Master's Thesis

Academic Year 2016

TALK ME THROUGH THIS!
The Design of a Two Player Virtual Reality Communication-Based Game Experience

Keio University
Graduate School of Media Design

Sergio Robles de Medina

A Master's Thesis
submitted to Keio University Graduate School of Media Design
in partial fulfillment of the requirements for the degree of
MASTER of Media Design

Sergio Robles de Medina

Thesis Committee:

Professor Keiko Okawa	(Supervisor)
Professor Susumu Furukawa	(Co-supervisor)
Associate Professor Liwei Chan	(Project Senior Assistant Professor)

Abstract of Master's Thesis of Academic Year 2016

TALK ME THROUGH THIS!
The Design of a Two Player Virtual Reality Communication-Based Game Experience

Category: Design

Summary

Virtual Reality is an exciting new medium that allows for new ways to interact with virtual environments. Its greatest strength is that of the sense of immersion it is able to provide. Paradoxically, its biggest strength is currently also one of its biggest weaknesses. The aspect of immersion allows people to enter different worlds, but comes at the cost of inclusion – the people in our direct surroundings cannot join us in the experience.

This paper addresses the design of a game by the name of TALK ME THROUGH THIS! It concerns an asymmetrical two player virtual reality game concept, utilizing only a single head-mounted display. One player enters a virtual maze, using an Oculus Rift DK2, and the other is provided with a document that holds all the information necessary to find a way through. In order to find the right information, quick and effective communication between the two players is key.

The results of the user tests and evaluations showed an overall positive attitude towards the concept of the game. Users indicated high levels of enjoyment, learning, and an overall more thoughtfulness towards communication. Additionally, the collected data and observations provided valuable insights into how people communicated with one another, and how they evaluated themselves and their partners within the context of the game experience.

Keywords:

Design, Virtual Reality, Communication, Games, Learning

Keio University Graduate School of Media Design

Sergio Robles de Medina

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Chapter 1
Introduction

1.1 Background

A multitude of light rays poured directly into his eyes, flashing, pulsating and changing colors rapidly, screaming for his attention. Simultaneously, his ears are flooded with sounds – music, ambient noise, and the sounds of objects, all coming from different directions. The experience is almost overwhelming, but feels amazing at the same time. This is the power of the new virtual reality headsets. The feeling of actually being somewhere else is undeniable, and provides for some truly magical exploration and engagement that was not possible before. With every new game or experience there are new worlds to dive into, and each one is more exciting than the one before. Standing on a spaceship, traversing the ocean floors, riding roller coasters and climbing to the top of mountains in tropical areas. It goes from relaxing meditative experiences, lying on a beach with soothing background music, to action-packed shooting games, fighting hordes of enemies for the survival of the fittest. As exciting as all of these are, something is lacking. There is no way for the people he cares about – friends and family – to join him in his adventures. The existing games and experiences are all focused on the individual, and as soon as he enters a virtual world, the real world is left as nothing more than a shell, only to serve as a container for him and his headset.

The situation described above concerns the current state of virtual reality. As the new head-mounted displays have only very recently been released to the commercial market, not many people are in the possession of one, and it will take time before they are widely adopted. Regardless, it is already expected to be the next big thing, due to the highly immersive and engaging experiences it is able to provide. However, because virtual reality is still in its infancy, only few official games and experiences have been released. Everything is still new, and developers are still experimenting with what works, and what does not. The field of experimentation is wide open, and anything is still possible.

1.2 The Power of Games

The playing of games is an inherently positive experience. The main reason that people play games is simply because they enjoy doing it. Players are faced with challenges to overcome, and succeeding them leads to a feeling of satisfaction (Gee 2008, McGonigal 2011).

As described by McGonigal (2011), sharing the experience of a game with others, makes people happy and potentially establishes stronger connections between them. Games can unite a group of people through the sharing of a (similar) goal, no matter how small or arbitrary that goal is. Even when people watch others play they often cheer each other on, and thereby establish a connection through which they share the joy of their success and achievements, or the disappointment when they fail. In that sense, games are able to help people build stronger social bonds, leading to more active social networks and pro-social emotions, such as love, compassion, admiration and devotion.

Royal (2013) states that current education systems are doing what they were created to do: *it sorts and sifts*; choosing some over others, creating winners and losers. There is an unhealthy obsession with grades, and the true passion for learning is shoved to the background, replaced by a fear of failure. The obsession with grades, in the case of many students, is hampering effective learning, as all they are focused on is a final result, instead of their own personal progress and development (Alofs 2013, Boud et al. 2010).

Based on an extensive amount of research on games and learning, Gee (2008) states that if there is anything to be learned from games it is that *progress* encourages *progress*, and failure is only motivation to do better. Games make people fall in love with failure within game contexts. In the majority of cases, players do not complete missions, run out of time, fail to solve a puzzle, lose a fight, fail to improve their score, crash burn or even die in games. Failure in games, however, while it does not make a player particularly happy, it also does not disappoint that much either, as they can try again. The more people fail in games, the more eager they become to do better. In that sense, games make people focus on attainable goals, and lets them believe in their chances for success (Portnow et al. 2014, McGonigal 2011). Simple mobile game, such as *Angry Birds* or *Candy Crush*, provide great examples of this. They are games that people can play for many hours on end, even though most of that time is spent on failing.

1.3 Concept

This project proposes the design of a two player virtual reality communication-based game experience, that goes by the name of TALK ME THROUGH THIS!

The game has one player on the inside of a virtual world, utilizing a head-mounted display, trapped in one of the twenty mazes of an evil persona. These mazes, however, are not like normal mazes, as the walls are invisible to the player, and if he or she runs into one, they are teleported back to their starting position. They are only allowed to walk into three walls, and have an overall time limit of five minutes, before they lose the game. To get through the maze they will need the help of another player on the outside of the virtual world, who is presented with a document that holds all the information necessary to find a way through. The virtual maze room holds several clues that, altogether, can help the person with the document find the correct maze map to look at. These clues can be considered ambiguous, meaning that they are open to more than one interpretation. In order to get through the challenge, quick and effective communication between the two players is key.

There are several reasons for why this particular game provides a relevant experience. Virtual Reality is an exciting new medium that allows for new ways to interact with virtual environments. Its greatest strength is that of the sense of immersion it is able to provide. Paradoxically, its biggest strength is currently also one of its biggest weaknesses. This aspect of immersion allows people to transport to different worlds, but it comes at the cost of inclusion, meaning that the people in our direct surroundings cannot join us in the experience. The game presented in this study, TALK ME THROUGH THIS, is then one of the first virtual reality game concepts that aims to offer a multiplayer experience through the use of only one head-mounted display. Moreover, it fosters clear and effective communication skills, as it tries to use communication between players as the main mechanic for the overall gameplay. Players will be exposed to situations where they have to communicate ambiguous information to one another. Through this process, a form of informal learning may potentially take place in which they may become more thoughtful towards how they communicate with others.

As virtual reality is still an emerging technology, only few multiplayer concepts have been released so far. Not only will this research provide an experiential design, but it could also provide valuable insights into the perception of such games, how the concept could potentially be used in future games and experiences, as well as into how people communicate.

1.4 Expectations & Hypotheses

In relation to the use and impact of the proposed game experience – TALK ME THROUGH THIS – a few expectations and hypotheses were established beforehand:

- The concept of a multiplayer virtual reality game with only one headset will be positively received.
- The majority of people will fail the first time they play.
- People that play games often will have a more strategical approach towards communication as well as the game in general.
- People that have a closer relationship to each other are more likely to succeed faster in the game.
- People will change their perspective on how well they communicate after playing.

As the game concerns a new type of experience using virtual reality, along with the focus on collaborative and communicative gameplay, players will automatically be more engaged in what they are doing, as they are doing it together. They have a shared goal and their successfulness is dependent on the both of them. Moreover, the virtual reality aspect completely separates the two players, visually, and therefore *how* they communicate becomes imperative. Since players initially will have to get used to the game, and find effective communicative strategies between one another, it is expected that most, if not all, of the groups will fail the first time they play. The more they play the more effective they will become. In this, it is generally expected that people who have closer relationships to each other already have knowledge of how the other person communicates, and they are therefore expected to succeed faster in the game than do people who have a more distant relationship. Furthermore, people that often play games may have an advantage, as they might have come across similar situations in games they have played before. Lastly, people are likely to change their initial perspective on how well they communicate after playing the game, as it will go either better or worse than they initially expected. In any case, one of the goals of this game experience is to make people more aware of how they communicate with others.

1.5 Thesis Structure

This thesis is divided into 5 chapters. Following this introductory chapter, related literature and works will be discussed, touching upon topics of games and learning, virtual reality and communication. Chapter 3 is then about the design process of the proposed game experience, where firstly relevant game- and virtual reality design practices will be discussed, upon which the design of TALK ME THROUGH THIS will be laid out. Chapter 4 addresses the evaluation methods that were used, as well as its results and corresponding discussions. Finally, Chapter 5 concludes with a proof of concept, limitations- and improvements for the proposed design, and the potential for future works.

Chapter 2
Related Works

2.1 Games & Learning

2.1.1 Learning

The process and importance of learning can be defined in many ways, but it is generally agreed upon that it refers to the acquisition of knowledge and skills. Lemke et al. (2015) explain that there are many channels through which people can learn, and the increasing use of various type of media in our daily lives have made it significantly easier for people to have constant access to vast amounts of information. They state that:

> "*Learning that matters is learning that lasts and that is mobilized across tasks and domains (Lemke et al. 2015, 11).*"

The European Centre for the Development of Vocational Training (2007) then categorizes learning into three categories, namely (1) formal learning, (2) non-formal learning and (3) informal learning. They describe that formal learning is provided by educational institutions that offer structured courses with clear learning objectives, and is certified. Non-formal learning is still structured in terms of learning objectives, but is offered through channels other than educational institutions. Informal learning then refers to learning, resulting from any other daily life activities. Informal learning is not structured, does not have any form of certification and is often not intentional. The European Centre for the Development of Vocational Training (2007) indicates informal learning as very important, but notes that it is difficult to be officially recognized, as it can only really be measured through individual needs and self-assessment.

Furthermore, according to Gee (2008), research in the fields of learning theory suggests that..

> "*..people primarily think and learn through experiences they have had, not through abstract calculations and generalizations*".

People then store such experiences in their memory, using them to create- and run simulations in their minds, in order to prepare for-, assess-, and solve any situation that may occur at a later point in time; for decision-making. Gee (2008) then goes on to explain that in order for an experience to be truly useful for learning it needs specific goals, some form of immediate feedback, there need to be opportunities to apply the experiences, people need to be able to interpret how it is useful, and people need to be able to learn from others their interpretations and explanations. Gee (2008) describes this as a situated learning matrix, as the content is an experience, of which learning can be a consequence. He then suggests that games provide limitless possibilities for learning.

2.1.2 Games

In our world today games come in multiple forms, platforms and genres. There are single-player, multiplayer, and massively multiplayer games, and people play them on computers, consoles, hand-held devices, mobile phones, but also simply outside, with cards, on boards, etc. In his book, *The Art of Game Design*, Schell (2015a) describes games as something you play. He then offers several definitions of what playing is, which all refer to activities that are fun, provide freedom, are engaging, but are also in a context of voluntary participation and spontaneity. He then provides his own definition in which he states that:

> "*Play is manipulation that indulges curiosity.*"

In other words, this summarizes the notion that playing is something people do on their own volition, and not because someone else told them to do so. It is about satisfying curiosity through willful actions. Schell (2015a, 47) then continues to define a game as follows:

> "*A game is a problem-solving activity, approached with a playful attitude*".

Moreover, McGonigal (2011) points out that all games share four defining traits, namely a goal, rules, a feedback system, and voluntary participation. The *goal* provides players with a sense of purpose. It is about a specific outcome that players want to achieve and will work for. The *rules* are there to set limitations

for the players, which unleashes creativity and strategic thinking capabilities, in order for players to work towards the goal. The *feedback system* is there to tell people where they stand in games and how they are progressing, which can be in many forms, such as points, levels, progress bars, etc. Essentially it is a promise to the player that the goal is achievable, which therefore provides motivation for players to keep playing. Lastly, the *voluntary participation* refers to all the players knowing and accepting the goals, rules, and feedback, so that the experience is somewhat organized and remains a pleasurable activity. McGonigal (2011) goes on to explain that every game still has its own additional traits, but these are all there to reinforce and enhance the described elements. Furthermore, Castronova (2008) then defines the playing of a game as...

> "*...the voluntary attempt to overcome unnecessary obstacles.*"

In any type of game people are trying to overcome obstacles, and succeeding in this endeavor creates a feeling of satisfaction and joy. Games enable people to focus on something with optimism that they are either good- or are becoming better at. Furthermore, the interactivity and engagement games provide stimulate the mind and even people their physical conditions to generate positive emotions and experiences (Chen 2007). This then holds great potential for learning.

2.1.3 Entertainment- vs Serious Games

Digital games are still a relatively new medium that is especially focused on the purpose of entertainment. While the (unnecessary) obstacles in games are taken seriously within its context, the majority of games aim to provide entertainment, engagement and satisfaction.

In recent years, however, researchers and educators have shown great interests in the potential of the use of games in education (Hsu et al. 2013, Gee 2008, McGonigal 2011). They try to create games they label as *serious games*, which refers to games that have the intention to fulfill a purpose other than pure entertainment, often in relation to more serious topics, such as education, scientific exploration, health care, politics, and more. Annetta and Bronack (2011) proposes thirteen important elements for serious game design: *"prologue, tutorial/practice level, interactive feedback, identity, immersion, pleasurable, frustration, manipulation, increasing complexity, rules, informed learning, pedagogical effectiveness, reading, and effective communication"*. Marsh (2011) points out, however, that the true concept of serious games is hard to define, wherein he notes that games

are often associated with voluntary participation, which is not always the case with the application of serious games. Serious games their cause is good, but the actual effectiveness of their intended purpose is still questionable (Mitgutsch and Alvarado 2012). Designing good serious games is very difficult. Charsky (2010) argues that while the idea behind serious games are very positive, they are often still just games focused on educational content, which may come at a cost of the aspect of fun. A closer connection between instructional design, serious game design and game design for entertainment is needed in order to integrate effective learning on specific topics.

While the proposed game in this study does not aim to be a serious game, it still holds the majority of the elements discussed above. The focus is on making it an interesting and enjoyable experience, but at the same time tries to make people more thoughtful about communication.

2.1.4 Learning in Games

Aside from serious games, games that focus on entertainment also hold great potential for learning. While not a lot of research has been conducted in this area, Portnow et al. (2012) note that games are great at inducing learning in people, even though that might not even have been the main intention of the game. They explain that entertaining video games create a setting for people where they are full of enthusiasm, and inherently care about what it is that they are doing. When the people playing games are in this kind of state they are more susceptible to learning. Portnow et al. (2012) define this as *tangential learning*, referring specifically to people educating themselves about topics that they were exposed to within a context that they are already positively engaged in. As such, a game like *Civilization*, a turn-based game where players have to build up their own civilizations using historical names and countries, might spark an interest in a player about certain historical events. Even a popular shooter game like *Call of Duty* may make players interested about learning more about World War II, and music games like *Rockband* or *Guitar Hero* may potentially expose people to music genres they did not even know they were interested in (Portnow et al. 2012, McGonigal 2011).

Furthermore, according to previous research, games present alternative ways for social activities. McGonigal (2011) argues that Massively Multiplayer Online Role Playing Games (MMORPGs), such as the famous game *World of Warcraft*, stimulates communication and collaboration with other people, both friends as

well as strangers from around the world. All of these people are playing the same game and therefore have similar goals, for which (spontaneous) interaction is always an option and sometimes even required. People then make new friends and form groups to collaboratively advance through the game, all the while learning about communication, teamwork, leadership, trust and responsibility, based on the role the player takes on in the virtual world (McGonigal 2011, Gurzick et al. 2011, Ducheneaut et al. 2006). McGonigal (2011) goes on to argue that playing games and communicating within them leads to more happiness and strengthens relationships between people.

Recently, exciting new technological tools are being developed that, along the same line of reasoning, could potentially provide possibilities for even more relevant experiences, both for entertainment- and learning purposes: Virtual Reality.

2.2 Virtual Reality

2.2.1 The Rise of Virtual Reality

While Virtual Reality (VR) is a broad term encompassing many different technologies, the concept generally refers to the use of computer technology that simulates a three-dimensional world that a user can interact with in a seemingly real or physical way, thereby creating a feeling for the user of actually being present in that world (Farra et al. 2013, Freina and Ott 2015, Linowes 2015).

Virtual Reality is not a new term, however. The use of the term goes back as far as the 1960s, when Ivan Sutherland invented the first head-mounted display (HMD). Since then, as discussed by Linowes (2015), there have been several failed attempts to bring virtual reality to the masses. Various experiments were done - especially for military purposes - but the devices used were often big in size, they had a lack of software support, and they were extremely expensive. As noted by Manjoo (2014), the main point of criticism of virtual reality has always been that the technology was not good enough, but recent efforts have shown that the technology can finally be developed for reasonable prices.

The virtual reality technologies of modern times involve the wearing of head-mounted displays that have motion tracking capabilities that tracks the position as well as the orientation of the head, in order to create the seamless experience of actually being inside a virtual world (North and North 2016, Linowes 2015). The first demonstration of the current generation came in 2012 by Palmer Luckey, the

founder of Oculus, who showed his early prototype to the famous developer, John Carmack, who is known for games such as *Doom, Wolfenstein 3D* and *Quake*. Thereafter, they put the first version of the Oculus Rift, the Development Kit 1 (DK1), up on Kickstarter, which turned out to be a great success. In March 2014, following the renewed excitement for virtual reality, Oculus was acquired by Facebook for 2 billion U.S. Dollars. In the meantime, other companies, such as Sony, Samsung, Google, HTC and Valve have also started working on their own versions of virtual reality. Mobile devices were released, from Google Cardboard to Samsung's GearVR, and more recently, in April 2016, the first commercial versions of the more powerful desktop head-mounted displays, the Oculus Rift and the HTC Vive, were released. Even though a lot has been achieved over the last few years, it is still early days for virtual reality, and various companies are continuously trying to innovate on input methods, feedback methods and software that will enhance the experiences (Linowes 2015, Freina and Ott 2015).

2.2.2 Presence & Immersion

Virtual Reality its greatest strength is what researchers define as the concepts of *immersion* and *presence*. As discussed by Freina and Ott (2015), researchers define the general concept of immersion as...

> *"...the involvement in the play, which causes a lack of awareness of time and of the real world, as well as a sense of "being" in the task environment".*

Respectively, a recurring definition of the concept of presence in various studies is that:

> *"Presence is the illusion of non-mediation" (North and North 2016).*

In other words this can be described as the user perception of actually being inside of a virtual environment, while treating it as if it is an actual physical world; the user feels like they are really there. This feeling of presence is usually not created by images alone, but comes from a combination of images with sounds and other stimuli that support the virtual environment (North and North 2016). Both the terms of immersion and presence have also been used for games and other virtual experiences, but virtual reality experiences are especially built around it and harvest its power. Therefore, virtual reality is now an exciting topic for study and experimentation, and recent games and applications are starting to contribute

to a deeper understanding of the senses of presence and immersion, as well as its potential for purposes outside of entertainment (North and North 2016, Linowes 2015, Freina and Ott 2015).

2.2.3 Virtual Reality Games

With the current wave of virtual reality, the main target audience for consumer-level head-mounted displays lies in the fields of gaming. Gamers are, at this point in time, the most likely industry to already be in possession of a strong enough desktop computer to run virtual reality equipment. Moreover, as noted by Linowes (2015), gamers are already engaging with immersive and interactive 3D environments, and therefore virtual reality is a logical next step in this market. Most of the virtual reality games created thus far, however, have been small experimental projects that provide a proof of concept. *I Expect You To Die* is a popular example, where the player takes on the role of a secret agent that has to escape from different situations using problem-solving skills. The game was considered special, due to the fact that it was one of the earlier prototypes that effectively used interactive objects in the entire virtual environment to facilitate a sense of immersion as best as possible (Schell 2015b, Baker 2016). Another example, *Land's End*, is an environmental puzzle-based game that was released in November 2015, where a player has to find dots to look at in their surroundings in order to advance through the game (Kuchera 2015).

Furthermore, only few multiplayer virtual reality games have been made thus far. Amongst them a notable one is *VR Karts: Sprint*, which lets users race against each other in a cartoon-like world. Moreover, *EVE: Valkyrie* is a multiplayer game that was released in April 2016, along with the release of the Oculus Rift consumer version. It concerns a space-themed fighting game, where players take control of a spaceship and have to battle other players (Miller 2016). Similarly, *Hover Junkers* is a multiplayer first-person shooter game, where players take control of a ship built from junk scraps that they have to defend- and battle other players with (Shanklin 2016). Slightly different from the aforementioned experiences are titles like *Altspace VR* and *Oculus Social*, which are considered more as social virtual reality platforms rather than games. Both of these titles provide users with an online virtual environment where they can meet other people, and join in social activities together, such as chatting and watching videos (Robertson 2016, Matney 2016). Almost all of the current multiplayer virtual reality games and experiences available on the market today, revolve around multiple individuals,

each wearing their own head-mounted display. The only game that currently provides a multiplayer virtual reality-specific experience, utilizing only a single head-mounted display, is a game by the name of *Ruckus Ridge*, which was released in April 2016, and concerns a series of minigames in which one player enters virtual reality, and battles three friends that use a controller and look at a monitor (Jagneaux 2016). As virtual reality games, in its current form, are still new to the market, no relevant academic research could be found yet.

Beyond gaming, however, virtual reality also holds great potential for other purposes.

2.2.4 Virtual Reality in Education & Training

Virtual Reality, as a general concept, has great potential for educational- as well as training purposes due to its natural stimulation of interactivity and immersion (Roussou 2004).

Various new platforms, like *Unimersiv*, try to take Virtual Reality beyond just gaming purposes and aim to use the immersion that Virtual Reality brings to the creation of learning experiences. They explore formal educational content such as space, anatomy and historical sites (Unimersiv 2016). Moreover, Radsky (2015) indicates that virtual reality will improve education in the following five ways:

1. Greater collaboration and social integration
2. Making new experiences possible
3. Increased student motivation
4. New rewards with a focus on positive stimulation
5. Inspiring creative learning

He claims that through the simulations of high-risk and high-pressure situations effective exercises can be created, upon which he points to an experiment in a high school classroom, whereby students showed great curiosity. Despite his claim, however, it is not entirely clear whether the curiosity came from the novelty of virtual reality, nor if they truly liked it. On the other hand, Google its *Expedition* program, where they worked together with teachers and content partners in order to provide guided tours into areas that students cannot go, has

already shown great promise in the last year (Google 2016). More than one million students from over 11 countries have joined in the Expedition program, and student evaluations indicate a positive result so far, albeit it still induces nausea (Martz 2016, Schoenbart 2015).

Aside from educational purposes, virtual reality has already been widely used in the research of military-, medical-, therapeutic- and recovery purposes. Upon reviewing the latest publications on some of the uses of virtual reality, Freina and Ott (2015) found that the main motivation to use it is to allow for the creation of situations that would otherwise be difficult to experiment with. As such, she notes that this refers to reasons of time travel, physical inaccessibilities, limitations due to the danger of a situation, and possible ethical problems.

Kahlert et al. (2015), amongst others, have experimented with the use of virtual reality environments for the training of motor skills with juggling being used as the prime example. Their system presents a combination of real world interactions with visual feedback inside a virtual world. According to their research experiment, a third of the users were immediately able to transfer the newly acquired juggling skills from the virtual- to the real world.

It is noteworthy that most of the research done so far has been on adults, and very little can be found on research in reference to younger children. This is likely because it has been difficult to look into the (longer-term) effects of virtual reality technologies on participants of a young age, and whether it could interfere with the development of their balance- and hand-eye coordination (Freina and Ott 2015).

As Virtual Reality, in its current state, is still in its infancy, the amount of research that has been published in this field is still relatively small.

2.3 Communication

Interpersonal relationships and communication are important topics of research. According to previous studies globalization has led to the increase of more complex problems in our world, thereby causing a growing level of demand for groups of people from different backgrounds to work together collectively and intelligently (Clear and Kassabova 2005, Clear and Daniels 2001). Oh et al. (2013) claim, however, that no appropriate training is offered yet in current educational systems that facilitates this kind of collaborative work.

Activity Theory

According to Clear and Daniels (2001) the promotion of computer mediated communication (CMC) can be achieved by establishing a shared purpose for the users involved. They claim that this argument is based on activity theory, which allows for the analysis of behavioral patterns in social contexts through an activity system, actions, and operations. According to previous research, in activity theory a shared purpose for a group is imperative, as a lack of one would not allow members of a group to mutually agree on the activities that need to be done, as well as what kind of communication is required to satisfy those activities (Clear and Daniels 2001, Tolmie and Boyle 2000). This then is also key in the design of communication-based games.

2.3.1 Communication Games

While communication is embedded in any type of activity, only few video games have been made where communication is the main mechanic for the gameplay. A few existing ones will be briefly discussed.

Keep Talking and Nobody Explodes is a game where one player is presented with a bomb to defuse, whereas another player (or multiple players) is responsible for the giving of instructions through the use of a manual. The bomb has several modules that can hold one of various mini puzzles that require a different set of instructions. *Keep Talking and Nobody Explodes* also allows for the use of virtual reality head-mounted displays, but it adds little to the game experience itself, as no moving- or looking around is required. The game itself, however, has become fairly popular and presents an example that communication can definitely be used as the main mechanic for gameplay (Grayson 2015, Machkovech 2015).

Furthermore, Chou et al. (2016) made an experiential game design based on unequal communication, which they describe as the communication with people who are mute or have impaired hearing, or the communication between humans and pets. They present an experiential two player game design, named *Human and Dog*, where one player is human, and another player takes up the role of a dog. Both of them can do different things within the game, but they have to solve certain tasks together by communicating with each other through unequal communication channels, due to the nature of their respective roles. The puzzles the two players have to solve include a number code, a reversed 8-puzzle, fighting ghosts, and the finding of an alphabetic computer password. Based on small user

tests, Chou et al. (2016) concluded that unequal communication as gameplay is an interesting topic for further research.

According to Manninen (2002) not much research has been done around the use of interaction as a concept, due to its ambiguity and subjectivity. He states that the entertainment industry and academic research, in terms of practice and theory, are often not able to work together. Numerous publications since then, however, do address that there are a lot of games where communication is part of a collaborative effort (McGonigal 2011, Gee 2008, Bailey et al. 2006). Most of the examples of such games come in the form of Role Playing Games (RPGs), from the paper-based game, *Dungeons & Dragons*, to massively multiplayer online role playing games (MMORPGs) like *World of Warcraft, Everquest* and *Guild Wars*. In these type of games a player takes on a role in a story and needs to work together with other players in order to advance. While communication in these games can be seen as important in order to do better, it is not the core focus of the game itself.

2.3.2 Collaborative Virtual Environments

Manninen (2005) suggest that the support of collaborative experiences through virtual environments is a very important topic, and is often referred to as Computer Supported Cooperative Work (CSCW). They argue that players their lives are enriched by such game experiences because they can learn how to work together with others in the active pursuit of a common goal. However, they add that collaborative play is difficult to implement in computer games. Various attempts have been made in small research projects.

The GIVE Challenge is a collaborative puzzle game about a virtual treasure hunt where there are two roles, one of an instruction giver, who gives instructions to the other player but cannot do anything in the environment itself, and one of the follower, who is in the environment but cannot communicate back. The game is based on real time natural language generation, which is what the researchers wanted to test as a system (Koller et al. 2010, Striegnitz et al. 2011). Danise and Striegnitz (2012), however, noted that GIVE failed as a game because all the players had to do was relay instructions without any sort of (creative) input, and it was therefore not very fun to play. They then proposed a game design of their own, using GIVE as an example, in which they wanted to test for human-to-human problem solving dialog in a situated scenario. Unfortunately, they never got much further than this proposal.

Clear and Daniels (2001) did a study on effective virtual group communication through the design of a cyber-icebreaker tasks. It required students to work together across different time zones, institutions and country boundaries, and the goal of the designed icebreaker artifact was to assist students in getting to know their overseas partners and improve their group its effectiveness. The icebreaker tasks involved the matching of personalities with clues given by the participants themselves. The study concluded that icebreaker tasks were successful in encouraging initial communication between group members and that it thereby enhanced the performance of the entire group in the icebreaker session.

Another group of researchers made *eScape*, a four-player collaborative game, where the goal is to solve puzzles in order to escape from an ancient prison colony (Manninen 2005). They emphasized group dynamics where they found that it was imperative that their game had a joint goal, negotiation between players, planning of solutions, sharing of information between players, co-ordination between different perspectives and joint rule-making on how players would (or would not) act in specific situations. Based on the results of their data collection they were very positive on the possibilities of collaborative puzzle games, but felt that their puzzles were seemingly straightforward, and missed a pressure- and risk level. Combining previous research with their own findings, they concluded that it is very difficult to design constructive multiplayer games where the methods of collaboration needed to succeed truly lies with the (group of) players, rather than single-player solutions. According to Nasir et al. (2013) the key to successful collaborative virtual games lies in the balance of gameplay and cooperative play characteristics, as is displayed in Figure 2.1.

Table 2.1: Gameplay and Cooperative play characteristics, derived from Nasir et.al (2013).

Gameplay	**Cooperative Play**
Moderate complexity	Balanced individual participation
Easy to use interface	Uniqueness of roles
Moderately easy difficulty	Need for social interaction
Appealing theme	Use of cooperative patterns
	Concurrent play

2.4 Contribution of This Research

As discussed in this chapter, previous research has indicated the inherent positivity of games, both for entertainment- and learning purposes. Virtual reality, in its current form, then has the potential to expand upon these principles even more, due to its nature in gaming and its strong provision of immersion. Not a lot of virtual reality games have been made yet, however, especially in relation to multiplayer capabilities. The ones that do exist focus mostly on multiple individuals, each wearing their own respective headset. Most of the virtual reality games and experiences that were mentioned in this chapter were released a few weeks before the submission of this paper. Additionally, there is also a lack of collaborative communication-based experiences, both as the main gameplay mechanic in games as well as in general academic research. Previous research has indicated the effectiveness of icebreaker games for interpersonal relationships between individuals, but not in the form of collaborators with a shared goal (Oh et al. 2013, Gurzick et al. 2011, Clear and Kassabova 2005, Clear and Daniels 2001).

This research then poses as a contribution on multiple fronts. It proposes the experimental design of a multiplayer virtual reality game that utilizes a single head-mounted display, and focuses on asymmetrical- and communication-based gameplay. While the game experience proposed in the present research is not purposefully designed as an icebreaker, it can be used as such, as it fosters communication and working together, collaboratively, towards a shared goal. Moreover, due to its collaborative and communicative nature, useful insights into how people communicate may be inferred, and potential learning amongst players may take place.

Chapter 3
Design

In order to properly discuss the design framework that was used for this research, various topics need to be discussed. This chapter is therefore divided into three sections:

1. General Game- & Virtual Reality- Design Information
2. Initial Design Process
3. Game Design Document - TALK ME THROUGH THIS!

The first section briefly talks about some general information on game- and virtual reality design, and what to look out for. The second section talks about the initial design process through which the initial idea for the game concept was shaped, and the last section introduces the game design document of the designed artifact: TALK ME THROUGH THIS.

3.1 Game Design

3.1.1 Introduction

Game design is one the most complex and broadest fields of design, and at present, there is no "unified theory of game design" that can be followed in order to design a good game. Game design, in one of its simplest definitions by Schell (2015a) can be described as...

> *"...the act of deciding what a game should be".*

This then does not refer to just one decision, but many different decisions ranging from rules to art, pacing, feedback, rewards, punishments, sound, interface, and

many more thing that are part of the player experience. Furthermore, it is important to note that this refers not only to video games, but to *all* type of games, including board games, card games, etc.

Schell (2015a) goes on to explain that game design includes many different skills concerning *Animation, Anthropology, Architecture, Brainstorming, Business, Cinematography, Communication, Creative Writing, Economics, Engineering, Games, History, Management, Mathematics, Music, Psychology, Public Speaking, Sound Design, Technical Writing, Visual Arts*, and many more. While one person cannot master all of these, more knowledge on each of these can be useful in the process of game design. Ultimately, all of this comes together in what it is all about, namely *the design of an experience* (see Figure 3.1).

As everyone is different, *how* someone experiences something is a very personal feeling that is impossible to perfectly recreate for someone else. Schell (2015a) then argues that a perfect replication of a real experience is not required for a game to be good. If one wants to create a certain experience the essence – the key features – is what is most important in order to make an experience memorable. As long as the essential elements of an experience are included in a game, it is perfectly fine for people to have their own personal journey with it. That is what experiences are all about.

As was discussed in chapter 2.1.1, Gee (2008) explains how memorable experiences are also directly related to effective ways of learning. In relation to games he then argues that learning is integral to game design, in which he states:

> "*Game Design is applied learning theory, and good game designers have discovered important principles of learning without needing to be or become academic learning theorists.*"

This is an important argument in relation to this particular research project, as one of the goals is to create a game experience that is, first and foremost, fun an interesting to play, whilst also exposing the players to some communicative practice that may prove useful in real live situations as well. The main purpose does not necessarily have to be some educational topic, but as players are voluntarily engaging in the game experience they are arguably in a more susceptible mindset, where some form of learning may take place, no matter how small that is or whether players even realize it themselves.

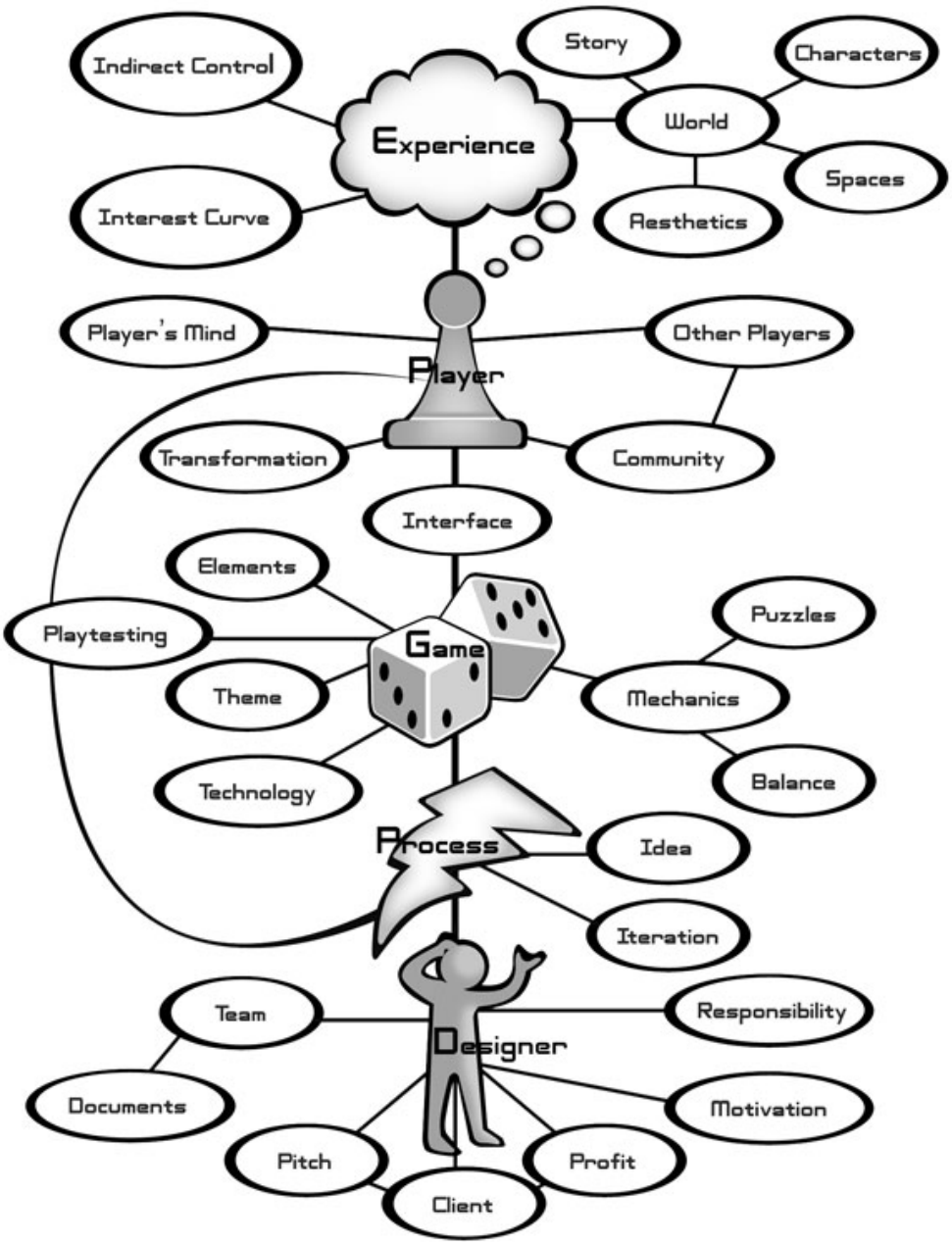


Figure 3.1: The web of game design relationships, as displayed in *The Art of Game Design: A Book of Lenses* by Jesse Schell (2015).

3.1.2 Game Design Document

In most circumstances games are being made by a whole team of people, with each of them responsible for specific roles in the game development process. In order to structure the core idea(s) of a game between all the team members, and the different tasks to be completed, a *Game Design Document (GDD)* is often established, which can also be described as a living design document. A Game Design Document is often part of the agreement between game-publishers and game-developers that is constructed in the pre-production stage of game development. This does not mean, however, that it holds the final design of a game. On the contrary, a Game Design Document is referred to as a living document, because it is continuously updated throughout the game development process (Moore and Novak 2009, Oxland 2004).

Authors on game design agree that there are no established rules on what should be included in a Game Design Document (Salazar et al. 2012). According to Schell (2015a) a magic template for a game design document does not exist, has never existed, and will never exist. As every game is different the developers have to decide for themselves what factors are important for their game and team, and what can be considered as supplemental, or what can even be left out. The majority of game design documents, however, do generally include topics such as the Story, Concept, Characters, Level Design, Gameplay, Aesthetics, Sound, User Interface, and Game Controls (Tuliper and Newman 2015, Schell 2015a, Salazar et al. 2012, Hrehovcsik 2004). For the purpose of this thesis document, a more descriptive Game Design Document, relevant to this particular game experience, will be laid out. While a much more basic version of the document, focusing on merely the concept and outline of the game, was actually used during development, a more descriptive version is needed here in order to further explain the design and reasoning for the experience design. The topics that were included are as follows: Introduction, Plot, Concept, Purpose & Significance, Features, Genre, Target Audience, Target Platform, Reference Games, Art style, Character Design, Level Design, Gameplay, Sound Design, User Interface, Game Controls, and Technology. While all of these topic titles are self-explanatory, the *Introduction* in a game design document is usually used with the purpose of a short but effective description of what the game is all about, written in a way so that it could be used directly by a marketing team. This is what could potentially be found on the back of the box the game comes in. Moreover, the *Plot* briefly explains the overall story of the game, directed towards its players.

3.1.3 Designing for Virtual Reality

While designing for virtual reality does have a lot of similarities with traditional game development, there are also a few differences in the approach towards fundamental concepts. Therefore, whilst keeping the traditional game design processes in mind, virtual reality development should be approached as its own entity. Because of the immersion virtual reality brings, the way a player *experiences* the game environment is completely different. There are many factors that could create discomfort for the player or make the experience feel unnatural, thereby coming at the cost of the sense of immersion. A few of the factors relevant to the creation of the TALK ME THROUGH THIS project will be briefly discussed below.

Movement and Comfort

Instead of looking at a stationary screen, as is mostly the case with traditional video games, with virtual reality the player has to physically turn their head in order to look around. As such, *movement* is a very important factor as to how a virtual experience will be perceived; it directly relates to the players their level of *comfort* (Oculus 2016). With most of the current headsets, and especially with the older Oculus Rift developer kits, the player is in a stationary position in the real world, as can be seen in Figure 3.2. The direction of the viewable area inside the virtual world is then directly related to the users their head movements, while moving forward, backward and sidewards are currently often still connected to the pushing of a joystick on a game controller. Some experiences also allow for the use of the *WASD* keys (as arrow keys) on a keyboard for moving a player around, as was a traditional standard in video games for computers, but this presents severe limitations to the extent that players can move their heads. Similarly, reliable input methods with objects, characters and menus inside virtual worlds were also limited to *gaze controls*, meaning where a player looks, as well as the pushing of buttons on a game controller, during the time of the development of this project.

New and better ways of movement and interactions are available for the new commercial virtual reality headsets. The new *HTC Vive*, for example, offers room tracking in physical space, combined with motion controllers for user input, and Oculus will offer a similar option in the near future with their Oculus Touch controllers.

Other than the methods of movement and interaction, *how* movements are represented inside of virtual worlds is also a great challenge. Whereas with tradi-

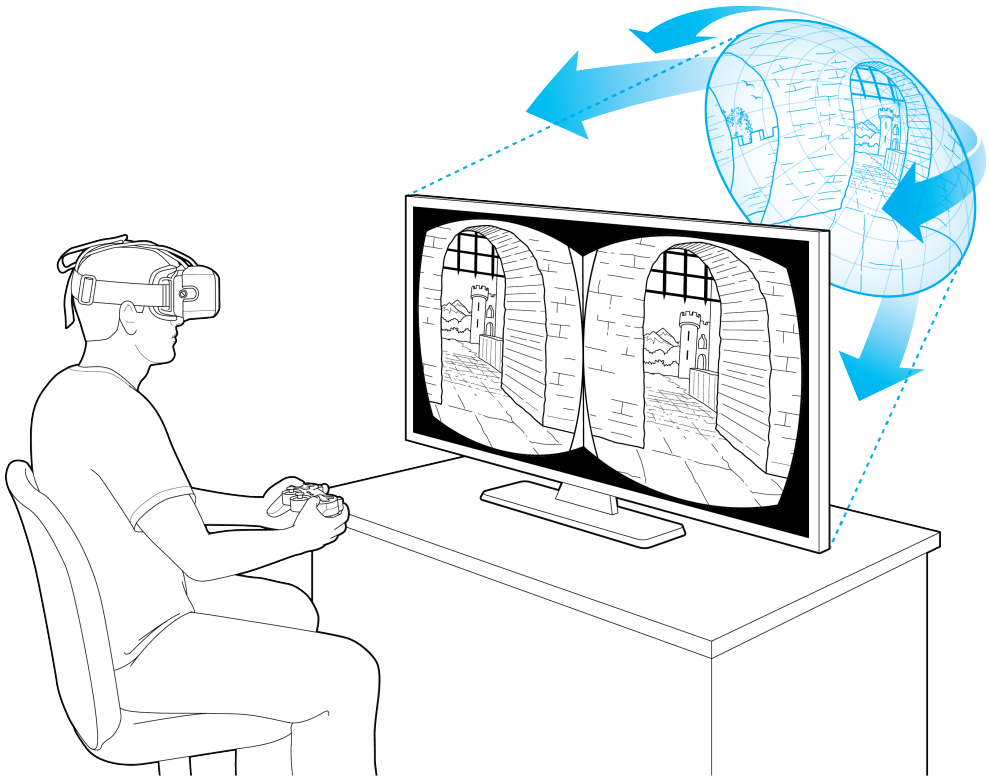


Figure 3.2: Oculus Rift DK2 Headset and Controller Setup. Illustration by Chris Philpot.

tional video games faster (character) movements could often be considered desirable, faster movements inside virtual reality makes the experience feel unnatural and could potentially induce motion sickness, which in this case refers to the mismatch between a user their visual perception of the virtual environment, and the response of their vestibular (balance) system (Fernandes and Feiner 2016).

Sound and Music

Sound and music in virtual reality require extra attention and effort compared to traditional video games, as it is directly related to the immersion a player experiences. Since the goal of virtual experiences is to make players feel *present* inside a different environment, spatial sounds are necessary and expected. Spatial sound then refers to sounds coming from a particular position or direction in an environment (Oculus 2016).

Modeling & Normal Maps

Being inside of a computer-generated environment, opposed to looking at it through a screen, makes the amount of detail in such an environment fundamentally different. A technique that is used a lot in traditional video games is something called *normal mapping*, which refers to fake lighting effects that makes it seem like virtual objects have more depth without having to add more detail to the actual (3D) model itself. Due to the stereoscopic view used in virtual reality, however, when a user has the possibility to get up close to virtual objects, normal maps will lose their intended sense of depth and look flat instead. Therefore, as also discussed by Allen (2015), the amount of detail in 3D models of virtual objects may play a larger role. While players are exploring their virtual environment they may consequently expect to be able to interact with virtual objects. This would of course require more time spent on the creation of more sophisticated 3D models. In addition, the scale of 3D models and environments become more relevant as users go into them, and is therefore another matter that should be taken into careful consideration during level design processes (Allen 2015, Oculus 2016).

User Interface

In most traditional video games the user interface would be done through what is called a *Heads-Up Display (HUD)*, which refers to all the information, such as timers, player health, etc., being displayed on top of the game screen in front

of everything else. With virtual reality, however, this type of user interface is highly impractical and unnatural, and therefore it is generally better to embed such information into the virtual environment itself. Experimentation here is imperative, as the optimal solution for the displaying of information may differ between (game) experiences (Oculus 2016).

3.2 Initial Design Process

Prior to the start of the TALK ME THROUGH THIS project, a few things were already decided beforehand. As such, it was decided that the project would concern the experimental design of a game experience, utilizing an Oculus Rift Developer's Kit 2 Head-Mounted Display. Moreover, it quickly became apparent that this experience would be created inside Unity, a free multi-platform game engine that enables the creation of interactive games, both in 2D as well as 3D. It has a relatively intuitive interface that is accessible for beginner developers, and has a connected Unity Assets store, through which other (Unity) developers can sell assets, such as 3D models, textures audio, scripts, animations, entire applications, and more. Access to these kind of assets allows Unity developers, both beginner and advanced, to create immersive game experiences fairly quickly.

Because there was no prior knowledge or skills in relation to game design, and all that comes with it, a lot of time was initially spent on reading and engaging with tutorials and online courses related to game design, programming, Unity, 3D modeling, sound design and more. Some of the resources, both free and paid, that were considered useful for the purpose of learning Unity and general game design, are briefly presented in Appendix A.

Furthermore, research was done in the field of what was currently available for virtual reality games and experiences. Thereafter, an ideation session was conducted to generate interesting concepts with the use of a head-mounted display and a controller. It was recognized that an overwhelming majority of virtual reality experiences in existence, at that point in time, were focused on individuals, alienating the player from the real world without any sort of possibilities for the inclusion of the people in the direct surroundings of the player. Moreover, it was also recognized that commercial virtual reality products would initially be fairly expensive and the market adaptation might be slow. Only a select group of people currently have a computer powerful enough to run virtual reality experiences, and it can therefore be speculated that for the foreseeable future

there will only be one head-mounted display in a single household, and possible even amongst a group of friends. This then resulted in the idea for the creation of a concept for a multiplayer communication-based virtual reality game experience that only utilizes a single head-mounted display. Following upon this, there was a brainstorm over the course of a few days for gameplay possibilities using this concept. Various ideas were considered, but eventually the idea of a memory maze-like experience was selected, as this seemed to be the most feasible, taking into account the limitations with regards to time, manpower and game design experience. Over time this evolved into the project under the name of TALK ME THROUGH THIS.

3.3 Game Design Document – TALK ME THROUGH THIS!

3.3.1 Introduction

TALK ME THROUGH THIS brings a two-player experience to virtual reality, a relatively new medium that until now has mainly focused on individual experiences. One player enters the virtual world through the use of an *Oculus Rift* Head-Mounted Display, and finds him- or herself trapped inside the environment of an "evil persona". The only way out is to get through the challenge that has been set out. This cannot be done alone, however, and requires the help of another player on the outside of the virtual world – the real world. Communication is key.

3.3.2 Plot

When you wake up in the virtual world you find yourself trapped inside the maze of an evil persona. Terrible things will happen to you if you do not find your way out. With a limited amount of time on the clock you need to get through the challenge in order to get out. But you will not be able to do all of this on your own. You will have to work together with someone on the outside of the virtual world in order to succeed. Thread carefully. It is your life that is on the line..

3.3.3 Concept

The game experience consists of a challenge that needs to be solved by two players, one *inside* the virtual world, and one on the *outside* (see Figure 3.3).

The player inside the virtual world takes on the role of the character that needs to escape from the evil persona. This is done through a first-person point of view, effectively meaning *through the eyes* of the character. The player outside of the virtual world is the one that has access to necessary information that aids the other player in their escape. Both players need to communicate with each other, using the information and tools that are available to each of them in order to advance through the game experience.

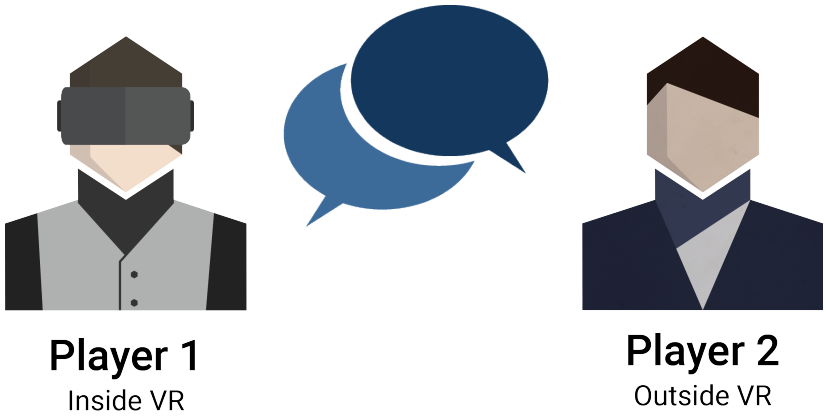


Figure 3.3: TALK ME THROUGH THIS Game Experience Concept

3.3.4 Purpose & Significance

There are numerous aspects that make TALK ME THROUGH THIS special. Firstly, it provides a multiplayer virtual reality experience, utilizing only a single head-mounted display. There are currently very few multiplayer games for virtual reality, and those that do exist require all players to wear their own individual headset. This game experience, however, allows people within the same environment to play together, thereby making it an example of how a virtual reality game can also be a more social activity. Moreover, the game is played through the communication between the players. While communication games do exist, not a lot of video games have been made that use communication as the main mechanic for the gameplay. Communication is something very important in the world, but in many cases it proves to be very complex, and is often the source for many conflicts. The importance of effective communication in the proposed game potentially allows for informal learning in players, through which they may become more thoughtful on how they communicate with others.

3.3.5 Features

- Multi-player VR experience - one person inside VR, and one outside
- Communication-based game mechanics
- Spatial clues
- Spatial sound

- 5–minute challenge
- Some informal learning
- Potentially relationship bonding or breaking

3.3.6 Genre

A two player Virtual Reality communication-based puzzle game.

3.3.7 Target Audience

The following target audience was kept in mind during the development of the game:

- Young adults
- Ages 18-35
- Both males and females
- Slightly tech savvy

A target audience with the age range of 18 to 35 year olds was selected to be on the safe side with possible influential factors, both psychology-wise as well as for the development of the eye. The theme of the game was set around the escape from an evil persona, with the consequences of success being either life or death. This theme, alongside the inclusion of certain scare elements upon failure inside of the game, may not be very suitable for a younger audience. Moreover, virtual reality, in its modern form, is a still a new medium that only just saw commercial release in 2016. Not enough research has been done into the possible side effects of the use of head-mounted displays for extended periods of time. It has already been suggested, however, that the use of virtual reality equipment could possibly interfere with the natural development of the eye during early ages (Crawley 2015). Taking both of these factors into account, it was decided to focus on a minimum target age of 18 years old. Furthermore, people within the age range of 18–35 are considered to be young adults that are part of the generations that grew up with technology and games, and are therefore more likely to be slightly more tech savvy. This is of importance in terms of this game experience,

because the players are expected to use a computer, and the player inside of the virtual world is required to use a game controller without directly looking at it.

Of course, this target audience is not set as a limitation on who might enjoy the experience, but rather as a range that was generally kept in mind during development. People outside of the aforementioned target audience may still very much enjoy partaking in the experience.

3.3.8 Target Platform

TALK ME THROUGH THIS was made for the Oculus Rift Developer's Kit 2 (Oculus Rift DK2), running on a desktop computer. A relatively powerful desktop computer, in accordance to Oculus its DK2 requirements, is needed in order to run the experience. A powerful computer allows for a smoother experience through the ability of a higher frames per second (FPS) output, thereby reducing the chances of motion sickness. Furthermore, such a computer also allows for better graphics, and more ways of user input in virtual experiences, such as the use of a game controller. While mobile virtual reality, such as Samsung and Oculus their *GearVR*, as well as *Google Cardboard*, provide a great introduction to virtual reality, they did not provide enough flexibility in terms of power and controller input at the time of development. Future versions of the GearVR, as well as Google's newly announced *Daydream* will in all likelihood open doors for the development of more mobile virtual reality experiences that include more user input methods.

3.3.9 Reference Games

The following games were used as a reference for inspiration during the development process:

Charades is a multiplayer word guessing game, whereby one player acts out a specific word or phrase without the use of any sounds, upon which the other players then have to guess what word or sentence was acted out. Charades can be considered a party game, and is most often played on holidays. It is a game that anyone can play anywhere and at any time, as it does not need to be purchased. Whereas Charades focuses on physical communication, TALK ME THROUGH THIS focuses on verbal communication. *How* people communicate and interpret a message is similarly important.

Keep Talking and Nobody Explodes is a relatively new game that comes closest to TALK ME THROUGH THIS. It uses similar game mechanics, concerning the communication between two parties, in order to defuse a bomb within a limited amount of time. *Keep Talking and Nobody Explodes* does allow for the use of virtual reality head-mounted displays, but does not use it as an element for the game itself and is therefore not a requirement. The mini puzzles are diverse and the game provides a great example for the use of communication as a game mechanic.

KMD G-EDU Global Workshop Ice-breaking Game is a game without a real name that is used in Global Workshop sessions on a Japanese high school by the Graduate School of Media Design its Global Education real project group. It concerns a communication-based icebreaker game, where a group of five students divide their group in the roles of a Builder, a Describer, a Runner, and two Observers. The Describer gets a small structure built of LEGO-like material, and needs to communicate exactly how it is built to the Runner, who is not allowed to see the structure itself. The Runner then needs to relay the information received from the Describer to the Builder, who is in charge of building the same structure based on the instructions given. The two Observers simply observe- and report back on the communication process between the Describer, the Runner and the Builder. The goal is that they are able to replicate the structure to the best of their abilities through effective communication. While the goal itself in this game is slightly different, the communication in there also served as an inspiration for TALK ME THROUGH THIS.

Metal Gear Solid is a famous action-adventure video game created by Konami. While the gameplay itself does not at all relate to TALK ME THROUGH THIS the game did serve as an inspiration for the initial concept of communication-based guidance. In Metal Gear Solid, the main character, Snake, is a soldier that has to infiltrate enemy territory, and is often communicating with his commanding officer on tactics to be used, through the use of what the game defines as *codec* calls.

3.3.10 Art Style

The art style of a game refers to how a game looks, but also how it feels. For TALK ME THOUGH THIS it was decided to give the environment the look of an old-

fashioned manor, in order to support the slightly creepy and scary theme of the game. The popular horror movie *Saw* was used as an inspiration for this theme. In the game environment you can see this return in the form of carpet textures for the floor, cracked walls, old-fashioned painting frames, wooden decorations, dust particles in the air and fairly yellow lighting in the scene as a whole.

Some of the 3D models and textures that were used came from the Unity Asset Store, while some others were created using software such as *Blender* and *Photoshop*. These models and textures were then imported into Unity, where they could be used to design the levels.

Figure 3.4: Example of a lamp design from sketch to 3D model, as was used in TALK ME THROUGH THIS.

3.3.11 Character Design

In terms of characters, very little design was done in the development of TALK ME THROUGH THIS. In fact, it could arguably be said that there are no game characters at all, but rather roles that the players take on, namely that of the escapee in the virtual world, and the helper on the outside. It was briefly considered to make a 3D model for the body of the person in the virtual world, but due to skill- and time limitations it was decided not to add this at this point in time.

3.3.12 Level Design

The level design was initially focused on a simple room with a grid-based floor that would allow for a maze with invisible walls. After playing around with ideas for different room sizes, it was decided that the room would be created with a

five-by-five square grid-based floor, where invisible walls could be placed on the lines of the grid (see Figure 3.5 and 3.6). If the player would come in touch with one of these invisible walls they would be teleported back to their initial starting position. The player inside the virtual world would then have to navigate a path, from one corner of the room to the other, where a doorway was modeled. At a later stage another door was added to allow for more and diverse maze levels. A total of twenty different maze levels were designed (see Page 43), of which one would randomly be activated upon starting the game.

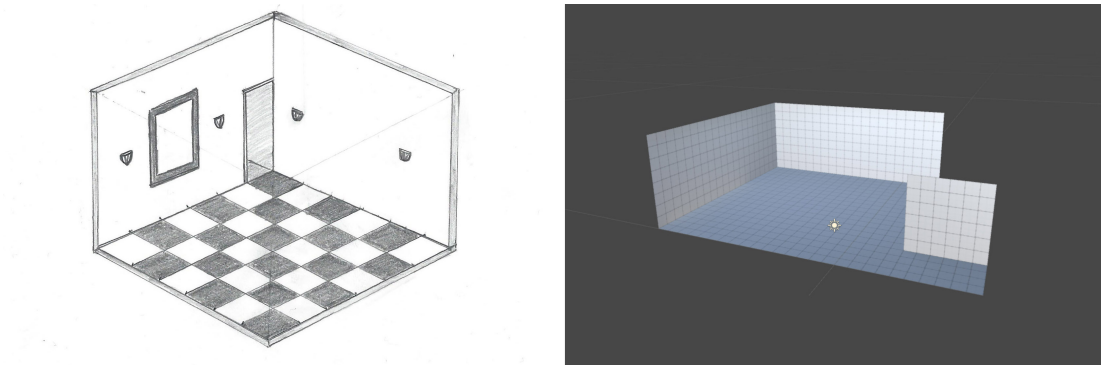


Figure 3.5: Level Design from sketch (left) to initial modeling in Unity (right).

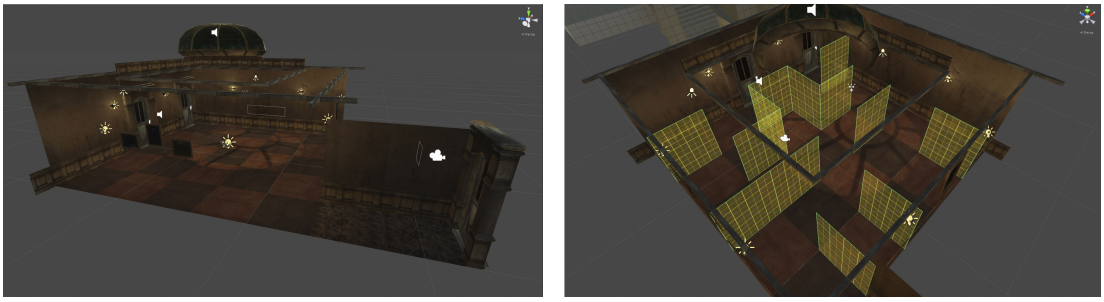


Figure 3.6: Level design inside of Unity, with the final room design on the left, and an example of a level with invisible maze walls on the right.

Once the development of the initial level was complete it was playtested by two people. It soon became apparent that the level was too small, and thus too easy, for just a simple maze without more dire consequences in place. Rather than communicating the position of invisible walls to the other player, it was easier and

quicker for the player inside the virtual world to simply memorize them and find their own way through the maze.

In order to implement more of a sense of urgency it was quickly decided that there would need to be an overall time limit, as well as a limited amount of times that a player could walk into the invisible walls. Moreover, as communication is the essential mechanic to the game experience, more complexity in the gameplay was needed to facilitate a more interesting communicative experience. A brainstorm session was done thereafter, about how further complexity in communication could be added, whilst being able to keep the current design of the level at the same time. This resulted in various ideas for the addition of more ambiguous layers of communication between the two players.

Eventually, this led towards the design where the player on the outside of virtual reality would receive a document that held all the information necessary to find a way through the particular maze the other player was trapped in. In order to find what specific information on the document to look at, questions would need to be asked to the other player about certain details in the virtual environment. Because the mazes already used the entirety of the floor, the extra details were added to the rest of the environment, such as the surrounding walls and the ceiling, in the form of a combination of paintings and lamps that could differ depending on what maze level was randomly selected upon starting the game. Especially important here was that the information that was added was slightly ambiguous to describe towards the other player, so that *how* they communicate what they see is more essential. For the purpose of the TALK ME THROUGH THIS maze level, it was designed so that the information that would need to be extracted from the virtual room comes from two paintings as well as the amount of lamps present in the environment.

The first relevant painting is positioned on the wall on the opposite side of the player's starting position inside the virtual world – the wall that has doors and displays the timer. This painting holds one of two possible images. Both images are the exact same optical illusion – displaying both a young- as well as an old woman, depending on how it is perceived – but drawn in a different style (see Figure 3.7). The images that were used here were found online under Creative Commons licenses.

The second relevant painting is positioned on the most right wall seen, from the perspective of the player their starting position inside the virtual world – the wall that also displays the amount of chances they have left before they are game

Figure 3.7: The two possible options for the first relevant painting in the level. Both are the same optical illusion.

over. The painting displays one of five possible images (see Figure 3.8) that are rather ambiguous:

1. The word “Nothing” written in letters
2. The word “Black” written in letters
3. The words “No painting” written in letters
4. An entirely black image
5. An empty frame holding no image at all

Figure 3.8: All possible options for the second relevant painting in the level.

The third communicative element concerns a calculation that needs to be verified, for which two numbers need to be found. The first number for the calculation then needs to be found by the player on the outside of virtual reality, using the Internet. One of the intentions here was to expose the player to some real information, in the form of a number that they might not have known before. To avoid unnecessary complexity for the purpose of this particular game, the numbers that were selected for inclusion are all easy to find through a single Google Search inquiry. Depending on the combination of the previously discussed paintings, one of five possible numbers need to be looked up:

1. The number of the speed of light in kilometers per second (= 299.792)
2. The number where Fahrenheit and Celcius are the same value (= -40)
3. The number of LEET – a combination of ASCII characters often used on the Internet that is derived from the word *elite* (= 1337)
4. The number of whole minutes it takes for sunlight to reach the Earth (= 8)
5. The number that is the answer to the Universe – a famous number from *The Hitchhiker's Guide to the Galaxy* (= 42)

This number would then be need to be divided by the amount of lamps inside the virtual world, which needs to be counted by the person on the inside. The amount of lamps in the room are again dependent on which maze the player is in and can range from 8 to 13 total lamps. The answer of the calculation then needs to be checked against an answer that was given on the player document. Whether it is equal or not is imperative as it tells the player which row of maze maps he can look at that will help him guide the other player through the maze.

The final communicative element concerns the maze and the corresponding maze maps. After the calculation, the player with the document knows which row number to look at. Each row still contains four different maze maps, and the correct one amongst them can be found through trial and error. The player inside the virtual world has three chances, meaning that he can walk into three invisible maze walls before he dies, within the context of the game. This means that they can communicate the position of a few of the invisible walls, which is enough to find the correct maze map, and thus the answer of how to get through the entire maze.

The document for the player – the Player Manual – was designed, using the required information as partly described above, in a way that was deemed the most logical flow of information for the use of the player. Various designs for the document were experimented with, but the final version is as can be seen on Page 40, 41, 42 and 43.

How all the information was structured and divided into the different Maze levels can be found in the developer notes in Appendix B.

Figure 3.9: The maze level through the eyes of the player, during gameplay.

Extra Areas

At a later stage two different areas were added to the game experience, namely a *Starting Area* and a *Game Over* area where the player would go if they did not successfully succeed the challenge.

The starting area had very little design. It is a very basic room where the player inside the virtual world would first find themselves (see Figure 3.10). Its purpose is simply for the players to be able to get ready first, rather than the experience starting right away in the maze, as this would also immediately start the timer. On one wall of the starting area, the title of the game and the name of the developer are displayed, and another wall contains a short instruction, asking the player if they are able to clearly hear the other player before pressing a button on the game controller that would initiate the experience.

The second area that was added at a later stage, was the room the player would go if they failed the challenge – the *Game Over Area* (see Figure 3.11) –

meaning when either the time ran out or the player walked into more than three walls. This room was designed with the purpose in mind of it being *creepy* and perhaps a little *scary*. The player is placed on a chair in the middle of a dark room, still able to look around, but no longer able to move. Various spatial sounds were placed in the room to make it more scary.

Figure 3.10: The Starting Area for the player on the inside of virtual reality.

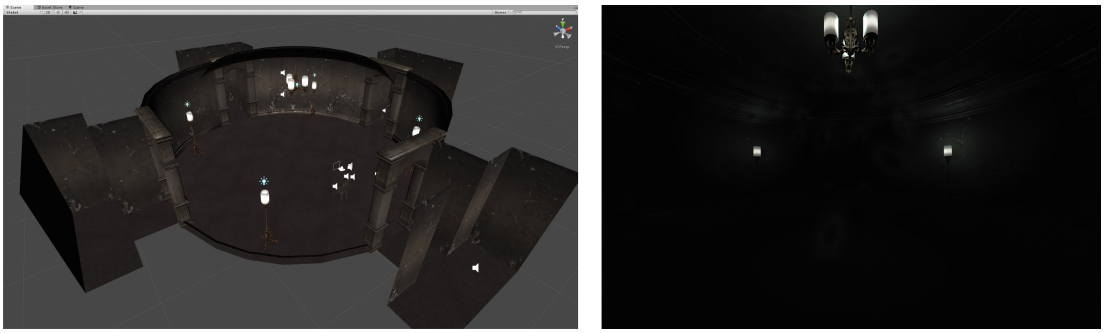
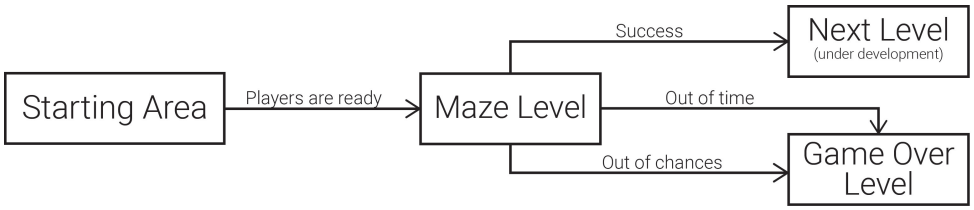


Figure 3.11: The Game Over area as designed in Unity (left) and from the point of view of the player (right).

Figure 3.12: Level Flowchart.

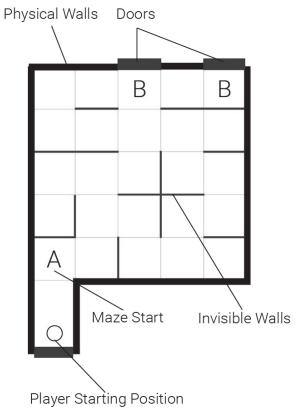


TALK ME THROUGH THIS

Let's Talk About the Maze

Don't forget the rules.

- The maze is a 5 x 5 grid.
- You have to get to one of the doors (from A to B).
- The maze has invisible walls. When you walk into one you will be teleported back to the start
- Only three mistakes are allowed, meaning that after walking into 3 walls you die…
- The challenge has to be completed in 5 minutes or else - you guessed it - you die.
- The other person has a document with information that can help you survive.



GOOD LUCK.

Figure 3.13: Page 0 of the TALK ME THROUGH THIS manual, which serves as the instructions before playing for the person *inside* the virtual world.

TALK ME THROUGH THIS

Hello, I want to play a game.

Most people are so ungrateful to be alive. Until a person is faced with death, it's impossible to tell whether they have what it takes to survive. So, I placed someone in a room to put them to the test. But they need you to talk them through it. In this document you will find the information that could aid to their survival. Whether they live or die depends on you.

Time is little, so be quick.
Let the games begin.

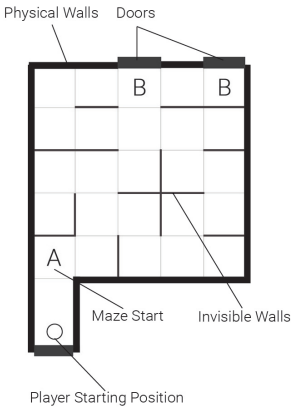
Room View

Inside VR

Let's Talk About the Maze

Don't forget the rules.

- The maze is a 5 x 5 grid.
- They have to get from A to B.
- The maze has invisible walls. When someone walks into one they will be teleported back to the start
- Only three mistakes are allowed, meaning that after walking into 3 walls they die...
- The challenge has to be completed in 5 minutes or else - you guessed it - they die.
- There are clues in the room leading to specific Maze Maps (see page 2 & 3) that can be used to guide the other through a maze.
- If you need to find out the number of something you are allowed to use the Internet.
- A lamp counts as one lamp, even if it has multiple lights in it.



Page 1 of 3

Figure 3.14: Page 1 of the TALK ME THROUGH THIS manual.

Talk Me Through This The Maze

Find the information you need..

Communication is Key.

IF The painting on the wall that has doors looks like:

LOOK AT SECTION 1

OR

LOOK AT SECTION 2

SECTION 1

IF the painting on the right wall...

1. SAYS "NOTHING"...
   - ...and the answer to (speed of light in km/s) / (number of lamps in the room) = 23,060.92, look at row 1
   - ...Otherwise, look at row 3
2. SAYS "BLACK"...
   - ...and the answer to (number where Fahrenheit and Celcius are the same) / (number of lamps in the room) = -3.6364, look at row 1
   - ...Otherwise, look at row 3
3. SAYS "NO PAINTING"...
   - ...and the answer to (number of LEET) / (number of lamps in the room) = -148.5556, look at row 5
   - ...Otherwise, look at row 4
4. IS BLACK...
   - ...and the answer to (number of whole minutes it takes for Sunlight to reach the Earth) / (number of lamps in the room) = 0.6667, look at row 4
   - ...Otherwise, look at row 2
5. IS MISSING...
   - ...and the answer to (answer to the Universe) / (number of lamps in the room) = 4.6667, look at row 2
   - ...Otherwise, look at row 5

SECTION 2

IF the painting on the right wall...

1. SAYS "NOTHING"...
   - ...and the answer to (answer to the Universe) / (number of lamps in the room) = 5.25, look at row 4
   - ...Otherwise, look at row 5
2. SAYS "BLACK"...
   - ...and the answer to (number where Fahrenheit and Celcius are the same) / (number of lamps in the room) = -4.444, look at row 1
   - ...Otherwise, look at row 3
3. SAYS "NO PAINTING"...
   - ...and the answer to (number of whole minutes it takes for Sunlight to reach the Earth) / (number of lamps in the room) = -0.6154, look at row 3
   - ...Otherwise, look at row 2
4. IS BLACK...
   - ...and the answer to (number of LEET) / (number of lamps in the room) = 121.5455, look at row 1
   - ...Otherwise, look at row 5
5. IS MISSING...
   - ...and the answer to (speed of light in km/s) / (number of lamps in the room) = 37.474, look at row 3
   - ...Otherwise, look at row 1

Page 2 of 3

Figure 3.15: Page 2 of the TALK ME THROUGH THIS manual.

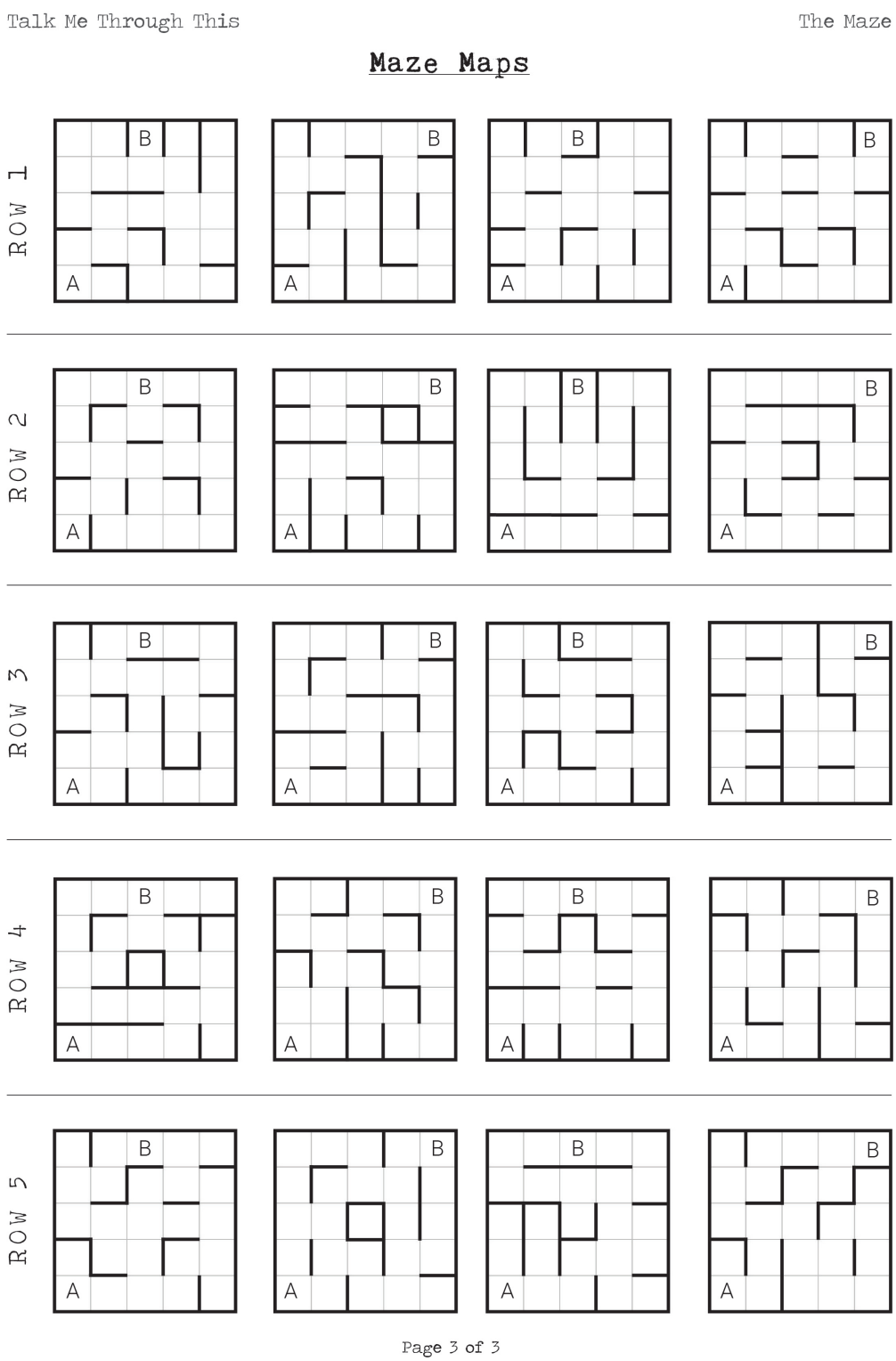


Figure 3.16: Page 3 of the TALK ME THROUGH THIS manual.

Other Level Considerations

The initial idea for the game experience was to have several mini games under the same storyline. The brainstorm session on potential levels brought up several other interesting ideas that included aspects of music, pattern recognition, shooting, and more, in combination with the communication feature between the two players. Due to time restrains and a limitation in man-power and skills, however, it was decided to go for the design of the maze experience.

3.3.13 Gameplay

For the game to be played two people are needed, who will have to decide amongst themselves which roll they will want to take on during the experience, that of the player inside virtual reality or that of the helper on the outside. Upon making that decision, both players are positioned close enough to each other so that they can clearly hear the other person talking. Ideally, they would both be positioned at the opposite ends of a table.

The players then receive separate instructions about the game. The person that goes inside the virtual world receives a one-page document to look at (see Page 40), before they put on the head-mounted display, that contains a brief description about the maze and its rules. Additionally, they are advised to use the rotating chair they are sitting on to look around inside of virtual reality, rather than using the game controller its right joystick, in order to prevent any motion sickness. The person on the outside of virtual reality receives a three-page document (see Page 41, 42 and 43) that they will have to use to help find a way through the maze for the other player. The first page of the document (see Page 41) explains the maze and its rules, along with two images that indicate what the room looks like from the inside of virtual reality. Furthermore, they are advised that they are allowed to use the calculator as well as the computer provided to them.

As was discussed in the level design, players then need to communicate through the information found on the document, as well as what is present inside the virtual environment. The players are provided with total freedom as to *how* they do this. A big part of the gameplay comes down to finding effective communicative strategies between the two players without being able to see what the other player sees.

Altogether, the gameplay experience seems to fall in line with how Gee (2008)

discusses the usefulness of an experience for learning, as was discussed in chapter 2.1.1. The shared goal is to get the player inside the virtual world though the challenge (from A to B) through effective communication. They receive immediate feedback from each other based on their immediate communication, as well as through the game level itself when a wrong path has been taken. They are allowed multiple chances within the game, so they have the opportunity to apply their (previous) communication experiences, and players have the chance to learn from each other through playing the communication game itself, as well as discussing about it after the experience is over. Lastly, it is generally expected that people will be able to interpret the usefulness of the experience, by having to communicate with slightly ambiguous information.

3.3.14 Sound Design

TALK ME THROUGH THIS has relatively little sound design, as too much sound could interfere with the game experience. However, *some* sound in a virtual space is still of great importance in order to add to the sense of immersion. The maze level therefore has some spatial ambient noise added to it, which is likely not to be noticed much by the player, yet the experience would feel more unnatural if it was absent. Additionally, some smaller sound effects were added for when a player walked into one of the invisible walls, a reminder for when there is only one minute left on the timer, and a door-opening- and victory sound for when a player manages to get through the challenge.

It was purposefully decided that there would be no music in the game, as this could cause difficulties for the communication between the two players.

Furthermore, the Game Over level is built around spatial sounds, coming from all around the player, that are meant to be scary. It starts with a voice saying the words "*Time to die!*", upon which there is evil laughter, ghost-like sounds, a circle saw, and the cracking of bones and blood gushing out on the floor. The voices in this environment were self-recorded, and edited in the audio editing software, *Audacity*. Some of the other sounds were found in the Oculus Audio Pack 1 that was made available to developers for free by Oculus. What is important with regards to spatial sounds, is that the audio is monaurally (mono) recorded, which refers to the audio coming from a single channel, instead of multiple, as is the case with stereo sound. Monaural sounds can then be imported into Unity and be attached to game objects in the game environments, thereby creating the illusion that a sound is coming from a certain position or direction (see Figure 3.17).

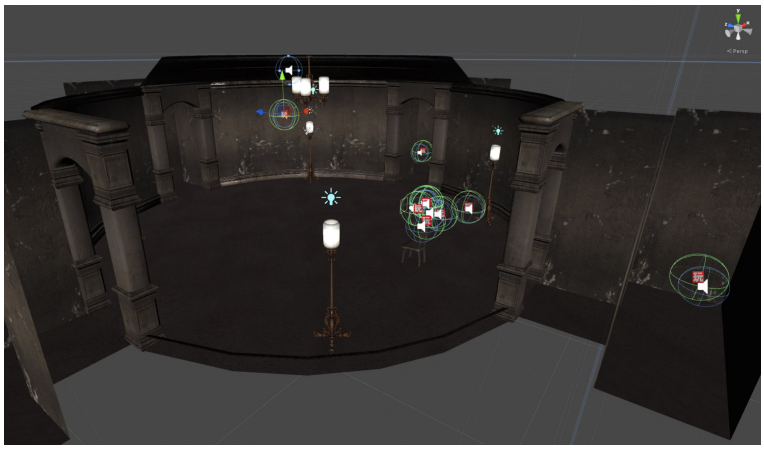


Figure 3.17: Spatial sounds in the Game Over area. The green spheres with sound symbols indicate the location of the sounds in the environment.

3.3.15 User Interface

Because of the nature of virtual reality, the player interface has to be incorporated into the virtual environment, rather than along the lines of a screen, as is often the case with interfaces for traditional video games. The game timer and the counter for the amount of chances (or *lives*) left were therefore embedded into the room its walls inside of the virtual environment.

Figure 3.18: The user interface elements have to be incorporated into the virtual environment.

3.3.16 Game Controls

In terms of game controls, TALK ME THROUGH THIS is very limited and straightforward. The player inside virtual reality can look around the environment by moving their head whilst wearing the Oculus Rift head-mounted display. In order to move forward or backwards they can use the joystick on the game controller (see Figure 3.19) that was provided to them.

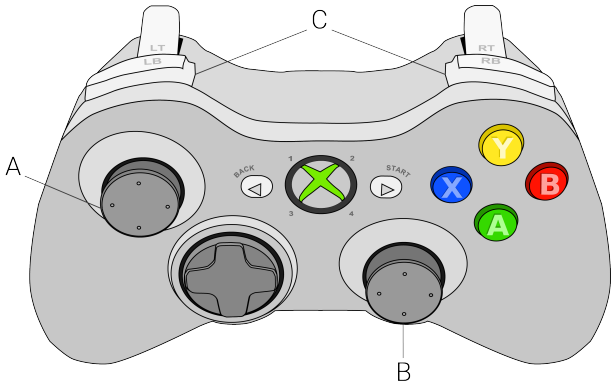


Figure 3.19: XBOX360 Controller, as used for TALK ME THROUGH THIS. (A) is used for walking inside the virtual world. (B) and (C) can be used to change the x-axis (horizontal) of the camera.

3.3.17 Technology

Head-Mounted Display (HMD) - An Oculus Rift Developers Kit 2 was utilized as the head-mounted display for this experience. The player that goes inside the virtual world will wear this display and use head movements in order to look around the environment. Commercial, and significantly better, versions of head-mounted displays such as the Oculus Rift and the HTC Vive, were released in April–May 2016, unfortunately too late in the development process to adapt the experience to any of those displays.

Desktop PC - A powerful desktop machine was used for development as well as to run the game itself. A relatively powerful desktop computer with a dedicated graphics card is needed to run the Oculus Rift and the game properly. At this point in time, laptops are not officially supported by virtual reality companies, due to the fact that the HDMI-port that is required for the head-mounted display, is not directly connected to the graphics card.

While early versions of the Oculus Rift are able to run from laptops using significantly out-of-date software, it does not provide an optimal experience and is therefore not recommended.

XBOX 360 Controller - An XBOX 360 game controller was used as the input method for interaction within the game experience. The player inside the virtual world uses the controller for the purpose of movement. A game controller may not provide the best experience for movement inside virtual reality, but due to the limited options available, in relation to the Oculus Rift Developer's Kit 2 head-mounted display at the time of development, it was the only suitable option and was therefore necessary.

Headphones - Headphones were utilized for the person inside the virtual world, where they are exposed to some spatial sounds relating to the game experience.

Second Computer or Mobile Device - A second computer or a mobile device, such as a tablet or smartphone, are needed for the player outside of virtual reality. This device is used for both evaluation purposes as well as a tool that the player could use to access the Internet through when needed.

Calculator (optional) - A calculator was used for the player on the outside of the virtual world, as they are required to solve an equation to advance in the experience. The calculator itself is an optional tool, however, as a calculator application on a computer or mobile device would also work sufficiently.

Microphone (optional) - A microphone is an optional tool that may be used to establish communication between the two players in the case that they have difficulties understanding each other well, or if they are playing together through a remote communication system.

Chapter 4
Evaluation

4.1 Method of Inquiry

In order to evaluate the design of the game experience, as well as the possible impact it had on the players, a combination of both quantitative and qualitative methods was used.

For the purpose of data collection on the users of the created game artifact, two questionnaires were made in the form of a pre-test and a post-test. The pre-test asked various questions about a user their relationship with games, whether they tried virtual reality before, and how they evaluated their own communication skills, both on an overall scale as well as in different areas of communication. Additionally, some basic demographic questions were asked. The post-test then focused on questions on the relationship between the two players, what they thought of the game experience, and the same evaluative questions on communication skills as in the pre-test, both targeted at themselves as well as the other person they were playing together with. Participants were asked to fill in the pre-test right before playing, and the post-test right after playing, before they had the chance to discuss the experience with each other. This way, the experience was still fresh in their minds and it also prevented their answers from being influenced by one another. They were first given an ID number that they would use for both tests, so that a person their pre-test data could be matched with their post-test data for the purpose of analysis, whilst keeping their anonymity. Both the questions for the pre- and the post-test were implemented into separate *Google Form* documents that were stored in a Google Drive folder, from where a link was directly shared to the participants, before- and after the game experience. The questions that were used for both tests can be found in Appendix C and Appendix D.

With regards to questions on self-evaluation in both the pre- and post-test, it does have to be noted that personal ratings on communication skills are very biased and cannot provide any general conclusions for the game experience. Some

people may be inclined to rate themselves very highly, whereas other people rate themselves extremely low, which could possibly have to do with their level of self-confidence and whether a person is more introverted or extroverted. However, while no generalizations can be made in the form of a mean score, it could prove useful to observe potential changes in how someone their self-evaluation differs before- and after the game experience, as well as how they rate the other person compared to how that person rated themselves.

Aside from the pre- and post-test, the users were also closely observed while engaging with the game experience, and were filmed wherever possible. Observation is arguably a necessary method of evaluation in the fields of design, as it is important to see *how* the designed artifact is being used by the (targeted) users. Moreover, observation allows for the interpretation of factors that cannot be measured by questionnaires, such as manners of non-verbal communication as well as possible outlying factors that the questionnaire did not measure for. Additionally, the communication between the two players can directly be observed by an outside, and perhaps a more neutral, party. If the players know each other well, it might create a bias towards how they would answer certain questions in the questionnaire. Following the post-test a few further follow-up questions, concerning the experience with the gameplay, were also occasionally asked directly to the participants.

The focus for the observation can therefore be summarized in two aspects: (1) How people communicated with each other, and (2) How people interacted with the game and design. Both verbal- and non-verbal behavior were taken into account.

4.1.1 Considerations and Limitations of Evaluation Method

It was briefly considered to use an approach similar to the Solomon Four Group Design which, as described by Babbie (2008), provides a way of testing the participants using a pre- and post- test, whilst also analyzing the possible influence that the pre-test itself might have on the results of the post-test. While this would be a proper method to test the effect of a particular stimulus, this reaches more into the fields of Social Science and requires a much larger sample size than was used here.

4.1.2 Sample

A total of 38 people participated in the game experience, meaning 19 groups of two players. The majority of the participants were fellow students at the Keio Graduate School of Media Design (KMD). The first user tests were conducted through voluntary participation at the KMD Showcase on Thursday April 21st, 2016, which is a recurring event held every semester, where KMD projects are presented to the new students. Furthermore, several additional tests were done on campus at later dates with available students, as well as friends and family. While the sample size used here is sufficient for the testing of the designed artifact, a much larger sample size would normally be required in order to effectively test the potential impact the designed artifact (as a stimulus) has on its users. In this project, however, such a user test was still conducted in the form of a pre- and post-test, and will be discussed in the evaluation. While some general suggestions on patterns and findings will be presented, no statistical significance can be claimed here due to the relatively small sample size.

4.1.3 Setting

The user tests were done in two different settings. At the KMD Showcase, a dedicated small space was available for testing. Participants would sit on the opposite ends of a table, so that they could clearly hear each other, but would not be able to see specifically what the other person was doing. At later user tests there was not always a single table available, so players would be situated at different table sections that were still close to each other. Each player was presented with different tools that could be utilized during the experience (see Table 4.1).

Table 4.1: Available tools for each player during testing.

Player Outside VR	**Player Inside VR**
Three-page game manual	One-page Game instructions
Laptop	VR Head-mounted display
Calculator	Game controller
Pen/pencil	Headphones
Any chair	Rotating chair

Figure 4.1: Player setup during the KMD Showcase.

4.2 General Findings

Overall, there was a good diversity amongst the participants, with 57.7% of players being male and 42.3% females respectively, all coming from a wide variety of countries, such as Japan, China, Indonesia, Malaysia, Thailand, Taiwan, America, Brazil, Russia and the Netherlands. While there were a few outliers, most of the participants were within the age range of 22 and 25 years old. Due to the relatively small sample size, however, the mean age resulted in an age of 27 years old. When asked whether they considered themselves a gamer a stereotypical pattern could still be observed, with males being more likely to say yes – 53% of males stated Yes, 47% stated No – as opposed to females – 18% stated Yes and 82% stated No. Interestingly, however, a lot of the females that did *not* consider themselves to be a gamer still indicated that they played between 2–4 hours per week (22.22%) or even between 4–7 hours per week (22.22%), which is higher than the majority of males in the study that did identify themselves as gamers.

Relating to the game experience, the first and foremost finding was, as expected, that 100% of the participants were unable to complete the challenge within the first try. They needed some time to experiment with the game and the rules, as well as finding a working communicative strategy.

With regards to self-evaluations, out of all 38 participants, 39% gave themselves a lower overall communication rating in the post-test, compared to how

they rated themselves in the pre-test, 28% gave the exact same score, and 33% rated themselves higher. Comparing the personal communication ratings from the pre- and post-test, after the first time people played TALK ME THROUGH THIS, showed that people who initially gave themselves a higher communication score were more likely to lower their score after the game experience, whereas people who initially gave themselves a lower score were more likely to give themselves a higher score, even though all groups failed in the first attempt. Additionally, 47.44% of people rated the overall communication skills of the other player – their partner – higher than themselves, 30.56% rated them the same, and 22.22% gave the other person a lower rating.

Furthermore, an interesting pattern that started to emerge from the collected data, as well as the observations, was that the less well the two participants knew each other the more likely they were to succeed at a faster pace; strangers were able to succeeded faster than did friends.

In terms of enjoyment, people rated TALK ME THROUGH THIS with a mean score of 4.08, using a 5-point Likert scale. Furthermore, the results upon the question of whether people felt like they had learned something during the experience, came back with a mean score of 3.5 out of 5. Some of the participants stated the following on the questionnaire:

> "*I learned how to listen to people well and be more cautious about directions that are given.*"
>
> "*I learned that verbally describing directions is a lot more difficult than I imagined.*"
>
> "*Good communication is extremely important.*"
>
> "*I learned how to communicate under the pressure of time; use less useless words.*"
>
> "*I tried to communicate with someone new with little information that we separately had. Basically I learned how to understand his point of view, and at the same time how to make him understand my point of view.*"
>
> "*I have learned that I tend to panic in urgent situations, that may result in a lack of concentration in listening, failure to think logically, etc. I should train myself to stay calm, communicate effectively, and think logically in extreme situations.*"

Participants rated the relevancy of the TALK ME THROUGH THIS game experience to communication skills with a mean score of 4.11 out of 5. They were also asked whether this particular experience made them more thoughtful on how they communicated with others, which resulted in a mean score of 3.94 out 5. No significant relationships could be observed between relationship status and speed of success- or communication ratings. Moreover, no patterns were derived from someone their level of education, the types of games people indicated they played often, or whether they had used virtual reality before.

4.3 Observations

4.3.1 Communication Between Players

Communication surrounding the first painting – one of two possible optical illusions that can be interpreted as both a young- as well as an old lady (see page 36) – differed amongst participants. Some people would ask the person in the virtual room to describe the painting as much as possible, whereas there were also those that used the pictures on the Player Manual to describe both paintings to the player in the maze, asking them which one best matched their description. Recurring questions they asked each other included the style of the painting, the amount of detail, whether there was a ribbon or not, and what color the background was. Not everyone was immediately able to see that both paintings concerned an optical illusion, however. They would ask whether the other person saw either a young- or an old lady, which often caused for confusion on both ends. Overall, the use of these two optical illusions can be considered successful, as the ambiguity required people to describe the painting in detail, or use an effective strategy in the form of a quickly recognizable point of the image, respectively.

In terms of the second painting, containing one of five possible ambiguous images (see page 36), it seemed that only about half of the players had some difficulties in conveying which image it was to the other person. The difficulties would come in the form of unclear communication, both in the questions asked and the answers given. Some teams would simply go by the very first thing that was said by the player on the inside of the virtual room, without ensuring understanding, resulting in the making of mistakes. Players that actually did ask follow-up questions to ensure understanding, seemed to have little trouble with this part of the game. A partial explanation for the ease of which some players

would pass this particular painting could be that a lot of them would communicate in a language other than English, while the main source of ambiguity was designed around communication in English. The ambiguity would get lost in translation, with English being used in the player documents, but the communication between the players itself being in another language.

The next part of the game required a calculation to be done, for which the person on the outside of the virtual world had to look up a specific number on the Internet, and then divide that by the number of lamps present in the virtual room. This part of the game sometimes caused for some confusion amongst participants. Through the Player Manual it was not always immediately clear that it concerned a calculation for which they had to look something up on the Internet. Additionally, there was also one instance where one participant did not know that the "/" symbol meant a division. She only knew this symbol as a reference to an alternative meaning of something. This was a possibility that was not taken into account during development, and should be rectified by using words instead of symbols. Moreover, many of the players inside the virtual world would initially miscount the lamps, due to not observing the entire virtual environment. Especially the lamps on the ceiling were sometimes overseen.

In general, people were having severe difficulties in finding common ground in terms of how best to communicate directions, without the help of any visual aids. Even though they were not able to see each other, a lot of the players would still try to use hand gestures to visually support their sense of direction (see Figure 4.2). Upon being asked the question of whether they felt like they had learned something, one participant even stated:

> "*It is so hard to explain what I see to someone who does not actually see the same thing*".

Moreover, people who indicated that they often played video games, often had a slightly different communicative strategy towards navigating the other player. They would be more inclined to describe the level from an up-top perspective, rather than from the direct point of view of the player inside the virtual world. Instead of separating the instructions of turning towards a certain direction first and then moving forward, they would simply communicate directions through stating: "Go *Up, Down, Right* or *Left*".

Also noteworthy is that once players found a working communicative strategy for any part of the game, the next time they played together, these parts would be significantly easier; the more they played the easier it became.

Figure 4.2: Two Players using hand gestures to support their verbal communication.

4.3.2 About the Game Design

The concept of the game was overall observed to be quite successful. Virtual reality seemed to play an essential role in how people experienced the environment and the communication was an essential and engaging part of the game. The use of a head-mounted display made it so that the player inside the virtual world was truly closed off from the real world, making clear verbal communication all the more important. Moreover, the fact that people really had to look around the virtual environment by moving their heads seemed to make the experience significantly more immersive, compared to the use of a traditional computer screen. Noteworthy is, however, that the use of the XBOX 360 game controller did not always go smoothly for people who have not played much games before, even though only very limited input was required of the user. They would press the wrong buttons or joystick, and move around very statically inside the game. Additionally, a few participants did appeared to have some difficulties seeing exactly where they were in the virtual world. Upon some follow-up questions, they indicated that they were not always entirely sure where they were positioned on the grid floor, and would have liked to have had a better visual representation of their in-game body and movements. Regardless of that, people did seem to like the virtual environments itself. Especially the Game Over area was quite successful in its purpose. People stated that that particular room was scary and creepy, due to its darkness and spatial sounds. A few participants that were more prone to scare elements even immediately pulled of the headphones and head-mounted display, upon entering the environment.

During the first experiment at the KMD Showcase, participants were only given the paper instructions. The document that was handed to them at that

time did not include the room view, and the information for the player on the outside of virtual reality was organized slightly differently. That approach resulted in people not knowing exactly what to do, or where to look, for the information. Based on those observations, the Player Manual was later changed to the most current version of the document (see Page 41, 42 and 43). In addition, some initial instructions were given in future sessions that were in accordance to what was on the player Manual. This was done in order to better prepare the Players and make them feel slightly more comfortable. While in the majority of cases players started to understand the game very quickly there were some instances were it was still not immediately clear for players what they needed to do after their first try. If it was observed that this had a significant impact on their enjoyment some small hints were presented to them, so that they were more likely to continue playing.

Based on observations, over the course of all the experiments, people truly seemed to enjoy playing a game like TALK ME THROUGH THIS (See Figure 4.3). They were constantly engaged, laughing when they made mistakes, and urging the other player to hurry up when the time was running out. Playing together with another person appeared to create a sense of relevance and urgency, as their success was dependent on the both of them.

Despite the fact that the ambiguous information, along with the time limitations, did cause some frustrations in people, it seemed to be a good kind of frustration, as they were engaged in the experience. Even though a lot of people initially failed the experience, they still kept smiling and often wanted to try again. On multiple occasions, they would say things along the lines of: "*We were so close! We can succeed it if we do it again*", or "*I want to try again*". In most of the experiments that were done, failure only seemed to be a motivation to try again and do better, as long as they still had a sense of progression. Failure, in this sense, was observed as part of the progression, and thus enjoyment.

Succeeding the challenge, however, seemed to bring even more joy. Based on the observations of succeeding teams, it seemed that solving the problem(s) presented to them after the initial struggles and failures led towards a feeling of happiness, and even a sense of pride.

Figure 4.3: People enjoying TALK ME THROUGH THIS.

Figure 4.4: Player frustrations as part of the game – the limited amount of time pressured Players to work quickly.

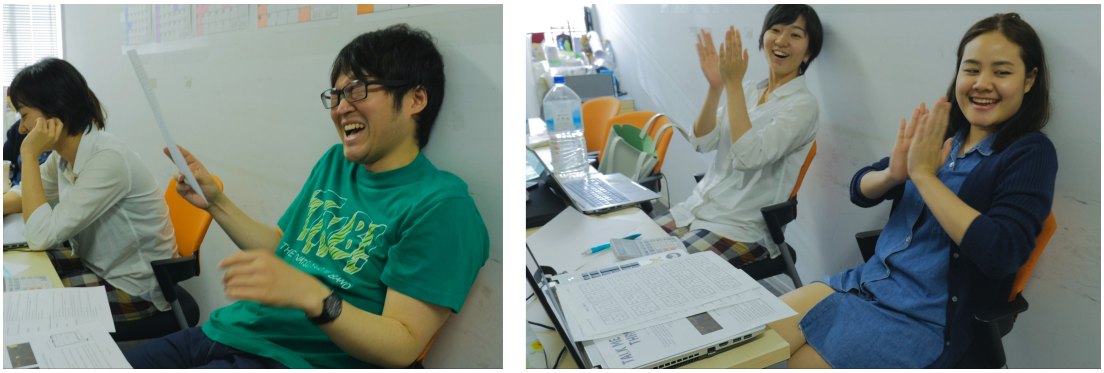


Figure 4.5: Example of Player reactions upon failure (left) and success (right).

Furthermore, it was observed that providing players with hints after multiple unsuccessful attempts, was often beneficial to renewing their hope and curiosity in the game. If the hints provided helped them progress further, it was still considered enjoyable. In a few occasions, if the hints were still not enough to help a team succeed, giving them one of the possible answers through the suggestion of effective communicative strategies for the entire game still provided enjoyment for the players. Even though they did not uncover all the (possible) answers to the challenge by themselves, it still seemed to give the players pleasure by being able to replicate the success.

Naturally, however, the experience was not necessarily enjoyed by everyone. There was one participant that did not enjoy TALK ME THROUGH THIS at all, due to the fact that this person did not understand the gameplay well enough. After playing three times, their team did not manage to find successful communicative strategies, and therefore did not progress much, even when provided with hints. This person stated that failing the game multiple times "*made me feel kind of dumb*". While this was an unfortunate situation, no constructive feedback could be derived on how to improve upon the experience.

Lastly, with regards to the potential of informal learning, people seemed to enjoy the exposure to difficult communicative situations. Some of them noted that after this experience they had to admit that they were not as good – or as bad – at communicating as they initially thought, and this made them more thoughtful towards how they communicated in general. Some participants also expressed that they felt that the experience was good for collaboration. In addition to communication and collaboration, the players on the outside of virtual reality also had to look up a meaningful number in order to do a certain calculation with it. While the purpose of this was merely to expose people to some outside information that they may not have had knowledge of before, most of the people that were asked days after the experiment, still remembered the exact number they had looked up for the game. No official statement on learning can be made here, however, it does seem like players remembered the number specifically because they were exposed to it through the engagement with the game experience.

4.4 Discussion

Based on the results and observations of the TALK ME THROUGH THIS experiment, a few interesting topics presented themselves. As such, a stereotype around the term gamer was still observed with males being more likely to consider themselves a gamer, whereas females were far less likely to do the same. Interestingly, as the General Findings above stated, a lot of the females that did not consider themselves a gamer still play more hours per week on average than do some males that do consider themselves gamers. This then raises the question of when someone can be considered a gamer. The term *Gamer* itself is both odd and unique, as it is a term labeled on anyone that plays games, whereas with most other types of media people would only be associated with it if they where obsessed (e.g. bookworm). The same people that play games might also spend just as much time on reading books, playing and listening to music, or watching television and films, but the only label they get is being a gamer. Moreover, even though opinions start to vary, there are still some stereotypes connected to the term, mostly associated with gamers being mostly males that consume a lot of snacks, do not leave their rooms, have aggression issues, use games to deal with their insecurities and escape from the real world. This is something that is slowly changing as games are becoming more prevalent in societies all over the world, but it is likely an issue that virtual reality will also face. As it is a new type of medium, it will most likely be confronted with fears for addiction, asocial behavior, and aggression.

With regards to how people evaluated themselves and the overall experience, a few things can be inferred. As such, there is a significant difference in how people evaluate themselves. The fact that the majority of people rated the other player higher than themselves supports the claim that people are their own worst critics. In terms of learning, the overall results seems to suggest that people did feel like they learned something. While, with informal learning, it is impossible to measure to what extend specific knowledge has been acquired, arguably the most important factors is the interpretation of the person themselves. TALK ME THROUGH THIS seemed to have made players more aware of the importance of clear and effective communication, in relation to themselves, and this particular experience may, or may not, have been helpful towards how they will construct their messages when they find themselves in a similar communicative situation in the future.

Furthermore, the observation of how different levels of experience between

participants, with games and technology, did have an impact on the smoothness of the experience, and how they approached communication and strategies for this game, also brings forth an interesting topic for discussion. In the modern age that we live in today, technology is becoming increasingly important as it influences every aspect of our daily lives. This trend is only expected to increase in the future. It is then worrisome to see that there are still such differences in abilities to operate, and work with, technology and games between people, while most of them fell within the same age category. Even with the minimal game controller requirements, some people still had trouble using it comfortably without looking down. Arguably, this could be referred to as *game-* and *media literacy*. Given the increasing importance of technology, this then raises a valuable question of whether game- and media literacy should be something that is taught in schools from a young age. As it is, after only a few years in school, children are expected to be able to read and understand texts. This is not the case for games and technology, however, and how familiar children are with them varies significantly. Consequently, this creates problems for the use of games and new technologies in the classroom, as is so often proposed in recent studies on games and learning. While there is great potential for new ways of learning and interaction, familiarity with games and technology cannot automatically be expected while there was never any preparation for it by the schools; this could create advantages and disadvantages amongst students. This seems like a significant issue that is yet to be fully addressed, and therefore more discussion on this topic is required.

One of the most interesting findings of TALK ME THROUGH THIS was that the less well people knew each other, the faster they seemed to succeed. It would normally be expected that people that are closer to each other – close friends, partners or family – are better able to work together, but an opposite pattern seemed to emerge here. One explanation for this could be that, with regards to communication, people that are already close to each other, automatically assume that the other person directly understands their way of communicating. Between strangers, however, such assumptions have not been established yet, possibly resulting in a more careful communicative approach. This explanation seems to be in line with what Savitsky et al. (2011) define as *closeness-communication bias*, in which they propose that people being close to each other may sometimes lead to an overestimation in how well they can communicate. Arguably, every person is different and requires a different communicative approach. The results of this research seem to support this notion, which seems to be a topic in the fields of

communication on which not a lot of research has been done yet.

Overall, people seemed to truly enjoy the concept of a multiplayer virtual reality game that they can play with people in their direct surroundings, such as friends and family. While TALK ME THROUGH THIS was only a prototype in the form of a puzzle-based maze, the concept itself holds great potential for future applications. Entire games could be designed around it, from short party games to full on story-based games for multiple players. As such, one can imagine a game with a compelling story where the choices a player makes have consequences on how the rest of story develops. Certain parts of the gameplay could then involve communicative multiplayer aspects, where one player has to try and help the other in their tasks. An example could be that a character in the game needs immediate medical attention after an accident, such as a precise incision or an electric shock using a defibrillator, but the other player outside of virtual reality needs to guide the player through the proper process. Success or failure may, or may not, have an influence on that character their survival, and thus the entire storyline. Another idea could involve one player having to fight specific type of monsters, where the other player has to do the research on the best ways to do so; much like what can be seen in the popular television show, *Supernatural*. The whole aspect of having one person inside of a different virtual environment opens up a whole world of new potential game experiences that revolve around communication, collaboration and trust, which is something that has not yet been done before. Moreover, as in the scenarios described, this kind of concept does not only provide entertainment, but also has great potential to facilitate learning through relevant gameplay. Ultimately, the good results of the concept in this research, lead to an expectation of great interest and popularity in this sort of genre in the near future.

Chapter 5
Conclusion

With the commercial release of premium head-mounted displays in 2016, a new and exciting industry for games, application and experimentation has opened up. As of yet, only few games and applications are available, and little research has been done into its potential implications.

This study proposed a design for a game experience by the name of TALK ME THROUGH THIS. It concerns an asymmetrical two player virtual reality game experience that utilizes only a single head-mounted display, and is played through communication. One player enters a virtual world using an Oculus Rift DK2 head-mounted display, where they are trapped inside a maze with invisible walls that they have to get through with a limited amount of time and chances. The player on the outside receives a document that holds all the information needed to find the right path through the maze. In order to find the right information, the players have to communicate quickly and effectively on the fairly ambiguous clues they are provided with.

5.1 Proof of Concept

Based on testing and the user responses, it can be inferred that the game offered a truly communicative and socially collaborative experience, where success was dependent on how quickly and effectively the two players communicated with each other. Even though, as expected, 100% of the players failed the first time they played, people were still highly engaged in what they were doing, and the evaluations and observations suggested that people found the experience to be highly enjoyable. As head-mounted displays are still new and fairly expensive items, it will take time before they are more widely adopted by the masses. Therefore, this kind of genre is especially interesting as it allows for an asymmetrical multiplayer experience utilizing only one headset. The designed artifact, along with the eval-

uation in this project, provide ample proof that people are interested in this kind of concept.

Additionally, the results provided some valuable insights into how people communicate with one another, and how they evaluate themselves and their partners. As such, the results suggested that the majority of people changed their perspective after playing the game. In general, the majority of participants also gave their partner in the game a higher communication score than themselves.

Furthermore, it was observed that people who identified themselves as gamers had a different approach towards relaying directional information. Moreover, while further research would be required to make an accurate claim, the results of the experimentation suggested that people who were less close to one another were slightly more effective in their communication, in which they were more likely to succeed faster in the challenge, than did people who were closer friends.

Overall, people indicated that they felt like they learned something through the game experience, and it generally made them more thoughtful towards their own communication skills.

Based on all of these conclusions together, the proposed project is seen as successful in its purpose. Ultimately, however, this was only an experimental design that was limited by the skills, time constraints and experience of the developer. There are a great many more exciting possibilities out there using a similar concept as was used here.

5.2 Limitations

Whereas the overall design and concept of TALK ME THROUGH THIS can be considered a success, it is still a limited experience.

The first and foremost limitation comes from the lack of skills, knowledge and experience of the developer with regards to topics like game design, programming and 3D modeling. Although a fair amount of knowledge and skills were acquired over a short period of time, only basic things could be achieved in terms of the virtual level design.

Furthermore, another limitation presented itself in terms of the user input methods. While the Oculus Rift Developer's Kit 2 was a great tool, it still had some shortcomings. For example, it has a relatively short-ranged positional tracker and could display a maximum of 75 frames per second. If a player moved only slightly out of the sight of the positional tracker it would still keep tracking

the head movements from left to right, but not the position of the head. This would result in small connection losses resulting in lag, which refers to a delay between the action of a player and the corresponding reaction inside the video game. As a consequence this could cause nausea and motion sickness. Therefore, the Player always needed to be in a sitting position right in front of the positional tracker. Moreover, the only reliable input method that could be acquired at the time of this project was an XBOX 360 game controller. Some brief experimentation was done using a Leap Motion device, which allows for the use of hands in virtual reality, but based on the short tests this was considered not to be reliable enough to be used as a main input method. An HTC Vive commercial head-mounted display, along with its room trackers and motion controllers, were ordered, but were not delivered in time in order to adapt the TALK ME THROUGH THIS experience to that device. For the purpose of this project, the Oculus Rift DK2 was capable enough, but more exciting and relevant things could be done with the newer headsets and methods of user input.

As for the multiplayer virtual reality concept proposed in this project, a limitation could present itself in relation to the topic of sound. As direct voice-to-voice communication is essential to the experience, the use of sounds and especially music needs to be carefully implemented. Consequently, this might come at the cost of the overall immersiveness of the virtual world. However, this issue could partially be resolved by the use of headphones and microphones, but more experimentation in this area is required.

The methodologies used for the evaluative purposes also provided some limitations. Firstly, the sample size that was used was too small to make any claims on the impact of the designed artifact, and there is also no way to measure any longer term effects it may have had. Moreover, the project mentioned a potential for informal learning, but as is usual with regards to informal learning, it is very difficult to measure, and is purely up to the interpretation of the user.

5.3 Future Work

5.3.1 Possible Improvements

While the expectations for the duration of this project were met, and the overall experience is considered a success, there are still many improvements that could be made.

First and foremost, the overall game experience was relatively short, with one game only lasting for about 5 minutes. This is related to fact that the game experience only has a single level, and offers replay ability only up until the point that a person succeeds. After the first successful completion of the game, the challenge becomes significantly easier and would probably lose its appeal soon thereafter. It would be much more interesting if there were more and different levels that participants could play through.

Furthermore, from the observations and user feedback a few elements of the current game design could still be improved. As such, the Player Manual used by the player outside virtual reality, was still not entirely effective. It was not always directly clear to everyone what needed to be looked at. Arguably, the combination of a sense of urgency and a large amount of information presented in the form of text, might not be the optimal approach. A better approach would perhaps be to use more visualizations, in terms of how to go through the information on the document. The creation of a digitally interactive document might also prove to be useful here, as it allows for more and different ways to visualize information, than does paper. Additionally, the document as well as the text-based information inside the virtual world could benefit from being translated into different languages. Players communicating in a language other than English may currently not experience the intended ambiguity, due to it being lost in translation.

With regards to the design of the virtual environment, a better representation of the player inside the virtual world is needed. Ideally, a full character body could be attached to the player camera, making it seem like the player has an actual body. Alternatively, a small shadow on the floor beneath the player, as a representation of their exact location, would already be a significant improvement.

Moreover, a compelling story was lacking in the actual gameplay itself. While the story was briefly presented on the player document, outside of the challenge itself the context for why the player was actually trapped inside of a maze was absent. For the purpose of a prototype, the lack of a story is completely fine, however, its inclusion would make the entire setting of the game more engaging, immersive and relevant for the players.

Lastly, much more different elements could be implemented to facilitate the exposure to real information that could potentially induce informal learning, and the experience could be adapted to newer virtual headsets and input methods.

5.3.2 Extension of Concept

The general concept of a asymmetric multiplayer virtual reality game, using only a single head-mounted, was a great success. It could provide great collaborative experiences in games where player choices and actions influence the storyline, but also in party games, puzzle games, and for learning.

To conclude, the concept of multiplayer virtual reality games, using only a single head-mounted display, seems to hold great potential. With the recently emerging virtual reality technologies, a new field of study and experimentation has been entered. Due to its high level of engagement, immersion and therefore relevance, it can be foreseen to be a tool that in the future will play a significant role in our world, both for the purpose of entertainment as well as for learning, training and other creative applications. Great virtual worlds and experiences await. We just have to make them!

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Appendix

A Learning Unity & Game Design

The following section presents some of the resources that were used to accumulate skills and knowledge with regards to the Unity game engine, programming, 3D modeling, and game design in general. It does not aim to be a structured guide of any sorts, nor does it claim to be the most effective approach. It merely provides some of the resources that were used by the developer of this project.

A.1 Game Design

The Art of Game Design: A Book of Lenses

This is a book written by Jesse Schell, and gives an excellent insight into what game design is, and how to approach new projects.

A.2 Unity & Programming – Free Resources

Unity: Developing Your First Game with Unity and C#

This concerns four articles from the blog of Adam Tuliper, a Microsoft employee that is very involved in the use of Unity and the provisions of tutorials.

1. `https://msdn.microsoft.com/magazine/dn759441.aspx`
2. `https://msdn.microsoft.com/magazine/dn781360.aspx`
3. `https://msdn.microsoft.com/magazine/dn802605.aspx`
4. `https://msdn.microsoft.com/magazine/dn857359.aspx`

C# Fundamentals for Absolute Beginners

For people who have no prior experience with the programming language C#. This course is not specifically for Unity, but it does teach the basic principles of C#.
`https://mva.microsoft.com/en-US/training-courses/c-fundamentals-for-absolute-beginners-16169?l=Lvld4EQIC_2706218949`

Unity Manual

The Unity Manual can, at times, be a very helpful source for general Unity-specific information.
`http://docs.unity3d.com/Manual/UnityManual.html`

Roll-A-Ball Tutorial & Survival Shooter Tutorial

Starts with creating a simple game that teaches some of the principles of Unity.

1. `https://unity3d.com/learn/tutorials/projects/roll-ball-tutorial`
2. `https://unity3d.com/learn/tutorials/projects/survival-shooter-tutorial`

Other Tutorials by Unity

Much like the two tutorials above, Unity provides some other tutorials on their website. While the developer of this project did not use these in their entirety, they can still provide useful information.
`https://unity3d.com/learn/tutorials`

Building Windows 10 Games with Unity 5

This tutorial provides a quick tour on controls, audio, lighting, game design documents, prototyping, C#, camera modes, Windows 10 UWP, and more. This one is highly recommended.
`https://mva.microsoft.com/en-US/training-courses/building-windows-10-games-with-unity-5-12572?l=EJJiCpxPB_8401937557`

Introduction to VR

This is the Oculus documentation on Virtual Reality. It provides some useful insights, especially with regards to interface and audio.
`https://developer.oculus.com/documentation/intro-vr/latest/`

A.3 Unity & Programming – Paid Resources

Learn to Code by Making Games – The Complete Unity Developer

This is an amazing course that teaches people C# programming by creating games in Unity. This is a highly recommended course.
`https://www.udemy.com/unitycourse/#/revie`

Make VR Games in Unity with C# – Cardboard, Gear VR, Oculus

A relatively new course, with a similar approach to the one above. It teaches C# programming by creating virtual reality games in Unity.
`https://www.udemy.com/vrcourse/`

Introduction to Unity 5

This tutorial goes over the core features of Unity, such as how to create new projects and how to manage game assets. Moreover, it teaches the general creation processes, from creating terrains, setting up a character, enemies, pick-up objects and user interface tools.
`http://www.digitaltutors.com/tutorial/2046-Introduction-to-Unity-5`

Introduction to C# in Unity

This tutorial goes over the creation of a 2D game using the provided assets, in order to learn some basic C# programming for games.
`http://www.digitaltutors.com/tutorial/1689-Introduction-to-C-in-Unity`

Lighting and Rendering in Unity

This course discusses lighting elements in games.
`http://www.digitaltutors.com/tutorial/2125-Lighting-and-Rendering-in-Unity`

Other DigitalTutors Unity Tutorials

DigitalTutors provides a vast amounts of different tutorials on Unity, and other creative software. A paid account is required to view them, however.
`http://www.digitaltutors.com/11/training.php?tid=25&cid=345`

A.4 3D Modeling – Paid Resources

Learn 3D Modelling – The Complete Blender Creator Course

This is a great course that teaches people how to make their own 3D models in the Blender software. It starts at the very beginning and goes until fairly advanced topics. This is also a highly recommended course.
`https://www.udemy.com/blendertutorial/`

A.5 Assets for Unity

On the Unity Asset Store people can download assets that can be used inside of Unity, from 3D models, to Audio, Animations, Scripts, Services, Textures and even entire projects. Downloading an entire project can be good to look at how exactly it is built up in Unity.
`https://www.assetstore.unity3d.com/`

Unity Standard Assets

Unity offers some great free basic examples. The standard assets include some interesting functionality demos. Additionally, they have also released some examples for the creation of virtual reality.
`https://www.assetstore.unity3d.com/en/#!/content/32351` `https://www.assetstore.unity3d.com/en/#!/content/51519`

Playmaker

Playmaker is a paid asset for Unity that provides visual scripting capabilities for Unity, bypassing a lot of the C# coding. This is a great tool for people who do not know programming, but is also capable of potentially speeding up the workflow of more advanced programmers. Famous games like *Hearthstone* and *Dreamfall Chapters* were made using Playmaker.
`http://www.hutonggames.com/` `https://www.assetstore.unity3d.com/en/#!/content/368`

Gaia

Gaia is a quick and easy tool that can be used for the creating of beautiful 3D terrains.
`http://www.procedural-worlds.com/gaia/` `https://www.assetstore.unity3d.com/en/#!/content/42618`

ProCore Bundle

The ProCore Bundle is a combination of 6 different assets that help people model environments directly inside of Unity fairly quickly. Each asset in this package can also be purchased separately. The most useful ones for the developer of this project were the ProBuilder and the ProGrids asset.
`https://www.assetstore.unity3d.com/en/#!/content/15447`

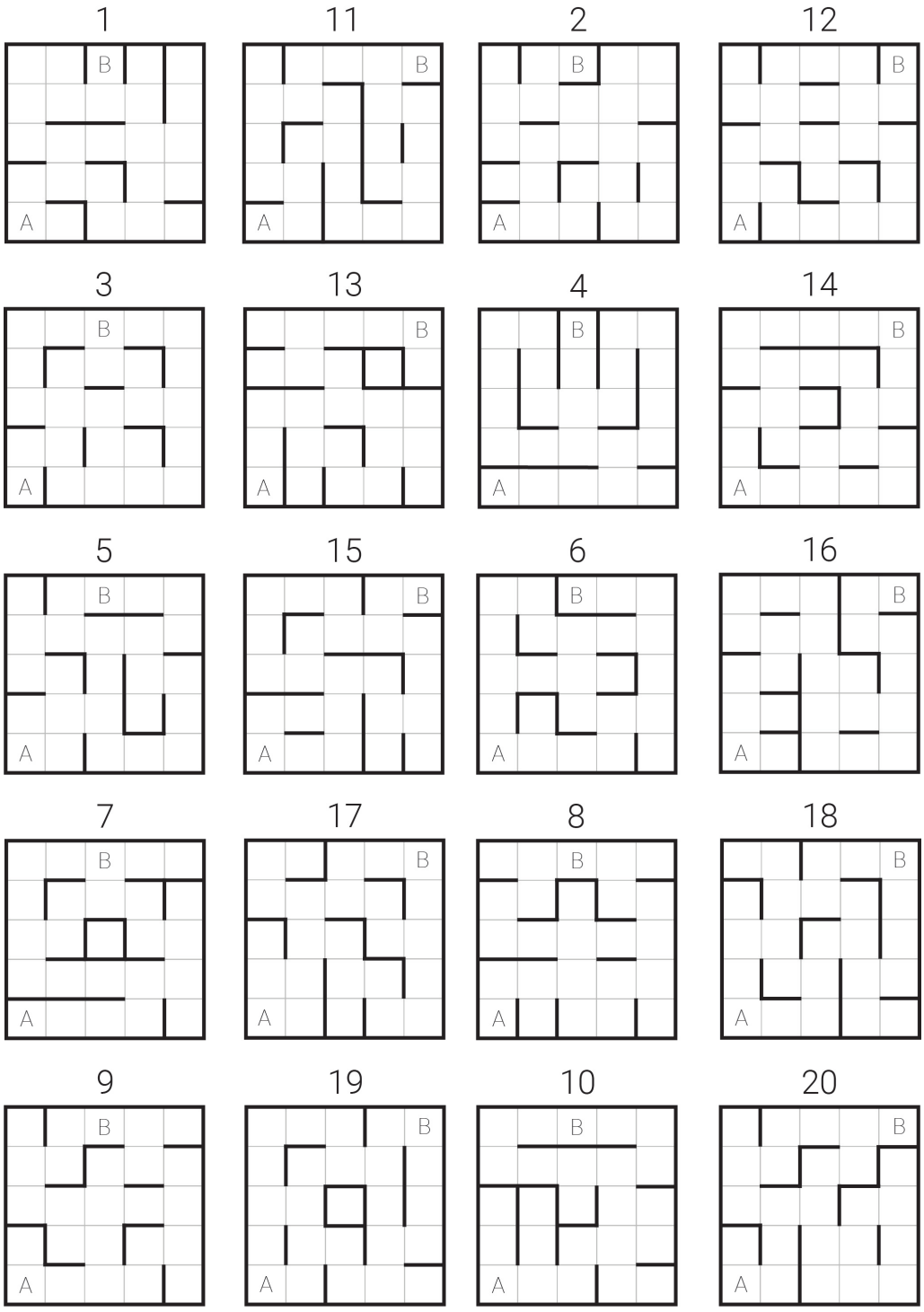
B Developer Notes

The following notes indicate how the information was divided in the different Maze levels, before it was implemented in the actual level designs in the Unity game engine. The map numbers correspond to the level numbers that were used inside Unity.

PAINTING #1	PAINTING #2	CALCULATION (number) / (lights in the room)	Maze Row/Map
	Says NOTHING	(Speed of light in meters per second) divided by (13 lights) = **23.0609**	Row 1 Map 12
	Says NOTHING	(answer to the universe) divide by (8 lights) = **5.25**	Row 4 Map 18
	Says NOTHING	(Speed of light in meters per second) divided by (11 lights) = **NOT 23.0609**	Row 3 Map 16
	Says NOTHING	(answer to the universe) divide by (9 lights) = **NOT 5.25**	Row 5 Map 20
	Is BLACK	(number of LEET) divided by (11 lights) = **121.5455**	Row 1 Map 11
	Is BLACK	(number of whole minutes it takes for sunlight to reach the Earth) divided by (12 lights) = **0.6667**	Row 4 Map 7
	Is BLACK	(number of LEET) divided by (13 lights) = **NOT 121.5455**	Row 5 Map 9
	Is BLACK	(number of whole minutes it takes for sunlight to reach the Earth) divided by (10 lights) = **NOT 0.6667**	Row 2 Map 3
	Says BLACK	(number where Fahrenheit and Celsius are the same) divided by (11 lights) = **-3.6364**	Row 1 Map 1
	Says BLACK	(number where Fahrenheit and Celsius are the same) divided by (9 lights) = **NOT -3.6364**	Row 3 Map 5

	Says BLACK	(number where Fahrenheit and Celsius are the same) divided by (9 lights) = **-4.4444**	Row 4 Map 8
	Says BLACK	(number where Fahrenheit and Celsius are the same) divided by (8 lights) = **NOT -4.444**	Row 2 Map 13
	Says NO PAINTING	(number of LEET) divided by (9 lights) = **148.5556**	Row 5 Map 10
	Says NO PAINTING	(number of LEET) divided by (11 lights) = **NOT 148.5556**	Row 4 Map 17
	Says NO PAINTING	(number of whole minutes it takes for sunlight to reach the Earth) divided by (13 lights) = **0.6154**	Row 3 Map 6
	Says NO PAINTING	(number of whole minutes it takes for sunlight to reach the Earth) divided by (11 lights) = **NOT 0.6154**	Row 2 Map 14
	Is no painting	(answer to the universe) divide by (9 lights) = **4.6667**	Row 2 Map 4
	Is no painting	(answer to the universe) divide by (8 lights) = **NOT 4.6667**	Row 5 Map 19
	Is no painting	(Speed of light in meters per second) divided by (8 lights) = **37.474**	Row 3 Map 15
	Is no painting	(Speed of light in meters per second) divided by (13 lights) = **NOT 37.474**	Row 1 Map 2

Figure B.1: Maze Map Numbers



C Pre-Test Questionnaire

Before Playing

Welcome. Thank you for your interest in "Talk Me Through This".

Before we start there are a couple of questions I would like you to answer. It shouldn't take too long.
Thank you for your cooperation.

* Required

1. What was the ID number you were given? *

.....

Demographics

Let's first start with some general information.

2. What is your gender? *
   Mark only one oval.
   - ◯ Male
   - ◯ Female

3. What is your age? *

.....

4. What country are you from? *

.....

5. What is your current relationship status? *
   Mark only one oval.
   - ◯ Single
   - ◯ Dating
   - ◯ Dating (long-distance)
   - ◯ Living with a partner
   - ◯ Engaged
   - ◯ Married
   - ◯ Widowed
   - ◯ Divorced (once)
   - ◯ Divorced (twice or more)

Figure C.1: Pre-Test – Page 1 of 3.

Before Playing

6. What is the highest level of education you have completed? *
Mark only one oval.

- Did not graduate high school
- High school or equivalent
- Some vocational and/or technical school
- Bachelor's degree (undergraduate)
- Master's degree
- Doctoral degree
- Professional degree (MD, JD, etc.)
- Other:

Games

Surely you play?

7. Do you consider yourself a gamer? *
Mark only one oval.

- Yes
- No

8. How many hours on average do you play games per week? *
(this includes any type of game: PC, console, mobile, card games, board games, etc.)
Mark only one oval.

- Less than 30 minutes
- Between 0,5-1 hour
- Between 1-2 hours
- Between 2-4 hours
- Between 4-7 hours
- Between 7-10 hours
- Between 10-15 hours
- More than 15 hours

9. How often do you play these genres? *
Mark only one oval per row.

	Never	Very rarely	Sometimes	Often	Very Often
Action/Adventure					
Fighting					
Music					
Racing					
Puzzle					
Role Playing					
Shooter					
Sports					
Strategy					
Simulation					
Educational					

Figure C.2: Pre-Test – Page 2 of 3.

Before Playing

10. Have you ever tried Virtual Reality (VR)? *
(e.g. Oculus Rift, HTC Vive, GearVR, Cardboard, etc.)
Mark only one oval.

- Yes, I have tried VR before
- No, I have never tried VR before
- Other:

11. Have you ever played the game "Keep Talking and Nobody Explodes"? *
Mark only one oval.

- Yes, I have played it
- I know about it, but have not played it
- No, I never played it

Communication

12. How would you rate your overall communication skills? *
Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Terrible											Awesome

13. How would you rate your communication skills in the following areas? *
Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I articulate well					
I am an active listener					
My body language conveys clear messages that reinforce what I am saying					
My communication is easy to understand					
I encourage feedback and ask questions to insure understanding					
My tone of voice is clear					
I repeat what I heard with different words (paraphrase) to insure understanding					
I follow up on key points to insure understanding					
I change my communication to the level of the other person					

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Figure C.3: Pre-Test – Page 3 of 3.

D Post-Test Questionnaire

After Playing

Thank you for playing Talk Me Through This!

As a follow-up, I would like to ask some questions (again).

* Required

1. What was the ID number you were given? *

General

2. How many times did you play Talk Me Through This? *
   Mark only one oval.
   - ◯ First time!
   - ◯ Two times
   - ◯ Three times
   - ◯ Four times
   - ◯ Five times
   - ◯ More than five times

3. Did you successfully complete the challenge? *
   Mark only one oval.
   - ◯ Yes
   - ◯ No

4. Were you the person inside Virtual Reality, or the person on the outside? *
   Mark only one oval.
   - ◯ I was inside VR (glasses on)
   - ◯ I was outside VR (with the documents)

5. How well did you know the other person you were playing with? *
   Mark only one oval.

	1	2	3	4	5	
Stranger	◯	◯	◯	◯	◯	Best Friend

Figure D.1: Post-Test – Page 1 of 4.

After Playing

6. Who is the other person to you? *
Mark only one oval.

- Family
- My partner (lover)
- A friend
- An acquaintance
- A stranger
- Other: .....

Your Communication Skills

What do you think now?

7. How would you rate your overall communication skills? *
This is about YOU.
Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Terrible											Awesome

8. How would you rate your communication skills in the following areas? *
This is about YOU.
Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I articulate well					
I am an active listener					
My communication is easy to understand					
I encourage feedback and ask questions to insure understanding					
My tone of voice is clear					
I repeat what I heard in different words (paraphrase) to insure understanding					
I follow up on key points to insure understanding					

The Other Person's Communication Skills

What did you think about your partner?

9. How would you rate the other person's overall communication skills? *
This is about the OTHER person.
Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Terrible											Awesome

Figure D.2: Post-Test – Page 2 of 4.

After Playing

10. How would you rate the other person's communication skills in the following areas? *
This is about the OTHER person.
Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
They articulated well	◯	◯	◯	◯	◯
They were active listeners	◯	◯	◯	◯	◯
Their communication was easy to understand	◯	◯	◯	◯	◯
They encouraged feedback and asked questions to insure understanding	◯	◯	◯	◯	◯
Their tone of voice was clear	◯	◯	◯	◯	◯
They repeated what was heard in different words (paraphrased) to insure understanding	◯	◯	◯	◯	◯
They followed up on key points to insure understanding	◯	◯	◯	◯	◯

Experience Evaluation

This is about the game you just played.

11. How much did you enjoy the (game) experience? *
Mark only one oval.

	1	2	3	4	5	
Hated it	◯	◯	◯	◯	◯	Loved it

12. To what extend do you feel like you have learned something? *
Mark only one oval.

	1	2	3	4	5	
Nothing	◯	◯	◯	◯	◯	Absolutely

13. Could you briefly describe what you have learned?
(You can skip this question if you did NOT AT ALL feel like you have learned something)

.....

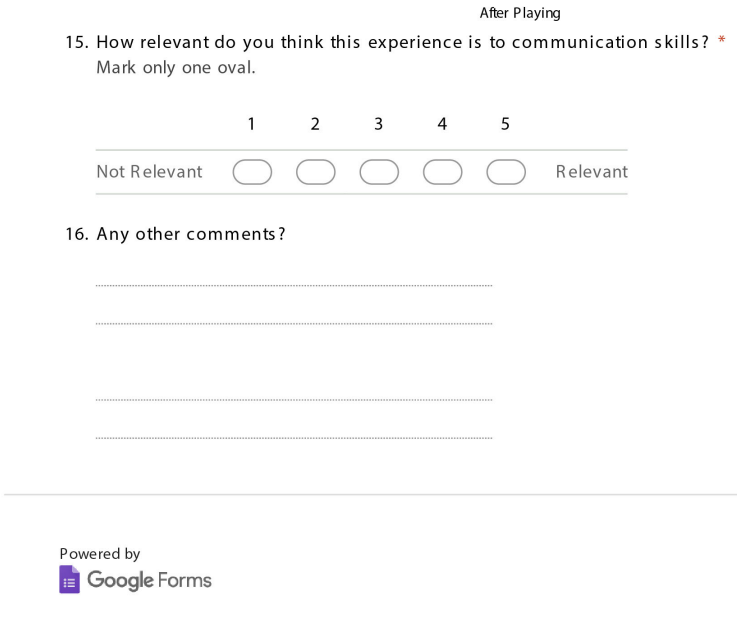
.....

.....

14. Did this experience make you more thoughtful on how you communicate with others? *
Mark only one oval.

	1	2	3	4	5	
Definitely not	◯	◯	◯	◯	◯	Absolutely

Figure D.3: Post-Test – Page 3 of 4.


After Playing

15. How relevant do you think this experience is to communication skills? *
Mark only one oval.

	1	2	3	4	5	
Not Relevant	◯	◯	◯	◯	◯	Relevant

16. Any other comments?

.....

.....

.....

.....

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Figure D.4: Post-Test – Page 4 of 4.