Talk it Out:

Promoting Verbal Communication Through Virtual Reality Games

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Abstract

Verbal communication skills have been shown to be important for both social and professional settings. However, a need for greater communication skills has been identified for graduated students entering the workplace, specifically task-based verbal communication (Daniels, 2001). In light of these findings new communication teaching techniques need to be explored to better prepare our students for effectively communicating information in their future work environment.

This thesis researched the potential for virtual reality video games to promote verbal communication skills in students. The motivation behind using virtual reality video games to teach these skills is based on the theory (Richard Van Eck, 2006) that video games have the potential to enhance the learning outcome of students. Initial research also shows that virtual reality experiences further immerse the player in the educational setting improving their engagement with the game's content (Thornhill-Miller & Dupont, 2016).

The thesis researched how virtual reality games can teach verbal communication skills firstly by analysing past works, completing an in-depth literature review and multiple case studies. Secondly, by using research through design methods in the creation of a prototype game that incorporates both communication and game teaching mechanics researched in the first stage. Finally, user tests were conducted on the prototype game to analyse how effective it was at promoting verbal communication skills in students. The paper's outcome was that virtual reality games can be effective at promoting verbal communication skills and have tested specific teaching techniques and video game mechanics that can be used to effectively promote these skills.

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Chapter 1: Introduction

The intention of this thesis was to create a body of work researching the potential for virtual reality video games to promote verbal communication in students. This can inform further research and game design in this area as it has been shown there is a gap in the current methods for teaching communication skills to students before they start entering the workforce (Dallimore, Hertenstein, & Platt, 2008).

The effects that playing video games have on their users is a vast topic covering many different genres, generations and subtopics. The motivation behind the thesis was to further add to the research around the positive outcomes that arise from playing video games. The aim was to research exactly how to make a game that could promote verbal communication in the users that played it. The topic, and the games it creates, are commonly referred to as "serious games". Serious games are simply games whose primary purpose is to positively affect the player in terms of skill or knowledge acquisition (Djaouti, Alvarez, & Jessel, 2011).

The skill this thesis focused on was verbal communication. Verbal communication had been shown to be crucial to both social and professional settings (Laamarti, Eid, & Saddik, 2014) making it an issue worth investigating. Current methods of teaching verbal communication such as class discussion and oral presentation are effective, yet there is reason to believe there are areas these methods miss. Issues with current forms of communication training stem from students being left out of the discussion during class and a lack of engagement with the topics being communicated with the oral presentation (Dallimore, Hertenstein, & Platt, 2008). These issues combined with some industry professionals seeking better communication skills from graduating students (Dallimore, Hertenstein, & Platt, 2008) shows an important gap in communication training that warrants new research. Verbal communication is a skill that is important to most people's everyday life which can also be a core mechanic to many video games. In such video games, it can be essential to effectively communicate enemy locations, strategies and sometimes complex theories, all the while under pressure pitted against the game AI or other players. There are some

multiplayer games where the level of communication between players can be the difference between winning and losing. This thesis explored and expanded on this concept to make a fun and engaging game that would force players to use and practice these communication skills. To research this concept further the thesis aimed to determine whether there were innovative ways these mechanics could be explored. This informed the decision of researching the subgenre of virtual reality games. The thesis explored how virtual reality (VR) could improve the acquisition of communication skills while playing the game and what it had to offer the gaming experience.

In researching virtual reality games, this thesis completed an in-depth literature review covering game theory, verbal communication theory, how communication is currently taught, and what issues there are with communication teaching methods. In conjunction with peer reviewed articles the thesis conducted research into precedents for game design and virtual reality theory. This was to find a criterion for how an effective serious game is made, how it can teach skills to its players and what effect virtual reality has on this process. Finally, this research produced a criterion on which a creative output was built upon and tested against.

The creative output was a fully functioning game prototype using the game methods found from the prior research. It incorporated multiplayer communication mechanics and virtual reality functionality. To determine whether or not the creative output achieves its goal it was tested against the design criteria from the literature review. The design process incorporated a number of prototyping and user testing methods to develop and test the final game.

The thesis explores the potential for merging virtual reality with video game experiences to test what extent they can promote verbal communication skills. By combining these two areas and focusing on how to teach and improve communication there is the possibility for real discoveries in how virtual reality games can benefit their players.

Chapter 2: Literature Review

Serious games are a large topic with literature and research that cover a broad range of fields. The definition of serious games is that they are games whose primary purpose is to positively affect the player in terms of skill or knowledge acquisition (Djaouti, Alvarez, & Jessel, 2011). Virtual reality is a relatively new field which has a steadily growing body of research surrounding it. The research that has been completed in the area has pointed to an increase in immersion and receptiveness to learning (Thornhill-Miller & Dupont, 2016). This relatively recent emergence of VR is contrasted to that of the research into teaching communication skills, about which James C. McCroskey (1984, p.260) stated, "the importance of competence in communication has been recognized for thousands of years. The oldest essay ever discovered, written about 3000 BC, consists of advice on how to speak effectively". During this time studies have found the importance of communication in social life (Lasswell, H.D. 1948, Littlejohn, S.W. & Foss K.A. 1978, Dance, F.E. & Larson, C. 1985) and professional life (Argenti, P.A. 1993, Dallimore, Hertenstein, & Platt, 2008). These skills include such things as effective listening, questioning and clarifying, to name a few. The following research focused on three areas: that of serious games, virtual reality and verbal communication. This was to find their key theories and how they might relate and be combined. The research also analysed past and current games that utilize verbal communication as precedents for how the final creative output of this thesis might operate. The goal of this was to find how VR video games might promote verbal communication skills in their players.

For this study to be relevant the thesis needs to establish three main concepts. Firstly, that verbal communication was not only an important skill to learn but there were gaps in how this skill was taught. This would establish the gravity of this study and how it can fit into the wider context on communication skill education. Secondly, it had to establish how video games were capable of improving user skills through play, setting up the relevance of using the medium of video games and researching how these concepts could be applied to this thesis' creative output. Thirdly, the

educational benefit of virtual reality needed to be established, stating and analysing how VR can facilitate the learning process.

The output of the research aimed to create a prototype for a serious VR game that promoted communication skills in its users. The research has the potential to influence future game design in this area and can be a foundation for further study in these areas. The research can be relevant to teaching in schools, engaging learners and facilitating growing connections between students. Communication has been shown to be one of the most important skills for any student to learn from their studies (Hargie, 1997). There is potential for VR to help facilitate the learning of communication through video games as the user can easily give two players separate game perspectives. Doing this and combining it with a shared common goal means students must use communication to complete the game's tasks.

The Importance of Verbal Communication Skills

Before any research into the learning benefits of video games or virtual reality experiences was undertaken what first needed to be established was the educational importance of verbal communication skills. This established the base reason for completing this thesis and underpinned the importance of any results gained from this research. As McCroskey (1984) found, the study of communication skills can be dated to at least 3000 BC, making the argument that the area of study can be considered over 5,000 years old. Since that time countless more studies have been completed on the area of communication. The main consensus of this body of work concludes that communication skills are essential to everyday life (Hargie, 1997). This is true for social (Lasswell, H.D. 1948, Littlejohn, S.W. & Foss K.A. 1978, Dance, F.E. & Larson, C. 1985) and professional life (Argenti, P.A. 1993, Dallimore, Hertenstein, & Platt, 2008). In terms of teaching communication skills, researchers found that core to learning these skills was studying and practising together. This was shown by the likes of Lev Vygotsky who in 1962 produced a study of cooperative learning and found that students learning and communicating together learn faster than students learning by themselves (Vygotsky, 1962). These findings have been

backed up by Thomas J. Wenzel, Caleb T. Carr and Paul Zube - all finding comparable results around teaching communication (Wenzel, 2000, Carr & Zube, 2015). Communication is best taught cooperatively with another learner compared to solo practising or forms like presentations in which there is no exchange between all participants. The importance of verbal communication skills in a professional setting cannot be understated; Elise J. Dallimore, Julie H. Hertenstein and Marjorie B. Platt found that "variety of reports identify verbal and written communication skills as the most important workplace skills for employees". They also identified that universities and schools have taken notice of this and now place an emphasis on teaching effective communication (Dallimore, Hertenstein, & Platt, 2008). What defines effective communication is complex, however the main characteristics are often described as listening, questioning, describing and clarifying (Astorga-Cabezas, 2015). Effective communication can also be identified as being clear, factual, and goal-oriented (Carpenter, Bauer, & Erdogan, 2017). What this thesis also aimed to teach is self-efficacy in communication. Self-efficacy, also referred to as personal efficacy, is the extent or strength of one's belief in one's own ability to complete tasks and reach goals (Ormrod, 2006). This is faith of one's belief in their ability to effectively communicate information to another person while under pressure or stress. This can be simulated in the game prototype as the pressure applied by a counting timer and a varied win or lose state.

The creative output of this thesis had to be cooperative in nature and promote not only effective and clear speech but also listening and clarifying to be successful in its aims. Effective communication skills are very important in all aspects of life; we communicate all the time and the efficiency with which we communicate highly influences our success, whether it is in personal relationships or professional career (Laamarti, Eid, & Saddik, 2014). With the importance of verbal communication skills established the relevance of this thesis is presented.

Problems for Current Teaching Models for Verbal Communication Skills

Verbal communication skills are vital to any workplace or educational field, and yet there are studies that point to a need for expanding the way these skills are currently being taught (Daniels, 2001). Former Chrysler CEO Lee Iacocca lamented, "I only wish I could find an institute that teaches people how to listen. After all, a good manager needs to listen at least as much as he needs to talk." (Iacocca & Novak, 1987). Elise J. Dallimore et al. found that participation was crucial when developing communication-based skills. They state that one of the main ways communication skills are currently being taught is in class discussions, however they observed that it was the same students participating and gaining the benefits to their communication skills while other students were left out. The study also pointed to a lack of engagement with the material being communicated, slowing the learning of these skills (Dallimore, Hertenstein, & Platt, 2008). To address these issues the creative output of this thesis had to guarantee each student had to participate to able to practise their communication skills. It is also important that the format for this communication is engaging to facilitate the learning process. Another common communication teaching method is presentations. However, when teaching through class presentations the students are not fully interacting with each other by creating a dialog - one is passive while the other is active. This does not fit with the theory of cooperative learning that Vygotsky found to greatly benefit the learning process (Vygotsky, 1962). By creating a multiplayer game this will avoid isolated communication exercises and further promote effective verbal communication.

Teaching Potential of Serious Games

The practice of using games to educate dates to at least the twentieth century (Rice, 2007, p. 87). The use of paper-based educational games enjoyed popular use in education in the 1960s before waning in later use. More recently video game based learning has developed from a small niche into a respected branch of technology enhanced learning (John Kirriemuir & Angela Mcfarlane, 2004). In addition, many consider the future of

educational technologies will use serious games as an instrument to be incorporated in varied learning scenarios (Moreno-Ger, Burgos, & Torrente, 2009).

Different authors have researched the potential of educational games as learning tools. Video games gain and hold a student's finite attention span and provide meaningful learning experiences for both students and adults (Richard Van Eck, 2006), while providing engaging exercises for deeper learning experiences (James Paul Gee, 2007). Colin Rose and Malcolm J. Nicholl succinctly sum up what has been studied for years now: "In simple terms a brain enjoying itself is functioning more efficiently."… "When we enjoy learning, we learn better" (Rose & Nicholl, 1998). That is when students are engaged with the learning medium and enjoying the experience they are more open to information and more motivated to learn. This point is of relevance because as Dallimore et al. found there is a link between students engaging with the material they communicate with and their ability to learn communication skills (Dallimore, Hertenstein, & Platt, 2008).

There has been a great deal of research produced in the area of learning potential of video games. The consensus of the studies and research papers is that video games can effectively teach students and increase their motivation to learn if they are used properly. The online teaching website Educause found that educational video games can promote collaborative learning, problem solving and experiential learning, and can offer innovative ways of addressing different learning styles (Educause, 2009). How exactly video games can increase motivation is not only their quantifiable progress, it also relates back to the concept of fun. Christina Bisson and John Luckner observed that fun plays the role of intrinsic motivator in two regards. Firstly, games create the desire for recurrence of the experience. Secondly games motivate learners to try new activities of which they have little or no previous experience (Bisson & Luckner, 1996). Bisson and Luckner also cite Middleton, Littlefield & Lehrer, 1992; Datillo & Kleiber, 1993; and Hastie, 1994; who concluded that fun increases a student's motivation.

It is stated that games can achieve these results when used properly, but what exactly are the requirements for making an effective educational game? To make an effective educational game it benefits if there is some sort of storyline, and there is no extrinsic, immediate award. Also, that the learning goals are essential for winning or the material is likely to be ignored (Lepper & Cordova, 1992). Ultimately what the prototype game produced from this research will offer is task-based learning, in which the user learns skills or information by completing tasks, or in this case game challenges. Mojibur Rahman found task-based learning is "well received by the majority of the learners. They found the experience to be rewarding, intrinsically interesting, and educationally beneficial. They got involved in the task, because the tasks were giving the feeling of real life situation" (Rahman, 2010).

Video games also offer a medium to facilitate role play which can be beneficial for the player in many ways. Role play can build confidence by providing a safe environment to encounter different scenarios and act them out. When role playing with others it forces them to use listening skills to understand the scenario being played out. Furthermore, it provides options for creating new situations in a controlled environment giving users new experiences (Freifeld, 2014). Role play also has the capacity to create greater involvement in the issues and knowledge, which is the focus of the training.

Role play can also be segmented to provide focus and options for mastery of certain aspects not always available in real world situations (Freifeld, 2014). In respect to which role play genre is most appropriate for the prototype game from this research, the spy genre was selected. The spy genre is perfect for transitioning to the video game medium (Mukherjee, 2002) and far more importantly (as Paul Driver found when completing a similar study) that "a simple spy narrative as both a cohesive device and a way of providing a semiotic background familiar to all the participants. This frames the context for authentic interactions and communication to take place." (Driver, 2012) This means the users can be immersed in a role that they understand and can focus on communicating without being confused by an overly complicated genre. For this reason, the genre of spy espionage was selected for the creative output of this thesis.

Educational video games are a well-researched field of study, which academics have analysed for decades. As a result, much of the benefits and boundaries of this field have been explored. However, there is far less research on the learning potential of virtual reality video games. Virtual reality is a new medium for the genre of educational video games and warrants investigation as it adds opportunities for game developers and future students.

The Teaching Potential of Virtual Reality

Virtual reality used in teaching is a new subject of research because of its relatively recent emergence. What research that has been produced points to increased feelings of immersion in students when in VR learning experiences, increased creativity, and that VR facilitates guidance or gamification (Thornhill-Miller & Dupont, 2016). The learning potential of VR and its possible applications such as in libraries and games have only just started to be discovered. The increased immersion it provides has been shown to improve student engagement with the content and their motivation for learning (Thornhill-Miller & Dupont, 2016). All this research is quite new and the field is still growing.

Furthermore Thornhill-Miller & Dupont (2016) found there were five ways VR could be used to enhance creativity and problem solving: by changing aspects of the self and self-perception, by optimising environmental conditions and influences, by facilitating guidance or gamification of the problem-solving process and by offering an arena for the integration of other technologies of creativity enhancement such as pharmacological enhancement, brain stimulation, neurofeedback, and lastly, by optimizing interactions and collaboration with others.

The three aspects of most relevance to the creative output of this thesis were changing self-perception, facilitating gamification, and optimizing interaction and collaboration. It is important to change self-perception in

engaging the users in the game and the material being covered to efficiently teach communication skills (Dallimore, Hertenstein, & Platt, 2008). Facilitating gamification offers increased benefits from game experiences explored in the last section. Lastly optimizing interaction is the most important as the users interacting with each other is core to teaching communication.

Others have agreed that VR experiences can have a positive effect on learning simulations; Heather Moorefield-Lang described the effect as making both gaming and learning fun and exciting (Moorefield-Lang, 2015) while Roxana Moreno & Richard E. Mayer found virtual reality increased immersion which increased the transfer and retention of information (Moreno & Mayer, 2002). No doubt more studies will emerge now there is wider access to VR technology. However, there is not currently enough data on the use of VR in educational games and how they affect the learning in them. Most research has been on virtual reality headsets on their own, leaving a gap of research around multiplayer experiences. This is a gap the thesis aimed to explore, in specific relation to teaching communication to which there are no current papers addressing the topic with virtual reality gaming.

Design Precedents

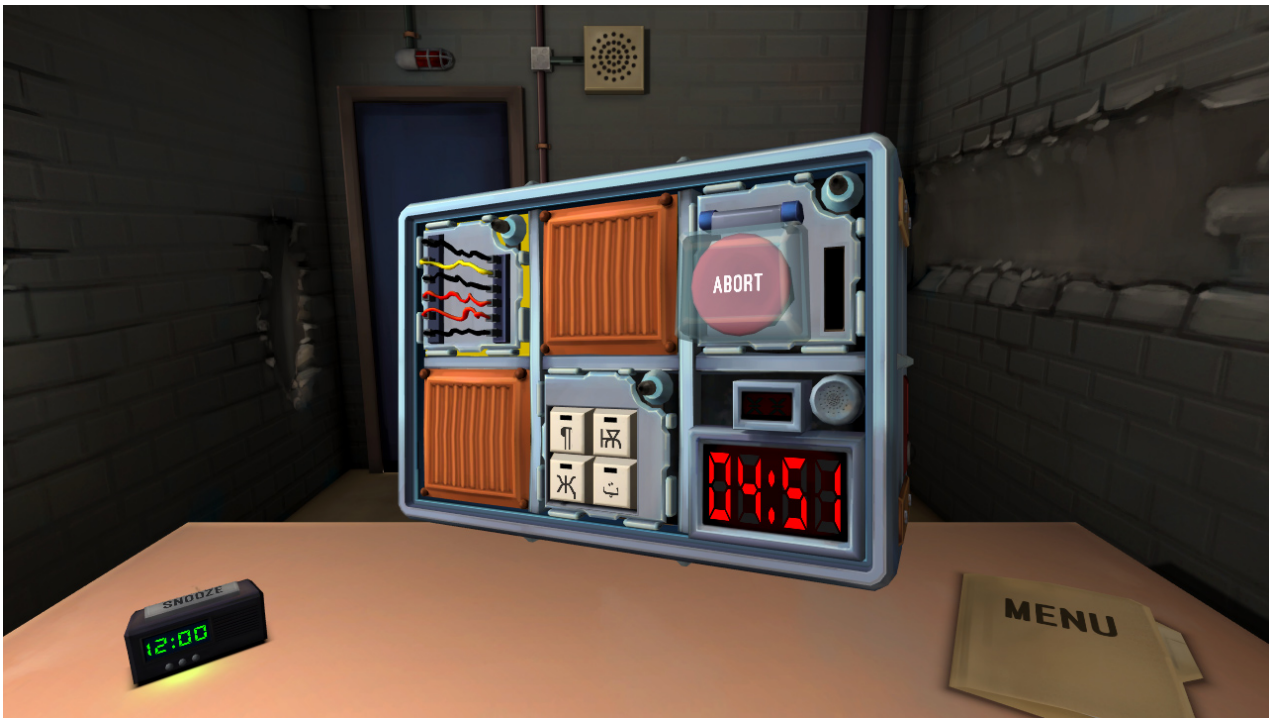

Figure 1 : Keep Talking and Nobody Explodes (Steel Crate Games, 2015)

Keep Talking and Nobody Explodes

A good precedent for using communication mechanics in video games was found in the video game Keep Talking and Nobody Explodes by Steel Crate Games released in October 2015 (Steel Crate Games, 2015). During the game, it assigns a player the task of disarming a procedurally generated bomb with the aid of other players who read a manual containing instructions. At least two players are needed to play the game, with one player as the defuser, playing the game on either a traditional screen or head-mounted display, and the additional players as the experts reading the provided bomb defusal manual. This game has the defuser unable to look at the manual but instead relying on the experts to instruct them on what steps to take, and likewise the experts cannot see the bomb and must communicate to the defuser who describes the bomb to them. This communication with each player occurs either directly from across the room or through online communication software. Each bomb in the game consists of various modules that are independent of each other and can be disarmed in any order. Once the modules are disarmed the bomb is

successfully disabled. The communication in this game takes the form of the defuser to relaying visual indicators to the other players, who then use the manual to determine what actions the defuser must take. Other module challenges are more difficult, some cannot be disarmed and require periodic attention to stop them from triggering while the bomb is still active. Each bomb has a countdown timer that will cause the bomb to explode if it reaches zero.

What this game does well is have many different ways the players can communicate with certain modules requiring complex instructions, challenges requiring the use of homophones (words with different meanings but the same pronunciation) and verbal tics such as “uhhh” or “uh huh”. This tests the user's ability to communicate, making the win state of the game achievable only by clear efficient communication between the players. These confusing challenges mean that to complete the level it is necessary to practise the core communication skills of listening, questioning, describing and clarifying (Astorga-Cabezas, 2015). This game is an example of how multiplayer virtual reality communication can be used in a game, and communication is a core game mechanic which Lepper and Cordova stated is essential to teaching that skill in any video game (Lepper & Cordova, 1992).

It incorporates the immersion of virtual reality and uses this further to create an asymmetrical experience for the players, providing different information to each player, forcing them to communicate to solve the game’s puzzles. One of the only missing aspects of this game to make it an even more effective educational game is a narrative which Lepper and Cordova found increases engagement with the game (Lepper & Cordova, 1992). The whole game is just solving the puzzle of each bomb, the players have no motivation to complete the challenge other than the satisfaction of completing it. Lessons can be taken from how this game has been designed forcing players to communicate by the incorporation of virtual reality and be improved upon by including a storyline to engage the players further in the challenges of the game. The key takeaway from this game is mixing up information to make sure players are using core communication skills of listening, questioning, describing and clarifying (Astorga-Cabezas, 2015) and along with applying pressure that could take the form of a timer before

an alarm is triggered, a low-stakes version of a bomb exploding. This timer and alarm is to put pressure on the players and give them confidence in their ability to communicate under pressure. This is key to teaching self-efficacy in communication (Ormrod, 2006) which again is the strength of one's belief in one's own ability to complete tasks and reach goals.

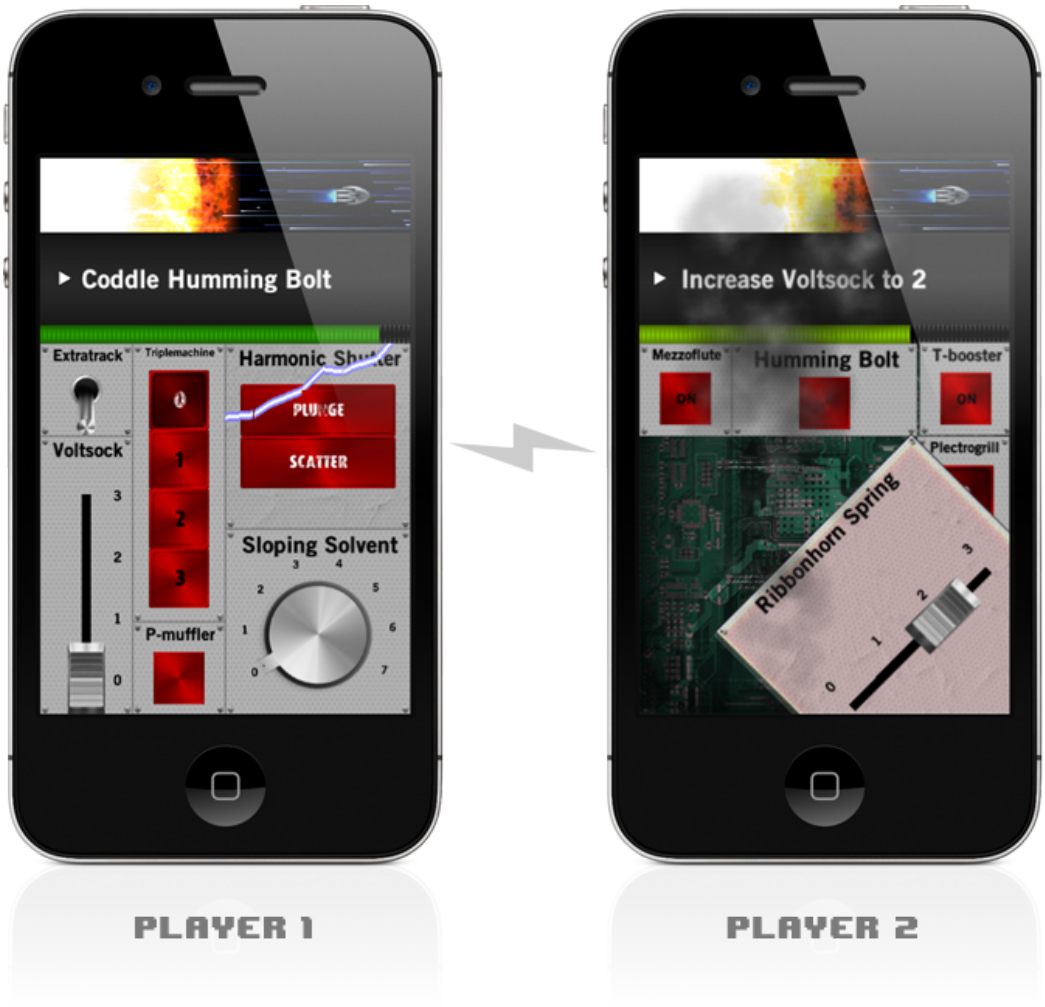

FIGURE 2 : SPACETEAM (SLEEPING BEAST GAMES, 2012)

SPACETEAM

Communication-based serious games are not limited to a computer. Spaceteam is a phone and tablet-based local cooperative game app developed and published by Henry Smith of Sleeping Beast Games. "The idea is that you're all members of a spaceship crew, trying to keep it from crashing" (Tsukayama, 2014). During play in Spaceteam each player is in charge of a different control panel on their individual device's screen, with

various options for interacting such as dials and knobs with an array of technobabble descriptions.

Each game begins with different orders for each player sent via their device providing them with tasks to fly the ship. The players must verbally communicate to the group the orders that need to be completed until the player with the relevant control panel executes the order correctly. This communication requires that each player must simultaneously listen for any orders that are relevant to their control panel and execute them accordingly (Blagdon, 2012). "The tasks get harder. Sometimes you may find your instruments mislabelled, for example." (Tsukayama, 2014) It is pressures like these that test the communication skills of the players, needing to speak clearly under stress. This is similar to the pressure players are put under in Keep Talking and Nobody Explodes, and with both games efficient communication is the difference between virtual life or death. Both games require listening, questioning, describing and clarifying which comprise effective communication (Astorga-Cabezas, 2015).

This game offers more multitasking in terms of communication compared to Keep Talk and Nobody Explodes as each player must simultaneously read out new instructions with listening for those relevant to their own station. This reinforces both clear efficient speech and active listening under pressure, providing more confidence in their communication skills and greater self-efficacy (Ormrod, 2006). The game achieves this goal but does not have a high level of immersion due simply to the fact of its medium as an app. This would be a problem if the creative output of this thesis was an app as one area it aimed to address was the lack of engagement with communication learning found in current methods (Dallimore, Hertenstein, & Platt, 2008). Increasing the immersion of these concepts in a virtual reality experience should lead to further engagement with the game content and information transfer (Moreno & Mayer, 2002).

FIGURE 3 : OVERCOOKED (GHOST TOWN GAMES, 2016)

OVERCOOKED

Ghost Town Games was a developer that aimed to create a game where communication and cooperation was its main focus and mechanic (Duncan, 2016). Ghost Town Games created the multiplayer cooking simulation game Overcooked in 2016 (Ghost Town Games, 2016) and was released for Microsoft Windows, PlayStation 4, and Xbox One.

This game was designed as a local cooperative experience in which players were able to control a number of chefs in a kitchen filled with various hazards and obstacles, while tasked with quickly preparing meals to specific orders under a time limit. In the game Overcooked the players are in the role of chefs in a kitchen, trying to create as many meals as possible under the time limit, completing tasks like preparing of ingredients, cooking, serving, and cleaning up. The players are presented with an order which must be completed during a round, the workstations being separated apart means the chefs must work together to complete the meals on time.

This cooperation hinges on the level at which the players can communicate their roles and what needs to be done. The number of meals correctly made

is ranked on a star system, which is an important feature as it lets players see if they have made progression in the efficiency that they work and communicate together. There are links between information including quantifiable advancement and players' increased performance (Veronica Zammitto, 2008) which points to a need for a score system in the final creative output of this thesis. "The cooking aspect is made difficult by the layouts of the kitchen, which change each level. Stations for ingredients, preparation areas, stoves and ovens, serving windows, and dishes are generally all separated across the kitchen, requiring time to move between them" (Duncan, 2016). This was another example of games putting stress on the players to test their communication skills similar to the last two precedents. Ghost Town Games found key aspects to creating a more verbal communication were multitasking during challenges, adding risk to actions and adding disruptions to play (Duncan, 2016). These factors caused players to rethink their strategies and more importantly to communicate. This is comparable to Spaceteam that has the player's controls swapping between each other, forcing the players to learn a new setup and listen for new cues for their actions.

From their play testing and developing Ghost Town Games found that a lives system made a player feel as if they were constantly failing or just prolonging their death. They pivoted to a time system and this freed up their players to coordinate and communicate together (Duncan, 2016). This is important for further game development as to learn skills from a video game the player can't be so demotivated that they stop playing. One key aspect of serious games is the motivation for recurring experiences (Bisson & Luckner, 1996) which lets players practice and learn from their time spent playing. A lives system would not be included in the prototype to avoid demotivation of the players and give them freedom to coordinate and communicate.

Ghost Town Games also encountered balancing issues with how much freedom to give players with how much to make the players communicate. Too much to communicate and remember and the game was bogged down by small mistakes; too little and there wasn't enough communication involved at all. This balance was important to consider when developing the

final output of the thesis, taking into consideration time limits and level of intricacy in communication.

Figure 4 : Spyfall (Ushan, 2014)

Spyfall

In 2014 a designer named Alexandr Ushan created the board game Spyfall. While not a video game like the other precedents researched, it is a communication game that has players using careful communication to achieve their goals (Ushan, 2014). The aim of the game is to find out who is the spy while not giving away what location the game is set in. Spyfall is played over several rounds and each round starts with players receiving a card showing the same location such as a casino, a circus or a space station, except for one player who receives a card that says “Spy" instead of the location. Players must then ask calculated questions to try to find the spy while vague enough that they do not reveal the location. The spy must listen carefully to deduce the location of the round. When the time runs out the spy must try and answer where they are. At any time during a round,

one player may accuse another of being a spy. If this is the case it requires all other players to agree with the accusation. Once this happens, the round ends and the accused player has to reveal their identity.

This game provides the players with an opportunity to practice selective communication, adding more weight to considering each word they use to avoid tipping off the spy as to where they are. This is a different kind of pressure compared to the previous precedents. If you are not the spy, each player is a potential teammate or enemy. It does not implement multitasking like Spaceteam or Overcooked, instead letting each player listen carefully to one player speaking at a time. To achieve at this game the communication needs to be clear, factual, and goal-oriented, all aspects of effective communication (Carpenter, Bauer, & Erdogan, 2017). This game also directly contrasts the previous games, as in the other games each player wants to communicate as much information as possible, while Spyfall has players using far more selective communication techniques when speaking. This is an interesting concept which could be explored at a later date. For the prototype game simply cooperative communication, used in such games as Keep Talking and Nobody Explodes, will be required as prior research found user cooperation enhanced the learning process of each individual (Wenzel, 2000, Carr & Zube, 2015).

Conclusion from Literature Review

This literature review aimed to research the three topics of serious games, virtual reality and verbal communication to find ways they could be combined together to create a VR game that promotes positive communication skills. The research found that video games have many beneficial effects on their players and can promote new skills through play. Furthermore, certain aspects of game design were found to be the cause of these positive effects, the inclusion of which is important to the success of the creative output of this thesis.

After researching the influence of communication to both social and professional lives, a gap in the current methods the skill is taught was identified, being a lack of engagement in the content being communicated

and uneven participation in communication activities. This gap offered relevance to this thesis, exploring new techniques to promote the important skill of verbal communication. Virtual reality experiences were studied and found to have positive effects on the learning process, increasing immersion and helping with the acquisition and retention of knowledge and skills. This literature review provided a stable base of research to draw upon when developing the creative output of this thesis, the prototype VR game.

CHAPTER 3: METHODOLOGIES

To achieve the aims and objects of this research, the following methods were adhered to. To find what methods were needed to create a virtual reality game that promotes verbal communication skills in its players the thesis included a thorough literature review. The literature review identified important criteria in serious game design, what effective verbal communication is, and how verbal communication is currently taught.

Furthermore, the literature review researched the benefits of virtual reality experiences and how they can be incorporated into the design output. The literature review comprised of examining current peer-reviewed articles and journals along with critically analysing design precedents in video games that use communication as a core mechanic. Analysing these game precedents to reveal how communication is incorporated into the game and how this could be taken further.

Based on the design criteria created from the literature review, Research Through Design techniques were adopted to test these theories. Research Through Design is the process of testing design theories by creating outputs based on their findings and examining these to determine their worth or relevance (Zimmerman, Forlizzi, & Evenson, 2007). The design output in this case was a virtual reality game that included game and communication theory from the literature review. The process to create this game followed the operation prototyping theory of Heather Maxwell Chandler & Rafael Chandler, from the book *Fundamentals of Game Development* (Chandler & Chandler, 2011). Operational prototyping consists of refining an initial prototype until it becomes the final working version.

To test how effective these features are and if the design theories are functional, testing of the game prototype must be done. To test the game prototype the thesis used playtesting methods from Pablo Moreno-Ger, Javier Torrente, Yichuan Grace Hsieh and William T. Lester (Moreno-Ger, Torrente, Hsieh, & Lester, 2012) which included three main types: expert, theoretical, and user methods. Moreno-Ger and their team

described these as such "(i) expert methods, in which experienced evaluators identify potential pitfalls and usability issues, (ii) theoretical methods, in which theoretical models of tools and user behaviours are compared to predict usability issues, and (iii) user methods, in which software prototypes are given to end users to interact" (Moreno-Ger, Torrente, Hsieh, & Lester, 2012).

The thesis focused on using user methods as the main source for meaningful feedback data to evaluate the success of its design output. As students were the target audience, a number were brought in to test the game at various stages to look for issues and possible improvements. The thesis also incorporated the expert method alongside the user method as there was regular contact with supervisors who gave feedback and critiqued the prototype during its development cycle.

There are two main types of approaches to completing these testing methods. The first is observation and analysis, where the users play the game whilst a researcher observes and records how they interacted with the game (Moreno-Ger, Torrente, Hsieh, & Lester, 2012). The second type of approach is that of a questionnaire in which after playing the game the users sit down and record their thoughts and feelings about the experience, including interviews by the developer (Nielsen & Molich, 1990). The thesis utilised both of these methods to gain as much data from the playtests as possible. From initial research, around five users should catch 80% of the development problems with any additional users providing diminishing returns for development time invested (Virzi, 1992).

A Likert scale questionnaire was also created to use when interviewing the participants. Likert scales are often incorporated in usability testing as they are simple and relatively straightforward to apply. It is also the most widely used method for directly testing (when the participant knows they are being tested) a participant's attitudes towards what is being tested (McLeod, 2008). Likert scale testing involves getting participants to answer to what extent they agree or disagree with statements provided about the topic. An example might be "I felt the interface of the product was too complicated"

and the participants would select an option from strongly agree / agree / neither agree nor disagree / disagree / strongly disagree.

Likert-type or frequency scales use fixed-choice response formats and are designed to measure attitudes or opinions (Bowling, 1997; Burns, & Grove, 2005) “Likert Scales have the advantage that they do not expect a simple yes / no answer from the respondent, but rather allow for degrees of opinion, and even no opinion at all. Therefore, quantitative data is obtained, which means that the data can be analysed with relative ease” (McLeod, 2008).

Chapter 4: Research Overview

The following design documentation outlines key decisions in the prototyping of the thesis output. Initial development of the game prototype focused on getting the core game mechanics in place of splitting information and verbal communication. Having a split information experience where one player could see different objects in the scene to their playing partner, creates the opportunity and need to communicate with one another.

Players communicating the differences in their gaming experience to progress was essential to have because the intended learning material must be core to the win state of the game (Lepper & Cordova, 1992). This splitting of information means to complete the level it is necessary to practise the core communication skills of listening, questioning, describing and clarifying what the other player sees (Astorga-Cabezas, 2015). If one player had all the information they would not need to communicate to the other player to gain a win state and the game would not promote verbal communication. This mechanic was also necessary for incorporating cooperative game play which improves the learning potential and engagement of the students (Vygotsky, 1962).

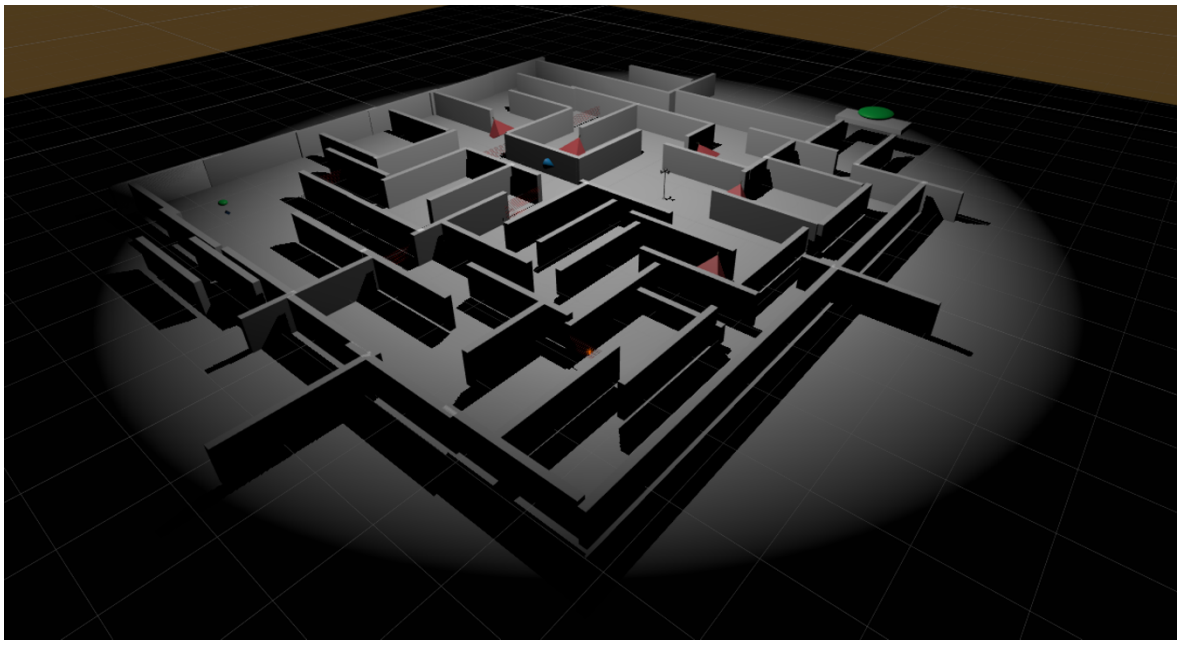

FIGURE 7 : EARLY PROTOTYPE MAZE

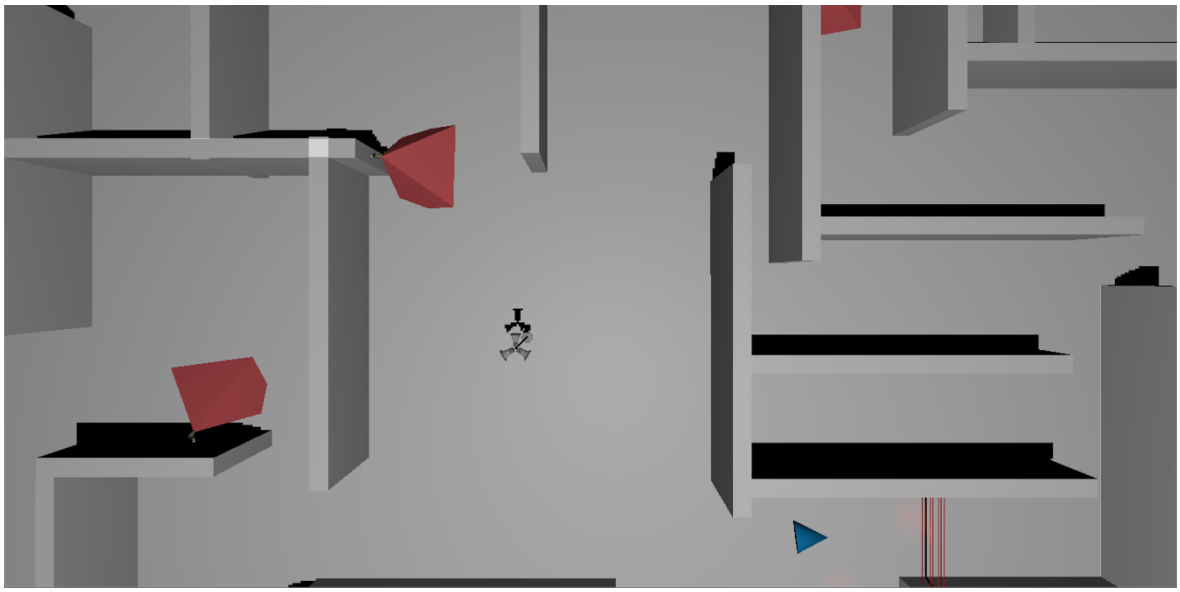

FIGURE 6 : EARLY PROTOTYPE MAZE MAP VIEW

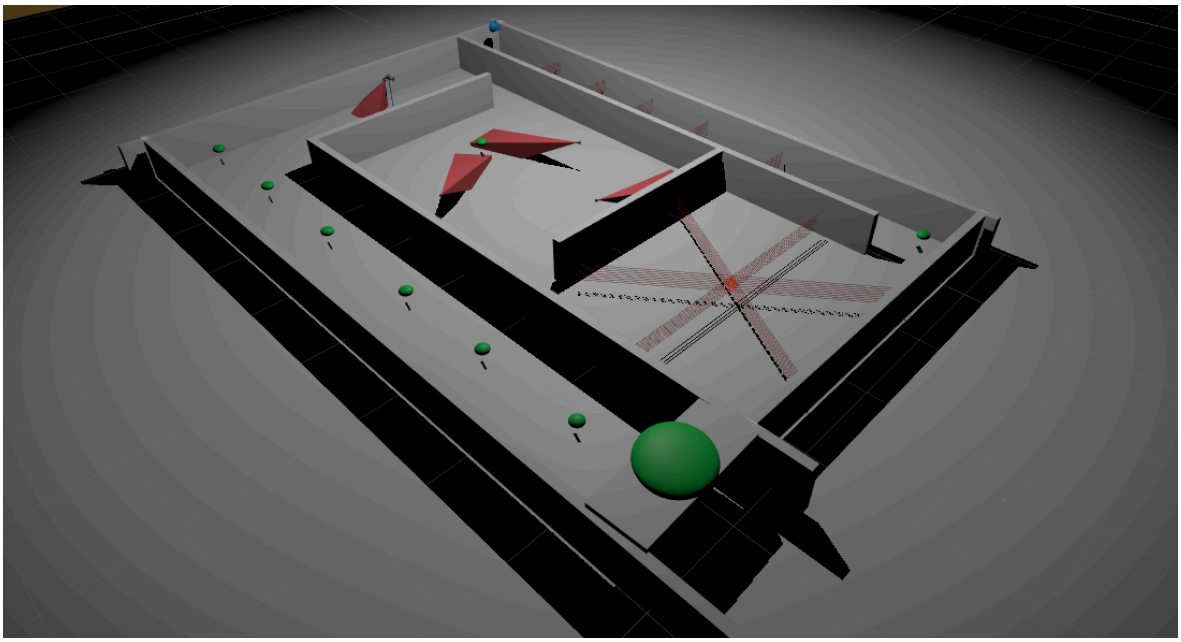

FIGURE 5 : EARLY PROTOTYPE CHALLENGE TESTS

The next step was implementing the use of a virtual reality headset into the scene. This was core to the thesis game theory and facilitated the division of game information in that one player is completely shut off from seeing what the other player is experiencing and any physical communication they try to use. This forces verbal communication to be the only viable form of transmitting information necessary to complete each level. It also provided further testing on theories of increased immersion when using VR experiences and how this affects the transfer and retention of information (Moreno & Mayer, 2002).

The earliest level prototypes tested featured mazes with lasers and security cameras that only the hacker operative could observe and communicate their location to the spy operative so that they could avoid the obstacles. The levels also had items to collect that could be seen from the hacker's map and described to the spy to add further diversity to the communication and objectives during play. While these were still just basic mock-ups of gameplay elements it showed how the division of information made it necessary for both players to communicate with each other to complete the level.

From initial tests, users found that obstacles only viewable from the perspective of one player, such as the laser grids, were an unsatisfying feature. This was because the spy operative had no visual information to inform them of the location of the lasers. This contrasted with the security cameras as they could observe there was an obstacle, but didn't possess all of the relevant information, such as the field of view of the camera that would trigger an alarm when entered.

This division of information was too one-sided and a balance had to be found to facilitate communication but not get bogged down in communicating every aspect of the game (which was known to hinder the game experience from looking at the development of past games like Overcooked) (Duncan, 2016). The use of laser grid fittings were included to address this so the spy could see that there was an obstacle but did not know when they were on or off.

Despite this change after further tests users still felt they needed more information about where the lasers and security cameras were pointing and where was safe for them to move to. Earlier advice had been to begin with cameras and lasers the VR player could see and progress to ones they could not. However, this sent the wrong message about the core game mechanic of communication, as the game would start off not needing any communication at all as the VR player can see every obstacle. Also, it still did not address the problem of the player not sufficiently knowing where it was safe for them to stand even with the hacker players describing the route they should take.

A solution to this was to let the VR player see the lasers at all times, yet only the hacker player could see when the lasers were activated and able to be tripped. This was done by making the lasers visible at all times but having a power box next to the laser grid only the hacker player could see, meaning they still needed to communicate when the grid was ok to pass through. This was a balance that felt right and still let the spy player know where the obstacles where. This followed the example of Overcooked in simplifying the communication to stop over burdening one player and slowing down the entire game to describe one challenge.

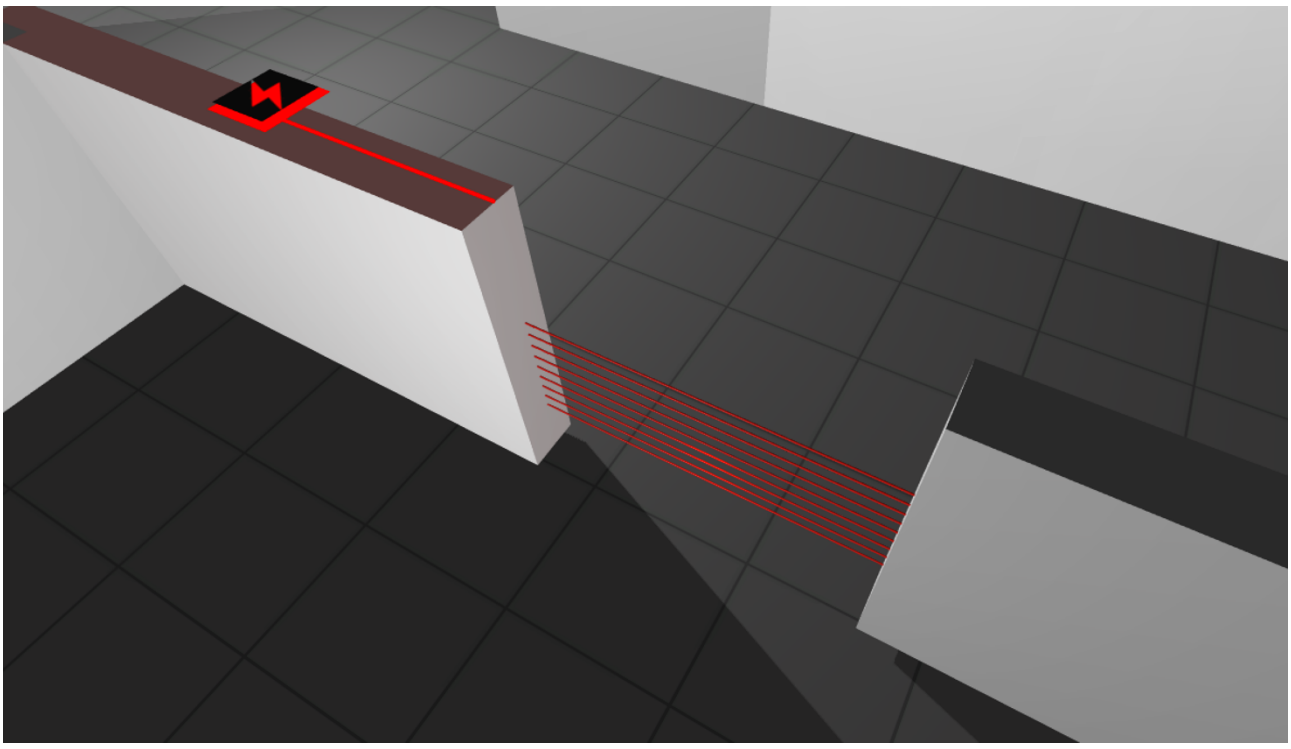

Figure 8 : Laser grid and power box indicating activation

The security cameras were a different problem as many of them moved and part of their challenge was avoiding their field of view which was constantly activated and rotating. If approached the same way as the laser grid showing where they were, it would remove any need for communication between the players. One solution was showing their possible field of view on the ground and the hacker player communicating where it was in that arc. A second solution was to mark sections of the map with visual cues that were easier for the hacker to describe to the VR player. These included coloured pipes, sectioning areas on the ground leading to and away from obstacles, various items around like chairs, desks and lights, or a grid on the ground differentiated by colour, pattern or code. The second solution was selected as it provided more opportunity for communication and made the main skill to be taught vital to winning the game (Lepper & Cordova, 1992). It was also necessary to obstruct the view of the VR player so that they couldn't see which way the security cameras were turning. Dark bubbles were placed around the cameras similar to ones in real life so as to not give away the position of their view.

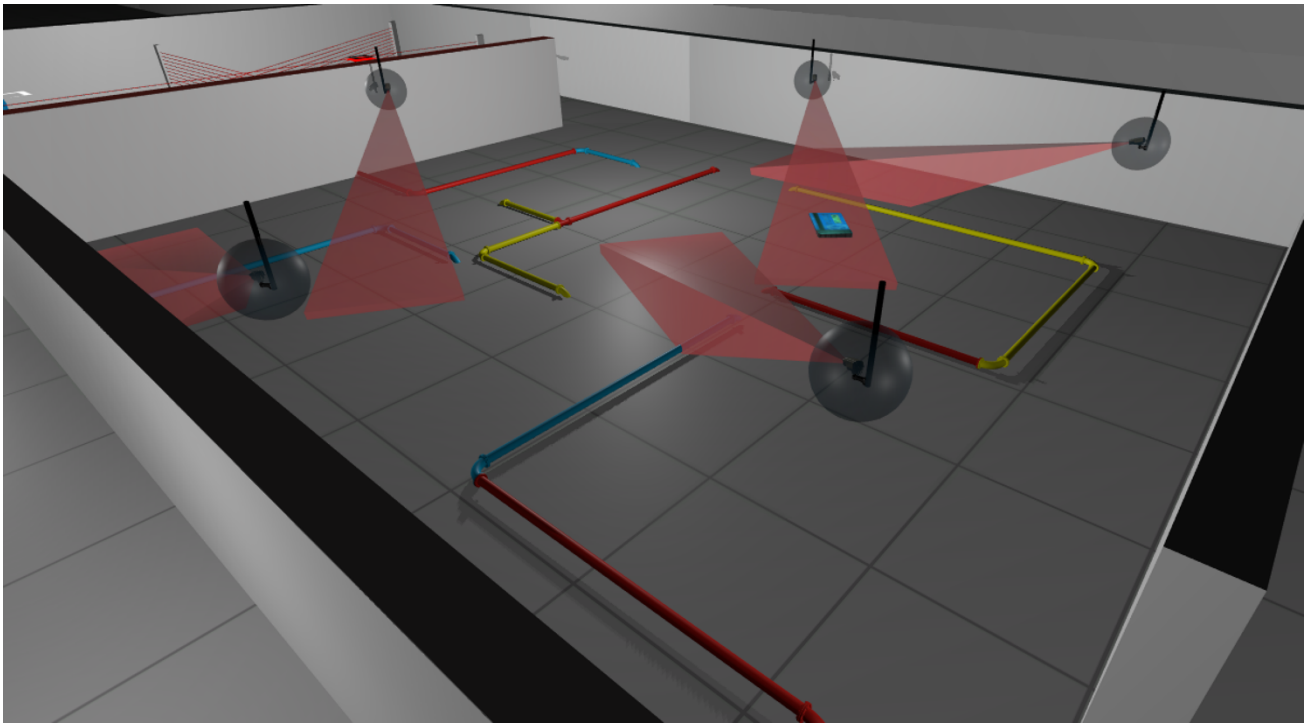

FIGURE 9 : PIPES USED AS VISUAL MARKERS ON FLOOR

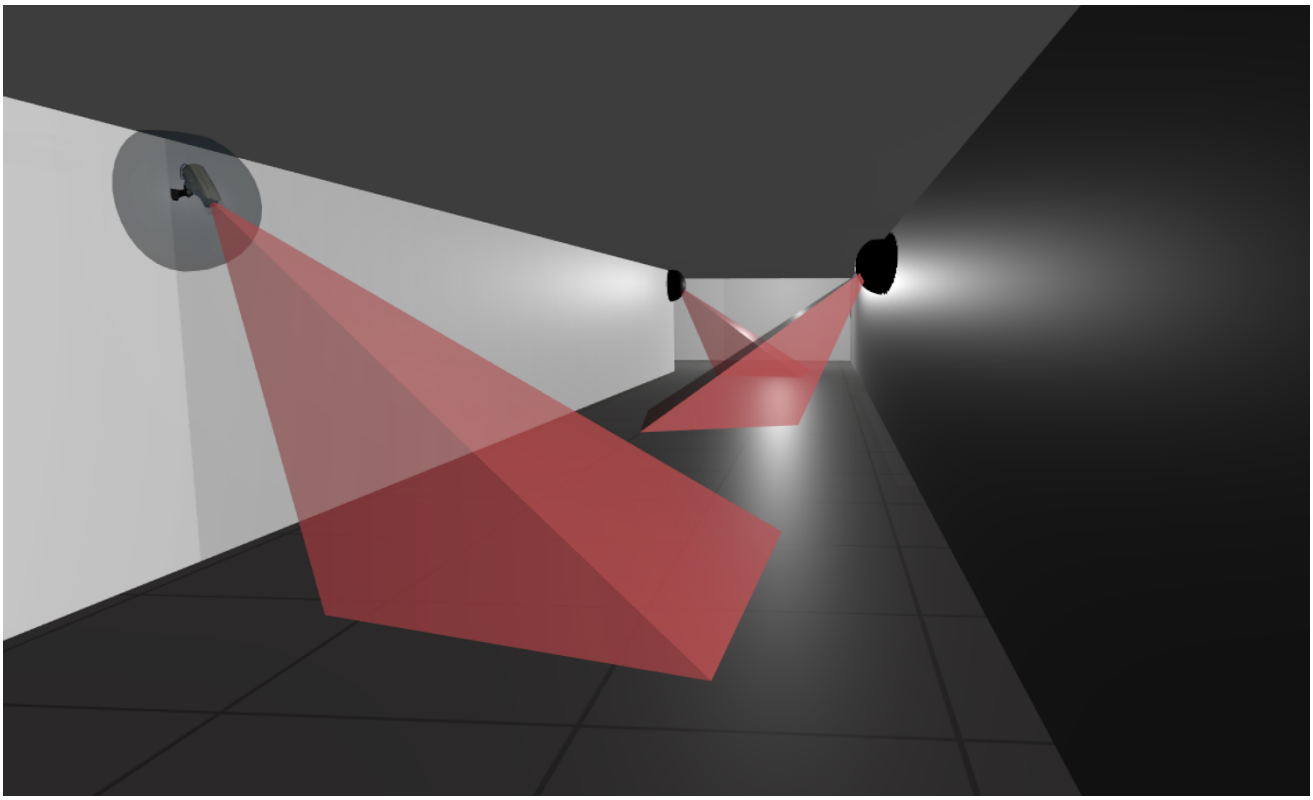

FIGURE 11 : DARKENED BUBBLES AROUND SECURITY CAMERAS 1

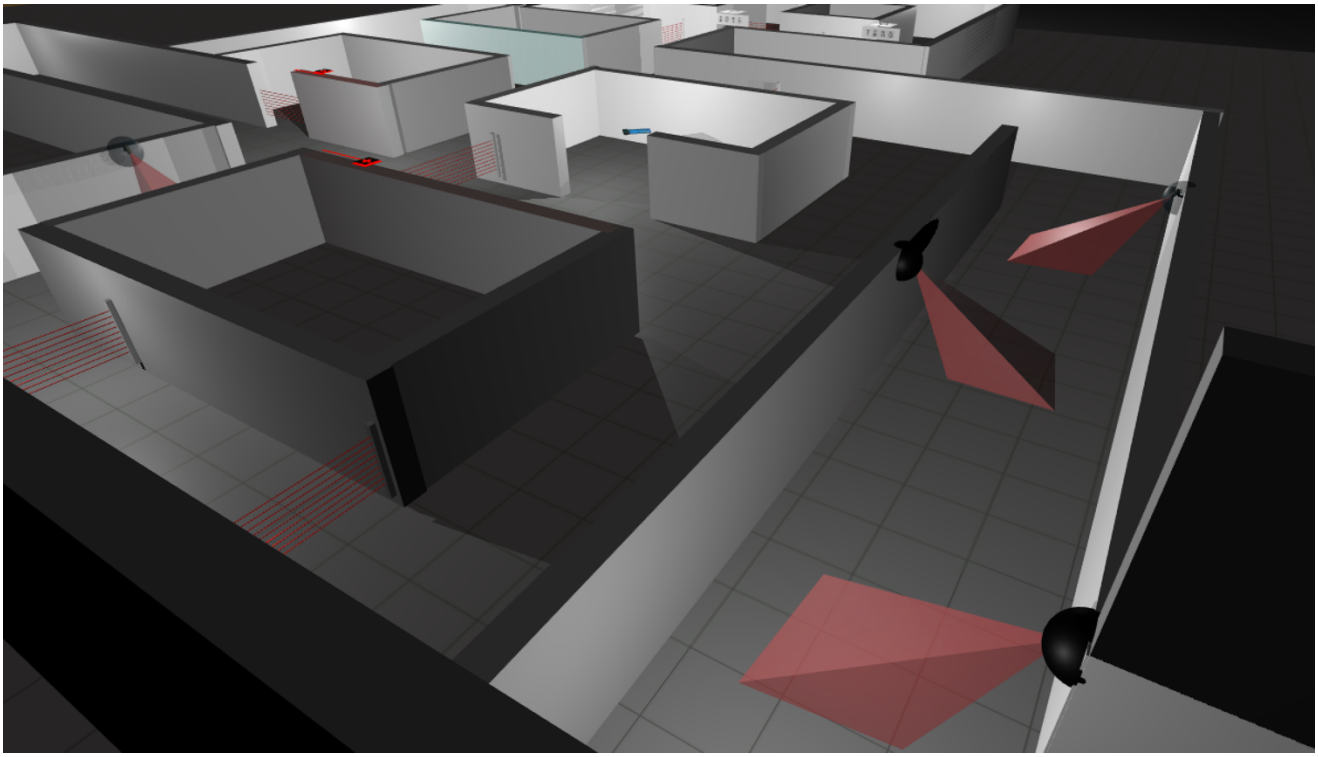

FIGURE 10 : DARKENED BUBBLES AROUND SECURITY CAMERAS 2

Initial tests showed that turning in the virtual world was a problem. The early prototype had players making smaller turns with their head and larger ones with a mouse. This caused discomfort among some players and an alternative had to be found. Comfort mode, or blink turning, was implemented to counteract the motion sickness that can come from dragging your virtual head around with a mouse or joystick. Comfort mode is where the user rotates their player using a button or joystick but the rotation is instantaneous (Oculus Discussion Forums, 2014). Because the player is not seeing the motion of turning around, the mind does not process it as moving their body. Instead it is a sort of teleport, rotating their body to either side without any force being applied to the body. This technique helped a great deal in removing motion sickness from the game experience.

The early prototype games information was far too one-sided with the hacker having all the information and the spy having only some. This was important to change because to properly promote communication there needed to be a way for the spy player to communicate unique information they can see back to the hacker player. Otherwise the game would only consist of the hacker telling the spy player what they see and what to do.

The hacker was practising the describing and relaying of information, but none of the important listening skills needed for effective communication. While this was happening the spy player practises listening without practising describing and clarifying. Both sets of skills are required for effective verbal communication (Astorga-Cabezas, 2015). This needed to be changed. The precedent of Keep Talking and Nobody Explodes was investigated, which had communication challenges that could be communicated between the two players and could give the spy player unique information that the hacker does not.

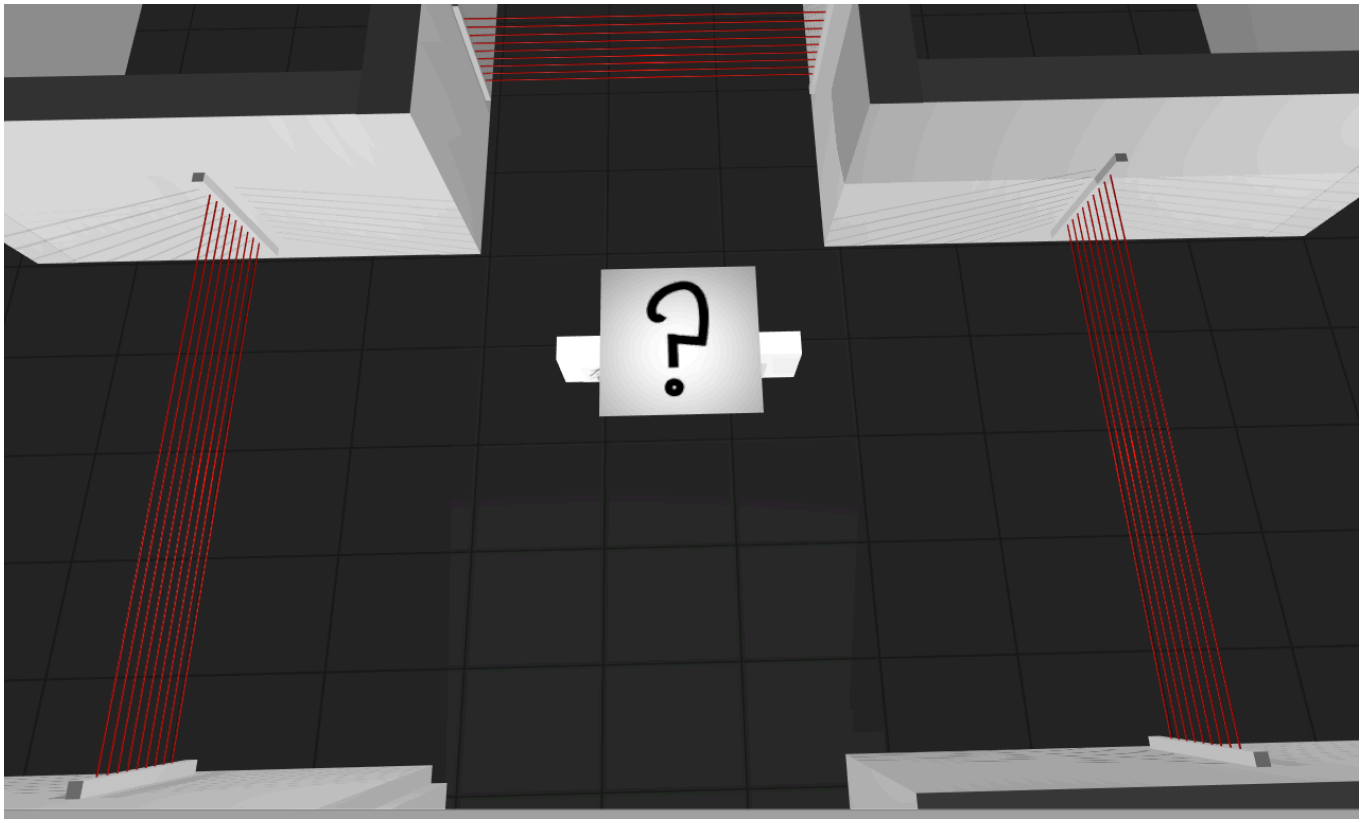

FIGURE 12 : TOP-DOWN VIEW OF SYMBOL CHALLENGES

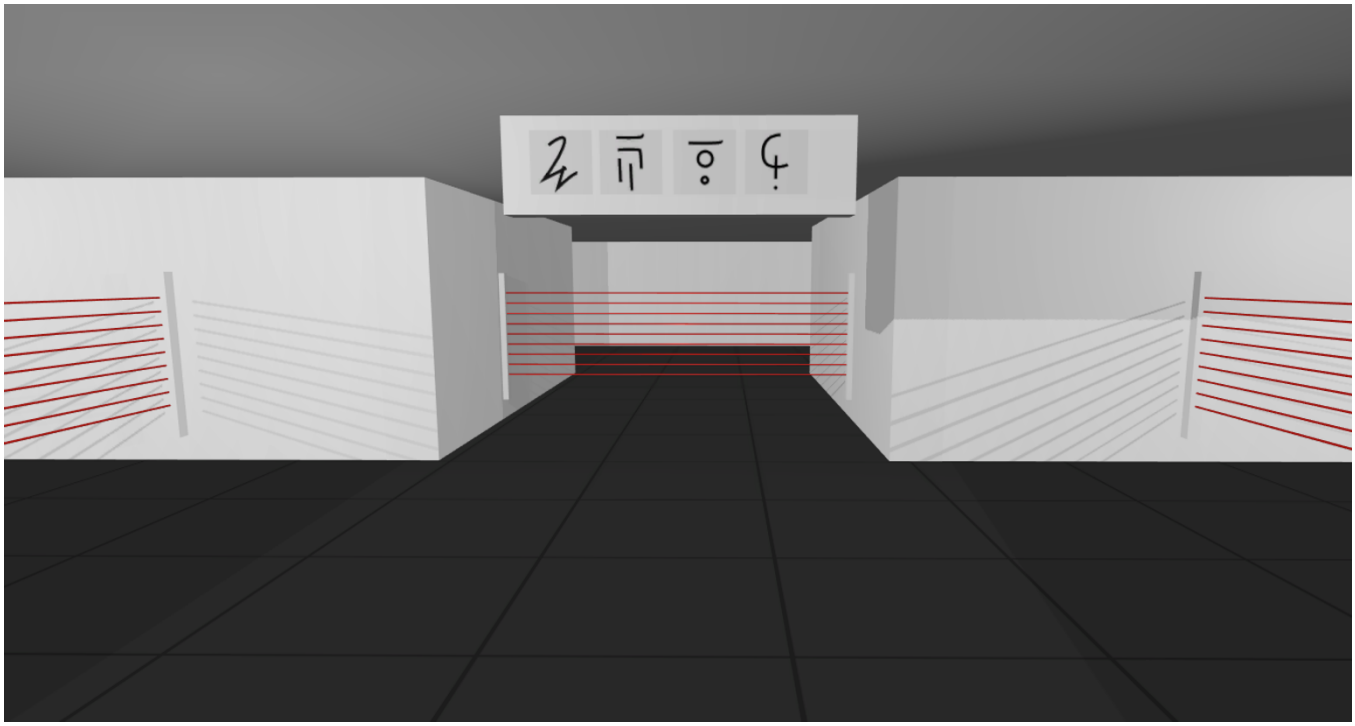

FIGURE 13 : SPY PLAYER'S VIEW OF SYMBOL CHALLENGE

It was decided to create a code that the spy player finds in the level and has to communicate to the hacker to decipher the information. This information can take the form of which direction is safe to take or which button to press. The hacker player would have a list of possible symbols and have to listen to which ones are in the level and match them up to the symbols on their screen. The codes have to be randomised so that each play through the players have to decipher them again. This way the spy player has something to describe to the hacker and the hacker must practise listening to the spy. Deciding where to place these symbols in the level, initially just for testing purposes, had them laid out on the floor for the VR player to see and communicate to the second player. In later versions, they were placed on signs at cross roads and at challenges for it to seem more an enemy code for the players to crack.

The initial layout for the hacker player's view of the map was a top-down perspective view. This was thought to look better than the flattened orographic view as it was more dynamic and visually stimulating seeing depth to the walls and obstacles. After testing and discussion this was changed back to orographic as it fitted more with the visual story, that of a hacker looking at the building schematics rather than that of a flying camera above the level. Instead, to make the view more visually stimulating, the use of filters such as edge detection to stylise the map view for the hacker player were investigated while still in keeping with its visual narrative. This stylised schematic approach adds more of a narrative reason as to why the hacker player cannot see the symbols the VR player must communicate to them. All of this adds to the immersion of the player in the game which as previously researched is linked to the user's ability to learn from the game (Moreno & Mayer, 2002).

A timer was also necessary to include in the game as it puts pressure on the communication. It forces the players to have to use fast and precise verbal communication to complete the level, otherwise they will run out of time and fail the level.

Game data visualisation is also important for player performance, as it gives them feedback and shows if improvements are being made (Veronica Zammitto, 2008). The timer was necessary to the game development as it put pressure on the users, forcing them to use effective communication. This relates back to the theory explored in the literature review of self-efficacy (Ormrod, 2006). This idea is that the user becomes confident in their ability to use skills, in this case verbal communication. This confidence in their own ability comes from having practiced these skills in a pressured situation and learning that they can competently communicate under such conditions. The timer in the prototype puts this artificial pressure on the user and thus strengthens the self-efficacy and their ability to communicate. Such pressures have been found to work in similar games such as Keep Talking and Nobody Explodes and Overcooked.

FIGURE 14 : PLAYING EARLIER ITERATION OF PROTOTYPE

The first user test brought back issues with motion sickness. Some felt that perhaps the speed was too fast in the game or some change needed to be made in that area. Despite this many found the comfort mode turning helped with the motion and wanted greater options for this. In the build of the game that was used in the first play test these rotations were a set 30 degrees. This amount was found to be good, with many people saying that it didn't make them sick and they found it easy to use. One improvement that was asked about was if the rotation amount could be increased for larger turning when the player wanted to completely rotate instead of minor changes, but still keep the option of the smaller 30 degree rotations.

Another change that was made to limit the amount of motion sickness was the slowing of the overall movement of the player in an attempt to address concerns of some participants. This worked a little to improve motion in-game, but testing still showed it elicited some motion sickness. To counteract this more research was put into how to move in VR without creating motion sickness.

FIGURE 15 : PLAYER IMMERSED IN VIRTUAL WORLD

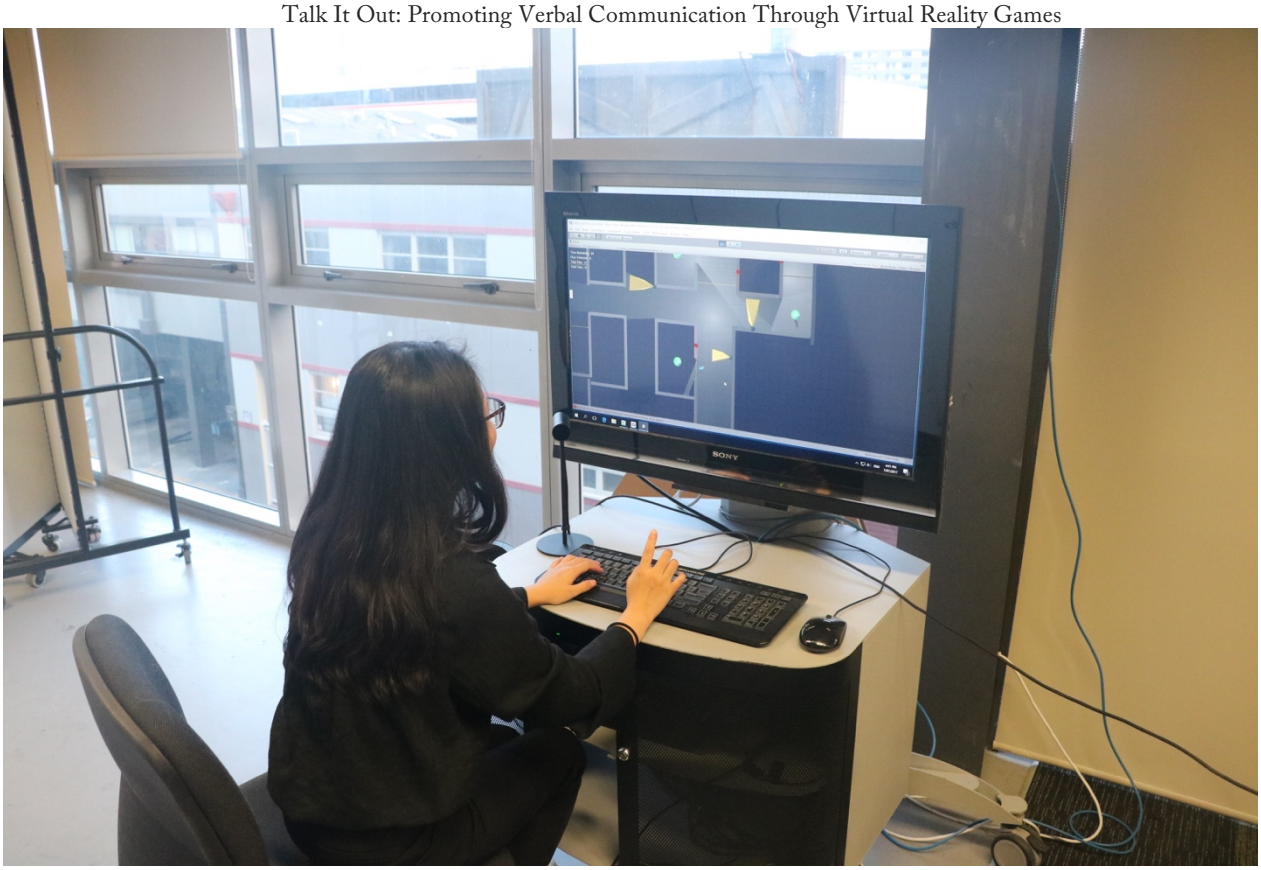

Figure 16 : Hacker looking out for obstacles for the spy

Two options were discovered that could help with this issue of motion sickness. The first was blink motion. Similar to blink turning, it moved the player forward a set distance but not showing the motion. These blinks have the same effect as teleporting the player, as it does not let the player's inner ear react to motion. The important difference between blink motion and teleporting is that blink motion is still moving the player forward and is necessary for many laser grid and security camera challenges throughout the game. Otherwise the player could just teleport through the challenges and there would be no need for any communication to the other player. The other reason, less important, is that blink motion still feels closer to normal movement compared to teleporting in the context of a spy narrative.

The other type of locomotion discovered was that of a 'move in place' motion where the player uses motion controls and as they move up and down on the spot, as if they were walking or running, the game moves them forward. This method uses tracking on the headset along with the motion of the controllers to calculate the direction and speed at which the player moves. This should allow for a more natural feel to the motion for the players and allows them to set how fast they move by how fast they jog and

move their arms. This does still mean they observe motion in the game so it may still cause motion sickness. However, with added control and realism it should be better than the initial locomotion mode.

These two locomotion options were found in an asset package created by The StoneFox, a developer who, with the help of other contributors, has created a robust asset package for developing in VR appropriately titled the Virtual Reality Toolkit or VRTK for short (StoneFox, 2016). The StoneFox based this asset package off another VR motion package called Immersive Movement by Highsight (Highsight, 2016). One successful example of the VRTK implemented into a game was the VR dungeon crawler Left-Hand Path created by Strange Company (Strange Company, 2016). This game used many aspects of this package but of most relevance was the locomotion system which made it a playable experience for most players without creating much, if any, motion sickness.

FIGURE 17 : PLAYERS COMMUNICATING DURING PLAY

Many issues arose by implementing these locomotion types, stemming from the base code for creating the locomotive player and how it did not interact the same way as the initial spy character. This took the form of not setting off alarms or collecting Items, clashing with trip wires when they should be able to walk through and overriding the output on the screen stopping the hacker player from seeing the map. Though through careful editing of their code these issues were taken care of. This created a far better feel for the for the move in place locomotion character when moving through the game world. There were still some deeper issues found with the blink motion locomotion model.

Upon further testing blink teleporting still felt like a break from the game's spy narrative immersion. It seemed too removed from sneaking around an enemy facility and felt like it belonged in a different genre of game. This broke from the immersion of the game which inhibited the user's potential for learning (Moreno & Mayer, 2002). This was a problem but the main reason blink teleport was not compatible with the prototype was as a game mechanic it let the player avoid many space-based challenges. Teleporting let a player move far too fast through movement timed events and bypass laser grids altogether. It was necessary to put limits on the spy's moment to create a need for communicating the time and space-based challenges, keeping communication as the core mechanic for completing the game (Lepper & Cordova, 1992).

The last issue found from the new locomotion added to the game is that it was less conventional to describe for the player how to move around the scene. A simple control diagram pointing to the analog sticks could no longer teach a player how to play the game. This is especially important for players who are new to VR and do not know the many game mechanics that can exist. Instead it was decided to have a tutorial level where the player can see animated panels showing them the motion of how to walk or jog in place to move around the scene, and test out these skills before going into the timed and higher-pressure game scenario. This also offered a moment for the hacker to test out moving their view of the world around, learning the keys to switch between the map view and the information on challenges to come.

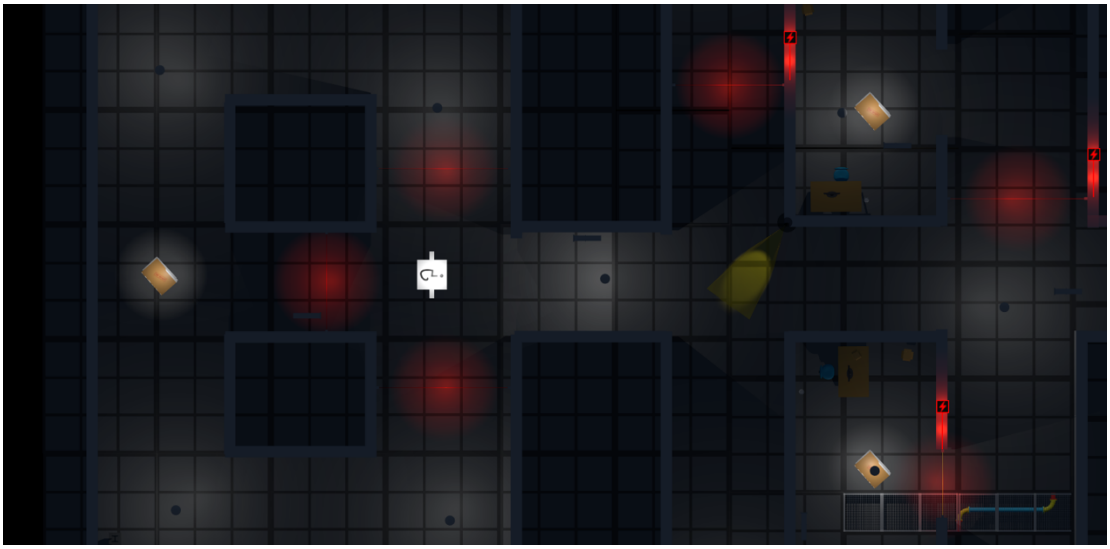

FIGURE 20 : HACKER'S VIEW OF LEVEL (1)

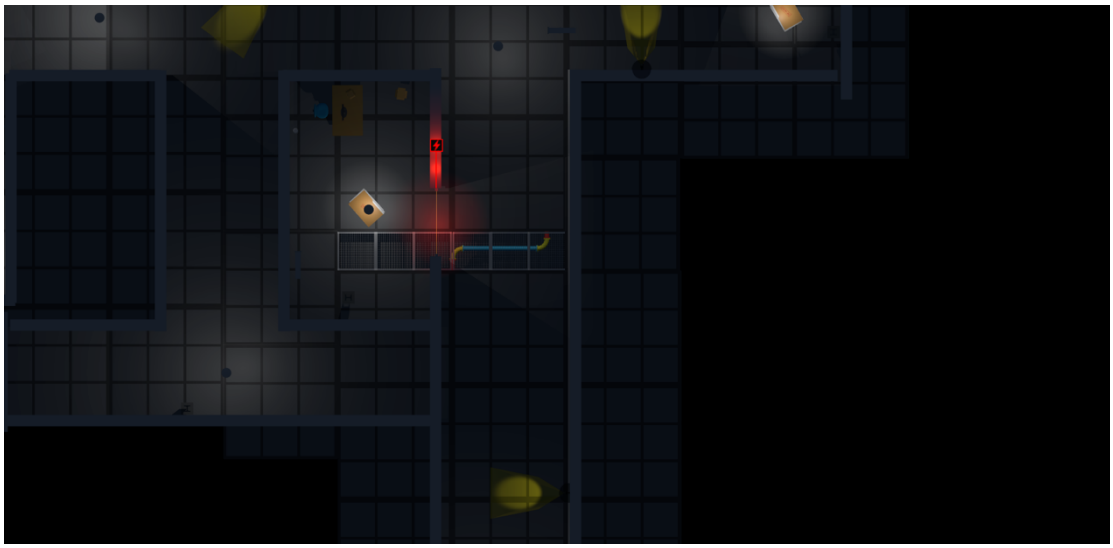

FIGURE 19 : HACKER'S VIEW OF LEVEL (2)

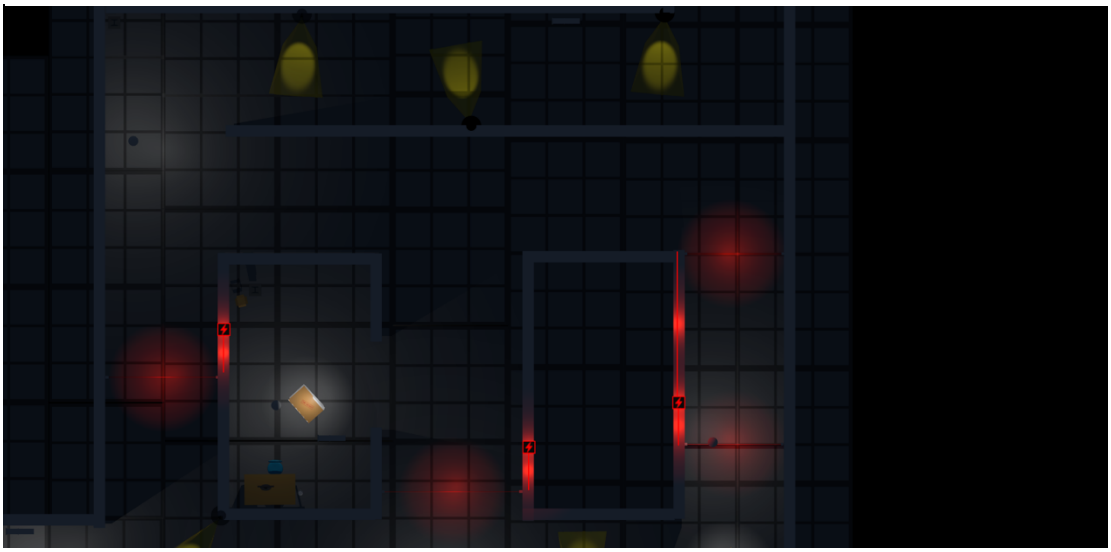

FIGURE 18 : HACKER'S VIEW OF LEVEL (3)

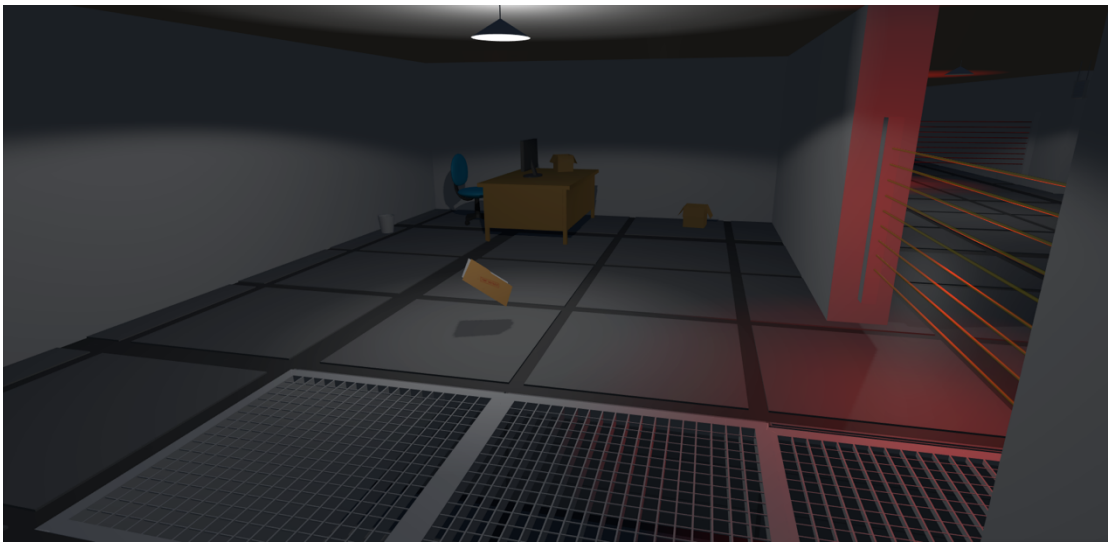

FIGURE 23 : SPY'S VIEW OF THE LEVEL (1), SHOWS A PICK-UP OF A SECRET FILE

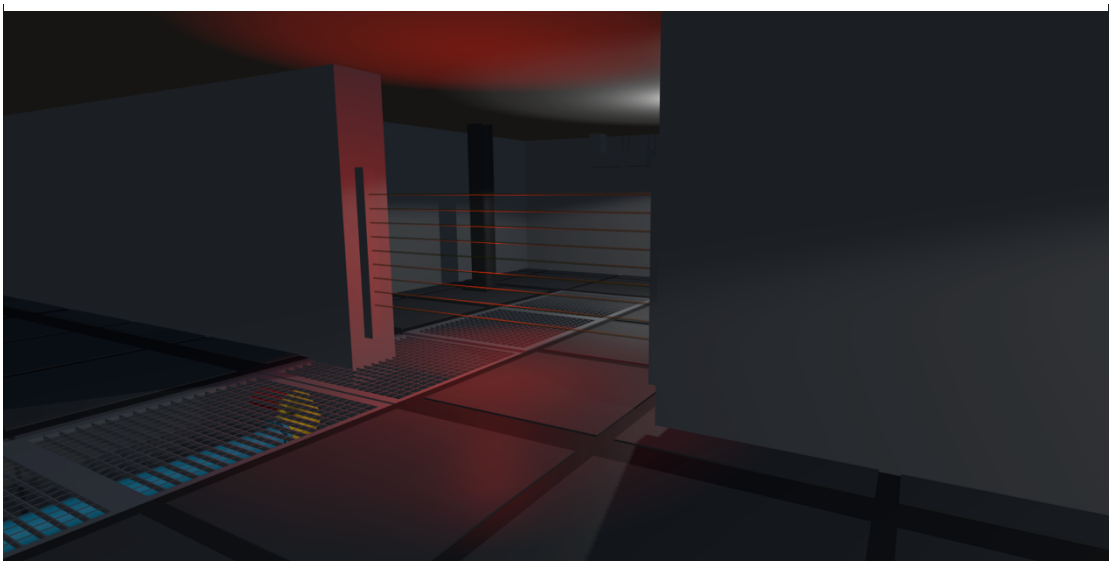

FIGURE 22 : SPY'S VIEW OF THE LEVEL (2), SHOWS LASER GIRD

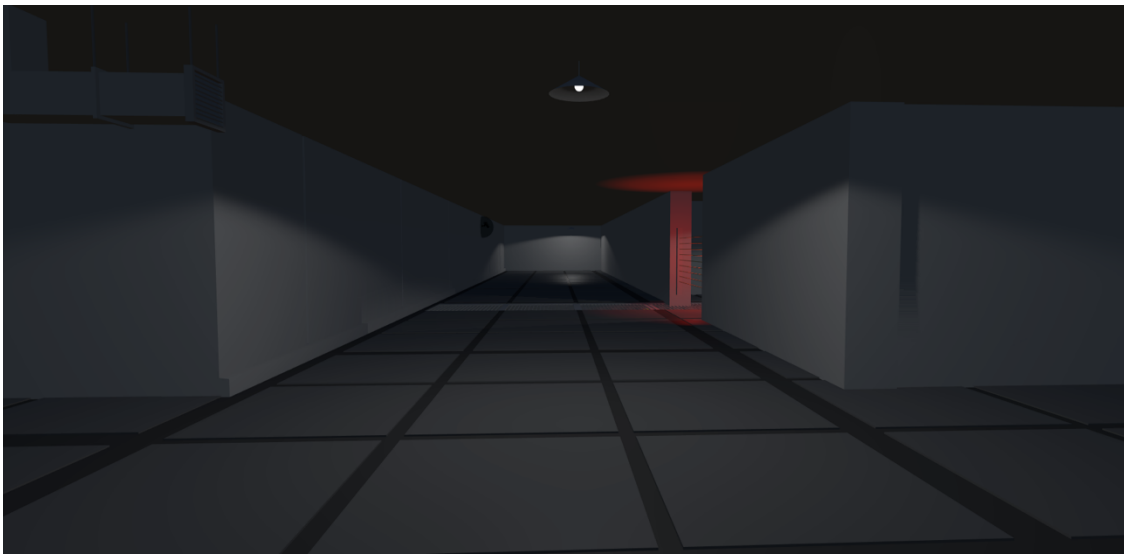

FIGURE 21 : SPY'S VIEW OF THE LEVEL (3)

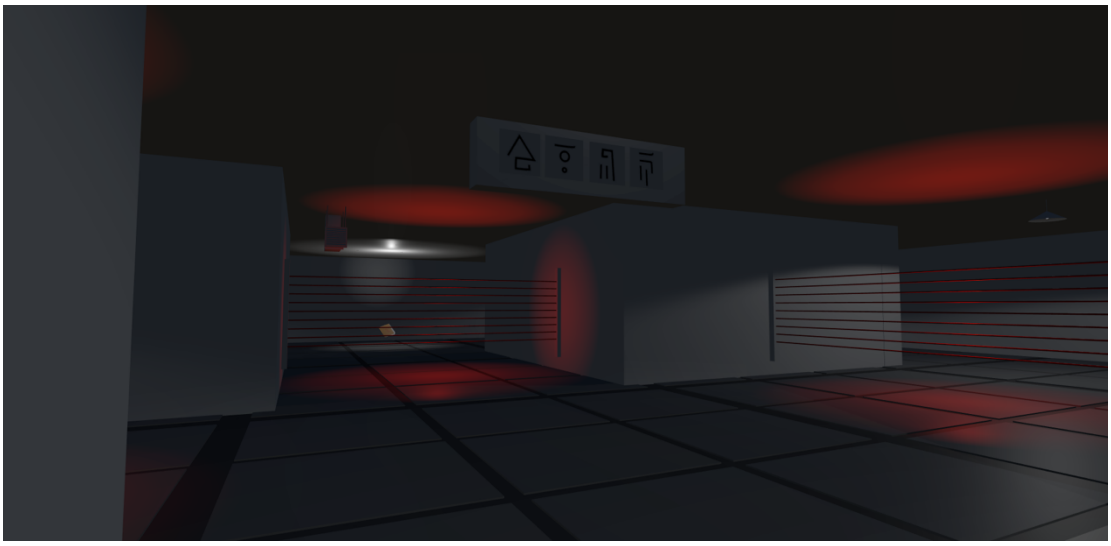

Figure 26 : Spy's view of the level (4)

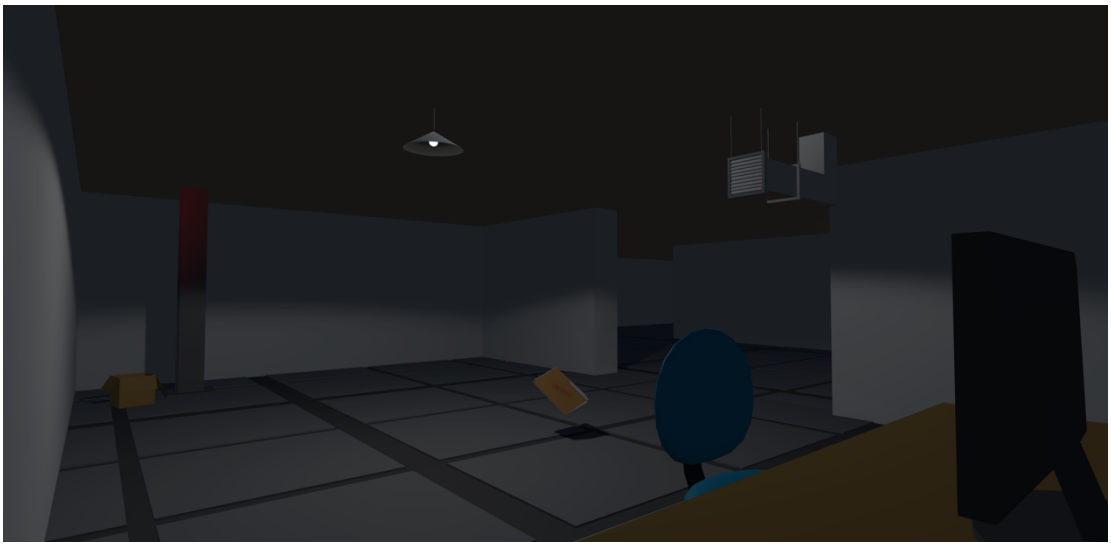

Figure 25 : Spy's view of the level (5)

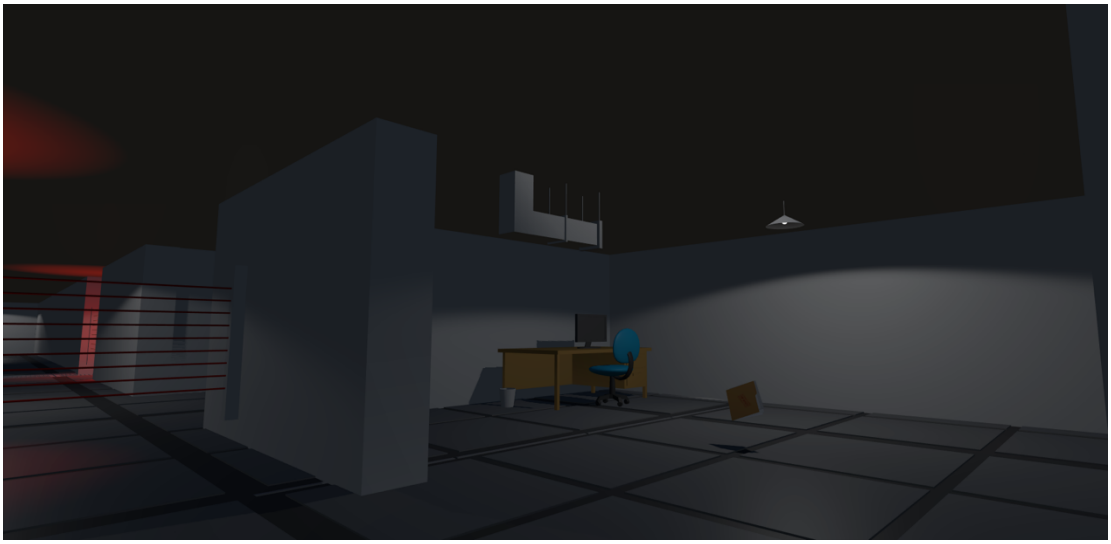

Figure 24 : Spy's view of the level (6)

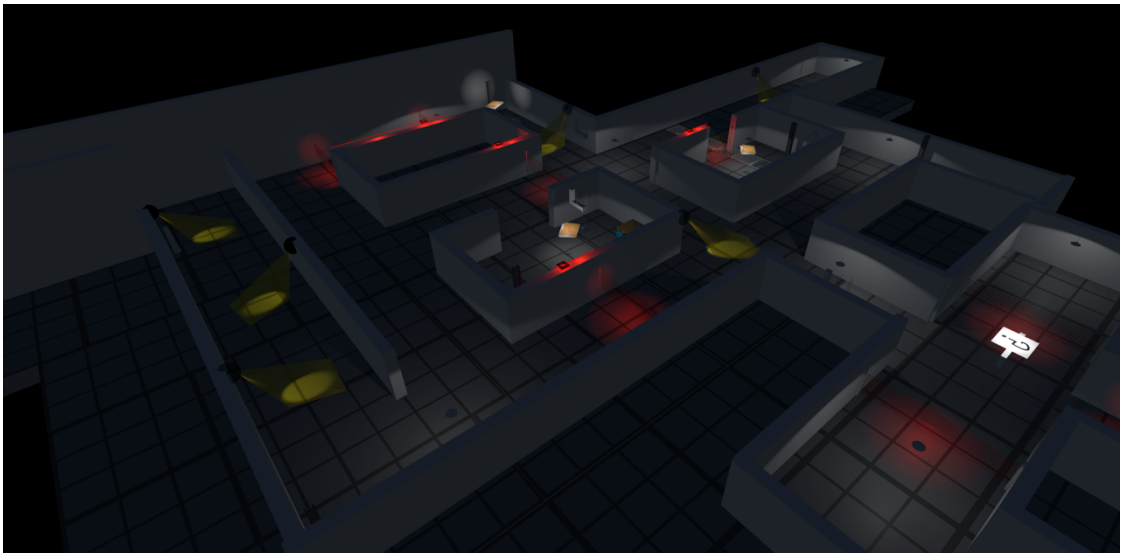

FIGURE 29 : OVERVIEW OF MAP ONE

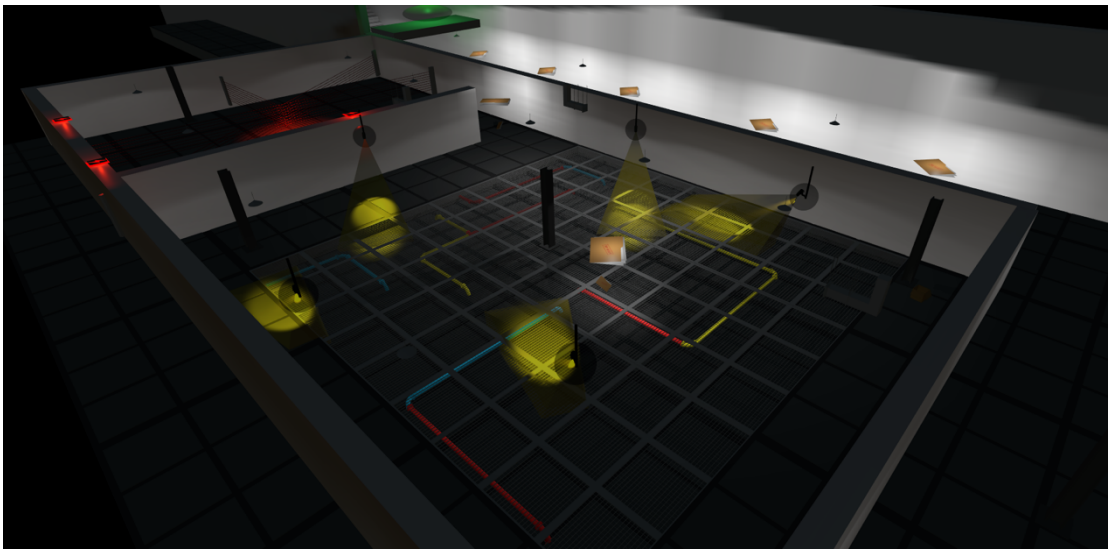

FIGURE 28 : OVERVIEW OF MAP TWO (1)

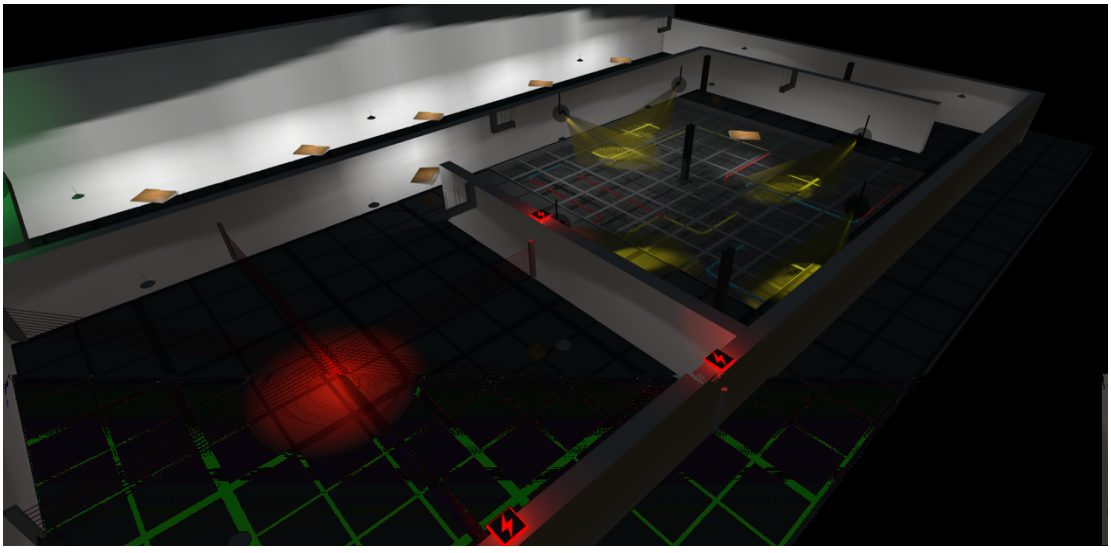

FIGURE 27 : OVERVIEW OF MAP TWO (2)

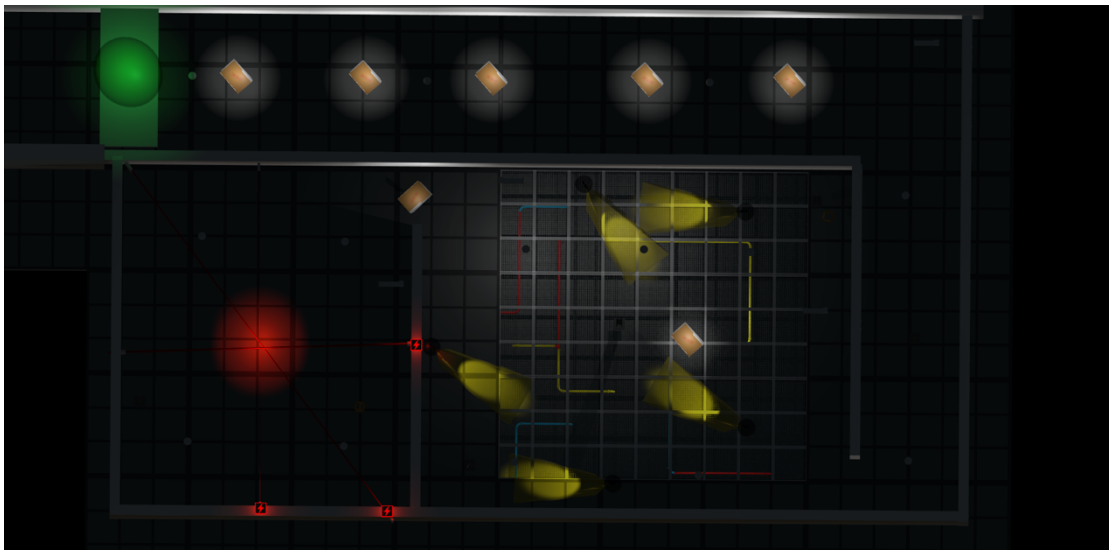

FIGURE 32 : HACKER'S VIEW OF LEVEL (7)

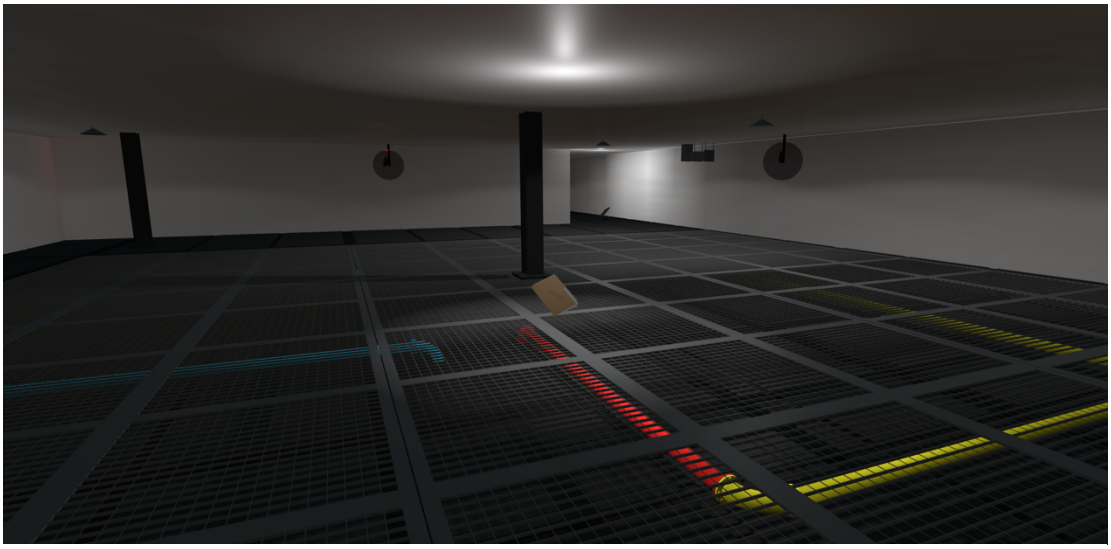

FIGURE 31 : SPY'S VIEW OF LEVEL (8)

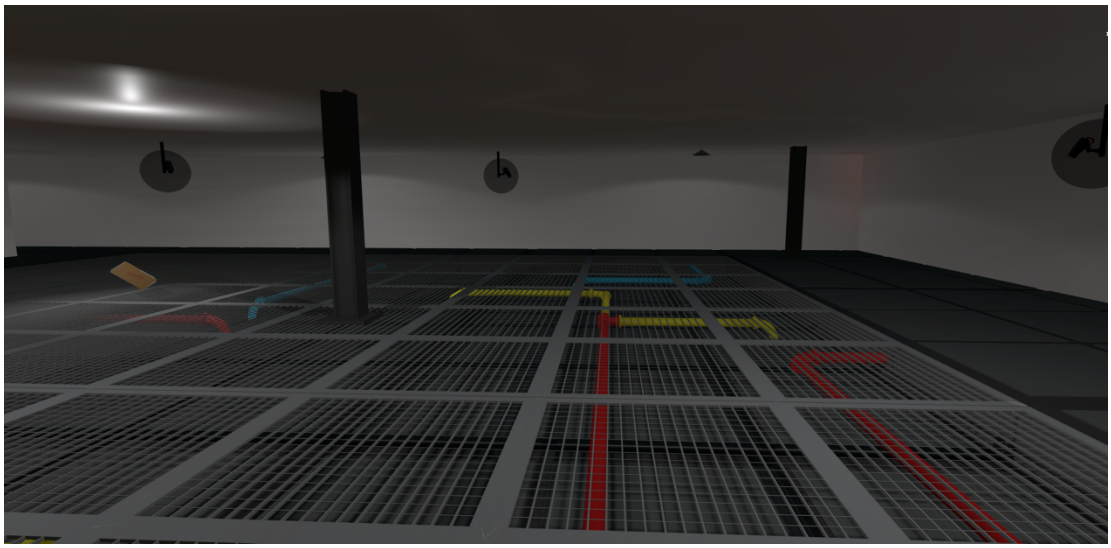

FIGURE 30 : SPY'S VIEW OF LEVEL (9)

Chapter 5: Results

Playtest 1 Questionnaire Results:

Playtest 1 was conducted midway during the prototypes development process.

Averaging out the results for the Likert Scale questionnaire.

1- Strongly disagree

2- Disagree

3- Neither agree nor disagree

4- Agree

5- Strongly agree

Table 1 : Playtest 1 questionnaire results

	Average Number	Average agreement with the statement
1. Goals of the game were clear	3.0	Neither agree nor disagree
2. Game was too difficult	3.0	Neither agree nor disagree
3. Game was too easy	3.5	Agree
4. You were aware of your achievements	1.0	Strongly disagree
5. The game was a motivating challenge	4.0	Agree
6. You felt you had options and choices during the game	1.0	Strongly disagree
7. The game made you collaborate with the other player	4.0	Agree
8. The game gave clear feedback for successful completion of tasks	1.0	Strongly disagree
9. Tasks and activities were understandable	3.25	Neither agree nor disagree
10. You had a chance to make a mistake and learn from it (repetition)	4.5	Strongly agree
11. Game environment was appealing	3.25	Neither agree nor disagree
12. Game interface was user-friendly	3.0	Neither agree nor disagree

13. Beginning of game was clear (I understood what the goal of the game was and the restrictions)	2.0	Disagree
14. Ending of game was clear (I understood why I won or lost the game)	4.5	Strongly agree
15. The game content was relevant to communication-based tasks	3.0	Neither agree nor disagree
16. The score system helped understand progress	1.0	Strongly disagree
17. You felt your communication skills were tested / You felt under pressure or stressed	4.0	Agree
18. The game experience offered situations to practice multitasking	1.0	Strongly disagree
19. You had to practice listening	3.25	Neither agree nor disagree
20. You had to practice clarifying	4.5	Strongly agree
21. You had to practice repeating when necessary	4.5	Strongly agree
22. You had to practice objective based communication	5.0	Strongly agree
23. You felt you practiced verbal communication skills	5.0	Strongly agree
24. You were invested in the narrative and were engaged with the theme	2.0	Disagree
25. You felt a sense of role play	1.0	Strongly disagree
26. The VR experience was immersive	3.25	Neither agree nor disagree
27. The VR experience enhanced the learning experience	4.0	Agree
28. The game provided guidance and instruction	2.0	Disagree
29. The game maintained your attention	4.5	Strongly agree
30. You have more confidence in your verbal communication skills after playing	3.75	Agree

Playtest 1 Comments and Observations:

- The play testers felt that the game at its current state was testing their verbal communication skills and the VR aspect of the game did facilitate this.
- They found they were learning how different people communicated differently.
- They learnt that using more common language was best for communication, simple is better.
- They wanted more choice in size of comfort mode turning. Some liked the 20 degree turning, some wanted a 90 or 180 degree turning for when more radical turns were needed.
- They observed the speed was too fast when the character moved around. A possible solution is to slow down the base walk speed and implement a run button which puts the player in more control of their speed.
- Key information needed to be clearer like the codes being randomised in their order. It already says this in the game dossier but it needs to be made clearer to the player.
- Some levels may need check points or the starts made faster to complete/less tedious.
- Many people thought at first they couldn't walk over the visual cues of the pipes. This concept either needed to be introduced earlier on in the game or they need to be moved either to the roof or under the floor. They still must be visible through a grate or grill so they can still be used to communicate space.
- Perhaps the use of coloured tiles would make this clearer as well.
- Certain challenges being too hard while others were too simple.
- The play testers found the game needed slower lasers for some sections.
- More indication of what the left and the right of the spy player is. Could mean different colours for each side or literally having an L and R on each side.

Playtest 2 Questionnaire Results:

Playtest 2 was conducted at the end of the prototypes development process.

Averaging out the results for the Likert Scale questionnaire

1- Strongly disagree

2- Disagree

3- Neither agree nor disagree

4- Agree

5- Strongly agree

Table 2 : Playtest 2 questionnaire results

	Average Number	Average agreement with the statement
1. Goals of the game were clear	4.25	Agree
2. Game was too difficult	3.0	Neither agree nor disagree
3. Game was too easy	3.0	Neither agree nor disagree
4. You were aware of your achievements	3.75	Agree
5. The game was a motivating challenge	4.0	Agree
6. You felt you had options and choices during the game	2.5	Neither agree nor disagree
7. The game made you collaborate with the other player	4.25	Agree
8. The game gave clear feedback for successful completion of tasks	3.25	Neither agree nor disagree
9. Tasks and activities were understandable	3.75	Agree
10. You had a chance to make a mistake and learn from it (repetition)	4.5	Strongly agree
11. Game environment was appealing	4.25	Agree
12. Game interface was user-friendly	3.75	Agree
13. Beginning of game was clear (I understood what the goal of the game was and the restrictions)	4.0	Agree
14. Ending of game was clear (I understood why I won or lost the	4.5	Strongly agree

game)		
15. The game content was relevant to communication-based tasks	4.25	Agree
16. The score system helped understand progress	3.75	Agree
17. You felt your communication skills were tested / You felt under pressure or stressed	4.5	Strongly Agree
18. The game experience offered situations to practice multitasking	1.0	Strongly disagree
19. You had to practice listening	4.25	Agree
20. You had to practice clarifying	4.5	Strongly agree
21. You had to practice repeating when necessary	4.5	Strongly agree
22. You had to practice objective based communication	5.0	Strongly agree
23. You felt you practiced verbal communication skills	5.0	Strongly agree
24. You were invested in the narrative and were engaged with the theme	3.25	Neither agree nor disagree
25. You felt a sense of role play	2.25	Disagree
26. The VR experience was immersive	4.25	Agree
27. The VR experience enhanced the learning experience	4.25	Agree
28. The game provided guidance and instruction	3.75	Agree
29. The game maintained your attention	4.75	Strongly agree
30. You have more confidence in your verbal communication skills after playing	4.5	Strongly Agree

Playtest 2 Comments and Observations:

- At the game's core, it tested the user's communication.
- Virtual reality helped engage players and facilitated splitting information from the users.
- Found more considered goal-oriented communication worked better.
- Greater self-efficacy in their verbal communication skills, feeling more confident in their ability to communicate efficiently.
- Found vast improvement with new locomotion system, reducing motion sickness from experience greatly.
- Greater control over turning and speed of character.
- Key information clearer thanks to introductory level and starting information panel.
- Levels were more streamlined with certain tedious parts taken out.
- Having pipes underneath grates gave players the visual cue that they can walk over them without issue.
- Difficulty of challenges was greatly improved such as removing areas too easy and slowing down certain time based tasks.
- Indication of what the left and the right of the spy player was helped when communicating spatial elements.

Chapter 6: Conclusion

The scope of this thesis was limited to virtual reality games and how to promote verbal communication skills in their players. The work aimed to complete this by creating an in-depth literature review around serious games, virtual reality, and the study and teaching practice of communication skills. These theories were further examined in case studies and put into practice through the creation of a prototype game. This prototype was then user tested to determine if the concepts found from the literature review apply in practice.

The main reason for this research was to find out if virtual reality games can promote verbal communication through play. From the literature review, video games were found to be an excellent means to teach skills to their players, in part gained from the engagement with the learning material that comes from the sheer enjoyment of the experience. Video games could indeed be used to teach or promote skills in their players.

Virtual reality was next scrutinised to see if it would improve or hinder the objective of teaching communication skills. The research demonstrated that virtual reality experiences did provide a more compelling learning environment, promoting a host of benefits, none more important than immersion, which had been found to increase a user's engagement with their learning material. VR experiences were also naturally suited for verbal communication-based challenges when it separates the players from being able to see the same information, forcing them to describe what each player can see.

Lastly verbal communication was researched and how it is currently being taught. Not only did the thesis find what helped make the building blocks for this game, it found there was a gap in the current models of teaching verbal communication which this video game could help fill. This gap also included that students weren't being prepared for communicating in the workforce after graduating and that this is in some part was due to a lack of engagement with the current teaching practices.

After developing a creative output based on the research from the literature review and refined by development and early play tests, a final prototype was ready to be tested against the criteria to find how effective it was at promoting verbal communication. The final user tests of the creative output prototype results came back positive on the core issue of promoting the communication skills of listening, questioning, describing and clarifying. This was the main test for the prototype and with positive results from the user tests it can be considered a success.

The other issues had positive responses to the following: virtual reality improved the immersion and experience; the game gave feedback and structure to the learning process; and the game motivated the player to complete challenges.

The areas the final prototype did not score a three or higher on the Likert Scale included: "The game experience offered situations to practice multitasking"; "You felt a sense of role play"; and "You felt you had options and choices during the game", scoring a Disagree or Strongly disagree. Multitasking was shown to be effective in putting pressure on users when used in games like Spaceteam or Overcooked. Role play having been shown to increase players' involvement and receptivity to communication (Freifeld, 2014) would have been an issue worth further examination - a greater sense of role could have further pushed players to verbally communicate.

Lastly, the prototype did not have many options for choices during the game aside from deciding to attempt extra challenges to gain more pickups, and possibly increase their score, or picking which route to take. These would be areas for further research given more development on the game in the future.

These issues aside, this thesis has still produced a body of work examining a topic worthy of research as it showed there was a gap in current methods for teaching verbal communication skills and provided a possible way to address this. It did succeed in testing the main theory of virtual reality video games

producing evidence that they have the potential to promote verbal communication skills. This work can now provide a base of information for further research in the area along with theories for future game design.

In conclusion, this thesis does not have a definitive answer for how teaching verbal communication should be conducted but offers options for how to better prepare students' verbal communication for entering the workforce through new VR gaming techniques. In the thesis' current state the project can be a starting point for further research, or exciting new games taking these concepts further. There is great potential for these fields when the areas of communication, game design and VR are combined.

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Appendix

Supplementary material to this thesis includes the game project files produced from the research completed in this thesis.

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MEMORANDUM

TO	James Bodnar
COPY TO	Byron Mallett Leon Gurevitch
FROM	AProf Susan Corbett, Convener, Human Ethics Committee
DATE	27 February 2017
PAGES	1
SUBJECT	**Ethics Approval: 23572** Talk it Out: Promoting Communication Through Virtual Reality Games

Thank you for your application for ethical approval, which has now been considered by the Standing Committee of the Human Ethics Committee.

Your application has been approved from the above date and this approval continues until 15 May 2017. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Kind regards

[redacted]

Susan Corbett

Convener, Victoria University Human Ethics Committee