Designing a Local Multiplayer Game with Virtual Reality

Exploring the Affects of Virtual Reality on a Social Play Experience

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Abstract

The use of virtual reality in the design of local multiplayer games is still very limited and thus there exist very little – if any – academical research on the matter. The goal of this thesis is to find out how the inclusion of the virtual reality medium in the design of a local multiplayer video game, affects the perceived sociality of the play experience.

The overall purpose of this thesis is to explore the design space of local multiplayer virtual reality games. With this project we are trying to elucidate some of the barriers that are created when including the rather solitary and isolating medium that is virtual reality in the design of a social and shared context.

To answer the problem statement of this thesis we first designed and developed a local multiplayer virtual reality game through an iterative design process, where we used a variety of design methods including playtesting. Subsequently this game was used as a basis for our research by conducting an additional playtest, specifically focusing on the perceived sociality of the game. The conducted research coupled with theories of design and sociology created the basis on which this thesis successfully identifies several design challenges and social barriers inherent to the virtual reality medium.

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1 Introduction

On August 1st 2012 the launch of the Oculus Rift Kickstarter-campaign sparked a new era for Virtual Reality (VR). The Rift was an instant success, receiving close to ten times the funding Oculus asked for, and not long after Facebook acquired the company.
The notion of VR was far from new, but the technology had previously not been up to speed with the prospects of the medium. Various forms of VR was developed in the end of the 20th century, but finally the technology has now reached a point where the quality is satisfactory and it is about to hit a price level where average consumers can join the party. In the mid-twentieth century several authors wrote about concepts similar to VR, but it was not until the nineties that VR appeared in a context of games. Sega released the arcade system Sega VR in 1991, and Nintendo the Virtual Boy in 1995. Unfortunately, none of the projects were commercially viable and Sega had to cancel the release of a console Sega VR system.

The release of the Oculus Rift led other companies, such as Google, HTC, Samsung and Sony, to develop their own VR systems, each with their own unique traits. Recent innovations in hardware has made the VR systems significantly cheaper and better than that of their 1990 counterparts. An example of the improvements is the HTC Vive that comes with a chaperone system that allows users to traverse a small area – in contrast to the other “sitting” VR experiences, where the player is in a fixed position. An example of the price drop is Samsung’s GearVR that is merely a holster, which in conjunction with a Samsung smartphone can work as a functioning VR system. For the Samsung smartphone owners GearVR presents a cheap and easy way to get started with VR. With the GearVR and other systems VR has now become accessible to a much bigger audience than ever before.

As games students, the improvements to VR technology naturally peaked our interest, as the medium seems to fit interactive game experiences very well. Like any other new medium it provides new opportunities as well as a lot of new challenges. To get hands-on experience with the different VR systems we had a field trip to Khora, a VR store and educational center in Copenhagen, where we got to try out various systems such as Oculus Rift DK2, Samsung GearVR and the HTC Vive. This trip convinced us of the immersive qualities that VR possesses, but we also discovered that they all had another thing in common that becomes apparent when you are more than one player to a VR headset: A lot of waiting time.

In the end of the setup guide for the HTC Vive an animation shows a room full of happy people celebrating that the system is set up and ready to use as seen on image 1. The reality, though, is a little different. At the beginning of this project, the games for the HTC Vive were predominantly singleplayer games. There were a few games that could be played with other people online, but only two games could be played locally with your friends: The bomb defusal game *Keep Talking And Nobody Explodes* (Steel Crate Games, 2015) and the hide and seek-like *Ruckus Ridge* (Foreignvr, 2016). Hence, if the animation should mirror the actual reality, we would see a single character jumping in joy, while the other players would be sitting on a couch checking their phones or otherwise waiting in anticipation for their own turn.

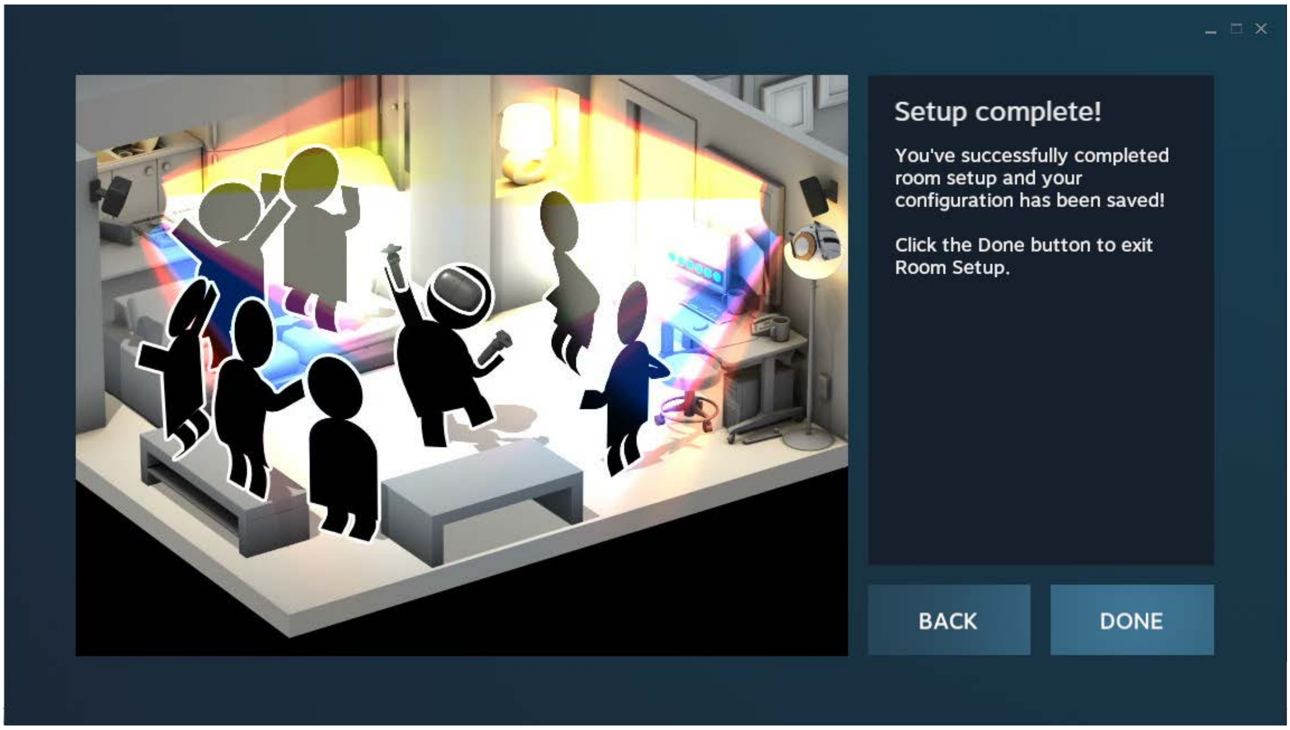


Image 1 | Screenshot of the end screen from the HTC Vive room setup guide.

Additionally, there is seldom an adequate way of following the game inside VR. The gaming experience can only to a shallow extend be shared with spectators. Most games project what the player sees onto another monitor, but naturally the experience of a 360 degree view cannot be fathomed on a 2D screen. All that is left for the other people then, is to wait for their own turn.

As game designers, as well as players, we find the social aspects of games interesting. We believe that these aspects coupled with the isolationist nature of the VR medium creates a new and interesting design space for local multiplayer games. We are naturally drawn to multiplayer games – be it physical-, board- or digital games. Many of our favourite games are based on group structures. Admittedly, the leap from singleplayer VR games to local multiplayer VR games does not seem straightforward. The player in VR will be blinded by the head-mounted display (HMD) and typically deafened by headphones. Though some physical games also do this, e.g. the children's game *Blind Man's Buff*, the blinding of one player from the others is in these games an integral part of the gameplay and not a constraint given by the medium. The challenge seems even bigger when considering that the player wearing the HMD (henceforth referred to as the HMD-player) is not only blinded from the real world, but rather immersed in another. So we ask ourselves whether it is even possible to have a local, social play experience, when either oneself or one's friend is virtually cut off from the real world. These thoughts, questions and concerns have led us to the following problem statement for the project.

1.1 Problem statement

What are the design challenges of making a local multiplayer game in VR, and how does the medium affect a local and social play experience?

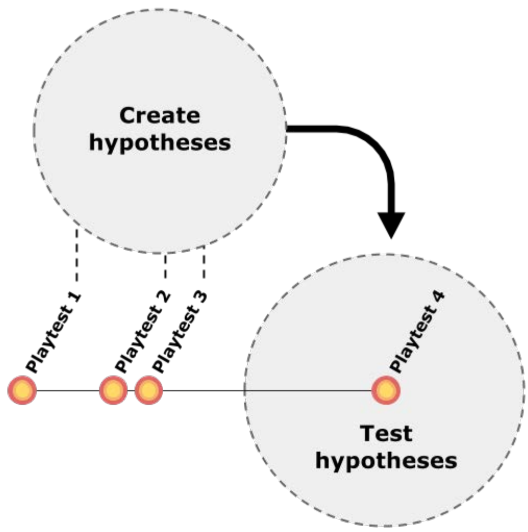
1.2 Hypotheses

In an effort to answer our problem statement, we will investigate various assumptions we had regarding social gameplay in VR. By the use of observations and group interviews in our first three playtests, that helped us gain a deeper understandings of the players' experiences, these assumptions were sharpened and later compiled into three hypotheses. In the discussion in chapter 6, we attempt to validate the hypotheses by conducting a fourth and final playtest, where we use observations combined with individual in-depth interviews with the participants. The hypotheses will therefore provide us with indicators about which factors are important in regards to creating a successful local multiplayer VR game. The relation between our four playtests and the three hypotheses can be seen on model 1. The three hypotheses are as follows:

Hypothesis 1: It is important that the players inside and outside the VR headset are able to communicate with each other.

Hypothesis 2: It is important that the player in the VR headset is able to identify a given player with his or her in-game avatar.

Hypothesis 3: Not being able to see other players, makes it harder to be included in a social game experience.



Model 1 | Illustration of the relation between playtests and hypotheses

1.3 Reading guide

Player is used when talking about a person taking part in a game in general.

Participant is used when talking about a person taking part in our playtests or other social encounters in relation to theory.

HMD-player is used to describe the player or participant wearing the head-mounted display in the given example of a gameplay situation, be it hypothetical or based on an observation.

We use the term *actual reality* as a contrast to *virtual reality*, covering the local and physical world outside the virtual reality headset.

2 Methodologies and method

The epistemological position of this study is rooted in social constructivism and takes an interpretivist theoretical approach to this specific research. This means that we believe that truth is constructed through social and cultural processes (Cote & Raz, 2015, p. 94), which complies with the nature of this study, where we seek to explore a social encounter among the players in the context of playing a local multiplayer VR game.

This chapter firstly presents the two overall concepts of the methodological approach of this project; *explorative research* and *experimental game design*. These are followed by an overview of the methods we have used to both design the game and conduct our research. These methods include *prototyping* and *playtesting* as well as qualitative approaches for studying play and players; *observation*, *group interview*, *in-depth interview* and *sampling*.

2.1 Methodologies

We use the methodologies of explorative research and experimental game design because we believe that they fit the epistemological position of this study. We engage in experimental game design to design and develop a local multiplayer game for VR, and conduct exploratory research to discuss our hypotheses on sociality in VR, because we believe that learning is a process that creates knowledge. This means that we perceive ourselves as constructors of the knowledge we generate through our process of designing a local multiplayer game for VR, as well as construct knowledge about the social experience the game offers, by investigating this from an explorative and inductive approach.

2.1.1 Explorative research

The research goal for this project is two-fold. Firstly, we want to develop a local multiplayer VR game with social interaction between players. Secondly, we seek to develop practices for local multiplayer games in VR. To help us formulate our hypotheses and answer the second half of our problem statement we take an exploratory research approach in our design process to investigate the role of social interaction in a VR game. According to Stebbins (2001) exploratory research can be used when researchers “have little or no scientific knowledge about the group, process, activity, or situation they want to examine” (p. 6). This approach therefore seems suitable as, to our knowledge, no research has been done when it comes to social interaction between a player engulfed in a virtual reality and people outside of it.

Typically, exploratory research takes an inductive approach, going from different sources of data to form a theory or a hypothesis. Exploration is often dominated by qualitative data and generalisations made from the data can later be moulded into a *grounded theory* – in short, a theory based on observations (Stebbins, 2001). The purpose of this project is not to create a complete grounded theory, but rather to utilise its methods, as we operate within a field where there is little knowledge available. According to Brinkmann & Tanggaard (2010) the purpose of grounded theory is to "discover, develop and verify a theory based on empirical data" (p. 228, own translation). Induction prevails where deduction falls short, as it can be utilised to create new ideas and innovations. But at some point the researcher must shift to an deductive approach in order to verify or disprove a hypothesis or theory that has sprung out of the exploratory process (Stebbins, 2001). The exploratory approach will help us formulate a number of hypotheses regarding VR and social interaction that we will later be able to test.

Exploratory research does have its weak spots that researchers must be aware of when drawing conclusions. In understudied fields (such as local social interaction in virtual reality), there can be weaknesses in the validity and generalisability of the first projects exploring an area. Having weak spots and being hard to generalise does not entail that the research should be less formal. Stebbins (2001) underlines its importance and relevance by stating that: "*Social science exploration* is a broad-ranging, purposive, systematic, prearranged undertaking designed to maximise the discovery of generalisations leading to a description and understanding of an area of social or psychological life" (Stebbins, 2001, p. 3).
Yet, exploratory research should often not solely be viewed in isolation, but in a larger context, by taking succeeding research into account. According to Stebbins, weaknesses tends to be corrected when the research is followed up and tested by other projects in the same field (Stebbins, 2001). In our reflections in chapter 7, we present some of the pitfalls of our research.

2.1.2 Experimental game design

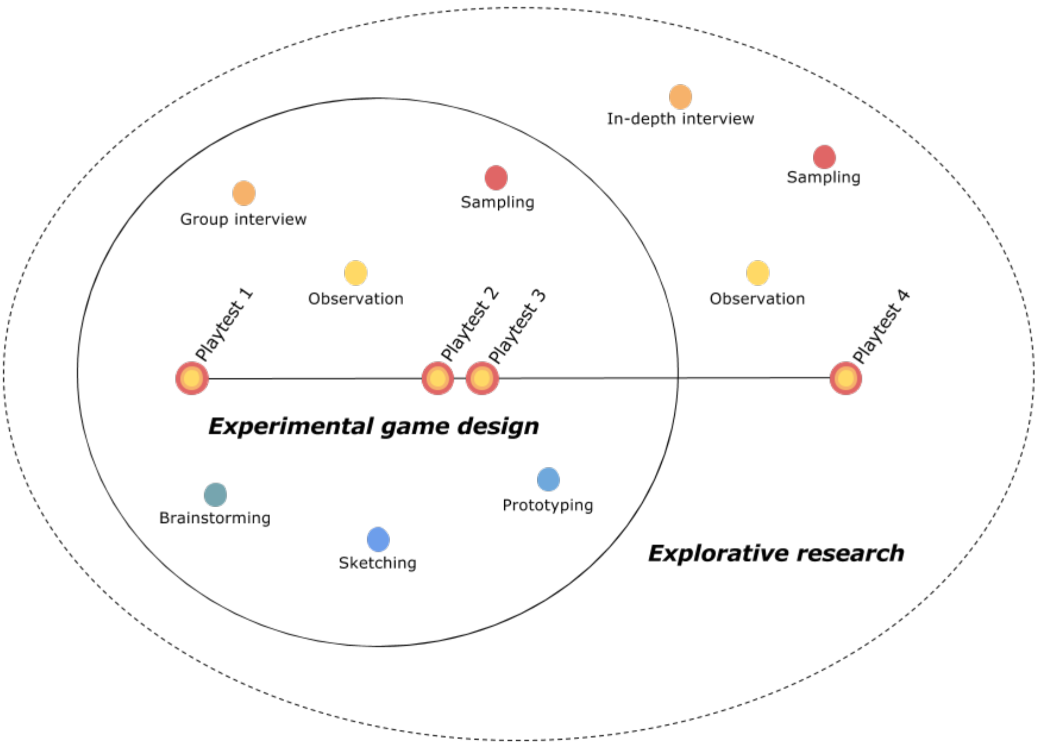
We take an experimental game design approach to create the game as well as to gather the data and knowledge to formulate our hypotheses. The notion of experimental design is arguably a part of the design process by default for most games. Comprehensive experimenting and testing is often tightly connected with essential game design aspects such as creating gameplay, balancing, changing rules, the use of controls and modifying and refining the style and themes of a game. This is most likely caused by game design being second order design, as a play experience is not a product of the game itself, but rather of the game session including the player (Waern & Back, 2015).
Experiments in this approach is typically divided into two categories; controlled experiments and more open forms of experimentation. For this project it is not feasible to perform controlled experiments, as the time frame is too short to have a game far enough in its development to use for these kinds of experiments (Waern & Back, 2015). Instead we put our focus on the more open evocative experiments. Considering the second part of our problem statement, it entails us to be open to new and surprising revelations and unexpected results in the relatively new and underexplored design field that is local multiplayer VR games. Starting out we do not exactly

know what to look for and where to find it, so evocative experiments fits the bill (Waern & Back, 2015).

We conduct several experiments to both refine our game, as well as to find more generic qualities of local multiplayer VR games. By using only our own game to perform research tests, we acknowledge that our findings will not necessarily be applicable to all other local multiplayer VR games, as they could differ significantly from our game in regards to gameplay, mechanics and number of players.

2.2 Methods of this thesis

This section presents brief descriptions of the various methods used for this study and explains how they contributed to this design and research project. Each method will be described to show our motivations for using them as well as our expectations for their contributions to this project. Our study consists of different methods, such as *brainstorming*, *sketching* and *prototyping*, which are used in design processes to generate, investigate and evaluate ideas. We have dedicated the following subsections to describe the methods of sketching and prototyping, but we choose not to elaborate on brainstorming, because we assume that the reader will already have sufficient knowledge about this method. Furthermore, *playtesting*, which in this case includes qualitative research methods of *observation*, *group interview*, *in-depth interview* and *sampling* will also be presented individually. All the methods are dealt with iteratively and adjusted to fit their specific purpose for this thesis and the outcomes and reflections of working with each method will be presented later as a part of the design process in chapter 4.



Model 2 | An overview of the methodological approaches and methods used for this thesis.

Model 2 provides an overview of our methodologies and when the methods are used in our design process. The methods of brainstorming, sketching and prototyping have exclusively contributed to our experimental game design process, where playtests including qualitative research methods; observation, group interview and in-depth interview, have been conducted within both methodological areas. The intention of the model is exclusively to give the reader an overview of this particular design and research process, and is thereby not applicable to game design processes in general.

2.2.1 Sketching

In his book, *Sketching User Experiences: getting the design right and the right design*, Buxton (2007) describes sketching as an activity with the purpose of "exercising the imagination and understanding" (p. 135). Sketching is a method where designers use pen and paper to communicate ideas – this being internally within the design team or with people outside the design team. Buxton's book is written as a complementary to the traditions of user-centred design and participatory design, which are approaches that involve users in design processes.

Sketching is useful in the early ideation stages where different concepts need to be explored. Buxton (2007) explains this quality of sketching on the basis of a number of attributes he attaches to the activity. Among the presented attributes, Buxton mentions that sketches are *quick*, *timely* and *inexpensive*, which naturally supports the attributes of sketches being *disposable* and *plentiful*. Sketching also provides a *clear vocabulary* because they offer a visual dimension to a spoken language, which strengthens the communication within a design team.

Buxton (2007) stresses that sketching is not the same as prototyping. In his view, the purpose of sketching is to make suggestions and explore design ideas, where prototyping is meant to confirm them. As the reader will discover in the next section, this study utilises a less confirming perception of prototyping, thus differing from Buxton's perceptions.

2.2.2 Prototyping

In *Game Design Workshop: A Playcentric Approach To Creating Innovative Games*, Fullerton (2008) makes several strong arguments as to why game designers should invest time creating prototypes. One convincing argument is that the prerequisite for creating the best possible gameplay is to understand how something works; and prototypes are designers' practical tools to test particular game mechanics and features to see how they work.
Prototypes can also be viewed as tools to refine and validate ideas. This means that the technique is mainly used by designers to move closer to a final design, rather than to help explore possibilities (Buxton, 2007). Inspired by approaches that attach this converging quality of prototypes, Lim, Stolterman & Tenenberg (2008) introduce prototypes as tools that designers can use to frame and refine ideas as well as explore the possibilities in a design space.

In “The Anatomy of Prototypes: Prototypes as Filters, Prototypes as Manifestations of Design Ideas” Lim et al. (2008) propose a framework for conceptualising prototypes. Their framework suggests that the anatomy of a prototype consists of two dimensions; the *filtering dimension* and the *manifestation dimension*, which are tightly connected.
A prototype can be seen as a filter that has certain qualities of a design idea. The filtering attributes are *appearance*, *data*, *functionality*, *interactivity* and *spatial structure*. Often it is not possible to explore the whole design space in one prototype, as it will be too complex; consequently the designer must "filter the prototype". Meaning that the prototype “filters in” certain qualities, so these can be tested. The most efficient prototype is the most incomplete one that still filters the qualities the designer wants to examine and explore (Lim et al., 2008). Additionally, Lim et al. state that every prototype is a manifestation of a design idea and that the attributes related to the manifestation dimension are *material*, *resolution* (fidelity) and *scope*. This dimension focuses on how the prototype is made, what materials it is made of, and how detailed it is. The two dimensions are closely related as the filtering (the purpose) of the prototype determines the use of manifestation attributes (what it is made of).

Where the filtering of a prototype depends on the purpose, and will develop through an iterative design process, there are concrete methods regarding how to manifest design ideas. In relation to the materials of prototypes, Fullerton (2008) mentions physical prototypes, visual prototypes, video prototypes and software prototypes (digital prototypes) as different methods of prototyping, and stresses the benefits of using more than one kind of prototype to address a unique question or feature of a game idea. For this project we have chosen to invest time in making physical and digital prototypes to manifest design ideas for our local multiplayer game.

2.2.2.1 Physical prototyping

Physical prototypes can be used to test mechanics and build structures for games before spending a lot of time translating them into hard code. The prototypes can be made out of whatever physical material available, which makes them a quick and inexpensive means of iterating on ideas. In the ideation phase, the physical prototypes will be used as an extension to brainstorm sessions, where we define issues and explore possibilities. Lim et al. (2008) support the use of low-fidelity prototyping techniques, though stressing that these prototypes are restricted to design exploration and communication and not formal design evaluation. Furthermore, physical prototypes do not require programming or other technical skills, which strengthens cross disciplinary cooperation within the design team and keeps focus on gameplay rather than technology (Fullerton, 2008). All together, these highly accessible qualities of physical prototypes make them almost inexcusable to stay away from.

2.2.2.2 Digital prototyping

According to Lim et al. (2008) physical prototypes are naturally limited to the properties of the materials, whereas digital prototypes have a less restricted design space due to the almost unlimited functions of this material. Although digital prototypes are more open-ended than physical prototyping, digital prototypes are sometimes harder to dispose compared to physical prototypes, because design teams tend to get more attached to code than paper, and it is important to note that digital prototypes are not the same as the final game. Therefore, digital prototypes should be incomplete and spartan, as well as focused on the parts of the design that need clarity (Fullerton, 2008). Another quality of digital prototyping is the fact that they allow designers to test the kinesthetics for a game, which Fullerton (2008) describes as the "feel" of a game. In relation to this project the kinesthetics are vital to the game experience since the VR medium allows players to control the game with their hands and body, which for many players will seem much more intuitive compared to the control types of other game platforms.

Another relevant aspects of the design choice to create prototypes relates to the overall methodological approach of this thesis. As stated, this thesis project is characterised as experimental game design, where players are included in the design process. This approach leans on co-design principles, where possible end-users will help shape the digital prototypes we, as designers, present to them (Sanders & Stappers, 2008). Sanders & Stappers refer to Sleeswijk Visser et al. (2005) when describing users as *experts of their experience* and note that designers must provide the players, or users, with tools to express themselves. With this in mind, we do not consider the users as expert *designers*. The prototypes are concrete tools that will help players articulate their needs. This information will then be interpreted before we decide what to implement into the final design.

2.2.3 Playtesting

A playtest can easily be mistaken for an internal design review, quality assurance testing or usability testing, but these methods are not the same. Playtesting is a far more complex activity than just "playing" and "testing" a game. In fact, a playtest starts before the game is actually being played by someone and is not an activity limited to *playing a game* and gathering feedback (Fullerton, 2008). The preliminary work, which consists of preparing the structure of the playtest as well as selecting and recruiting participants (sampling), is highly important for the outcome of the playtest. Equally important to consider is the qualitative collection and treatment of data gained through the playtest. The purpose of this section is to present the most important considerations when conducting playtests, and explain how we have conducted playtests in different ways at various stages of this project.

Playtesting is a highly recommended method for game designers to perform throughout an entire design process, because it helps designers to gain useful feedback from players on how to improve the overall experience of a game. Iterating a design through playtesting helps maintain relationships with players and ensures that their needs and perspectives are taken into account. The distribution of roles between players and designers in playtests corresponds with a co-design approach, where people outside the design team are seen as active contributors to a collective design process. Designers are *advocates for the players*, which leave them with the responsibility of involving the players and making the final design decisions when needed (Fullerton, 2008).
An internal design review or self-testing is a way for designers to explore core mechanics for the system, whereas playtesting and the involvement of other players provides a more accurate understanding of how the game actually feels to play and "[...] whether or not the game is achieving your player experience goals" (Fullerton, 2008, p. 248). The goal(s) can be determined

by different factors and vary from one playtest to another depending on the purpose of the playtest. The overall play experience for this local multiplayer game is linked to the problem statement, which seeks to explore the possibilities and limitations of creating a social and local multiplayer game for VR. This implies a range of questions that we expect to identify through playtesting. This means that playtests in this case have a dual function, since they will help discover issues as well as give clues on how to solve them.

Playtests can either be informal and qualitative or more structured and quantitative (Fullerton, 2008). This project uses playtests as methods to gather qualitative feedback from players. The methods used for qualitative data collection, i.e. group interviews and in-depth interviews, and sampling are variables we have used to adapt playtests to fit their purposes; this being of either design and development *of the game* or research *on the game*.

When a prototype of a game is in its earliest stage of development the strategy can be to test it with *confidants* (Fullerton, 2008). Confidants can be friends, family or colleagues. Revealing a prototype of a game with an incomplete gameplay can be uncomfortable, but self-criticism and excuses must be put aside so the participants can test it without much intervention. According to Fullerton (2008), too much intervention might influence participants' immediate attitudes towards the game, causing them to suppress their honest opinions. Consequently, the design team misses out on valuable feedback. The confidants' responses will also be influenced by their personal relationship to those in the design team, which can obscure their objectivity. This often shows that most confidants are either too harsh or too forgiving (Fullerton, 2008).

The design and development phase of the game is a mixture of self-testing and playtesting with confidants. Each playtest with confidants is iterated on and adjusted to optimise the outcome of the playtest and the qualitative data have been collected through group interviews. Our willingness to "risk" soft or pleasing answers by choosing to playtest with confidants in the design phase is due to the fact that we want to test *how* the game works and not *how well* it works. This means that we expect the findings to be suggestive and useful for soft arguments, rather than being conclusive and useful for strong arguments, when playtesting with confidants. In the case of this project, strong arguments are preferable when the design process ends and the research process begins. Playtesting with people you do not know is crucial, "because outsiders have nothing to lose or gain by telling you honestly how they feel" (Fullerton, 2008, p. 251). In the research phase – where the intention is to investigate which aspects of our final prototype supports a social play experience in VR – we need to search for strong arguments to shape our discussion.

The following sections consist of the methods we have used during the playtests to gather qualitative data.

2.2.4 Observation

Observation is a method researchers engage in when seeking to understand human activities when seen in a context. Observation of player behaviour and group dynamics is included in the playtests in this study. In this section we will focus on how the observations were performed.

The primary motivation of using observation in the playtests is to gain a deeper understanding of the activities between the participants, since "what people say and what they do are not the same" (Blomberg, 1993, p. 130). Blomberg (1993) makes this distinction to emphasise the difference between what people believe they *should* do (ideal behaviour) and what people *actually* do (manifest behaviour). Acknowledging this distortion of perception, the observations are meant to identify irregularities between participants' ideal behaviour and manifest behaviour. Furthermore, observing the participants during playtests will provide more nuanced information about the activities and help us formulate questions from their point of view.
The participants are observed from a "fly on the wall" approach, which is the least obtrusive way to conduct observations (Blomberg, 1993). This subtle approach will enable us to obtain information about the participants' behaviours as well as their interactions, without interfering or influencing the activity ourselves. Again, the intention is to gain insights on how the participants actually interact with each other and not steer their behaviour in a desired direction.

The observations of participants' individual behaviour and their interactions are audio recorded and written down in real time. Video recording a playtest can be a substitute or additional way of capturing information. But in the case of researching social interaction, we have chosen not to video record the playtests because we fear that it might increase the participants' sense of self-awareness and thereby influence their behaviours. That being said, video recording a playtest can be convenient because it enables researchers to go back and see who says what, look at body language, as well as remember different moods. But since the social aspect of the playing activity is key to our investigation it seems unjustifiable to do anything that can cause obstruction to that.

The observations will help validate the data collected through the qualitative research methods of group interviews and in-depth interviews, which are conducted subsequent to the play sessions. The insights gained from the observations will also be used as inspirations and "lessons learned" for future playtests. This will include unidentified tendencies or problems as well as evaluating our own approach and general structure of the playtest to stay open to improvements.

2.2.5 Semi-structured group interview

In our attempt to establish the best possible conditions for gathering qualitative information during the playtests sessions, we considered two methods for interviewing the players: Focus group and semi-structured group interview. This section will explain why we chose to conduct semi-structured group interviews, after the actual play sessions in our playtests.

Focus groups and group interviews are easy to confuse because they are so closely related. Eklund (2015) defines focus groups as “in-depth group discussions focusing on a particular topic of interest or relevance to the participants as well as the researcher” (p. 133). In compliance with this definition, Halkier (2002), who leans on David Morgan’s (1997) definition of focus groups, adds the dimension of *group interaction* as an important aspect of focus groups. When conducting focus groups the role of the researcher is to moderate and observe a group discussion among participants, thus limiting the moderator’s influence to merely regulating the conversation and not participating. In a constructivist view this may challenge the intent of using focus groups in a co-design process. Cote & Raz (2015) argue that since the moderator is not actively participating in an opinion-forming group discussion, the insights gained from the method will be based on analysis: “For the constructivist, this could be viewed as too top down, with analysis built more by the researcher alone than as a joint project with the participant” (p. 94).

In contrast to focus groups, semi-structured group interviews typically involve a higher degree of interaction between interviewer and participants, because questions are asked more directly from interviewer to the participants (Halkier, 2002). Also, the interactions between the participants are not the primary focus of investigation as in focus groups. During the design process of our game, semi-structured group interviews are used in the playtests to gather information about the participants’ needs. The digital prototype we use for the playtests isolates specific elements of the game, and we seek to gather concrete feedback, rather than having the players discuss more general concepts or topics about the game. The information will help us gain deeper insights about how the game works and which design choices to make in order to create the most optimal game experience for the participants.

Conducting semi-structured group interviews will not exclude interaction between players completely, but encourage a fairly open discussion between the participants, while maintaining an appropriate level of structure. The assessment is that we will gain more useful feedback from the participants if the conversation is focused around a semi-structured topic guide, consisting of concrete questions addressing specific issues in the game.

Planning and preparing a group interview is crucial to the outcome of the method. Some of the important aspects that needs to be considered concern the ethics involved in this type of interview. Focus groups rely heavily on the relationship between the participants, because the ambition is to situate a casual discussion where opinions are not being suppressed by the group dynamics. Conversely, a group interview is more centralised around the interviewer, but also here, it is necessary that the participants find themselves comfortable enough to express their honest opinions in the group and possibly discuss different views.

The topic guide is semi-structured and constructed prior to a playtest. This means that the questions will be designed to match the purpose of the playtest and that the conversation will unfold on the basis of a structure that allows unexpected responses and thoughts. By using qualitative methods to collect information about the game, we are aware that the data will not be applicable to a larger group of people. The opinions are restricted to those who participate directly in the investigation and can therefore not be used to explain more general attitudes about the game experience.

2.2.6 In-depth interview

An in-depth interview is another method to collect qualitative data and as with group interviews, individual interviews are qualitative and thereby not representative to a broader group of people. In-depth interview is an effective method to gather information about users' preferences, opinions and experiences (Cote & Raz, 2015), and we perceive this as a fitting method to use in our fourth and final playtest. At this point in our study we focus on how well the game works in relation to our intended play experience. We are looking for in-depth answers to help clarify exactly which elements of the game that either strengthen or compromise the participants' social experience when playing.

In order to detect the designed elements in the game that relates to the social play experience, we need to construct a semi-structured interview guide that focuses on this particular subject. The subject of social play, however, will not be revealed to the participants to ensure that they are not trying to please us with their answers. The semi-structured interview guide will allow the respondents to come with inputs that deviate from the pre-written questions, if it seems relevant to them and stays on the subject.

To strengthen the data further we will conduct the interviews with people whom we have no personal relations to (Fullerton, 2008). This is determined by the fact that we assume that they will provide us with more honest answers because they have no incentive to spare our feelings. This will leave us with stronger arguments to use in our discussion.

2.2.7 Sampling

Making a sampling strategy is to carefully think through the desired characteristics of the people you want to include in a study. The strategy involves selection criteria and recruitment tactics, which must be determined from a theoretical, rather than a practical perspective (Cote & Raz, 2015).

In order to create a strong foundation for data collection, researchers need to know what results they are looking for before setting up selection criteria and recruitment tactics for the sampling strategy. "The characteristics needed in a sample will always be specific to the research questions or goals of a project. However, a beneficial place to start is by thinking through basic personal characteristics like gender, race, nationality, age or sexual orientation" (Cote & Raz, 2015, p. 99). Some of the characteristics presented by Cote & Raz seem insignificant to the purpose of this study, where others can be justified. Although it can be argued whether or not any of the abovementioned characteristics have any relevance to this study, we have chosen to include gender, nationality and age as a part of our sampling strategy. One of the reasons is that a party game inherently directs itself to a broad target audience. In contrast to other more niche game genres, where the demography is narrower, we consider the party game genre to have a generally broad appeal. When we include gender, nationality and age as a part of our selection criteria it is to ensure that the participants contributing to this study are a diverse selection of representatives from the target audience. The intention is therefore to recruit male and female participants, who do not necessarily share the same cultural background and in terms of age represent a relatively broad sample of our target group.

Another relevant characteristic to include in the selection criteria is the participants' gaming skills and familiarity with the VR medium. To support the argument of selecting participants who represent gamers in a broad sample, we include both casual gamers and hardcore gamers in this study. Since the game challenges conventional local multiplayer games by including a VR system, we insist that all the participants have some gaming experience. Otherwise we fear that it will create a too imbalanced and disrupted play experience. All the participants that have contributed to this study met the desired characteristics.

Because we want the game to appeal to a broad target audience, consisting both of players who play games regularly to those who only play games occasionally. The participants in *playtest 1* are hardcore gamers, whereas the participants in *playtest 2* and *playtest 3* cover a broader sample of gamers. Here, the participants range from hardcore gamers to casual gamers and not everyone are experienced with flying games or using a controller. The intention is to include the broadest range of participants within our sampling strategy to collect the most nuanced data.

Changes were made to our sampling strategy from the design process of the game to our final research on the game. The participants selected for playtesting during the design process are classified as confidants and recruited through our personal networks. Those who participate in the final research, and contribute to the discussion of this thesis, are classified as “strangers” and recruited through our network at the IT University of Copenhagen (ITU).

3 Theory

In this chapter we present the design theory that we have utilised in the design of our game as well as the theory used for discussing the social play experience relating to our game. First, we present a selection of design theory principles, drawing on Donald Norman's iconic book *The Design of Everyday Things* (2013). Subsequently, we include Miguel Sicart's (2008) concept of game mechanics in an effort to better understand the VR medium in a gaming context. Lastly, we present theory on social encounters as presented by Erving Goffman in his text *Fun In Games* (1961).

We include selected design theories in our experimental game design process as they will contribute with a useful vocabulary as well as guidelines. This design theory will not determine the direction of our design process. Instead, the theoretical design concepts and principles we have chosen to include, will improve our understanding of what we experience during the design process. Where internal design reviews and playtesting will help identify *what* we need to solve, we expect that the design theories can give us clues in terms of *how* to solve them.

3.1 Donald Norman's design principles

In designing the final prototype, and the interaction with the game itself, we had to consider, what Norman (2013) defines as the two most important aspects of good design: *discoverability* and *understanding*. The former refers to the notion that a user needs to be able to figure out what actions are possible with a given design, and how these can be performed. The latter refers to a user being able to figure out how a given design is supposed to be used in all its complexity (Norman, 2013). If a given design is to fulfill the notion of discoverability, it needs to apply the following six concepts.

Affordances are relationships between a design and its user. It describes what a user perceives an object can be used for. Since an affordance is a relationship – and not a property – the affordances of an object will change depending on the user (Norman, 2013). For the world famous skateboarder Tony Hawk a skateboard might afford transportation and doing cool tricks, while for most others it affords falling, hurting oneself and looking anything *but* cool.

While affordances tell a user what actions can be taken with a design, *signifiers* helps the user understand *how* to perform those actions. Norman (2013) describes it as "[…] any mark or sound, any perceivable indicator that communicates appropriate behaviour to a person" (p. 14). It can be thought of as little clues as to how to use a design. For example, in many modern games, an icon referring to a specific input button will be shown close to items that can be interacted with, to signify which button should be pressed to interact with the item.

Mapping is a term used to describe “the relationship between the elements of two sets of things” (Norman, 2013, p. 20). Norman emphasises natural mapping as a way of guiding the user towards an intuitive understanding of a design by using spatial analogies. In the soccer game FIFA (EA, 2015), pushing the move stick to the left, will make the selected player run to the left. Natural mapping can also draw on principles of perception, like those from gestalt psychology that uses principles like groupings and proximity. Norman (2013) notes that a natural mapping for some people, will not necessarily be considered a natural mapping for others.

Norman (2013) stresses the need for *feedback* in design, which relates to the way an artifact “talks back” to the user; in other words, information telling the user what action has actually been done, as the result of an input. Feedback must be informative and immediate. It is not always sufficient just to give feedback, to prove that something happened, if the user does not know what caused the feedback. This just leaves the user with the knowledge that *something* happened, not *what* happened. Likewise, if the feedback is not immediate, the user might not always be able to discern what the feedback is a response to.

A *conceptual model* is a type of mental model that exists in the heads of people. These are usually simplified models of how something works and they are not necessarily very accurate. Despite their simplicity and inaccuracies, conceptual models are valuable “[…] as long as the assumptions that support them hold true” (Norman, 2013, p. 26). They can help people interact with well-known objects by allowing users to predict how they will behave. Conceptual models help us when there is a lack of signifiers or feedback because we can draw on our prior experiences with similar designs.

The last concept, *constraints*, is divided into four categories: *Physical*, *cultural*, *semantic* and *logical constraints*. Physical constraints relate to the physical manifestation of an object and how it is designed. Designers can use physical properties, like size or form, to disallow certain uses of an object. For this project, we do not design anything physical ourselves, but we use equipment that contains physical constraints that we must adhere to in our digital design. Cultural and semantic constraints guide the user as to what would make sense in the world – be it virtual or physical. The last category is logical constraints which refers to the logical use of an object (Norman, 2013). For instance, there is only one logical place for the last puzzle piece in a typical puzzle.

3.1.1 The two gulfs of interaction

When people in their everyday lives face a new design, they encounter two gulfs; the *Gulf of Execution* and the *Gulf of Evaluation*. The Gulf of Execution refers to the uncertainty of how to interact with an unfamiliar object. What helps decrease this uncertainty are the aforementioned concepts of signifiers, constraints and mappings as well as the conceptual model of the given object. Adequate and attentive use of these concepts will guide the user to understand how to interact with an object. The Gulf of Evaluation refers to the uncertainty that arises when a user *has interacted* with an object and awaits a response to the given input. The easier it is for the user to understand what happened, the smaller the gulf. Well designed feedback and the conceptual model help minimise this gulf (Norman, 2013). Both gulfs can vary in size independently from one another as both affordances and conceptual models will be understood subjectively by the users.

3.2 Miguel Sicart's definition of game mechanics

In the design of the game, we have used Miguel Sicart's definition of game mechanics as presented in his paper "Defining Game Mechanics" (2008). The novelty of Sicart's (2008) definition is that it seeks to separate *game mechanics* from *game rules*. Sicart defines a mechanic as "[…] the action invoked by an agent to interact with the game world, as constrained by the game rules" (para. 26), meaning that a mechanic can be everything a player can do to change the state of the game. In contrast, rules define the possibility space wherein these mechanics can be performed by the player. As an example, in FIFA (EA, 2015) scoring a goal is not a mechanic. Rather the player can shoot the ball, which is the mechanic, while a rule states that if the ball passes the goal line, the team is awarded one point. Mechanics are closely related to the input device(s) and they can be formalised as verbs, e.g. shoot, run, pick up (Sicart, 2008). Mechanics can be context dependent, as not all necessary actions can be done at all places and/or at all times in a game (Sicart, 2008). If we go back to the FIFA (EA, 2015) example, almost every input button is tied with two mechanics. The mechanic is changed depending on whether the player's team is attacking or defending, e.g. *shoot* becomes *tackle*.

Sicart (2008) separates mechanics into two main categories; *primary* and *secondary*. Primary mechanics are those that can be used to reach the end state of the game (if one exists). The primary mechanics are introduced early and will be persistent throughout the game and will typically be mapped in accordance with similar games (Sicart, 2008). Secondary mechanics, on the other hand, are not vital in order to reach the end state. Rather they can ease the road to it and perhaps allow players to be expressive in the game. A player in FIFA (EA, 2015) should be able to win a match simply by using the steer, pass, shoot and tackle mechanics. All other mechanics, such as lob, cross and dribble, can definitely make it easier to score a goal, but they are not necessary to use in order to win a match.

3.3 Erving Goffman's theory on social play encounters

In this section we present the acclaimed sociologist Erving Goffman's theory on encounters and social gatherings as presented in his text "Fun In Games" (1961), which will help us better understand and discuss the data that we gathered during our final playtest. As Goffman's essay is quite elaborate, we will focus strictly on the aspects of his concepts that we believe can be directly applied to our research focus. Our account and reading of Goffman's work will therefore be based on gaming situations and the concepts that we believe contribute to the discussion of our hypotheses.

3.3.1 Encounters and gatherings

Goffman (1961) describes an *encounter* as a situation where two or more people – or participants – share "a single visual and cognitive focus of attention" and have "a mutual and preferential openness to verbal communication" (p. 17). The participants should also be able to observe the other participants' monitoring of them.

Encounters happen during gatherings; situations where two or more people are in proximity of each other. Gatherings can be found in three variations: *focused*, *unfocused* and *multi-focused* gatherings. The prefix is determined by the number of encounters in these gatherings. The focused gathering happens when every participant shares a single focus such as jury duty or a game of cards as exemplified in the text, and are therefore engaged in the same encounter, while the unfocused has no encounters and the multi-focused has multiple.

Regarding encounters, Goffman (1961) is patently concerned with shared experiences between two or more participants, with an inherent sense of togetherness centered around a clear focus of attention – in our case, a video game. We would argue that this understanding can be more or less directly applied to video games, at least when the player interaction is based on local, physical, social structures and presence. Though players of our prototype do not in the most direct sense share one single visual cognitive focus of attention, we would argue that the fact that they view and interact through the same virtual space constitutes an adequate shared focus to utilise Goffman's theory. Furthermore, even though the participants have somewhat different foci of attention based on visual output, we do not find the gaming encounter to be a multi-focused gathering, as the overall focus and attention is still directed towards the same virtual world.

To elaborate on his idea of encounters, Goffman (1961) introduces three main concepts, both as a means of formalising his theory and to help further explain the social dynamics within an encounter; namely *rules of irrelevance*, *realized resources* and *transformation rules*. We will elaborate on and present our understanding of these three concepts in the following paragraphs.

3.3.1.1 Rules of irrelevance

Encounters distinguish themselves from other elements of social organisation as "their order pertains largely to what shall be attended and disattended" (Goffman, 1961, p. 19), which means that not all presented elements or information in a given encounter carry equal significance for the encounter to be satisfying for all participants. As an example, Goffman states that playing a game of checkers with bottle caps on a piece of linoleum could in fact "generate the same contour of excitement" as playing the game with more detailed or valuable figurines (Goffman, 1961, p. 19). Just like certain physical properties in the encounter can be disregarded, so can specific properties of the participants. For instance, the size of the participants' paychecks or their favourite dish will not matter in an encounter based on playing checkers.

According to Goffman (1961), an example of the strength of inattention in gaming encounters is a game's ability to "place a 'frame' around a spate of immediate events, determining the type of 'sense' that will be accorded everything within the frame", ultimately helping the participants leave out any irrelevant information for the duration of the play (p. 20). Games then can be seen as an engaging activity that "acts as a boundary around participants, sealing them off from many potential worlds of meaning and action" (Goffman, 1961, p. 24).

More so, the irrelevant elements must be excluded from the player's attention, left out of the "frame", meaning that outside distractions should not be permitted to interfere with the play situation, as they can threaten the stability of the interaction. Hence, participants are bound by a shared sense of responsibility, obligations, and duty to keep the given encounter a pleasant one, by maintaining decorum and respecting the rules of interaction: "To adhere to these rules is to play fair. Irrelevant visible events will be disattended; irrelevant private concerns will be kept out of mind. An effortless unawareness will be involved, and if this is not possible then an active turning-away or suppression will occur" (Goffman, 1961, p. 24).

3.3.1.2 Realized resources

Above we have described how some elements or information should be excluded from the encounter to uphold a pleasant social experience for its participants. But, to understand what is actually included and to be treated as part of the encounter's reality, we will now move on to what Goffman (1961) calls realized resources.

As previously stated, games can provide a clear frame, or boundary, shielding participants from irrelevant meanings and actions. In games, a set of rules tells us what we are to treat as real, as well as what shall be disattended and not be given any relevance: "There can be an event only because a game is in progress, generating the possibility of an array of game-meaningful happenings" (Goffman, 1961, pp. 24-25). Here, we understand the array of game-meaningful happenings as the matrix of possible actions afforded by a game's mechanics. In the game of chess one such mechanic could be the castling of a king and a rook.

One important point that Goffman (1961), albeit only briefly, touches upon, is the creation of game-generated roles and identities within the encounter world. Different games and settings, bring about different roles and actions, which are inherent to the specific game's culture:

> *A matrix of possible events and a cast of roles through whose enactment the events occur constitute together a field for fateful dramatic action, a plane of being, an engine of meaning, a world in itself, different from all other worlds except the ones generated when the same game is played at other times. [...] Games, then, are world-building activities.*
>
> (Goffman, 1961, p. 25)

We therefore understand realized resources as the array of possible actions, based on the game's mechanics, and the roles that can be enacted in a specific game.

3.3.1.3 Transformation rules

After the irrelevant information has been excluded, realized resources must be allocated between the participants, based on what Goffman (1961) calls transformation rules. These rules for distributing realized resources, are most often based on external factors, such as the attributes of the participants: "[...] externally realized matters are given some official place and weight in most encounters, figuring as avowed elements in the situation […]" (Goffman, 1961, p. 28). Delegating the roles on a soccer team will often lead to inclusion of externally based resources. It will seem like an obvious strategy that a tall player will be picked as the goalkeeper, while a player who is quick on her feet will be placed in the offense.

Goffman (1961) romanticises the encounter completely void of externally based matters, including externally based attributes of participants, suggesting that it is in theory possible. However, he also states that externally realized matters are most often, if not always, given some official place and weight in encounters. The most basic example being the physical appearance, namely the sex or age, of the participants; both of which can serve as misleading information when measuring up your opponent. A good example of where the latter was included as a relevant external factor, was when the then 13 year old current chess world champion Magnus Carlsen ended up drawing against the best rated player in the world at the time, Garry Kasparov. Arguably Kasparov underestimated his young opponent, thus being mislead by the externally based matter that was included in the encounter.

3.3.2 Dynamics of the encounter

In the second part of his essay, Goffman (1961) presents the concepts that he believes to constitute the social dynamics that can happen within an encounter. In the following we have chosen to focus on the aspects that we have found relevant in relation to what we observed during our final playtest. Therefore we will selectively present the descriptions of *spontaneous involvement*, *ease and tension* and *byplays*, as well as his analogical understanding of what he calls an *interaction membrane*. As mentioned above, these following concepts will all be discussed later in relation to our findings and formed hypotheses in the discussion in chapter 6.

3.3.2.1 Spontaneous involvement

When Goffman (1961) uses the term spontaneous involvement, he refers to the mental state that a participant can enter when said person gets caught up or engrossed in an encounter “with an honest unawareness of matters other than the activity” (p. 35). Goffman puts much weight to the importance of participants’ spontaneous involvement in encounters. A participant’s apparent involvement will show other participants of her intentions and thereby create security in the situation, as it will confirm the world or reality established in the encounter.

When a participant gets spontaneously involved she also becomes an integral part of the situation. In an encounter it is obligatory that participants both get involved and sustain this involvement in a fitting manner. Not too much and not too little. Many readers will recognise a situation casually playing a board game with a too invested player or with a too little involved player that have already given up and zones out of the situation.

Goffman attaches importance to gaming encounters where people are sitting together, as they are much more powerful than games played at a distance. As the activity goes on before your eyes and with other participants the alternate reality created by the game is continuously confirmed by their presence and involvement. As Goffman (1961) puts it: “[…] there seems to be no agent more effective than another person in bringing a world for oneself alive […]” (p. 38).

3.3.2.2 Ease and tension

In his essay, Goffman (1961) introduces the two opposing terms ease and tension. A participant can be at ease, when she is spontaneously involved in the same world as created by the transformation rules. Contrary, tension is presented as “a sensed discrepancy between the world that spontaneously becomes real to the individual, or the one [s]he is able to accept as the current reality, and the one in which [s]he is obliged to dwell” (Goffman, 1961, p. 40). The sensed discrepancy can arise in two ways: If a participant is drawn towards matters that are excluded by the transformation rules or if she is repelled by the official focus of the encounter.

As stated earlier, involvement from all participants is what secures the reality of the encounter and therefore management of tension can be viewed as a method of maintaining the integrity of the encounter. When participants observe someone else’s tension and diminished involvement, they themselves can become less involved. In that way tension can have a multiplier effect, as it spreads out among the participants in the encounter.

Goffman acknowledges game encounters as a prime example of encounters that are able to keep away tension and thereby maintain participants’ involvement. He bases this on his assumption that games in general are fun, and therefore easy to engage in.

3.3.2.3 Byplays

During an encounter something may arise that will make several or all of the participants withdraw their spontaneous involvement from the main encounter and form what Goffman (1961) coins a byplay. When forming a byplay the involved participants will shift their focus to a subordinate encounter, but in a way as to not ruin the main encounter. Byplays will often be handled quite secretly in a sense that “[…] the gestures through which they are sustained will be modulated so as to show a continued respect for the official or dominant encounter” (Goffman, 1961, p. 55). Byplays are seen in several variations, e.g. voluntary or involuntary as well as communicative or collusive, some of which have the effect of reducing tension among distracted participants in the encounter. For example, if a participant experiences a lot of tension, she can refrain from flooding out by forming a collusive byplay with others, that opens up for “[…] a kind of ratification [that] can be given to feelings and issues which have had to be suppressed in the dominant encounter” (Goffman, 1961, p. 58). *Postplays* are similar to byplays but does not take place during the encounter, but immediately after.

3.3.2.4 Interaction membrane

Surrounding an encounter is the interaction membrane; a metaphorical boundary set by the transformation rules shielding it from the outside world (Goffman, 1961). When something from the outside passes through the interaction membrane the rules and the encounter as a whole are challenged. The outside elements can sometimes be easily disattended and will not affect the rules. But other times they will have to be repressed or suppressed at the loss of involvement and if the pressure on the encounter gets too big, the transformation rules will be challenged – thereby challenging the entire encounter.

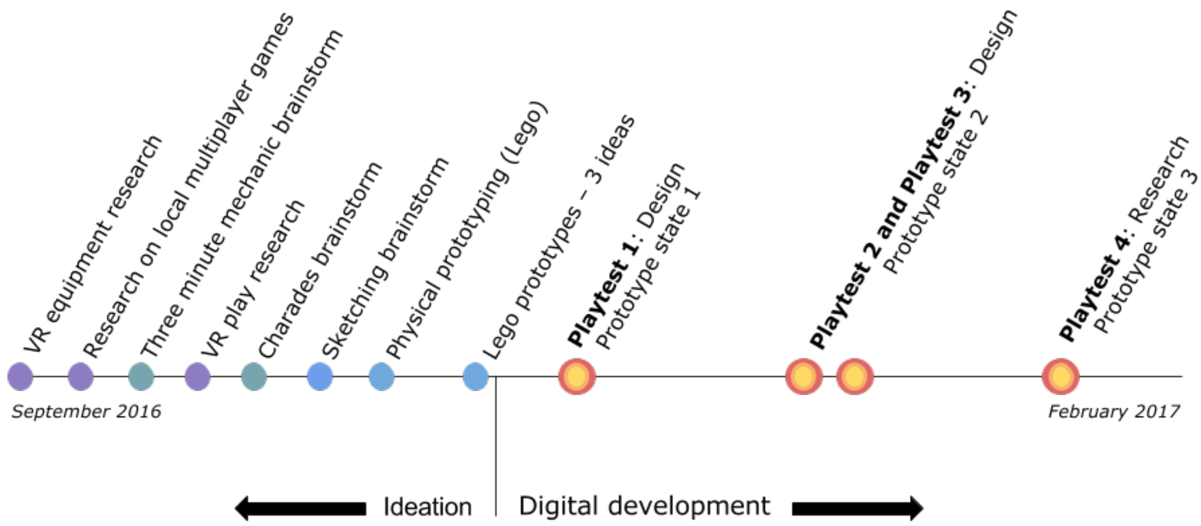
3.4 Summing up

In this chapter we have presented relevant theory regarding both design and social interaction. We have presented Donald Norman's (2013) design principles and Miguel Sicart's (2008) definition of game mechanics as well as theory on social encounters by Erving Goffman (1961). The two former will be used in our design process in chapter 4 and give us clues as to *how* to solve the design challenges we meet. The latter will be utilised in our discussion in chapter 6 and provide us with a vocabulary to discuss the social encounter in our fourth and final playtest.

4 Design Process

Up until now, we have presented the methodological and theoretical foundations that provide the framework for our design process. In this chapter we will present our design and the design process that lead to it. We will ignore all elements of a dramatic composition and begin this chapter by revealing the final prototype of our local multiplayer party VR game. We present the final prototype of the game to improve the reader's comprehension of the design process, and hope that this will not spoil the surprise, but instead, increase the reader's curiosity as to learn how the game was designed and developed.

This chapter is in some ways the heart of this thesis, and it is with excitement that we reveal some of the building blocks that have been shaped and put together to create our local multiplayer VR party game. In this chapter, we present the most influential experiences we have gained throughout the design process of making our game. As an attempt to improve readability the experiences are described individually going from ideation phase, through the development process, to the final digital prototype. Each section includes one or more methods, learning outcomes and reflections on the experience. The intention is that this will provide deeper insights to the design process and ultimately prepare the reader for the final part of our research, where we discuss the game in relation to social play experiences.
Furthermore, in this chapter we continually refer to model 3, as an effort to make it clear exactly what part of our process we are presenting. Be aware that we make a few jumps back and forth on the chronological timeline to improve readability.



Model 3 | A chronological overview of the whole process presented in this chapter.

After a presentation of the final prototype, we start from the ideation phase, which is dedicated to our preliminary desk research on VR games and local multiplayer games, study of VR equipment, and studying and playing a large selection of VR games for the HTC Vive.
Next, we reveal how we have used the findings from our initial research to actively generate ideas for our own design. This part of the ideation phase involves methods of brainstorming and physical prototyping, which have been used to communicate ideas gained through the ideation phase.
Thereafter, we present earlier iterations of the prototype at key points in the development process to show how the digital prototype has evolved over time. This will prove to be useful later when we refer to the digital prototype at different stages of its development in relation to our conducted playtests.

As shown in model 3 we have conducted four playtests in total. The first playtest was conducted on the first playable prototype we created (state 1). Note that the second and third playtest were conducted in quick succession using the prototype at state 2, whereas the fourth and final playtest was conducted on the basis of the prototype in its final state.

Closing this chapter we will present the most influential design challenges in relation to creating our local multiplayer game for VR. These design challenges are identified through internal design reviews and playtesting and the solutions include notions from our presented design theory.

4.1 Gameplay in the final prototype

The game is a local multiplayer game for three to five players, where one player in VR plays against two to four other players. The game takes place on and above a group of tropical islands from where the player in VR – now a dreaded pirate – is trying to escape with an unearthed treasure. The pirate stands in a barrel being lifted towards the sky by hundreds of balloons, armed with a slingshot. The remaining players each control a monkey in a small airplane and must work together to stop the pirate's attempt to escape as seen on image 2.

The goal of the pirate is to either reach a zeppeliner, dangling high above the islands, or have all the airplanes neutralised simultaneously by shooting them, while the goal of the flying monkeys is to pop all the balloons to make the barrel and the pirate plunge to the ground.

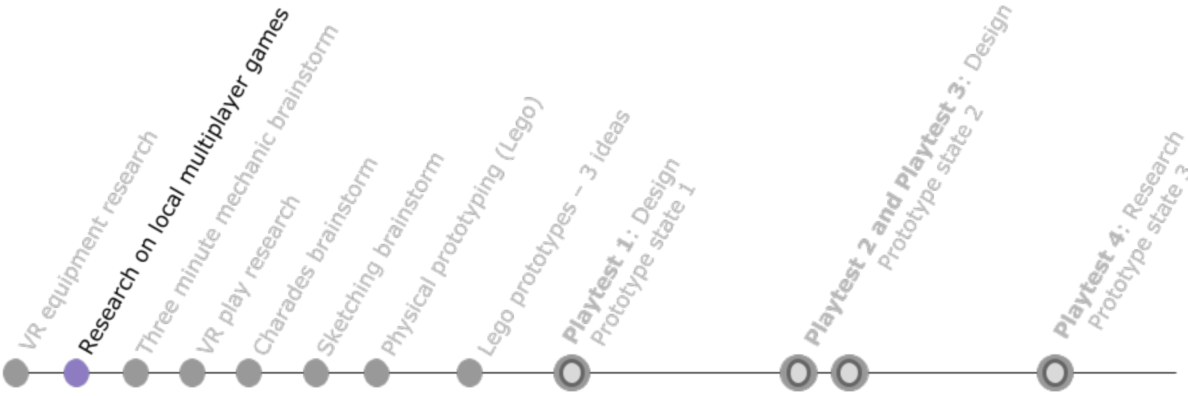
The pirate can shoot the airplanes by using the slingshot. When an airplane is hit, a balloon is released, prompting the airplane to move very slowly as seen on image 3. The monkeys must cooperate and set each other free, by popping each other's balloons. If, at any point, all airplanes have their balloons released the pirate escapes and wins the game.

Each time a balloon is destroyed, between one and three power-up crates are released from the sky. These can either be obtained by a flying monkey or shot down by the pirate. A crate will contain one of four power-ups: boost, invisibility, shield or smoke. Boost will make the airplane fly faster, invisibility sets the opacity of the airplane to five percent, the shield will make the airplane immune to the slingshot and smoke will burst out a thick smoke behind the airplane. Each power-up has a limited use and will be exhausted after a duration of use specific to each power-up.

Image 2 | Four airplanes flying towards the balloon ship. Screenshot from the final prototype.

Image 3 | A neutralised airplane "frozen" in the air. Screenshot from the final prototype.

4.2 Desk research on local multiplayer party games



To quick start the project, we looked into a bunch of classic party games as a part of our preliminary research. It is out of the scope for this project to map and analyse these games, but we have used them to seek inspiration for our own project. Some of these games include *Mario Kart 64* (Nintendo, 1996) and multiple games from the *Mario Party* franchise (Nintendo, 1998, 1999, 2000). Even though they are several decades old, they are still fun and exciting to play with friends today. We think that these games excel in creating short and focused gameplays with simple mechanics and controls. All of these examples accommodate both casual gamers with their simplicity and the low skill needed for playing, and more hardcore gamers by striking a near-perfect balance between skill, strategy and luck.

4.3 VR equipment research

In the preliminary stages of our project we attended a seminar called “Virtual Reality: Future Game Development” organised and carried out by Khora VR in their office space in Copenhagen. This was to get an introduction to the field of game design for VR and try out some of the various VR headsets on the market to see their respective strengths and weaknesses, as the choice of technology would shape the possibility space for us as game designers.

At the event we tested Samsung’s GearVR, the Oculus Rift DK-2, and the HTC Vive. All the demos we tried with both the GearVR and the Oculus Rift were based on a static player position (sitting in

a chair, to be consistent with the game avatar's posture) with no direct player interaction other than being able to look around and leaning closer or further away from objects or creatures inhabiting the virtual worlds. Needless to say, these demos posed obvious limitations on player interaction within the gameworld. However, the same cannot be said about what turned out to be every group member's very first experience with room scale virtual reality.
In the back of Khora VR's office space, in a small white tile room, a HTC Vive play area was installed, with beacons squeezed up into two opposite corners of the ceiling as seen on image 4. The beacons track the player's position warns the player if she is on the edge of the physical play area. One by one we were equipped with the HMD, and one by one we were blown away by the experience of practically stepping into a virtual space and feeling the almost somatic sensation of inhabiting another world.

After trying the HTC Vive, we were all certain that this was the technology that we wanted to work with in our impending design project. Not just because of its obvious and unmatched immersive qualities (at least on the consumer market), but also because of the freedom of movement and means of immediate interaction via handheld controllers; a technology which none of the other VR headsets offered at that time.

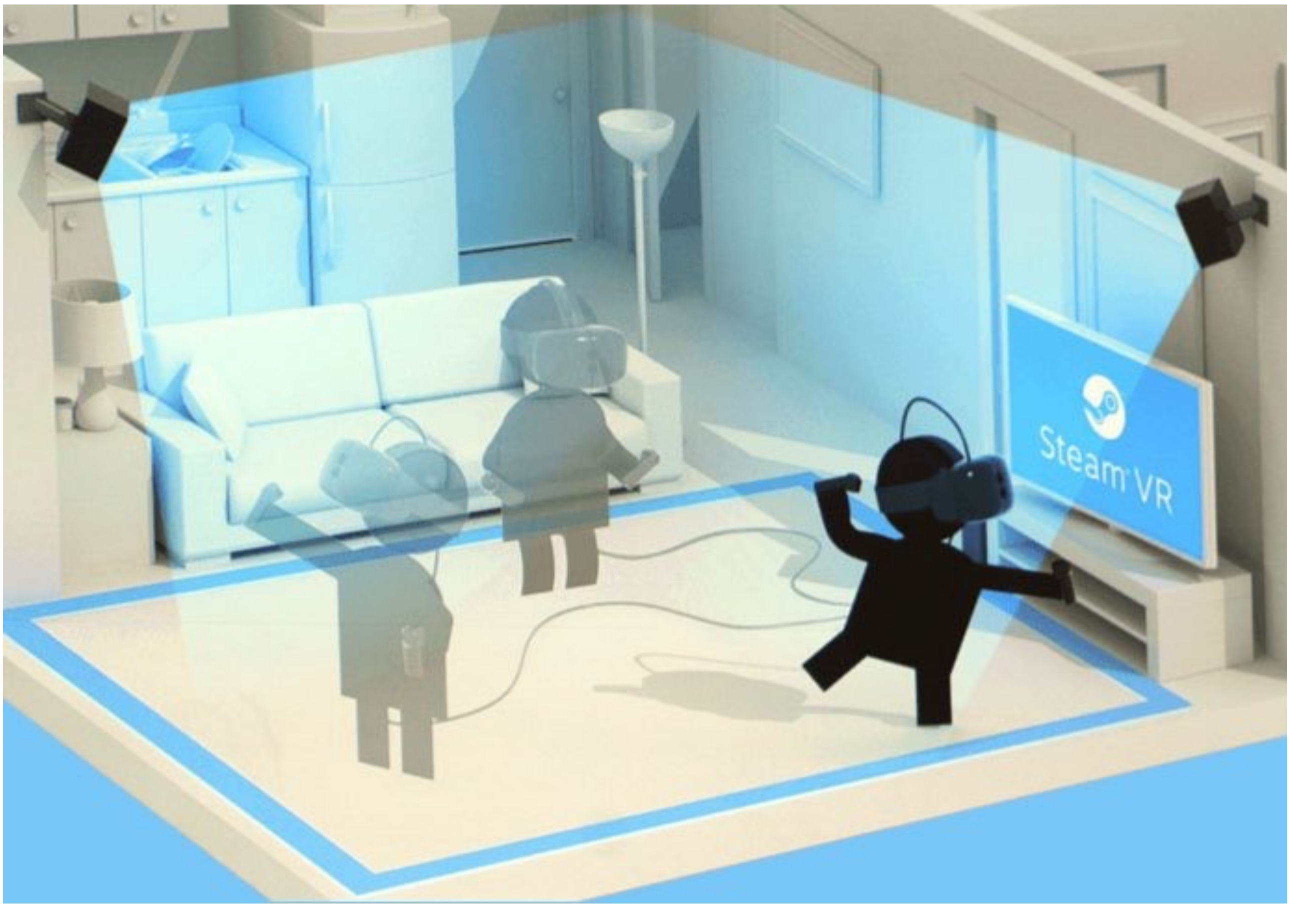


Image 4 | The Vive chaperone system uses two beacons two track the player inside the physical play area. Source: https://www.pixeldynamo.com/wp-content/uploads/2016/02/HTC-Vive-Chaperone.jpg

4.4 Studying and playing VR games

For the second part of our ideation phase, we went on to play and investigate approximately 30 different games available for the HTC Vive. We wanted to get familiar with the array of design possibilities and challenges within the medium and find some best practices, with the purpose of striving to utilise the full potential of the virtual reality medium. On top of that, this was also an opportunity to get more acquainted with the VR medium in general and the HTC Vive in particular.

We must note that there are pitfalls in our play research that make our findings hard to validate. First of all, as most of the games were no more than a few months old – if a final version had even been published – we studied these games while playing them for the first time. We are aware that this is not an optimal approach, as this prevents us from avoiding the powerful first impression and enjoyment of trying something new, which in turn makes it hard to keep an objective attitude towards the games. When you are encompassed in sheer play, you cannot at the same time have an analytic attitude towards the game and vice versa. How we should play games for analytical purposes is a question that is hard to answer.

According to Espen Aarseth (2004) there are a number of positions we should consider, when playing games as games researchers. For example: What types of players are we? Do we know the genre? Do we take notes during or after playing the game? Does the fact that we are bad at a certain game change our analytical basis for understanding it?
Although Aarseth's positions are related to analytical games research, and not game design, we still find these relevant to consider in relation to our process and approach. Likewise, as we take an exploratory approach, we do not seek to draw final conclusions regarding existing VR games, but merely an attempt explore the games to gain a better understanding of them and the medium.
In an attempt to separate play and analysis, we had a structure of first having every team member play a given game, while the other team members took notes, followed by a group discussion on the most interesting aspects of it. The game was revisited frequently to test out what had been discussed, in an effort to qualify the discussion even further.
Secondly, we did not get to learn any of the games intimately as any group member spent at most a few hours playing a single game. Analysing things you only partially understand makes it risky to draw final conclusions based on it – especially as we are trying to understand the VR medium in general and not just various games in isolation. Following our exploratory research, though, our

goal is not to draw eternal conclusions, but rather to scour a novel research area. Hopefully future research will be able to confirm, correct and build upon the findings we have made here.

The findings from our play research have been divided into five main points that relate to gameplay and game feel. In the next five sections we will touch upon subjects such as the weight of the controller and the connection between the virtual and physical play area, and hopefully provide some novel, and perhaps surprising, insights to the reader.

4.4.1 The power of haptic feedback

Haptic feedback is a mechanical stimulation that can be used to simulate the sense of touch. It was first introduced in video games in the late 1970ies and today it is implemented in most modern controllers and game pads. In video games today it is used in a variety of ways and not only to simulate the sense of touch. In some games it is used as a warning of low health, a notification that something happened, or to add a sense of urgency – like in the final moments of a penalty shootout in *FIFA* (EA, 2015), where the rather intense vibration of the controllers attempts to induce a feeling of stress and pressure in both the player taking the penalty and the goalkeeper. However, the uses of haptic feedback in VR games so far is not very varied. In the tested games, haptic feedback is used almost solely to simulate the sense of touch and create the illusion of substance and force conveyed by the virtual objects in the player's hand, e.g. the recoil of a gun.

In our experience, haptic feedback can support, but also break the player's immersion. This became clear to us after testing two bow-and-arrow games: *Longbow* (Valve, 2016) and *NVIDIA VR Funhouse* (Lightspeed Studios, 2016). The former was one of the first games we picked up, only to be blown away by the realistic feeling of the bow and arrow. We all agreed that it genuinely felt like shooting a bow. When you load an arrow onto the arrow rest, a small haptic feedback simulates the small bump between the bow and the arrow, indicating that it has been loaded. Small vibrations are also used when drawing the bow. The further back it is drawn, the more intense the haptic feedback is, indicating a stretched and trembling string. When the arrow is released a vibration indicates the release. All of this is done very delicately and the first few times the haptic feedback might only be subconsciously detected by the player. In *NVIDIA VR Funhouse*, however, the haptic feedback of the bow and arrow is simply not fine-tuned enough. You immediately recognise that the feedback is coming from the controller and not from "the bow" in your hand. This breaks the immersion and you are reminded that there is no bow in your hand, only a controller.

Other uses of haptic feedback is experienced in a Whack-A-Mole-like game, also from *NVIDIA VR Funhouse* (Lightspeed Studios, 2016). In this game the haptic feedback is applied to simulate the collision between an oversized hammer and a wooden table – or the moles, if the player is quick enough. Here, the use of haptic feedback makes the player automatically draw the hammer back on impact, instead of letting it unnaturally disappear into the wooden table. Hence, haptic feedback helps to not break the visual illusion; it guides the player to interact with the environment as she is used to from the natural world.

Based on our research, we argue that thoughtful application of haptic feedback – rather than thunderous and clunky rumbling, triggered at every given opportunity – works much better to keep the player immersed in the action being performed and as to guide the player in how to interact with the virtual environment. As stated above, bad implementation of haptic feedback can work counterproductively and break the immersion, as it reminds the player of the fact that she is merely wielding two plastic controllers.

4.4.2 The sound of real

It was by coincidence that we first realised how great of an impact audio has on the immersion in a virtual world. During one of our play sessions, one of the team members had simply forgotten to put on the headphones when starting up a new game, and was not in any way as impressed by the game as the other team members were. After a few minutes of play the mistake was discovered and when the headphones came on, the immersive feeling of the game changed drastically for the better. Similar to non-VR video games, audio in VR games is used in a variety of ways, e.g. to provide feedback on actions, to strike a mood with music or ambience, to enhance notifications and to mimic objects in the virtual world.

Where sound in VR games differs, though, is in how it weaves together with the visual side of VR and makes the simulated world come to life, to the effect of greatly enhancing the player's immersion in the virtual world. When being in VR you expect audio to come from the position of the source. For instance, if an object emitting audio is behind the player, the sound should resemble that the player has her back to the object. To create a realistic 3D sound image, you need either headphones or a surround sound system, with many audio speakers placed around the player. As most of the tested VR games have 3D sound, playing back the audio on one or two speakers would not really make sense for the player. The position and rotation of the players head would alter the audio from the game, as to simulate a 3D effect, while all audio would still come from the same position in the physical space, i.e. the speakers.

The lesson to note, is that sound can greatly improve the player's immersion in a game, if it is experienced with 3D sound. This entails the need to wear headphones, as this is the only way to achieve 3D sound in VR at the moment.

4.4.3 The weight of the controllers

One thing that took us by surprise in our research was the significance of the weight of the controllers. Never had we considered the role of the weight of controllers on non-VR game systems, but when playing VR games, this suddenly becomes apparent. Unlike non-VR video games, there is a close connection between the player's hands and the controllers, as the position of the controllers in the physical space is precisely tracked.

During our research on VR games we have seen the controllers used for mainly three purposes; in some games they work as hands, allowing the player to turn knobs, press buttons, pick up, place and throw things, load guns etc. This is seen in games such as *Job Simulator* (Owlchemy Labs, 2016) and *Fantastic Contraption* (Northway Games, 2016). Another use is as a “guiding wand” as seen in *Tilt Brush* (Google, 2016), where the player paints in a 3D space by moving the controller around. Similarly, in *GPU Cubes VR* (Omnipudding, 2016) the player guides millions of small cubes around. The third use is when a controller represents a virtual object and then the weight of it really starts to matter.

As a HMD-player, when the controller is represented by an object in virtual space, the object has a perceived weight based on the player’s real world experiences. In real life, holding a bow usually does not feel as heavy as holding a long steel sword. In virtual reality though, it does, because the weight of the controller never changes. Sadly, this breaks immersion, as it does not feel like you are holding a two meter steel sword in *Spell Fighter VR* (Kubold, 2016). On the contrary, in *Hot Dogs, Horseshoes & Hand Grenades* (RUST LTD, 2016) holding a handgun is more believable. Combined with haptic feedback when shooting, the player is in for a realistic shooting range experience. Based on what we have seen, objects do not feel real if there is a mismatch in the perceived object weight and the controllers weight. Therefore, it is our assessment that objects must imitate the weight of the controllers in order to support immersion in a game.

Image 5 | The shield from VR Pirate Trainer (I-illusions, TBA) is seen on the left. Screenshot from the game.

In its medieval version, a shield could be made of steel and wood, and would most likely weigh several kilos. In a VR version the perceived weight would be much too heavy. But, in the futuristic wave-based shooter *Space Pirate Trainer* (i-illusions, TBA), the player can equip herself with a shield (see image 5), that actually feels very real and authentic. The trick is, that the shield is composed of a thin frame around a semi-transparent plastic-like surface, and it is therefore perceived to be much the same weight of the controller, making it feel real in the hands of the player. The point here being, that objects traditionally considered heavy can be designed in a way as to appear lightweight and thereby resembling the weight of the controller.

Making objects appear to have the same weight as the controller in the player's hand has a big impact on the feel of using the object. We do not say that having a discrepancy in weights will ruin immersion, as we think that players can somewhat easily accept it without further questions, but it can definitely create uniquely convincing experiences when the weights align perfectly, as seen in *Longbow* (Valve, 2016) and several shooting games having handguns.

4.4.4 The physical limitations and moving in virtual space

The biggest challenge for VR interaction designers so far is arguably how to facilitate natural movement in virtual space. The HTC Vive is, for now, the only VR system that provides a few physical square meters for players to traverse. But what happens when the player wants to go beyond those few square meters? How can walking or running be simulated to move around in the entire virtual world? In our play research we have experienced two different methods – none of which enforce naturalism – and one alternative.

The first method of transportation in VR is teleportation, which is used in a lot of games. One common variation allows the player to point the controller at a spot on the ground, click a button and then the player is instantly moved to the desired spot. This is seen in games like *Fantastic Contraption* (Northway Games, 2016), *Out Of Ammo* (RocketWerkz, 2016), *Tilt Brush* (Google, 2016) and *Rec Room* (Against Gravity, TBA). Variations include quickly pulling the player towards the target – opposed to instant teleportation – as seen in *Raw Data* (Survios, TBA), showing the player the view from the desired spot before the teleportation happens, as seen in *Budget Cuts* (Neat Corporation, TBA), and using a warm-up timer, so the further the player wants to teleport, the longer she has to wait for it to happen, as seen in Spell Fighter (Kubold, 2016). The last example of teleportation we have found is automated teleportation, as seen in *#SelfieTennis* (Bandello, 2016). In *#SelfieTennis* you play tennis against yourself, which is only possible because the player is teleported back and forth between the sides of the net, when the ball is successfully hit to the other side. Teleportation does not mimic natural physical movement in any way, but as a player you quickly accept it as the way to move around.

The other mode of transportation we experienced, is what we internally named *hockey puck-movement*, as it feels like standing on a hockey puck being shot over ice. We were first introduced to this method in *Spell Fighter* (Kubold, 2016). The player uses the trackpad on one of the controllers to guide her movement in the virtual world. So, if the player presses the top of the trackpad, the player will move in the front-facing direction of the head. For all of the team members this method led to immediate motion sickness. Later, though, we tried similar movement in the multiplayer shooter *Onward* (Downpour Interactive, TBA), where it did not lead to nausea – even after an extended period of play. We suspect that gliding over the hilly landscape in Spell Fighter was what triggered the motion sickness, not the horizontal movement in itself. Likewise, no substantial amount of nausea is produced in *Google Earth VR* (Google, 2017), where the field of view is severely shrunken when moving around, ultimately reducing the sense of bodily movement.

An alternate way of getting around immersion-breaking unnatural movement is simply to leave out that mechanic. This is seen in games like *Brookhaven Experiment* (Phosphor Games, 2016), *Job Simulator* (Owlchemy Labs, 2016), *Space Pirate Trainer* (i-illusions, TBA) and *TheBlu* (Wevr Inc., 2016). In these games the entire gameplay takes place in a small area, not bigger than the physical space. Though, in all of the games, it seems like the player *should* be able to move outside the play area in the virtual world, there is no method for the player to move outside of the given area.

Another way to expand the playing field is to not only have gameplay around the player, but also above and below her. This is seen by the quadcopters – perhaps better known as drones – in *Raw Data* (Survios, TBA) that attack from the air at the same time as the humanoid robots on the ground, and in *Longbow* (Valve Corporation, 2016), where the player is standing on a castle wall, shooting enemies in different levels and occasionally leans over the brick wall to shoot enemies sneaking past close to the wall. Similarly, *Out of Ammo* (RocketWerkz, TBA) allows players to change the scale of the virtual world, making it possible to both be a soldier at street level as well as a colossal general with a view of the battlefield.

Summing up this section, we have found two general ways of moving around in a virtual world: Teleportation and hockey puck-movement. Best exemplified by the latter, there are both good and horrible ways to implement these. The specific gameplay in a game might help determine how to implement a movement mechanic, as we see by the automatic teleportation in *#SelfieTennis* (Bandello, 2016) and the sneak peek teleportation found in *Budget Cuts* (Neat Corporation, TBA). Though we have not seen this in any games so far, gameplay can also be designed to be confined to a small play area, not bigger than the physical space, making movement mechanics obsolete.

4.4.5 Positional tracking of head and hands

The VR medium as presented by the HTC Vive excels in one aspect compared to regular gaming on a 2D screen that provides a lot of exciting possibilities for game designers. That is, the extremely precise positional tracking of the HMD and controllers in the physical space. The tracking allows the game designer to map game mechanics to the bodily movements that you perform in real life. As stated earlier this does not include movement in the virtual space, but there are many other applications that are very well implemented.

Using the previous example of the bow and arrow in *Longbow* (Valve, 2016), we will see how the mechanics in that game resemble movements linked to using a real bow and arrow. Placing the arrow at the rest is translated to placing the two controllers next to each other and pressing and holding the trigger button. Drawing the bow is translated to keeping the trigger button pressed while moving your hands apart. The player aims in the same manner as a real archer would do, by turning the body so the arrow is pointing in the direction of the target. Letting go of the arrow to shoot is translated to letting go of the trigger button. Compared to using the left stick on a gamepad to aim, and pressing a button to draw and shoot, using the bow in *Longbow* (Valve, 2016) feels very real.

Following the definition of game mechanics as proposed by Sicart (2008), we notice something interesting with the HTC Vive. Actions like crouching and peeking is now inherent within the medium and not something that designers can turn on and off, if they do not want to limit player movement. However, designers can choose to facilitate these build-in ways of interaction by creating game worlds that either encourage or discourage these. A mechanic available by head movement is peeking as seen in the sneaky spy-game *Budget Cuts* (Neat Corporation, TBA). If you want to peek around a corner, you simply stick your head out – just like in real life. This can be compared to the peeking mechanic in the non-VR game *Alien Isolation* (Sega, 2014), where you use one of two buttons to peek either left or right. In the same arena, we have crouching, which is an important mechanic in the online multiplayer VR shooter *Onward* (Downpour Interactive, TBA). Again, crouching is just an effect caused by the playing bending the knees, so not a mechanic in traditional sense, but the levels are filled with objects not high enough to hide a standing person behind. Therefore crouching becomes a useful mechanic in order to survive in the game. Following these examples we argue that the build-in actions that each VR medium inherents can be considered mechanics if the gameplay affords and encourages these actions to be performed.

Being able to map mechanics to bodily movements presents exciting possibilities for game designers. In our experience mapping mechanics to real life movements can facilitate intuitive controls, unlike the somewhat irrational controls scheme of "press this button to perform that action". We argue that this is one very important aspect in supporting immersion in a game.

4.4.6 Summing up the VR design findings

In the research presented here, we discovered many findings that were related to both game feel and gameplay. Relating to the former was the use of haptic feedback, 3D audio and the considerations regarding the weight of the controllers. These three areas can, if used with care, deeply enhance the player's immersion in a game. Of findings relating to gameplay, we found that VR has the incredible power of connecting mechanics to real life movement compared to a standard use of controllers and keyboards in non-VR games. As there are not yet any standards for natural movement in VR, we found that creating gameplay in a limited playspace will eliminate the need for a movement mechanic.

4.6 Brainstorming, sketching and physical prototyping

Based on our research of existing VR and local multiplayer games and our initial experience of playing with the HTC Vive, we take the next step into the ideation process, where we seek to generate ideas for our own game. The following sections will present how we have used methods of brainstorming, sketching and physical prototyping to explore the possibilities of the mechanics we found inspiring during our previous research.

4.6.1 The three minute mechanic brainstorm

The purpose of the first brainstorm session arose on the basis of the technology in use and an obvious approach to start the process was to consider the HMD and the other players as two separate teams. At this point, it was not settled whether or not the teams would be cooperating or competing, however, the game would be played and perceived in technologically different ways, which naturally distinguishes the VR play experience from the other players' experiences. The technologically divided play experience provided us with a starting point for the first brainstorm.

In this brainstorm the challenge was to write down as many mechanics as possible on a whiteboard in a collective brainstorm within a three minute time limit (Appendix A.18), as seen on image 6. The purpose of the brainstorm was to generate as many ideas for mechanics for the HMD-player as possible, forcing ourselves to think of those mechanics that were less obvious. The three minute brainstorm created the starting point for the next part of the exercise, where we paired up all the ideas for mechanics with contrasting mechanics. This time the intention was to seek inspiration for creating an even greater contrast between the HMD-player and the other players.

While our research on existing VR games ultimately helped us narrow down the number of our preferred mechanics for the HMD, the three minute mechanic brainstorm initially made us expand our list of mechanics. Additionally, the combination of time pressure and being confronted with a big, blank whiteboard encouraged us to write down as much as possible, without considering the quality of the ideas yet. Giving ourselves the task of matching contrasting mechanics forced us to consider mechanics that we would not have thought of otherwise, because they would not be based on past experiences or references, but instead constitute less obvious choices. Another outcome of the brainstorm was that the list of contrasting mechanics opened a discussion of how the game could offer different objectives for the players, thus hinting towards a more competitive gameplay between the HMD-player and the other players.

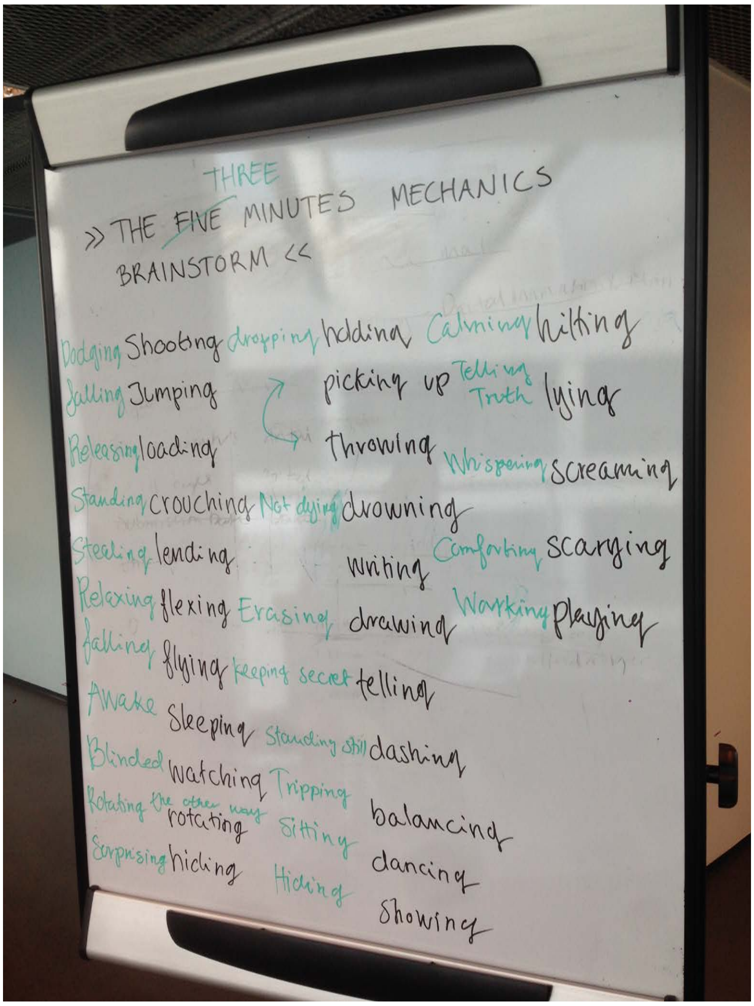


Image 6 | The whiteboard with the original and matching mechanics from the three minute mechanic brainstorm.

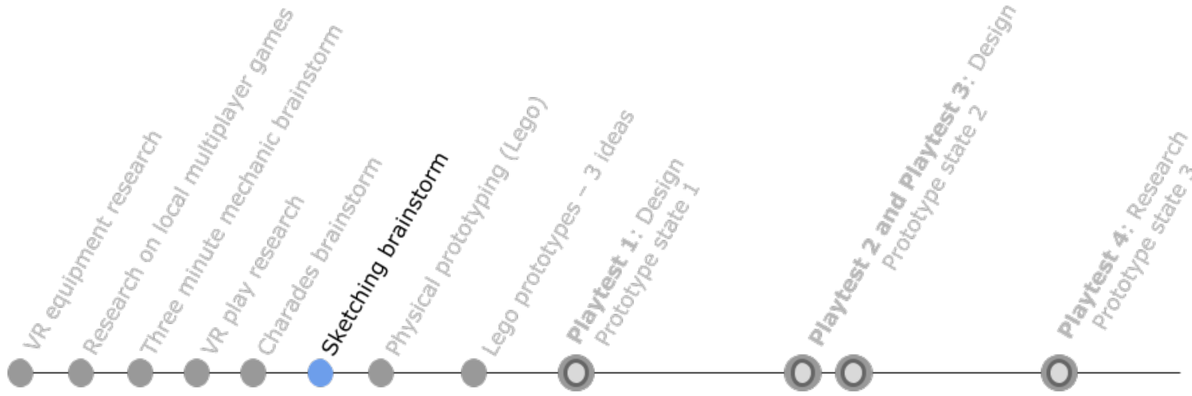
4.6.2 Charades brainstorm

The challenge of making a local multiplayer game, where one player is sensorily confined within a virtual space, involves designing for the physical space that includes all players inside and outside the HMD. For most games, and for the experience to be most optimal, the virtual space requires an emptied physical space of approximately eight square meters. This virtual space influences the visible physical space, which potentially can create a stagelike and artificial setup, by putting the HMD-player on display.

In the charades brainstorm one team member "took the stage" to mime a sentence, written on a small piece of paper, while the other team members guessed what it said. The sentence carried a mechanic and at least one character. This could be: "A fruiterer slams flies with a flyswatter" or "Little girl shoots off earwax with a rubberband" (Appendix A.16). The purpose of the charades brainstorm was to engage in a more abstract approach to the more conventional whiteboard brainstorm and explore how players would physically occupy the physical play space. As Fullerton (2008) aptly puts it, "[d]oing research means immersing yourself in a subject" (p. 156) and since it was our assumption that the body language of the HMD-player would have an impact on the collective play experience, it seemed obvious to use our bodies as tools for the brainstorm.

The charades brainstorm enabled us to visualise how the HMD-player would appear to the other players, and it was interesting to experience how the faux HMD-player created an experience solely through body language. The most valuable outcome of the charades brainstorm, however, was that it gave us valuable insights in relation to the physical constraints of the HTC Vive and which movements were possible. In our experience there were movements that would instantly make the HMD and the controllers clash, if they were performed "naturally".

4.6.3 Sketching brainstorm



The third brainstorm was another attempt to use visual aid to generate ideas for the game. Buxton (2007) explains that “[...] one of the key purposes of sketching in the ideation phase of design is to provide a catalyst to stimulate new and different interpretations. Hence, sketching is fundamental to the cognitive process of design, and it is manifest through a kind of conversation between the designer(s) and their sketches” (pp. 115-117). The intention of implementing sketching as a part of a brainstorm was to investigate how the visual dimension of a word or to an idea will affect our interpretation of it.

The sketching brainstorm started with each team member picking up three pieces of paper from three separate piles. The first piece of paper presented an existing *sport*, the second one revealed a *setting* and the third a *core object*. The objective was to come up with ideas for a game, using all three elements, within a five minute time limit. The sketches were made individually and each team member sketched their idea.

As an example, one team member was challenged to sketch a game idea out of the words “chess”, “on top of a skyscraper” and “scissors”. Although it can seem counterproductive to create a sketch in five minutes, when there is no obvious coherence, it was our experience that the sketches helped manifest a coherence between the three words. When sketching a skyscraper next to a scissor on the same piece of paper, at least one of them is not going to be true to size. The skyscraper will probably be slim to illustrate its natural proportions and the scissor will appear much larger in comparison to the skyscraper. The material, too, is now the same; the skyscraper is not made out of bricks or concrete anymore, and the scissor, even if it is drawn open and ready to cut, it will not hurt your finger, because it is made out of paper – just like the skyscraper. The point here is, that a sketch allows changes to be made to the attributes of an object, which provides new ways of perceiving it. Image 7 shows a sketch of a scissor ready to cut a chessboard in half, which might conflict with more general perceptions of what a scissor is physically able to do. If we had used an actual scissor and chessboard they would most likely have kept their natural attributes, and thereby limited the numbers of interpretations.
Overall the brainstorms provided us with an abundance of ideas, which was part of the intention of using these highly productive methods. The three minutes mechanic brainstorm helped increase the number of ideas for mechanics for the game, and the charades brainstorm gave us

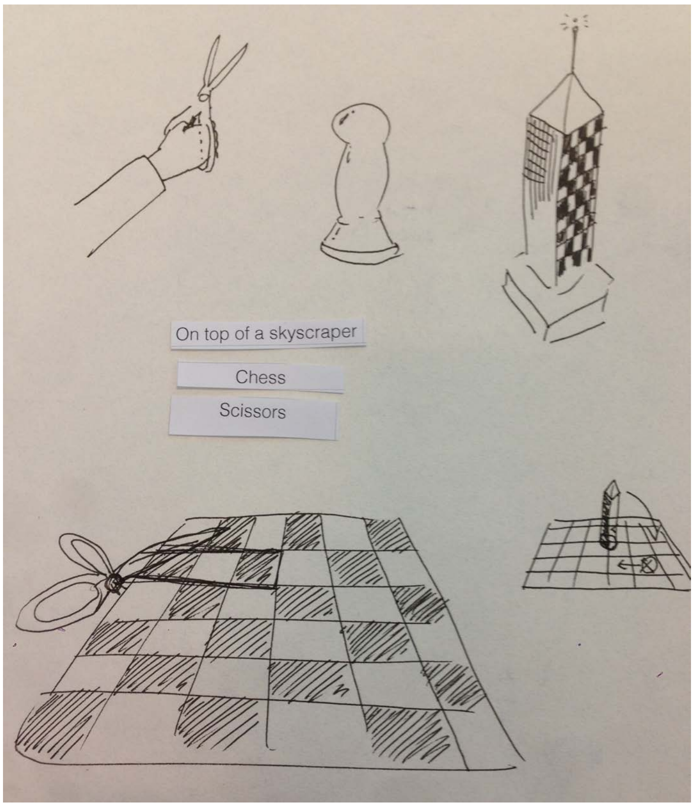
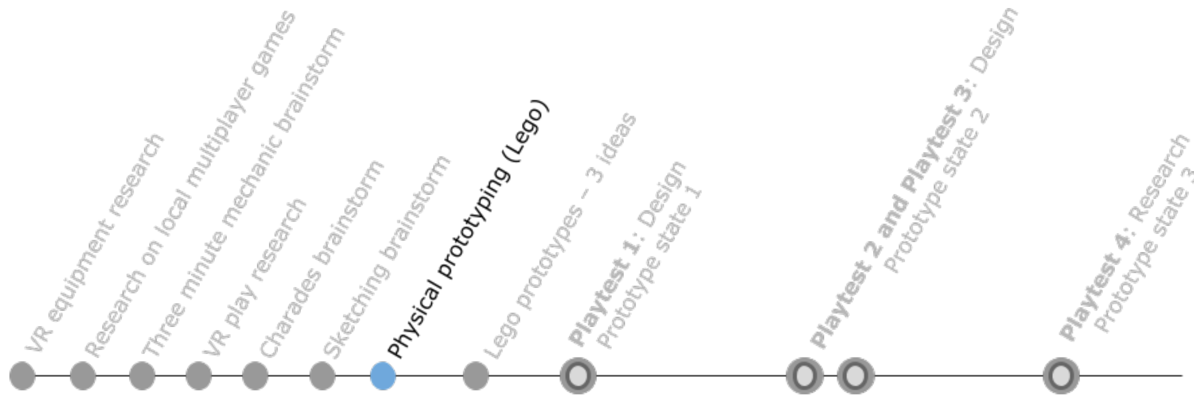


Image 7 | The sketch of the chess-scissor-skyscraper game idea.

hints towards the physical constraints of using the HTC Vive. The greatest gain of combining brainstorming with sketching has been the fact that sketches allow you to present the world as you perceive it – or how you want others to perceive it. When you present a sketch to others, it will be interpreted by others and this can inspire to whole new levels of idea generation.

In the final sections of the ideation phase of the design process, we will present how we continued to work with the ideas generated through our various brainstorms by making physical prototypes.

4.6.4 Making physical prototypes: Building with Lego



According to Fullerton (2008) when you have "become experienced at prototyping, you will find that this is probably the most effective way to create gameplay because it takes you right down into the mechanics and permits you to experiment in a way no other process can" (pp. 177-178).

Practice makes perfect, which is why we, with a modest experience in physical prototyping, are eager to engage in this practical method of creating and testing ideas for games.

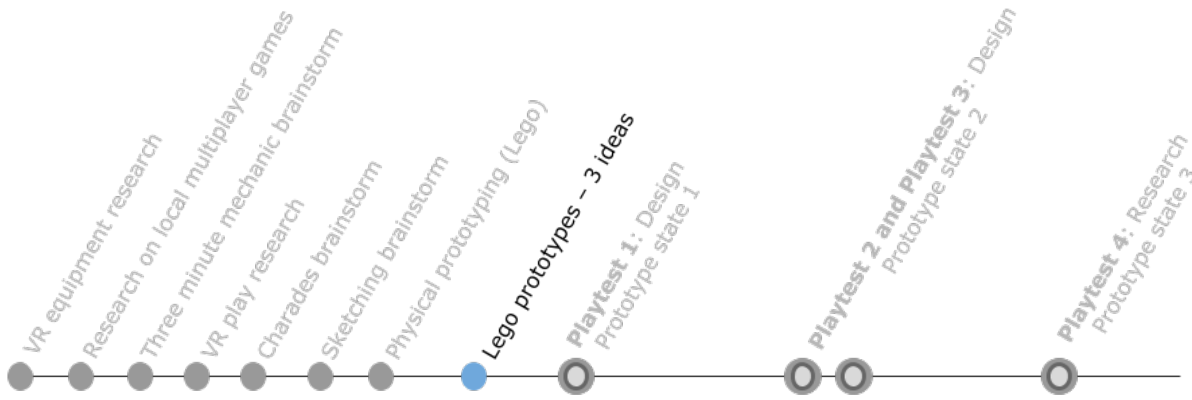
The exercise of building physical prototypes followed the same procedure as the sketching brainstorm – with each of us drawing a sport, a setting and a core object. This time, however, the idea had to be visualised in Lego, using bricks, figures and different kinds of Lego objects. Making physical prototypes in Lego was an experiment. We were curious to see what would happen if we build ideas where we could move physical objects around to see how the game would be played (Appendix A.15).

In contrast to the sketches, making prototypes in Lego was less open to interpretation. Due to the specific qualities of the objects, i.e. the lego figures and blocks, the Lego already carries certain connotations. For example, when a skater figure was chosen to help visualise an idea, it became a part of the prototype's design (see image 8). The interpretation of the character in this example will therefore typically include the connotations of a laidback and young type of person. Therefore we argue that interpretations are limited by the materials that we use.
Lego has the ability to bring out the inner child in everyone, and in our experience it was literally through "playing around with the idea" that allowed us to imagine how it would work as a game.

Image 8 | Three different outcomes of prototyping with Lego. The skater figure can be seen on the left image.

As the game ideas were played around with, storytelling became a natural part of the activity. We found that playing around with multiple Lego figures simultaneously in the designed play space brought attention to the local multiplayer aspect of the game. It was physically possible to tell how many of the players were active in the game depending on how many Lego figures were active. Since the ambition is to create a local multiplayer game that offers a high level of interaction between players, the experience of making physical prototypes helped bring focus to the players outside the HMD. Therefore, our main finding from these physical prototypes was that the other players should be provided with incentives to cooperate, while competing against the player wearing the HMD.

4.6.5 Making physical prototypes out of the most promising ideas



The rewarding experience of making physical prototypes encouraged us to continue to work with the method and using Lego as material to manifest our best ideas. Continuing with this method enabled us to easily dive deeper into and explore the strengths and weaknesses of our ideas.

The methods used in our ideation process and the findings from our research had so far helped us dispose some ideas while sustaining our interest in others. The most essential element that we wanted to implement in our next physical prototypes, was a bow-like mechanic for the HMD-player. This is on basis of our play research, that unveiled to us the power of mapping mechanics closely to their bodily counterpart, such as shooting a bow. In all of the ideas the bow has become a slingshot, a weapon that is used in much the same way as a bow. Another element was a team structure that encourages the other players to cooperate, while competing against the player in VR. From this point, the slingshot mechanic and the team structure became core elements for our next physical prototypes. The purpose of building physical prototypes from these constraints was to explore *if* and *how* these elements could be implemented in the same game idea. As Fullerton (2008) states you should "[a]lways ask a question, which will give you purpose, and have a hypothesis, which is a specific idea you are testing out" (p. 184). The questions that we wanted to explore through the prototypes, mainly concerned the cooperating players in relation to roles, mechanics and objective(s), because, as Fullerton (2008) states, "[a]ll you need to worry about are the fundamental mechanics, and if these mechanics can sustain the interest of playtesters, then you know your design is solid" (p. 175).

We had three ideas that we wanted to explore further by building physical prototypes in Lego (see image 9) and use them as a foundation to talk about the concepts behind. There are both similarities and differences between the ideas. Generally, all the ideas has the notion that the player in VR is playing against all other players and is equipped with a slingshot.
In the first idea, the HMD-player is standing on a front porch shooting critters that have to gather food around the garden. In the second idea, the HMD-player is in a treetop house shooting critters that are trying to cut down the tree that holds the treetop house. In the third idea, the player is in a hot air balloon, trying to defend it against flying enemy airplanes trying to take her down (Appendix A.14).

Image 9 | The Lego prototypes of our three best ideas.

Building with and talking about the Lego prototypes helped us realise that our three ideas differed in one key aspect, which was how they matched up the virtual play area with the physical play area. In all of the ideas the gameplay was limited to a virtual play area, not bigger than the physical space – which meant that all movement mechanics, such as teleportation, were not needed. But in the “front porch” and “treetop house” ideas the HMD-player could perceive the garden as an area that she *should* be able to enter and thus *want* to move to. Contrary, in the “hot air balloon” idea the virtual play area was smaller than the size of the physical area and it would be illogical to move outside of the barrel of the balloon ship, as the player would crash to the ground. Following Norman’s design principles (2013), the barrel of the balloon ship can be seen as a logical constraint containing the player within the physical play area, while still allowing her to move freely inside of it. With such a type of virtual play area, the player should not be concerned with the lack of a movement mechanic, as she would have no incentive to leave the barrel (unless, of course, the player is a cheeky game designer, who wants to “test” the game). Thus, we avoided having unnatural movement mechanics in the game.

There are also differences as to how the ideas used the space around the HMD-player. Imagine our HMD-player standing inside a metaphorical dice: In the “front porch” idea, the gameplay only took place on one side in front of the player; the “tree top” idea utilised all four sides around the player as well as the side below her; the “hot air balloon” idea was then the only one activating all six sides during gameplay, as the airplanes would be able to approach her from all directions.

Based on our experiences of playing with the ideas, along with the following discussion of the three prototypes manifested in Lego, we decided to move forward with the “hot air balloon” idea and convert it into a digital prototype. Like the other ideas, it included what we hoped to be a fun and intuitive shooting mechanic as well as asymmetrical gameplay where the player in VR competes against the others. Our main argument for choosing the “hot air balloon” idea was based on how it utilised the play area for the HMD-player – both in regards to having gameplay happen all around the HMD-player as well as to the logically constrained play area as described earlier. By following this idea we wished to create gameplay that harnessed the full potential of virtual reality.

Overall the three physical prototypes helped us answer the questions we needed to solve. However, the answers were very similar and the prototypes did not challenge our ideas in constructive ways, perhaps due to the manifestation attributes (Lego). It is therefore worth considering if the prototypes would have provided more nuanced answers if we had tested the ideas separately and manifested them through different materials. The physical prototypes, though, did help us to consider the spatial structures behind the ideas and how this would affect the somewhat similar gameplay. Using a different material than Lego could also have contributed with less predictable outcomes. Since the purpose of a prototype determines the use of manifestation attributes, it could have been interesting to explore e.g. the slingshot mechanic by experimenting with a real slingshot.

4.7 Going from physical to digital

Throughout our ideation phase we learned a lot and got many new insights through testing and discussion of equipment, games, ideas and prototypes. The brainstorms supported by different visual materials were many and varied. Combining brainstorming with other methods stimulated our thoughts and helped us explore design spaces in regards to VR as a medium as well as sparking ideas for new types of gameplay. Concerning the physical prototypes, it is our belief that we would not have been able to gain the same level of insights if we had not created these. Up until this point, ideas had only been expressed in words and sketches. The physical prototypes helped everyone in the group to gain similar views and better understanding of the ideas by allowing us to “play them out”. Later, it also provided a way to visualise the spatial properties of our ideas and allowed us to compare them.

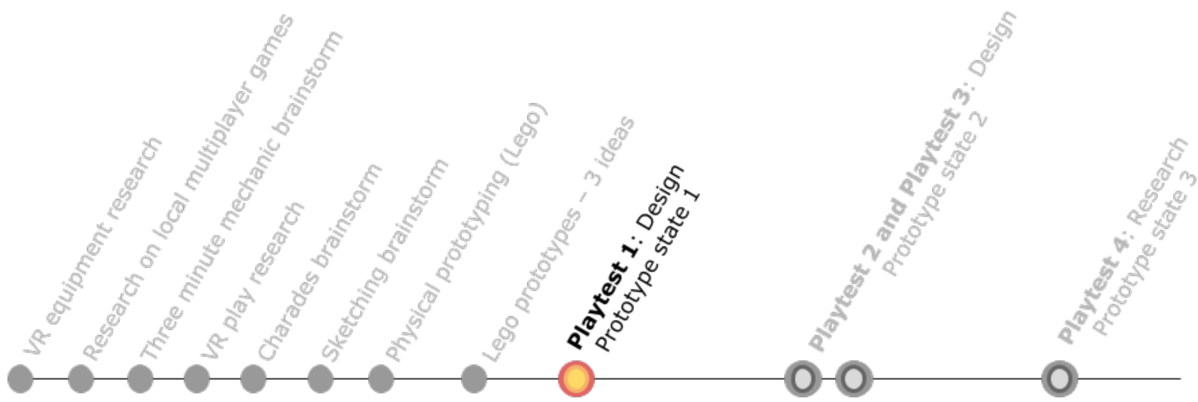
Based on our research and by using various brainstorming, sketching and prototyping techniques, we were able to come up with an idea for the final game. The next sections will present how the digital prototype has developed through iterations, starting from the first prototype and ending with the final prototype of the game that was presented in the beginning of this chapter.

4.8 The digital prototype

In this section we start out by roughly presenting the two earlier states of the prototype that was used for our first two rounds of playtests. Subsequently, we will give a more in-depth description of the final prototype and uncover the mechanics and the gameplay loops. This overview should create a foundation for our closing presentation of the main design challenges in the design process and how these were dealt with iteratively.

The development process of the digital prototype started in September 2016 and ended in January 2017, before the fourth and final playtest. During this process we had two rounds of official playtests as well as a few spontaneous and unofficial playtests that were mainly used to bug test work-in-progress implementations rather than e.g. exploring gameplay.

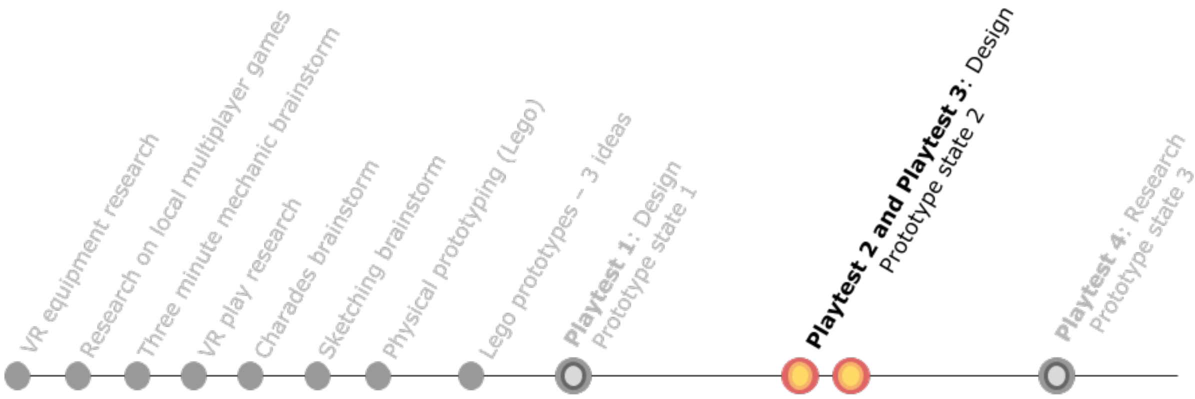
4.8.1 Prototype state 1



The prototype was initially playtested after only a few weeks of development and it was very primitive – both in regards to gameplay and mechanics as well as overall feel. Back then, the gameplay was set in a green valley encircled by a mountain range as seen on image 10.
At this very early state there were not any defined win conditions for either teams, but the goal was to pop all the balloons for the airplanes and shoot the airplanes for the balloon ship. The objective for the HMD-player was to shoot with the slingshot, but it was a very early implementation and the aim was inadequate. Consequently, it was a challenge to hit anything with the slingshot. At this point the other players had only two mechanics; steering the airplane and looking at the balloon ship with the camera. Similar to shooting the slingshot, the steering was very premature and the feel was somewhat terrible.
One notable difference in the gameplay compared to the final prototype, was that the revival of airplanes was wave-based. Whenever an airplane was hit, it crashed to the ground, and only when all airplanes were shot down they all respawned at the same random location in the level.

Image 10 | Screenshot from the prototype at state 1

4.8.2 Prototype state 2



At this state, we were a little over two months into the development of the digital prototype and the game was starting to take shape. After the first playtest a lot of bugs and challenges were discovered and up until this state a lot of these had been fixed and some changes to the gameplay had been implemented. The theme had also been changed to the final pirate theme. Most of our participants in the first playtest found it very entertaining to be in VR (despite the bad aim), but we wanted to make it just as fun to play as an airplane. This caused us to put a lot of focus on the controls and feel of the airplanes.
Of gameplay changes worth mentioning are *power-ups*, which had been added to the game, and included boost, shield and smoke as explained in section 4.1.

The mechanic for the pirate was still shooting with the slingshot, and not much had been done to improve the aim and feel as our main focus had been on the airplanes. The steering mechanic for these had been improved a lot to make it easier to navigate the level, and bugs had been fixed with the look at camera mechanic and a *free look* had been added.

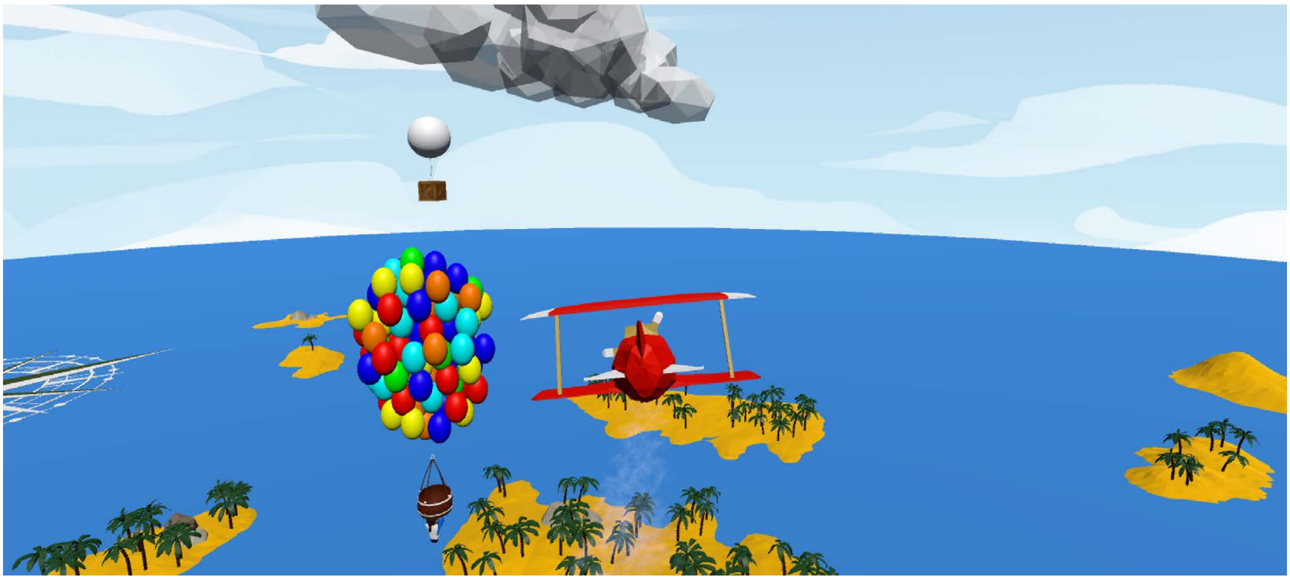


Image 11 | Screenshot from the prototype at state 2

We also differentiated the airplanes by using different colours and shapes for each of them. The main reason was to allow the other airplanes to differentiate between each other, but it had the added benefit of also allowing the player in VR to distinguish between them.

4.8.3 Prototype state 3 (final prototype)

In this section we describe the final iteration of the digital prototype, as it was presented at the fourth and final playtest. Some of the last changes were made not on grounds of our playtests, but to accommodate and test our hypotheses in the fourth playtest. These specific changes, and the reasonings behind these, will be presented in section 5.2. First, the setup and equipment for playing the game is introduced, followed by an exposition of the primary and secondary mechanics. Last, we will present the gameplay loops within the game.

4.8.3.1 Setup and equipment

The game handles two different teams of players on each their medium, leading to a bit of an extensive setup. The game runs on a Windows PC. The player in VR is using the HTC Vive system and the accompanying controllers. The other players are playing on a split-screen television using

Playstation 4 controllers. The sound is played back on a common speaker by using the mini-jack output on the HMD.

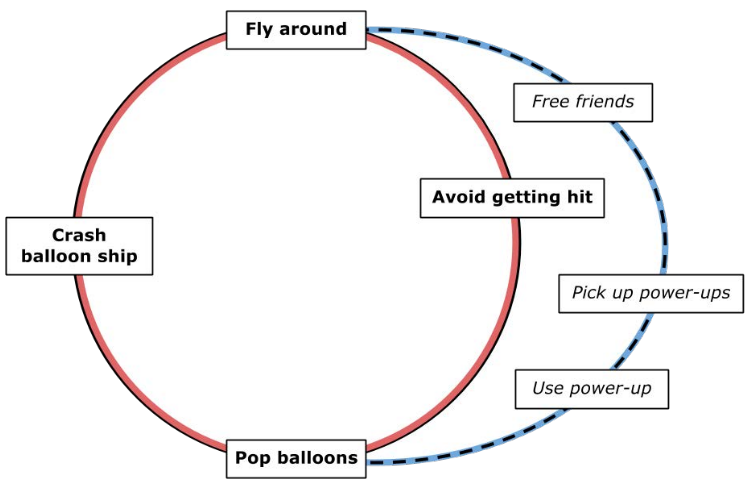
4.8.3.2 Mechanics

For the player in VR there are just two mechanics: *shooting* the slingshot and *turning* to locate airplanes. Shooting happens in three steps: loading, drawing and shooting. The slingshot is loaded by placing the two controllers next to each other, followed by pressing and holding the trigger button. The slingshot is drawn by moving the controller with the projectile away from the other controller. There is a threshold for drawing that must be exceeded in order not to fail the shot, which is indicated by haptic feedback when this has been reached. Releasing the trigger button will release the projectile and make the shot.
We argue that turning, in this game, is a mechanic because the airplanes can appear from all angles and turning is therefore a necessary action in order to detect the airplanes. We argued in section 4.4.5 that regular actions inherent in the VR medium can be seen as mechanics if the game encourages the use of them. Comparing turning and peeking in our game, we see that peeking would have no effect on the gameplay, while playing without turning would make it almost impossible for the pirate to win.

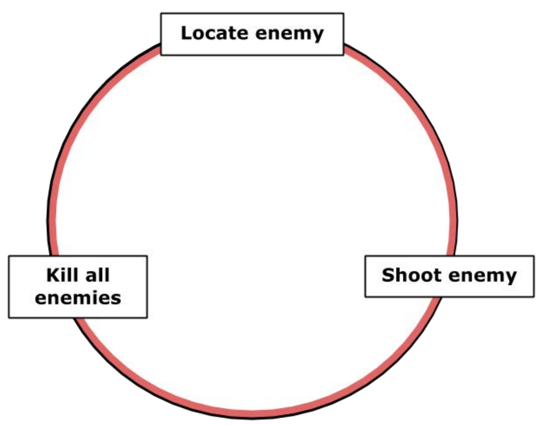
The mechanics for the airplanes can be divided into primary and secondary mechanics as explained in section 3.2. To reach the goal of popping all the balloons the only necessary mechanic is *steering* the airplane around, thereby constituting a primary mechanic. The steering will also be used both to avoid being shot down and to free the other players. The secondary mechanics are not necessary to stop the pirate, but can be used to make it easier. Those mechanics include *braking*, *use power-up* (if available), *rotate camera*, and *look at the balloon ship*.

4.8.3.3 Gameplay loops

To provide a better overview of the possibility space in the game, we now present the core and secondary gameplay loops for the pirate and the airplanes respectively. The core loop relates to the actions of the primary mechanics that have to be repeatedly performed to progress in the



Model 4 | The core (red) and secondary (blue) gameplay loop for the airplanes.



Model 5 | The core gameplay loop for the pirate in VR.

game, while the secondary loops provides variety and expands gameplay (Sicart, 2014). The core loop shown in model 4, shows that the airplanes' ultimate objective is to pop balloons until there are no more left, while avoiding getting hit by the slingshot. The secondary loop includes freeing the other airplanes that are stuck, as well as picking up and using power-ups. The pirate has less mechanics, directly related to reaching the end state, and therefore only a core loop. As shown in model 5, the pirate will repeatedly have to locate the airplanes and shoot them down, until either the goal has been reached or all airplanes are "frozen" at the same time.

4.8.4 The most essential design challenges

The following presents six design challenges, which we have worked with iteratively through the development process of our digital prototype. Each design challenge was identified through internal design reviews or playtesting. The purpose of this section is to give the reader an extensive description of how we have dealt with the design challenges during our development process. This will provide deeper insights into the design issues and also clarify the reasonings behind our design choices. This presentation does not cover all the challenges that have influenced the final prototype. Instead, those presented here are selected due to their essential contribution to the creation of our hypotheses or their extensive influence on the final prototype.

4.8.4.1 Simple controls for the airplanes

As mentioned before, we want the controls for the airplanes to be simple. The reason for this is related to the party game genre and the atmosphere we want to create with the game. By using fairly simple controls it is the intention that the least skilled players will experience a flat learning curve and that the more skilled players will find enough challenge in the game not to get bored.

During the playtests we found that the participants, who were not used to flying games, were challenged by the controls of the airplanes. "When I first got it [the controller] in my hand, I'm like: 'I have no idea how to control this' and I was looking for my speed" (Appendix C.03i, Lotte, 46:33). Although several of the participants from playtest 2 and playtest 3 had trouble getting used to the controls, the level of difficulty was justified. "I think there's a nice balance, because sometimes it seems easy, but other times you fuck up and you can't control the airplane [...] If it was too easy to control, it wouldn't be that much fun" (Appendix D.03i, Adam, 51:31 [own translation]). Another participant stated that the simple controls matched the game well, and it corresponded with the simple mechanic of the HMD-player (Appendix D.03i). The more experienced gamers in playtest 2 and playtest 3 requested being able to do more with the airplanes. "I thought it was a shame that you couldn't loop [the airplane]" (Appendix D.03i, Christian, 52:02 [own translation]). It turned out that our attempt to adjust the controls to the participants with less experience in flying games, affected the more skilled players' experience of flying. "Dodging is the important part, because you have to dodge. But dodging, here, feels hacky, because you're just doing left and right [...] in many flying games you have barrel roll or something [...] so it feels like skill. And I didn't feel cool dodging" (Appendix C.03i, Pierre, 39:56). Although some of the participants struggled with the controls most of them felt like they got better flying the airplanes, and others said they got a hold of it (Appendix C.03i; Appendix D.03i). The playtests also showed that the participants, to a certain extent, accepted the fact that controlling the airplanes was challenging. However, since controlling the airplanes is not a goal in itself it should not dominate the experience of playing.

From a designer's point of view, it is crucial to determine a proper level of difficulty that complied with the broadest sample of participants as possible. It is therefore a warning signal when a participant is confused about how to use the controls. This can be related to Norman's (2013) notion of discoverability, including the feedback in the game. The feedback of having smoke coming out of the airplanes signifies movement. The fact that the participant was looking for a speed button could however indicate that the feedback was not strong enough. One solution was to intensify the smoke to signify that the airplane is moving by itself. It should be mentioned, though, that we actually did design and try out several types of permanent boost mechanics. Unfortunately, in regards to gameplay, permanent boost is a challenge for the balance of the game, and as it also adds extra controls, the permanent boost was later laid to rest again.
We experienced that the participants' difficulties with controlling the airplanes diminished as we got to work on the sensitivity of the controls. In combination with their statements as well as many unofficial tests of the controls, we believe that the final prototype have struck a fine balance between responsiveness and manageability of the airplanes.

4.8.4.2 Dealing with downtime

The ambition of creating gameplay with a minimum of downtime for the players was not a requirement from the beginning, but something we became aware of when making physical prototypes. Here, we became aware of the different players' level of activity in the game and found that in order for all players to stay active in the game, the players outside the HMD, should have incentives to cooperate. When playtesting the digital prototype, we found interesting and contradicting opinions between the participants.

The rule that forced players to wait until respawn caused frustration for the participants already in playtest 1, where downtime for the airplanes was experienced as a boring part of the game (Appendix B.03i). Similarly, in playtest 2 when the participants were asked about their least favourite part of the game, the response was immediate: "when I was dead" (Appendix C.03i, Jessica, 36:07). Three of the participants said that they liked controlling the airplanes more than playing in VR, but in the same breath they also expressed that they wished they could respawn right away (Appendix C.03i). The participants in playtest 3 did not experience downtime as a problem and one participant even stated that it was a fair consequence of being hit by a slingshot projectile and that it increased the sense of teamwork. "It would be boring if you just respawned all the time, because then you don't have that team spirit, and it is pretty fun to look at the last player" (Appendix D.03i, Adam, 53:30 [own translation]).
Downtime was a big downside to controlling the airplanes in playtest 1 and playtest 2, and some of the participants' statements came without compromises as they expressed that the game was only fun to play as long as they were active in the game (Appendix C.03i). On the contrary, none of the participants in playtest 3 expressed that downtime was an issue to them. Instead they mentioned benefits of having determined waiting periods. However, during playtest 3, one participant was observed glancing out the window while he waited to respawn (Appendix D.02).

This could imply that his attention to the game broke for a short period of time – probably without him being aware of it.
The participants were asked directly what could be done to either reduce or completely remove downtime for the airplanes. In playtest 2, a participant made a reference to a another local multiplayer game: “Like in Stikbold! [Game Swing, 2016]. You can do something in the meanwhile. [You can] shoot [and then] help the others” (Appendix C.03i, Pierre, 53:17), and another participant suggested that players, when they had been hit, could place extra power-ups in the sky (Appendix D.03i). The last idea was supported by another participant who suggested; “it would be fun if you turned into a seagull or something” (Appendix D.03i, Adam, 57:29 [own translation]).

The design challenge, in this case, was to find consensus in the arguments and implement a solution that accommodated most of the participants’ needs. As presented in section 4.1 we modified the gameplay, so instead of players crashing when hit by the pirate, a balloon is released, and they are almost “frozen” in the sky. The airplanes are not uncontrollable, but both speed and steering is severely limited. While dangling in the air, the player can try to locate a player in proximity that can come to her rescue. This requires both an in-game activity such as locating, but also a social activity such as convincing that player to free her. Also, the player can go on a hunt for nearby power-up crates, as well as try to annoy the pirate by being in the way. So, instead of removing players momentarily from the game and creating downtime, we have instead provided them with alternative objectives until they are released by another player.

4.8.4.3 Issues with top-down attacks

Working with the VR medium leaves the possibility of creating gameplay that takes place all around the player. This unbounded virtual space caused design challenges more laborious than first anticipated.

During our observations in playtest 2 and playtest 3 it is evident that the participants, when wearing the HMD, feel defenceless when the airplanes perform top-down attacks on the balloon ship. One participant found herself caught in a dilemma when she realised that she shot her own balloons on the balloon ship, when she tried to defend herself from airplane attacks coming from above (Appendix C.02). A similar situation occurred in playtest 3, where a participant called out;

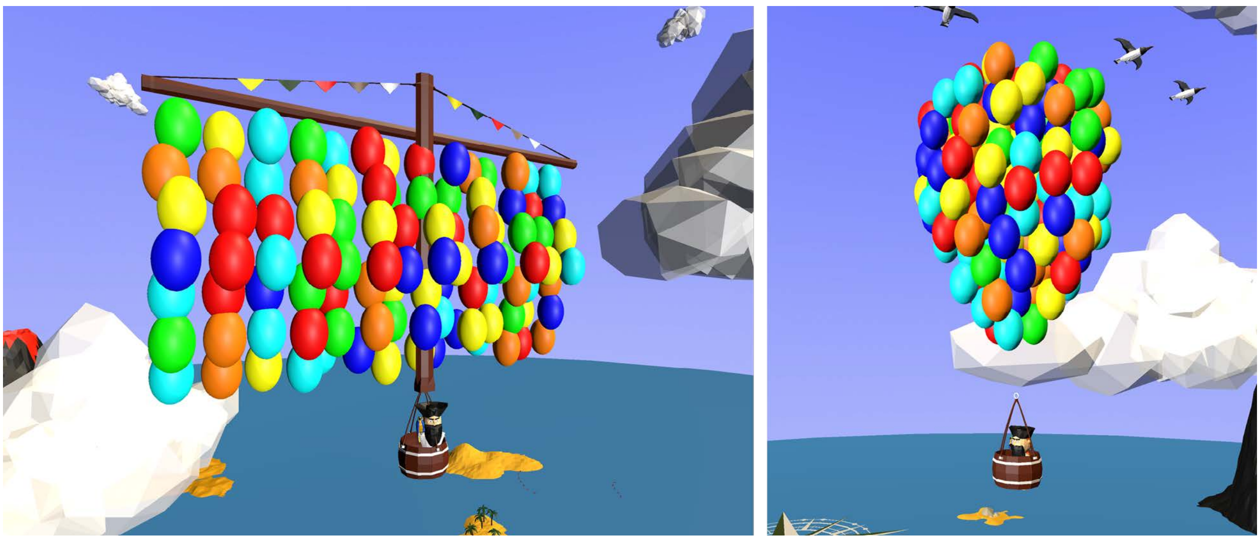


Image 12 | On the left, a screenshot of the sail shaped balloon configuration that was tested. On the right, a screenshot of the balloon shaped balloon configuration from the final prototype.

“I don’t want to shoot my own balloons” (Appendix D.02). In the group interviews in playtest 2 and playtest 3 the participants expressed their frustrations of feeling defenceless in situations of top-down attacks. “What I don’t like [...] is that there is clearly a winning strategy [...] if they come from the top you cannot hit them and that is frustrating” (Appendix C.03i, Pierre, 38:32). The other participants agreed and explained that “it feels like a hopeless situation” (Appendix C.03i, Tori, 45:01).

Based on our findings from the observations and group interviews from the playtests, we found that it was crucial to solve the issue of top-down attacks on the balloon ship. As an attempt to find a sophisticated way of preventing these attacks, we designed new configurations for the balloon ship’s balloon layout. The example on image 12 illustrate a different take on the formation of the balloons.
The sail of the balloon ship consisted of 150 balloons with a ship mast in the middle and a crossbar at the top. The intention of the sail formation was to create a solution that left no blind spots for the HMD-player, while supporting the pirate theme of the game. We evaluated the sail formation through an internal design review, but found that it was still possible to find blind spots from the HMD-player’s perspective. Furthermore, the flat configuration of the balloons meant that the airplanes could no longer pop a large number of balloons in one attack, which had been mentioned as a pleasurable feeling by a majority of the participants in all playtest. “I think popping the balloons was quite satisfying” (Appendix C.03i, Pierre, 35:34).

Image 13 shows how we continued to work with different designs for the balloon ship – mainly focusing on the formation of the balloons. All the alternatives that we were able to come up with created angles where the airplanes were invisible to the HMD-player, thus insufficient to solve the issue.
We kept facing the same issues with the different formations of the balloons and decided to turn to our playtests to search for ideas on how to solve the issue. During the group interview from playtest 2, one of the participants came up with an interesting suggestion for how to prevent the

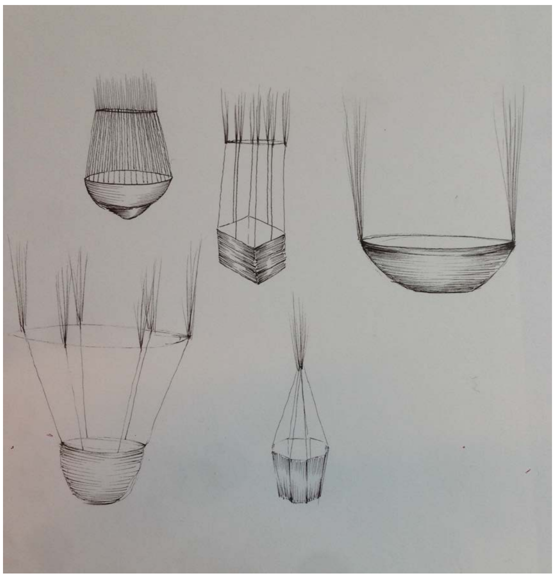


Image 13 | Our sketches for alternative designs for the balloon ship.

airplanes from performing top-down attacks on the balloon ship. “Have something there on the top [...] like fabric or something, so you can only fly in from the sides and not the top” (Appendix C.03i, Tori, 45:43). This became the turning point as we instantly were able to combine this idea with previous ideas of turning airplanes into seagulls.

Our solution to prevent top-down attacks is a flock of seagulls circling just above the balloons as seen on image 14. When an airplane hits a seagull, the balloon is released and the airplane is “frozen” – just like when hit by the slingshot. Even though the seagulls do not prevent top-down attacks completely, they severely limit the chance of a successful one. The rule still allows bold players to dive into the mutable configuration of seagulls, which can add tension to the game as well as balancing the game towards a more equal gameplay.

Image 14 | Seagulls circling above the balloon ship to minimize airplane attacks from above. Screenshot from the final prototype.

4.8.4.4 The pace of the game

Based on our findings from the playtests, we are able to state that the pace of the game is extremely important to the experience of the game. As a design challenge, the pace of the game relates to the actual speed of the assets in the game as well as the length of each round of play.

From playtest 2 we learned in the group interview that the participants would like to increase the speed, both for the airplanes and the balloon ship. “I would also like to go faster in general, so everything is faster” (Appendix C.03i, Pierre, 43:29). The participant explained that the speed would also improve the controls and the airplanes’ abilities to dodge projectiles coming from the

sling shot. “I would like to be more StarFox basically” (Appendix C.03i, Pierre, 43:51). The same participant also suggested making the rounds shorter, because this, together with an increased pace, would create a more challenging and vibrant gameplay. “If the match in general was shorter everything would be more frantic [...] also it would feel more intense [...] It moved so slowly that I didn’t feel in danger as a plane” (Appendix C.03i, Pierre, 55:34). Increasing the speed for the airplanes might also require changing the pace of the balloon ship and a participant suggested a dynamic solution, where the pirate could increase the speed herself during the game: “If you have a lot of balloons you go faster, if you have fewer you go slower. It is just an extra mechanic, but there could be something where you can – while you are waiting for the planes to get in – blow up balloons and put more up” (Appendix C.03i, Tori, 58:10). All the participants agreed that the game should feel more hectic and have shorter rounds, and their suggestions were to make both the airplanes and the balloon ship faster.
Another balancing aspect to consider, when increasing the speed of the airplanes, is that the pirate should still be able to hit the airplanes. We needed to make sure that the slingshot was improved as well to account for the faster airplanes. This could e.g. be improving the aim, speeding up the slingshot projectiles, or perhaps adding aim-assist.

In relation to Elias, Garfield & Gutschera (2012), who emphasise that shorter lengths of the playtime is better fit for party games, complies with the findings from our playtests. As an attempt to meet the participants’ requirements, we have continuously worked on increasing the pace of the game. One challenge was to push the speed limit of the airplanes without making them too difficult to control for less experienced players. The speed of the airplanes also needed to be balanced with the HMD-player’s chances of aiming and hitting the airplanes with the slingshot projectiles. Fortunately, improving on the slingshot was a focus point in our development process after the second round of playtests, so even with the more rapid airplanes it still got easier to hit them. Another challenge was to find a suitable length for a round that correlated with the participants’ expectations for a party game. The speed of the balloon ship is controlled by how many balloons there are (the more the faster) and the speed of the balloon ship and length of each round is thereby dependent on the players’ performances in the game.

4.8.4.5 Aim and feel of the slingshot

The slingshot imitates a real weapon and it is important that it feels like shooting a real, physical slingshot. As presented earlier in section 4.4, a designer can work with elements like haptic feedback, perceived weight and sound to give the illusion of holding and shooting a real slingshot. In order to keep players engaged in the game we find it very important that the slingshot has a nice feel and is intuitive to use.

Based on our observations and the following group interview in playtest 1, it was evident that we were not finished designing the slingshot’s shooting mechanic. The feel was off as well as the aim and it was difficult to get enough power on the shots. Several participants agreed that it was hard or very hard to use it, and that was caused by several factors. One participant realised that the angle between the controllers had an impact on the direction of the shot rather than the direction that he looked in (Appendix B.03i). Another participant figured that his shots were too far off to the left and compensated by drawing the slingshot into his chest to make it shoot straighter, but "then you don't shoot as hard, because you can't draw it back far enough" (Appendix B.03i, Magnus, 33:25 [own translation]). Subsequently he explained that he preferred drawing it closer to his right eye. Additionally, one participant was afraid to bump the controllers together when loading the slingshot (Appendix B.03i).This made us realise that the placement of the objects in the hands, ie. the slingshot and the projectiles, matters and must be positioned as to avoid this.

Between the first and the second round of playtests we did not improve much on the slingshot, as our main focus was on improving the controls and feel of the airplanes. This meant that much of the critique was repeated. Several participants agreed that the aim was of, and some even requested an actual aim or crosshair on the slingshot. In playtest 3 we discovered to our own surprise that the slingshot could be fired rapidly like a machine gun. This started with one participant and spread out as other participants saw it as a beneficial tactic. The participant stated that: "If I hadn't been able to shoot really fast, I would not have done that. Then I would have probably attempted to aim better" (Appendix D.03i, Janus, 41:45 [own translation]). There was not a general feeling among the participants that it was a nice feature being able to shoot fast, but rather something they did because it was possible. It was hard to aim, so rapid fire seemed like a good tactic. After the second round of playtests we shifted our focus back to the slingshot and started working with the aim, the haptic feedback etc.

To solve this challenge we once again turned to Norman (2013), who emphasises the importance of feedback, in order to notify the user how they interacted with the design. There are several steps in the process of using the slingshot, and the user should be informed of the progression all the way. Likewise, Norman talks about the use of natural mapping and since we are trying to recreate a slingshot, and not some "typical control scheme of a slingshot", we should accommodate "natural" use of it. This, among other things, entails that players should be able to aim with either their left or right eye by positioning the drawn rubberband in proximity to one of these.

We ended up making several changes and improvements to create a better feel and aim for the slingshot, as well as prevent the rapid firing that we saw in playtest 3. To prevent players from bumping the controllers together when loading, we repositioned both the slingshot and the projectile after the first playtest, and we have not since experienced it to be an issue. To stop the rapid fire and force players to aim on each shot we added a cool-down timer – not more than a few tens of a second – after each shot has been fired and until a new one reloads in the player's hand. With the improvements, players were hitting airplanes much more often and the players were impressed with the haptic feedback as it added a nice feel to the slingshot. This was right until a left-handed player came along. This broke our design, as some of our implementations that should help players, acted counterproductive when she played.

From all of our playtests, it was evident that the participants needed some kind of feedback on the various steps of shooting, ie. loading, drawing and releasing. A lot of this was achieved with the use of haptic feedback that had the added benefit of enhancing the feel of the slingshot. When

loading the slingshot the player puts the two controllers close together and press the trigger button. We added visual cues as to when the slingshot and projectile were close enough to load. When in range, the projectile gets bigger and the surface changes from semi-transparent to opaque. When the trigger button is pressed a little shake is sent through both controllers. When drawing, there is a minimum distance to draw as to not drop the projectile upon firing. When the threshold is exceeded, the controller carrying the projectile starts to rumble – resembling a stretched rubber band. In an effort to resemble a real slingshot, the further back it is drawn, the harder the rumble. The projectile is fired by releasing the trigger button and a big final shake is sent through both controllers.
It was more challenging to improve the aim of the slingshot. We realised that when drawing, players generally want to draw it close to one of their eyes so the rubber band is stretched out between this eye and the slingshot, allowing them to aim, as seen on image 15. The problem is that the player has the HMD on her face, which prevents the controller from getting in proximity of her eye. In our design we have added a compensation, meaning that when the projectile is released it will first be rotated eight degrees clockwise around the position of the slingshot before the shot is fired. This compensates for the player having to position the projectile "too far" to the right of her head. As we observed in the unofficial playtest this made the aim even worse when put into the hand of a left-handed player. Fortunately, with a few changes, the projectile now rotates eight degrees towards the head, rather than always clockwise, to suit both left- and right-handed players.

Image 15 | A man aiming a slingshot by positioning the projectile near his right eye. Screenshot from the YouTube video How (I) to Aim a slingshot by the user LIGHTGEODUCK.

4.8.4.6 The sound barrier

The final design challenge was one of the most surprising discoveries. Since our desk research showed that sound was crucial to players' immersion in the virtual world, we expected that this would also be the case with this game. But since our study of other VR games did not include any local multiplayer games we had no previous experiences to turn to in this regard. It was therefore a surprise to find that wearing headphones when playing in VR obstructed the sociality of the play experience.

Our findings from the playtests show that there is a trade-off between including headphones as a part of the VR playing experience and creating common sound for all players. It was very evident that some players communicated more with the other players, when wearing the HMD, than others. The participants did not engage in actual conversations, when wearing the HMD, instead they mostly made sporadic outbursts into the room. One participant stated that he found it highly entertaining to multitask in VR (Appendix C.03i), where the majority of participants did not speak to the other players. To our surprise, we did not experience that the participants listened in on the other players, when wearing the HMD, because they were too focused on being in the virtual world (Appendix D.03i).

Our expectation that sound would be important to the experience of playing in VR, in terms of orientation and feedback, was confirmed by the participants. In playtest 2 the participants explained that they in general miss auditive feedback, both as an indicator of what was happening in the game and as a way to be rewarded. In relation to the feeling of shooting airplanes with the slingshot, one participant stated that "[...] it was so difficult to hit someone with a rock, and once you do it, it's only 'ding'. [...] It should be exploding, because the balloons are rewarding, because of the sound" (Appendix C.03i, Pierre, 47:57). The participant found it more rewarding to pop balloons with the airplanes than to shoot down an airplane in VR because of the sound. In his perception this was an unfair balance considering how much effort the HMD-player had to invest in taking down airplanes (Appendix C.03i).

The playtests showed that sound was extremely powerful in terms of giving feedback to the HMD-player. It was also a way to stimulate the participants' experience of playing in VR and reward them for performing well in the game. During both playtest 2 and playtest 3 we observed a participant removing the headphones while playing in VR (Appendix C.02; Appendix D.02). In the group interviews, when the participants were asked to elaborate on why they chose to remove the headphones, the participant who intentionally removed the headphones in playtest 2 explained that she would have preferred not having the headphones on "because it feels very enclosed the whole VR thing [...] so when I could hear I feel more like 'okay, I'm a part of what they are doing'" (Appendix C.03i, Jessica, 1:09:10). One of the participants who did not remove the headphones could relate to the experience. "I also think one of the most fun thing [...] is when you can be like 'haha, I got you', and if I know I actually got you, Tori. I am missing that a bit if I am totally closed off, because that is, at least for me, the most fun thing" (Appendix C.03i, Lotte, 1:09:52). The same participant also suggested making the rounds shorter as an attempt to make the HMD-player feel more connected to the other players (Appendix C.03i).

The other participant, who was observed removing the headphones, was less aware of her actions. She explained that she took off the headphones from one ear as an impulse, because she felt more comfortable not being totally enclosed in a virtual world (Appendix D.03i). The participants who did not remove the headphones explain that they did not do so, because it violated the rules of the game. “It feels like I am cheating when I overhear something and it bothered me that, when I was sitting here [controlling an airplane] when I played, and I didn’t know if I could communicate with my team or not, because I didn’t know that the person [HMD-player] had headset on so I was like ‘oh shit, can I say that?’” (Appendix C.03i, Tori, 1:09:25). The fact that some participants – whether it being intentionally or unintentionally – removed the headphones, indicated that there was a communicative constraint that needed to be investigated further.

The playtests show that the participants did whatever they could to follow the rules we set for the game. It was a crucial reminder that we not only orchestrated what was happening behind the screen, but also in front of it. The participants who removed the headphones did so in order to feel less enclosed in the virtual world and more connected to the other players. The other participants stated that it to them would have felt like cheating if they would have eavesdropped on the other players’ conversations outside the HMD. Because of its damaging impact on immersion, we personally were not fond of the idea of removing the headphones. But, to accommodate our hypotheses and afford a more social play experience, we have ended up playing back sound on a common speaker. This will be elaborated in the following chapter.

5 Findings from the design process

In this chapter we highlight the findings from the design process that focus on the social play experience of the game. In other words, the purpose of this chapter is to bring focus to the specific design findings that relate directly to our research question: Whether it is possible to create a social and shared multiplayer experience using VR. Some of the findings relate to the presented design challenges, while other findings will be introduced for the first time here. As mentioned, the process up until the final playtest provided the basis for the formation of our three hypotheses, which we then tested in the final playtest to be able to deduce specific elements that either support or contradict our assumptions. In this chapter we will first present the findings that have helped us create the hypotheses for the final part of our research. Second, we reveal the changes that were made to the prototype prior to the final playtest. With these changes we attempted to create the most socially including version of the game as well as test our hypotheses, by means of which it will also be clear what elements support a socially including VR game.

5.1 Forming the hypotheses based on design challenges

In the following we will present the findings that we extracted from our first three playtests, specifically related to the social interactions or the lack thereof. Subsequently, we will present the three hypotheses that were constructed on the basis of these findings, which we seek to validate in our final playtest.

5.1.1 Lack of communication between players

During the first three playtests we rarely saw that players communicated with each other across the metaphorical barrier that was created around the player wearing the HMD and headphones. In terms of actual verbal communication, the players who partially removed the headphones would not always partake in two-way verbal communication per se, or even respond to what the other players were saying to the room during gameplay. However, afterwards, most of the participants expressed that they did so solely because they wanted to hear what the other players were saying; not necessarily because they wanted to be able to eavesdrop on what the other players were conspiring to do in the game, but rather as to not feel excluded or miss out on things being said in the room.
Our first hypothesis corroborate our belief that unhindered verbal communication between the player wearing the HMD and the other four players controlling the airplanes will be important for

the encounter to feel social and shared. Given that not all of our participants knew each other beforehand, we would argue that standing completely visually and audibly isolated in a room either full or partially full of strangers or distant acquaintances would make some people feel tense. Enabling oneself to hear what “is going on” in the room could arguably ease this tension. On the basis of our findings we created the following hypothesis (H1):

It is important that the players inside and outside the VR headset are able to communicate with each other.

5.1.2 Player distinction in the game

During our very first playtest, all airplanes looked exactly alike. This was a result of prioritising our focus on testing the main mechanics and basic gameplay ideas, and not spending a lot of time making 3D models. Nevertheless, the participants in the first playtest stated that they wanted to be able to tell who was who, by different colours or even by having names on the airplanes (Appendix B.03i).

Throughout our entire design process, the four airplanes have become visually more and more distinct from each other – namely in relation to shape and colour. This was because it became more and more important to us, as we wanted to enable players to easily distinguish between each other – initially, only with the four players controlling the airplanes in mind. However, in the light of the overall scope of the report, we later started to focus on different implementations that we could incorporate to help make the player wearing the HMD feel more connected with the players “outside” the VR headset.
Hence, based on what we found out during our first three playtests, we believe that, for the play encounter to feel more social, players should be able to easily identify an in-game avatar to the player controlling it. Therefore we formed a hypothesis regarding the player wearing the HMD being visually obstructed from seeing who controls which airplane. Our belief is that making it possible for players to easily see who is who, will present a better basis for a social experience, as this would enable the HMD-player to communicate directly to or with an opponent that she engages with in the virtual space. For example, if one airplane is close to the balloon ship, the HMD-player would be able to see who it is and engage in conversation with the specific player. Therefore we formed the hypothesis that it is important that the player wearing the VR headset is able to not only distinguish between the avatars, but even identify a given avatar with the player controlling said avatar (H2):

It is important that the player in the VR headset is able to identify a given player with his or her in-game avatar.

5.1.3 The significance of eye-to-eye connectivity

The HMD cuts away the player's ability to interpret the non-verbal interpersonal communication in the social encounter, as it restricts her from seeing the gestures, body movements and facial expressions – the body language – of the other players.

Additionally, the HMD might limit the HMD-player's use of body language. Even though the headset does not physically hinder the player from performing expressive body movements or gestures per se, it could be argued that this would require a player to feel present in the room with the other players and less engulfed in the virtual space. Furthermore, making gestures, where the direction of the receivers is uncertain, and to people, whom you cannot be certain are even looking, would arguably make most people feel embarrassed.

Another example, which also concerns the visual link between the players, comes from a player controlling one of the airplanes. One of the participants in playtest 3 stated that he did not notice the player wearing the HMD, when he was controlling one of the airplanes. He expressed that he would like to have a better view to the HMD-player, as this would enhance the party-like feeling in the game (Appendix D.03i). The importance of visual connectivity between players will be investigated in the final playtest on basis of our last hypothesis (H3):

Not being able to see other players, makes it harder to be included in a social game experience.

The findings from our conducted playtests show that communication between players as well as being able to distinguish the players from each other in-game, are two valuable aspects of a social play experience. Furthermore, the significance of visual connection between the HMD-player and the other players is a design challenge that requires special attention. This finding, however, is interpreted more freely compared to the two first, which have been more openly expressed by the participants during the playtests.

Altogether, the findings from our design and development process of the game have contributed with notions that, in short, are presented through the following three hypotheses that we want to investigate through a final and fourth playtest.

5.2 Final implementations prior to the final playtest

In the light of the design challenges, regarding social play from our design process, we made some changes to the game and the setup for the final playtest. The changes made to the prototype involve aspects that relate to the presented hypotheses, in order to test these and gather information for the upcoming discussion. As a reminder, the hypotheses are as follows:

Hypothesis 1

It is important that the players inside and outside the VR headset are able to communicate with each other.

Hypothesis 2

It is important that the player in the VR headset is able to identify a given player with his or her in-game avatar.

Hypothesis 3

Not being able to see other players, makes it harder to be included in a social game experience.

5.2.1 Removing the headphones and using common sound

In relation to the first hypothesis we wanted to investigate how the game encounter would change if we did not audibly impair the HMD-player with headphones, but instead had all game sound come from one common speaker in the room. However, this design decision came with a cost. As stated in section 4.4.2, sound is of huge importance when it comes to letting yourself immerse in virtual reality. However, when designing a local multiplayer party game, we believe that the sociality of the encounter is more important than one player's level of immersion in the virtual game world. It can therefore be argued whether or not this local multiplayer party game exploits the full potential of the VR medium, but it is our belief that it there is a necessary trade-off between the immersive qualities of VR and the social experience of a local multiplayer game.

5.2.2 Names above the airplanes

As a result of our observations in playtest 2 (Appendix C.02) and group interview in playtest 3 (Appendix D.03i), we learned that the distinction of the airplanes helped to create a better basis for more social dynamics and interaction across the mediums. For example, the player wearing the HMD was able to talk directly to the other players "on the outside" more easily. We wanted to

Image 16 | The name above the airplane to improve player identification. Screenshot from the final prototype.

explore this further, as a part of our second hypothesis. To explore our second hypothesis we chose to implement player names above each airplane, as seen on image 16, prior to the test; an implementation that was actually mentioned as a possible improvement in our very first playtest (Appendix B.03i), but one that we, up until this point, did not not prioritise. Our hope was that this would improve the social experience, especially for the otherwise rather isolated player wearing the HMD.

5.2.3 Compensating for missing visual connection between players

We expected the third hypothesis to be investigated through the implementations that relate to hypothesis 1 and 2. The hypothesis that the HMD-player feels less included in the game experience, as a consequence of not having visual contact to the other players, is something that the VR medium entails and not an active design choice. It was our belief that by enhancing aural communication it would to some extent compensate for the lack of visual connection between the HMD-player and the other players. Additionally, keeping the rounds short, was also a wish from one of the previous playtests (Appendix C.03i).

6 Discussion

Based on our first three playtests, we formed three hypotheses that focus on the aspects that we believed were essential elements for the game and the encounter to have inherent social qualities. We wanted the game experience to feel “local” and “social”, meaning that we want all of the participants to feel equally socially included in the encounter. To explain it in Goffman’s (1961) words, we want the participating players to have a sense of togetherness centered around one shared focus of attention: our game. In the following we will present what we learned from the final playtest and discuss the three hypotheses in relation to Goffman’s theory on social interaction to either confirm or contradict our previous assumptions, as well as tacitly ask new questions to inspire future research on the topic.

The discussion is divided into three parts based on the hypotheses, which are then subdivided into more focused subtopics. The three hypotheses are very much interrelated, as they treat the same overall problematics of “sociality and virtual reality”. Therefore they can sometimes seem overlapping, as the scope of this project is completely limited by our design and the findings based thereon. The discussion has a deliberate focus on the communication between the player wearing the HMD and the other players. The internal communication between the players controlling the airplanes will therefore not be discussed unless it relates to the overall sociality of the encounter.

The following discussion is based on the observations and in-depth interviews that were conducted as a part of our final playtest. The playtest was conducted with only four participants, as one of the invited participants failed to appear for the playtest.

6.1 Discussion of the first hypothesis

It is important that the players inside and outside the VR headset are able to communicate with each other.

6.1.1 It is fun to talk

Based on our subsequent individual interviews with the participants, we found that being able to hear the other players in the room played a big role in relation to both how the game was played and the enjoyment of playing the game. As an example, Pablo stated that the ability to hear the other players talking and laughing, made the experience more enjoyable: “[I]t would make a world of difference if they had been playing in a different room, or if they had been quiet throughout the whole thing. But hearing them laugh and hearing them joke about how hard it was to maneuver the planes; that’s what makes the experience more pleasurable” (Appendix E.06, Pablo, 11:40). Also, the fact that the game is played locally and that the player wearing the HMD

can hear the other players, is what makes the players feel like they are "playing against another human being, not just some bot, or artificial intelligence" (Appendix E.06, Pablo, 06:24).
All of our four participants stated that they were aware of the other players and some even tried to listen to what they were saying while wearing the HMD. However, they would rarely communicate themselves. Similarly, the other players would rarely talk directly to the player wearing the HMD: "I wasn't really that concerned with what the pirate was doing. I was more concerned with 'how can I avoid getting shot down'" (Appendix E.06, Pablo, 03:29).
Both Line and Martin stated that they felt that the communication between players, especially bantering, was a big part of the game experience and playing local multiplayer games in general. However, Line felt that her communication was limited by her need to focus on the controls of the game: "I think that if I had gotten better at the controls faster I would start to interact with people directly corresponding to the colour [of the airplanes] because that's a part of playing, right? [...] but I think because I also spent a lot of time learning the controls, that wasn't really my first priority" (Appendix E.04, Line, 09:57).
So, even though the players could hear what the others players were saying, arguably potentially posing a threat to their concentration and in-game commitments, the participants expressed that they were either actively focused on the game and its controls instead or simply not disturbed by it. As an example, Stelios stated: "I was aware of the other side [the other players], but they didn't really distract me" (Appendix E.05, Stelios, 03:52).
However, we were also attentive to the fact that byplays between the three participants playing as airplanes could occur; somewhat leaving the participant wearing the HMD as the only participant left in the main encounter. As an example, the three participants playing as airplanes could have a high level of communication with each other during a game round, as the team structure affords working together and coordinating attacks, subconsciously ignoring the HMD-wearing participant's physical presence and what this participant says to either the room or directly to another participant. However, we did not observe any clear instances where any participants were ignored or excluded as a result of a byplay. On the contrary, as mentioned before, one participant stated that he enjoyed the fact that he could hear the other players talk, without him taking part in the conversation (Appendix E.06).

Throughout all of our playtests we have seen that participants have mostly successfully cut us (as observers) "out of the frame" of the encounter. We believe that this is due to the explicit playtest setting and because they knew that we were there to observe them interact with the game. Even though we – as the designers of the game – were present within what Goffman (1961) calls the encounter's "interaction membrane", the participants would almost always ask the other participants, if they had questions regarding the rules of the game or the controls.
Likewise, during the last playtest, we saw that the participants, when struggling with the controls, would ask the other participants for advice or guidance (Appendix E.02). We would argue that this type of interaction during a play session falls under what Goffman (1961) calls a "subordinate side-encounter" (p. 19). As an example, we saw that Stelios and Pablo engaged in a momentary subordinate side-encounter when Stelios, while wearing the HMD, asked openly to the other participants whether he could shoot his own balloons, whereafter Pablo responded that he in fact could (Appendix E.02). They were able to sustain a subordinate side-encounter simultaneously

with the main one, dissociating from their in-game roles as opponents. This tells us that although the participants are engrossed in the game activity, they are still aware of the social structure of the encounter itself. For example, it could have been regarded as rude or awkward if none of the other participants had responded to Stelios question. In other types of encounters, for example around a dinner table, a participant can ask an open question to everyone at the table but then direct the question with eye contact or body orientation. However, because Stelios is blindfolded by the VR headset and therefore cannot covertly direct a question to one participant in particular, he would have to direct his question to a particular participant by calling out his or her name. This would undeniably have sent the signal to the group that Stelios only wanted a response from this person, ultimately excluding all other participants. Nevertheless, we saw that – even though Stelios' communicative conditions had changed – the other participants still showed that they were aware of both his presence and their own social responsibilities within the encounter.

6.1.2 Personal relations matter

In the beginning of our fourth playtest we saw that the participants rarely communicated with each other across the mediums, and when they did, the participant wearing the HMD would seldom say anything to the other participants that required a response. More so, we observed an exchange of exclamations between the participants without direction or a targeted recipient – and mostly one-way communication. Later, specifically when the last two participants were playing with the HMD, we saw a drastic increase in communication between the participants. Although it was still predominantly one-way exclamations and reactions, it seemed as if the communicative barrier between the mediums had become thinner.

We observed that personal relationships between the participants played a major role in the amount of communication during gameplay. For example, Martin and Stelios communicated considerably more when either of them were wearing the HMD (Appendix E.02). Our observations show that Martin and Stelios communicated more than the other participants, conceivably because they knew each other better than the others, whereas the remaining participants had previously only made brief acquaintances. As Martin stated during the subsequent interview, the fact that he knew Stelios beforehand made it easier for him to tease or make fun of him (Appendix E.03). Similarly, Stelios mentioned that he specifically "trash talked" Martin for the same reason (Appendix E.05, Stelios, 04:20). Supporting our claim, the two remaining participants, namely Line and Pablo, almost did not communicate with the other players, while wearing the HMD. Using Goffman's (1961) notion of transformation rules, the fact that Stelios and Martin knew each other beforehand became an official and avowed element of the situation, transforming the encounter. In this case, Stelios and Martin friendship was an externally based factor that penetrated the interaction membrane of the encounter. The abovementioned observations bring us to believe that there would generally have been more communication across the mediums if all the players had been a close group of friends. This claim is supported by Line, as she stated that it would probably have been "a little bit more intense" and with "a lot more yelling" had she played with a close group of friends (Appendix E.04, Line, 10:29).

As a side note, we are aware that our presence as three non-participating observateurs, within the boundaries of the encounter, can also have an effect on how the participants interacted during the playtest.

As we also mention in the design findings in chapter 5, we believe that the fact that not all of our four participants in the final playtest knew each other beforehand could create a feeling of discomfort or tension, specifically for the HMD-player who is visually and audibly isolated from the other players. Therefore, we hypothesised that enabling the HMD-player to still be able to hear what is being said in the room could help avoid this tension. Generally we did not observe any signs of discomfort or uneasiness during the final playtest, nor did any participants mention that they felt uncomfortable or uneasy in the subsequent interviews. Apart from the participants being able to hear what was being said by the other participants, we believe that this is in part also due to the short length of each round. We will elaborate on this in the discussion of the third hypothesis.

6.1.3 It is hard to juggle two realities

Some participants would not always feel that they were able to comprehend what was being said among the other players. Even though they could all see the potential advantage in hearing what the other players would conspire to do within the game, the participants had a hard time acting upon the information in a calculated manner, because they would be either too engrossed in the virtual world or struggling with the controls (Appendix E.04; Appendix E.06). Yet, we found examples where the player in the HMD used some information in the game that was audibly intercepted from the room. In the following discussion of our second hypothesis in section 6.2.1, we go more in-depth as to what information was overheard and how the players used it.

As previously stated, the general level of communication between the participants wearing the HMD and the remaining participants was limited. However, when asked about it, all participants expressed that they did not feel any problems with communicating with the other participants if they wanted to do so. Nor did they feel communicatively limited by the HMD and the fact that they could not see the other participants. However, the participants expressed that communication was difficult because of the combination of being visually isolated from the room and mentally immersed in the game. In other words, they did not feel that their communication was limited by the visual constraint posed by the HMD, but much rather simply by their own capability – or lack thereof – to both comprehend the world they were seeing and mind the social structures they were inevitably a part of outside the HMD; all while also wanting to performing satisfactorily within the game. For example, Martin stated that he, despite having previous experience with the medium, still felt that it demanded a lot from his attention and broke his concentration when he communicated with the other players: “I felt that I got worse at the game, if I had to concentrate on communicating with people outside the virtual reality-world” (Appendix E.03, Martin, 03:41). (As a side note, it can be argued that players with more experience with the medium would have an easier time comprehending the insisting and amazing nature of virtual reality, thus being able to juggle their attendance in both the real and virtual world).

This tells us that it could generally be regarded as more challenging to communicate with people in actual reality, while being engrossed in a virtual reality. However, Martin stated that he would rather uphold a level of communication with his friends, supporting the idea of shared enjoyment in local multiplayer games, rather than exclusively focusing on winning the game (Appendix E.03).

6.1.4 No incentive for communication

Another reason for the lack of communication across the mediums, could be that there simply is not a clear reason or incentive for the participant wearing the HMD to communicate with the other participants; other than when they want to trash talk or in other ways intimidate their opponents. As Stelios stated, he “didn’t find any other thing to communicate [about]” when he was playing as the pirate (Appendix E.05, Stelios, 04:45).

The observations of Martin wearing the HMD show that he addressed the other players with questions several times, without getting any responses (Appendix E.02). However, the observations show no signs of Martin reacting negatively to the lack of attention from the other players. As mentioned before he explained that he could not concentrate on both playing and communicating (Appendix E.03). The fact that Martin asks the other players direct questions without getting any responses, can be seen as a failed attempt to form a communicative byplay with some of the other players. Because of the fact that the HMD-player has no eye contact with the other players or no safe way to know which direction to speak, the attempts to communicate fall short and the result is often a one-way communication from the HMD-player to the other players.

Contrary to playing with the HMD, there are undoubtedly plenty of information to be communicated between the participants playing as airplanes; e.g. team tactics, strategies, what kind of power-up a player has obtained, the location of the balloon ship, or the position of a “frozen” player awaiting a revival. However, because open and honest verbal communication might compromise an attack-operation if the HMD-player is eavesdropping, the other players might not risk sharing (too much) information or discuss the whereabouts of each other openly. As mentioned earlier, according to Goffman (1961), when playing a game, each player assumes a game-generated role or identity, for example as the lone pirate trying to escape with the treasure. Thus it could be argued that the one-versus-four team structure, coupled with the fact that the HMD-player can hear what the other players are saying, works counterproductively in relation to communication between the solo HMD-player and the opposing four-player squadron. This claim is supported by Stelios as he states: “sometimes maybe you want to say some plan or something, but you don’t want the pirate to hear” (Appendix E.05, Stelios, 06:23). However, as he later elaborates on this point in relation to his impression of the gameplay: “I mean, for me it’s not a strategic game. I wouldn’t think that I would really need to [share information]” (Appendix E.05, Stelios, 06:23).
We believe that the casual game mode and genre, as well as the relaxed setting of the playtest, made the participants feel at ease, which ultimately contributed to keeping a relaxed basis for communication. One participant expressed directly that he believed that the casual vibe of the game helped maintain an open basis for communication (Appendix E.03). Arguably, the basis for

communication would have looked very different, had the game been a highly competitive one and if the participants felt that there was more at stake – but examining this is beyond the scope of this project.

6.1.5 Summing up

Throughout our observations and the subsequent interviews in our fourth playtest we did not see any instances that disprove or contradict our first hypothesis. Generally, we saw that wearing the HMD limited the players' communication. However, we found that enabling the HMD-player to hear and communicate with the other participants of the encounter supported the level of both sociality and shared involvement.

Though it could be argued that the removal of the headphones enabled the players to have a foot in each "reality", we found that the insisting nature of the HMD and the level of engrossment in the virtual world limited the players' ability to attend both the virtual reality and the actual reality. The argument here could be that it is probably harder to ignore what you see, than what you hear.

Not that surprisingly, we found that personal relationships played a big role in the amount of communication that we saw among the participants. However, the fact that our participants knew each other on different levels created an interesting basis for communication through byplays.

We saw that the HMD-player's level of communication was limited by the fact that there was a lack of incentive to talk to the other participants. We believe that this was due to the game's design, the team structure and the fact that the HMD-player was always placed in solitary opposition to the other participants. As we shall also briefly touch upon later in the report, it would be interesting to do similar tests with a game where communication between the HMD-player and the other participants plays a larger role in the gameplay.

6.2 Discussion of the second hypothesis

It is important that the player in the VR headset is able to identify a given player with his or her in-game avatar.

6.2.1 What names?

To help especially the player wearing the HMD identify a given avatar with the player controlling it, we had implemented player names above the airplanes in the final prototype. To our surprise, we found that they either did not notice the names or did not find them relevant. For example, Line stated: "Even though there [were] names on it I didn't really take note of it and I didn't know if it did anything for me if it hadn't been there" (Appendix E.04, Line, 08:39). Rather, while playing with the HMD, we found that the players would create a (sometimes) subconscious connection between what they heard in the room and what they saw in the game. As an example, Martin stated that he could tell which airplane was controlled by who, based on what was said by the other players coupled with where the airplanes were in the game and what they were doing (Appendix E.03, Martin, 08:57). As an illustration, if the HMD-player would observe an airplane miss a balloon by an inch and subsequently hear a person exclaim in the room. This would reasonably bring the HMD-player to believe that the person who exclaimed would be controlling the given airplane. In other instances, the HMD-player overheard the other players asking each other about who was controlling what colour airplane, whereas the information was just openly shared. In no instances did we observe that the players controlling the airplanes tried to hide their identities from the player wearing the HMD. All of our participants expressed that they used only the colours of the airplanes to distinct the avatars from each other. As mentioned above, they knew who was who in the game world based solely on either previous knowledge from earlier rounds (where they were a part of the three-player team) or by means of connecting what they saw in the virtual world with what they heard the other players say. In the light of this, we believe that if the HMD-player had not been able to hear the players outside the VR headset, a certain recognisable playstyle or a friend's preference in avatar (or colour) would have been the only way of finding out who was who, had there not been names above the airplanes.

Though some of our participants stated that they did not at all (at least consciously) notice the names above the airplane-avatars, we now believe that the implementation of names could limit the incitement of the HMD-player to listen to what the other players are saying. We speculate that if the names were purposely left out of the game, it could act as a means of urging the HMD-player to try to eavesdrop and decipher who is who based on what the other players say and how they react to in-game happenings.

6.2.2 Personal relations *really* matter

Generally, we found that the distinction between the airplanes and the ability to tell who was who, was only improving the degree of social interaction when the HMD-player and the identified player controlling the given airplane had a personal relationship, as we saw that this opened up for more communication between these players:

> *It was more fun when, you know, like I was shooting at Martin and then- making fun of him at the same time, so if I didn't know it was Martin, then I [would not have been] able to do that. So in a social context, I think [that] is very interesting and useful [...] I think that if I was not able to see that, I was just shooting at airplanes, but now I'm shooting at players, that I know in the social context, and that gives a nice dynamic to the game.*

(Appendix E.05, Stelios, 08:45)

Still, one participant stated that, to him, whoever controlled a given airplane was of less importance than whether or not the airplane was perceived as the greatest threat. However, paradoxically, we observed that the same participant quickly identified the avatar connected to the player that he had the closest relationship with, and perceived this player as the biggest threat throughout the entire play session. This was supported, as he stated that he did in fact see him as the biggest threat, possibly regardless of their personal relationship (Appendix E.03). Still, we would argue that players would focus more on players that they know, over players that they barely know, even though the latter might constitute bigger threats based on skill. But unfortunately we do not have enough empirical evidence to support this claim.

As we also concluded in our discussion of the first hypothesis, we believe that the social relationships between the players play a big role in the social dynamics of the game; playing party games with good friends could even be regarded a necessity more than a desirability for the game to be enjoyable. Generally, for the players who did not know each other, we saw that they were not concerned with who was controlling what airplane, as they would just try to shoot whatever airplane was closest or posed the biggest threat. As Line stated: “I think Martin and Stelios were really aware of who was which colour and so, but I didn’t really think about it” (Appendix E.04, Line, 08:06).

Using Goffman’s (1961) notion of byplay, we saw that the two participants who knew each other beforehand, namely Stelios and Martin, would engage in a communicative byplay. Because our game is both literally (in the virtual world) and figuratively centered around the HMD-player, it had a significant effect on the gameplay whenever that participant would engage in byplays with another player. On various occasions we observed that Stelios and Martin would – albeit momentarily – focus all their attention on each other in the game, paying less attention to the other participants in the game (Appendix E.02). Although they would still engage in the mutual activity, they would do so among themselves for a short time. Whenever the byplay would stop, they would again return to the more inclusive encounter. However, after the playtest it was evident that at least one of the other participants, Line, felt that she had sometimes assumed a more observing role in the game encounter, as when she stated: “[...] I think Stelios and Martin interacted a lot, but I think they also know each other really well. [...] they definitely were each other’s targets a lot of the time and that was very evident” (Appendix E.04, Line, 05:14). Thus, we would argue that the relative imbalance in the social relations among the participants in our playtest could create an inapt basis for momentary exclusions of the other participants not included in the byplay, making them feel less a part of the otherwise shared and inclusive experience and ultimately lowering their spontaneous involvement. Byplays can of course still happen even if there is no imbalance in social relations, but we believe that some players might have a tendency to focus their attention on one another in-game purely based on their personal relationship, ignoring skill and perceived threat.

The effort to enable the HMD-player to distinct and potentially identify the other players could work counterproductively for the feeling of social inclusion for the participants in the encounter. As mentioned above, the byplays that we observed between two participants seemingly had an excluding effect on another participant. This made us question whether the game should actively help players distinct each other in-game, or whether the avatars should be kept somewhat anonymous. Our thought was that anonymity would create a basis for more equal and non-favouring allocation of attention, specifically from the HMD-player to the other players. On the other hand, if playing with a group of close friends, clear distinction between all the players might encourage a more social play experience.

6.2.3 Difficulties with controls hindered social interaction

Some participants expressed that they simply were not concerned with player identification, as they were just trying to figure out the mechanics of the game or learning the controls, and therefore did not feel like they were able to strategise or otherwise use the player distinction to their advantage in the game: “I think that if I had gotten better at the controls faster I would start to interact with the people directly corresponding to the colour" (Appendix E.04, Line, 10:18). This tells us that the difficulty of shooting with the slingshot and the fact that it takes some time to get a hang of, hinders the sociality of the game. However, even though the learning curve of the slingshot might be rather flat, we believe that most players will quickly reach a point where they are able to play the game and not feel hindered by the controls on a social level. Unfortunately this level of confidence with the controls was not achieved within the timeframe of our playtest. Here it is clear that the relatively short duration of the play session within the playtest that we offered our participants had a direct influence on the outcome of our observations, the data that we gathered, and the assumptions as well as the conclusions that we have made. We can only speculate that If we had given the participants more time to play, they would have been better at the controls and possibly have communicated more. We will elaborate more on how the short duration of our playtests influenced our data in the reflections in chapter 7.

Multiple participants expressed that they had difficulties with the controls throughout the entire playtest. Based on our observations and the subsequent interviews, we argue that problems with the controls, both when playing with the HMD and as the airplanes, increased the level of tension. As a result of this, problems with controls posed an immediate threat to the level of individual spontaneous involvement – and thereby also the collective spontaneous involvement, as a result of what Goffman (1961) calls the multiplier effect, also mentioned in section 3.3.2.2.
As an example, we saw that Pablo struggled so much with the controls of the airplane in the beginning, that he acquired an almost despairing attitude and stated openly that he was having difficulties with the controls (Appendix E.02).

If one or more players struggle with the controls, it can have a negative impact on the gaming encounter. If one player is unable to carry out the task that is required of him to win, it can create tension; not only within the given player, but also within her fellow team members or even the opponent(s), if the opposition is perceived as insufficient. Also, it can entail that the remaining players will have to momentarily withdraw from their state of spontaneous involvement to help the struggling player, which could potentially challenge to the collective involvement in the activity. However, presumably because all participants were equally new to the game and its controls, we argue that the level of tension that could potentially have been created by this aspect was limited. Arguably because of both the participants' forbearance towards each other and the relaxed setting.

6.2.4 Summing up

Even though we had implemented the names above the airplanes specifically to enhance player identification in the game, we found that the participants seldom even noticed the names. More so, they connected the given avatars and its colour with the players controlling them from outside the virtual world via audiovisual summations.
Even though our attempt to ease the connection between avatar and player failed, we still believe that the perceived level of the other players' presence in the virtual world is important for the HMD-players feeling of inclusion in the encounter. This assumption was partly confirmed as

several of our participants had subconsciously made an effort to decipher who was who in the virtual world. Based on the social interaction that we saw during our playtest, in the cases where the participants knew the identities of each other across the mediums,
we would argue that knowing who is who would be preferred for the social interaction to be the most enjoyable.
Additionally, we have discussed how difficulties with the controls hindered social interaction with some of the participants and that this can pose a threat to the collective involvement in the game.
Lastly, we saw that an imbalance in personal relationships played a big role in how this information was used in-game and how it created byplays that could potentially lower the level of shared involvement.
On this basis we cannot disconfirm the second hypothesis. However, it seems that knowing each makes it even more important to be able to identify the participants in-game.

6.3 Discussion of the third hypothesis

Not being able to see other players, makes it harder to be included in a social game experience.

6.3.1 Virtually isolated

When we formed our third hypothesis, we believed that the visual and somewhat physical separation of the HMD-player from the other players would make it harder for players to feel included in the encounter. As stated in the theory section in chapter 3, one of Goffman's (1961) conditions for an encounter to exist, is that the participants need to have "a single visual and cognitive focus of attention" and "an eye-to-eye ecological huddle that maximises each participant's opportunity to perceive the other participants' monitoring of him" (pp. 17-18). As we understand this, and if we look at the literal sense of these formulations, each participant must be able to see, not only the same "world", but also each other. While we have previously argued that the first part is covered in our game, as the participants do share a common focus of attention (the game world), the latter is more problematic to justify; not all of our participants are able to see each other – at least not physically. However, we were curious to see whether being able to identify the other players within the virtual world would prove to be sufficient as a means of "seeing each other" and, through that, increasing the feeling of togetherness. Still, our appropriation of the understanding leaves out the HMD-player's "opportunity to perceive the other participants' monitoring of him" (Goffman, 1961, pp. 17-18). This is the biggest social challenge of our game and the main reason we formed the hypothesis in the first place. Still, one might ask how big of a problem this actually is; a question that we will also try to discuss throughout this last section of our discussion.

Initially we believed that wearing the HMD in a local multiplayer game could make players feel less part of the group and (to some extend) excluded. Here there was a minor discrepancy in opinions and experiences among our participants. While some expressed that they did not feel

socially excluded from the group (Appendix E.03; Appendix E.05), others expressed that they did feel less a part of the group when wearing the HMD (Appendix E.04; Appendix E.06).
Although Martin first said that he did not feel excluded when wearing the HMD, he later expressed that being visually cut off from the encounter, coupled with the fact that he was physically separated from the group (i.e. not sitting next to the other players, but having to stand in the Vive's solitary play area away from the general viewing direction of the other participants), automatically and inevitably placed him in clear opposition to the other players: "[...] you feel like you are on the other side of the group. You are not excluded, but you are an adversary of it" (Appendix E.03, Martin, 18:15 [own translation]). Similarly, Pablo stated that he felt a little less part of the group when playing with the HMD, as "[...] there were three other players trying to shoot [him] down" (Appendix E.06, Pablo, 10:34), and Line stated that the fact that she was standing there "alone, blinded", combined with the feeling that the others constituted a team "that actually [talked] together", made her feel "a little bit singled out in some sense" (Appendix E.04, Line, 03:04).
Naturally the one player, who single-handedly has to fight off up to four other players, will feel less a part of the group as she is alone in direct opposition to "a team". This feeling is arguably hard to avoid with the team structure that our gameplay is built upon. However, we were curious to see whether the team structure *combined* with the visual and physical separation of the HMD-player would generate a too strong feeling of being, in Line's words, "singled out" (Appendix E.04, Line, 03:04).

6.3.2 Short game rounds

When processing the subsequent interviews, we found an unexpected recurrence in some of the answers we got from the participants; three of our four participants independently recognised the short game rounds as one of the main reasons that they did not feel more socially excluded from the encounter. As briefly mentioned in our design process in chapter 4, Elias et al. (2012) have previously pointed out that short game rounds are preferable in party games. Though we believe this to be true, we did not ourselves make the connection between the lengths of the rounds and the players having a higher risk of feeling excluded because of the HMD. That being said, we now argue that it can be an important factor in regards to designing an including local multiplayer experience with VR.

As recounted below, Martin believes that the short rounds and the frequency of the rotations helps him sustain a feeling of being a part of the encounter: "[...] because it is such a short game, because the rotations can happen so fast, it means that it doesn't become 'him against us' and that you become separated that way" (Appendix E.03, Martin, 12.26 [own translation]). Here it seems that the team structure plays a big role in why Martin would feel separated from the group, if he had to wear the HMD for too long. We believe that this would probably not have been the case, if the team structure had been different. For example, if the team structure had been arranged to support social interaction between players across the mediums, i.e. with the HMD-player and one other player on one team and the remaining players on another. It would be interesting to see if Martin would have responded differently if he, as the HMD-player, had been forced to cooperate with one or more players outside the VR headset. Arguably, this could

produce a means for the HMD-player to feel more included in the group dynamic happening around the player and outside the virtual reality.
On a similar note, Stelios stated the following: “I think because the game has short rounds and the headset [goes] around [in turns], you see the other players in the end quickly. [...] I don’t think [the game] really distances you from the other players” (Appendix E.05, Stelios, 10.35). Here Stelios brings in the fact that he cannot see the other participants, while playing with the HMD, as a factor, by stating that he “sees the other players in the end” again after a relatively short time. This shows that Stelios is aware of how the HMD could limit his inclusion in the physical encounter. However, Stelios ends this statement by saying that he in fact did not feel distanced from the other players, namely because of the short length of the round.
Lastly, Line also supported this statement when she said: “Maybe you felt in some sense a little bit left out because you were a single player, but since you kind of switch roles once in a while that’s not really an issue [...] for me it was really important that we changed the roles a little bit” (Appendix E.04, Line, 11.51). Here it is obvious that Line also imagined that she would have felt more socially excluded from the encounter, had the rounds been longer. Line carefully compares it to a singleplayer experience – and she was not the only one making that association.

6.3.3 A virtual encounter

Despite the difference in game mediums, three of our four participants expressed a feeling of inhabiting the same virtual world as the other players, when playing with the HMD (Appendix E.03; Appendix E.04; Appendix E.05). However, one participant stated that he felt that he was “in a different place”, in the sense that he felt that he was “the only one truly in the game” (Appendix E.06, Pablo, 04.31). This does not mean that he felt “alone” in the virtual world, but that he perceived an imbalance in the level of virtual presence. Here he expresses that while he had a somatic feeling of inhabiting the virtual world, he was aware that the other players were not “truly there” with him, as they were only looking at the world through a TV-screen. This is an interesting theme, as this brings attention to the fact that the HMD-player might feel alone in the game world, if she does not easily perceive the other avatars to be controlled by her friends, steering them from outside the virtual world. Conversely, Stelios expressed that he did in fact – at least to some extent – see the airplanes as direct virtual embodiments of his opponents, sitting physically beside him in actual reality: “[...] you see them in-game from a different perspective” (Appendix E.05, Stelios, 10:06).

In her interview Line stated: “In some sense if there hadn’t been any conversation [between the other participants], it could have felt like it was a singleplayer [game]. But because of the verbalisation of [...] people interacting – or *how* they were interacting – that didn’t make it feel like a singleplayer [game]” (Appendix E.04, Line, 10:49). In this statement Line expresses that, because she could not physically see the other participants, she would have presumably felt like it was a singleplayer experience, more than a shared multiplayer experience, had she not been able to hear the other players. Here it seems that being able to hear the other participants acts as a sufficient means of keeping the HMD-player rooted in the physical encounter.

Apart from being able to hear the other participants communicate, we would argue that the fact that the participants could discern that the airplanes were indeed controlled by the other participants also made them feel more included in the encounter: "[...] the planes were basically just like flopping around a little bit and you're like 'okay, if this was an NPC it would probably be a little bit more smooth'" (Appendix E.04, Line, 10:49). In other words, Line felt the virtual presence of the other participants in the game world, through the airplanes uncanny movements. We argue that this could make players feel more a part of the encounter. In some sense, the fact that Line recognise the avatars as the other participants, creates a virtual sub-encounter within the main encounter, wherein the HMD-player is no longer visually cut off or excluded; here she is very much a part of the interaction and arguably even the main character of it. But that is probably taking Goffman's mid-twentieth century theory a bit too far.

6.3.4 Summing up

Summing up our third and last point of the discussion, we found that the one-versus-three team structure, coupled with the implementation of the VR medium, made it hard for all of our participants to feel equally included in the encounter at all times. This proves that there are some truth to our hypothesis. However, we do not feel that we are able to neither confirm nor disconfirm this hypothesis on the basis of one playtest.

In our fourth playtest we found that three of our four participants recognised the length of the rounds as the main reason why they did in fact not end up feeling completely excluded when playing with the HMD. Here it seemed that forcing one player to be visually and physically separated from the rest of the group for too long would make the player feel socially excluded. Above we have discussed the fact that the VR medium entails the possibility to give a higher sense of being somatically present in the virtual world, as opposed to playing on a TV-screen, and that this difference in the sense of virtual presence can bring about the feeling that not all players are equally involved in the game. However, we also argue that the fact that the HMD-player is able to hear the other participants in our game, acts as a sufficient way of keeping the player present in the physical encounter.

Lastly, we argue that the player wearing the HMD feels more a part of the encounter if they can identify the in-game avatars with their physical counterparts in the real world, adequately making up for the fact that they cannot physically see them.

7 Reflections

In the following we will reflect upon our process and design choices. Firstly, we will talk about the team structure in our game and how this could have been designed differently to better support communication across the mediums. Secondly, we will talk about our selection criteria for our playtests and how we adjusted these in relation to convenience. Thirdly, we will briefly talk about the format of our final playtest and how this could have been done differently to help us better answer our hypotheses.

7.1 Including the HMD-player in a team

As we stated in the very beginning of this report, most VR games so far are singleplayer experiences – and with good reason. Today's VR technology has fantastic inherent immersive qualities that are ideal for singleplayer games. However, when it comes to designing local and social multiplayer experiences, the VR medium holds inherent challenges that can be hard to overcome as game designers.

In our research, we found that the fact that the players, when wearing the HMD, cannot physically see the other participants to be the biggest challenge. Undeniably, the ability to see the people you engage with in a local encounter of any kind encompass significant social qualities. However, we learned that the level of collective involvement – of which we have (maybe wrongly) taken the amount of communication between the players to be a key indicator – was highly dependent on the design of the gameplay. If, for example, we had designed a game where the HMD-player had to work together with a non-HMD-player, the experience would presumably have looked very different in regards to the level of inclusion and feeling of togetherness for the HMD-player. The lesson here being that the gameplay design should take into account that the HMD-player is already physically separated from the group, and therefore should maybe not play against all the other players. On the face of this, we believe that game designers should either try to avoid team structures that single out the HMD-player or make sure that the duration, in which the player is separated, are held as short as possible while still respecting the immersive qualities of VR.

7.2 Selection criteria and the location of our playtests

Considering the fact that we have created a party game that – due to the general culture and traditions of the genre – might often be played in a well-known and homely environment and by a group of friends, it could be seen as a flaw in our research design that we conducted three of our four playtests at the ITU with participants who did not always know each other. However, based on our observations, we argue that all of our participants felt relaxed and comfortable in the environment and setting of our playtests. Still, it could be argued that our playtests should have been conducted in an environment matching an actual play scenario setting – at a participant's home for example – to get the most valid results. However, this would undoubtedly have presented some practical and logistical challenges. Conducting the playtests at ITU was mainly a question of convenience, as the rather complex setup was installed there.

Likewise, we believe that playtesting with a group of friends would have fit better with an actual play scenario. However, we learned that finding participants for our playtests was a difficult task. This was the main reason why we were not consistently able to put together groups of participants who all knew each other – especially when it came to playtesting the game with strangers in our last playtest, as this would require someone we do not know to assemble a group of friends for us.

As a side note, we initially had "previous experience with VR" as a selection criterion for our participants. This was because we wanted to avoid the overwhelming emotional effects it has on most people trying VR for the first time, as we believed that this would influence the participants' opinions towards the gameplay and their responses to our subsequent questions; we wanted our participants' responses to be as impartial as possible. However, as VR is still a relatively new phenomenon on the consumer market and because of the fact that few have access to high-end VR technology, this too proved to be a rather limiting selection criterion.

Despite the fact that finding participants proved to be difficult and that we felt compelled to compromise on our selection criteria, we still believe that we successfully managed to find competent participants for our playtests as well as gather valid, usable and interesting results.

7.3 Playtest format and validity

If we had more time to work on this project, we would have liked to conduct additional A/B-testing to help us better answer our hypotheses. As an example, our first hypothesis, which relates to the importance of being able to communicate across the mediums in a local multiplayer VR game, could be tested differently. By using the method of A/B-testing, as explained by Fullerton (2008), we would have been able to test and subsequently make a comparative analysis of the differences in immersion and group inclusion in relation to using headphones or not, which could ultimately have helped us draw more valid conclusions. In the present project, we decided not to do so, mainly because of the time constraint and the fact that we had two additional hypotheses that we wanted to answer. However, we still feel that additional tests could help us strengthen or reshape our hypotheses even further, though this is beyond the scope and resources of the project in its current state.

8 Conclusion

This project was based on an exploratory research approach in an effort to explore and study the adolescent and novel field of game design in virtual reality, as well as to dive deeper into VR as a medium for local multiplayer experiences. Using an experimental game design approach we have designed and developed our own local multiplayer game for the HTC Vive by utilising a variety of methods, such as brainstorming, sketching, physical and digital prototyping as well as playtesting. Findings derived during our initial research and the development phase of the game led us to form three hypotheses regarding social play in VR. By playtesting our game with participants, we have investigated the hypotheses in an effort to validate these.

Initiating this project, we went on to play and discuss a large and varied selection of VR games for the HTC Vive. The learning outcomes related to both gameplay and game feel in VR as it is manifested by the Vive system hardware. In relation to game feel, we experienced that thoughtful use of haptic feedback, three-dimensional sound and having “handheld” 3D assets that imitate the weight of the controller, will greatly enhance the player’s immersion in the virtual world. We discovered that when these elements are well designed and play together, the experience of the virtual world can seem to be consistent with our experience of the physical world.
We found two important points relating to gameplay, which we believe every VR game designer should consider. First, the perfectly tracked Vive controllers allow mechanics in VR to be mapped to closely represent their real world counterparts, such as shooting a bow. This gives rise to a new degree of natural mapping compared to traditional natural mappings on various controllers and keyboards. Depending on the VR hardware, there will be a number of inherent actions – such as peeking and crouching – that the game designer can choose to support in the gameplay, in order to make these actions a part of the primary or secondary mechanics scheme. The second thing to consider is how the physical play space matches up with the virtual play space. To avoid “unnatural” movement mechanics, such as teleportation or the sometimes nausea-inducing hockey puck-movement, the gameplay can be designed to take place in an area not bigger than the physical space.

Our three hypotheses are related to assumptions about what elements increase the sociality in local multiplayer VR games. These include the players’ abilities to hear one another, knowing who is controlling what avatar in-game, and that a player enclosed in the HMD will have a hard time being socially active in the physical encounter.
Even though our gameplay does not require communication between the player inside the HMD and those outside of it, we still found that enabling the HMD-player to hear what was being said in the room supported the level of sociality and shared involvement in the game. It also allowed the HMD-player to banter against the competition, which was mainly observed between two of the participants who knew each other beforehand. However, playing the audio on a common speaker,

rather than headphones, does have significant drawbacks in regards to the HMD-player's immersion in the virtual world.
Our second hypothesis stated that the player in the HMD needs to be able to identify in-game avatars with the players controlling them outside of the HMD. For our last playtest we added names on top of the airplanes to accommodate this, but to our surprise, almost none of our participants noticed the names. Even so, our participants still managed to identify each other with the avatars, by connecting the given avatars and its colour with the players controlling them via audiovisual summations.

Lastly, we hypothesised that being blocked from seeing other people makes it harder to feel present in the social game encounter, as the HMD blinds the player from the physical world. We identified this as a significant inherent challenge in the VR medium for designers of local multiplayer VR games. Based on the statements from our participants it seems that a short play time in combination with the absence of headphones will not lead to the HMD-player feeling excluded from the social context of the given encounter.

The findings from our research show that there are a lot of new possibilities as well as challenges when it comes to designing games for VR – be it local multiplayer or not.
Supported by our exploratory approach as well as an admittedly small amount of collected data it is hard for us to draw final conclusions regarding our findings and hypotheses. However, on the basis of the data from our last playtest we are not able to disconfirm our hypotheses, and we argue that the data points towards validation and as presented in our discussion we have even been able to refine some of them. Our hope is that future research might be able to provide additional insights into our findings and hypotheses.
In other words, if VR is a game, there is still a long way to the final boss and collecting all the trophies, but with this project we hope to have cleared the first few levels and delivered a "save game" that future designers can continue playing from.

9 Bibliography

Aarseth, E. (2004). Playing Research: Methodological approaches to game analysis. Game Approaches / Spil-veje. Papers from spilforskning.dk Conference, august 28.-29. 2003 Spilforskning.dk.

Blomberg, J. (1993). *Ethnographic Field Methods and Their Relation to Design* in Participatory Design: Principles and Practices. Chapter 7. Lawrence Erlbaum Associates, Publishers.

Brinkmann, S., & Tanggaard, L. (2010). *Kvalitative metoder: En grundbog*. First Edition. København: Hans Reitzel.

Buxton, B. (2007). Sketching User Experiences – getting the design right and the right design. San Francisco: Elsevier Inc.

Cote, A. & Raz, J.G. (2015). In-depth interviews for games research. In: Lankoski, P., & Bjork, S. (Ed.), *Game research methods: An overview*. (Chapter 7). Pittsburgh, PA: ETC Press.

Eklund, L. (2015). Focus group interviews as a way to evaluate and understand game play experiences. In: Lankoski, P., & Bjork, S. (Ed.), *Game research methods: An overview*. (Chapter 9). Pittsburgh, PA: ETC Press.

Elias, G.S., Garfield, R., & Gutschera, R.K. (2012). Characteristics of Games. Cambridge, Massachusetts: The MIT Press.

Fullerton, T. (2008). Game Design Workshop: A Playcentric Approach To Creating Innovative Games. Second Edition. Burlington, MA: Elsevier Inc.

Goffman, E. (1961). Encounters: Two Studies in the Sociology of Interaction – Fun in Games. Indianapolis: Bobbs-Merrill.

Halkier, B. (2002). *Fokusgrupper*. Samfundslitteratur & Roskilde Universitetsforlag. Third Edition. Gylling: Narayana Press.

Lim, Y.-K., Stolterman, E., & Tenenberg, J. (2008). The Anatomy of Prototypes: Prototypes as Filters, Prototypes as Manifestations of Design Ideas. *ACM Transactions on Computer-Human Interaction (TOCHI), Volume 15 Issue 2, July 2008*. Article No. 7. New York, NY, USA.

Norman, D. (2013). *The Design of Everyday Things*. Revised and expanded edition. Cambridge, Massachusetts: The MIT Press.

Sanders, E.B.-N., & Stappers P.J. (2008). Co-creation and the new landscapes of design. CoDesign: International Journal of CoCreation in Design and the Arts Volume 4, 2008 - Issue 1: Design Participation(-s).

Sicart, M. (2008). Defining Game Mechanics. Game Studies: the International Journal of Computer Game Research, Vol. 8, Issue 2. Retrieved from: http://gamestudies.org/0802/articles/sicart

Sicart, M. (2014). Lecture 5: Loops and Metagames [PDF]. Retrieved from https://learnit.itu.dk/pluginfile.php/113102/mod_resource/content/1/05Loops.pdf

Stebbins, R.A. (2001). *Exploratory research in the Social Sciences.* Sage University Papers Series on Qualitative Research Methods, Vol. 48. Thousand Oaks, CA: SAGE Publications, Inc.

Waern, A., & Back, J. (2015). Experimental Game Design. In: Lankoski, P., & Bjork, S. (Ed.), *Game research methods: An overview*. (Chapter 20). Pittsburgh, PA: ETC Press.

10 Ludography

Against Gravity, TBA, *Rec Room* [demo].

Bandello, 2016, *#SelfieTennis.*

Downpour Interactive, TBA, *Onward* [demo].

EA, 2015, *FIFA 2016*.

Foreignvr, 2016, *Ruckus Ridge*.

Game Swing, 2016, *Stikbold!*.

Google, 2017, Google Earth VR

Google, 2016, *Tilt Brush*.

Kubold, 2016, Spell Fighter VR.

I-illusions, TBA, Space Pirate Trainer [demo].

Lightspeed Studios, 2016, *NVIDIA VR Funhouse*.

Neat Corporation, TBA, *Budget Cuts* [demo].

Nintendo, 1996, *Mario Kart 64*.

Nintendo, 1998, *Mario Party*.

Nintendo, 1999, *Mario Party 2*.

Nintendo, 2000, *Mario Party 3*.

Northway Games, 2016, *Fantastic Contraption*.

Omnipudding, 2016, *GPU Cubes VR*.

Owlchemy Labs, 2016, *Job Simulator*.

Phosphor Games, 2016, *Brookhaven Experiment*.

RocketWerkz, 2016, *Out of Ammo*.

RUST LTD, 2016, Hot Dogs, Horseshoes & Hand Grenades.

Sega, 2014, Alien Isolation.

Steel Crate Games, 2015, Keep Talking and Nobody Explodes.

Survios, TBA, *Raw Data* [demo].

Valve, 2016, *Longbow* (*The Lab*).

Valve, 2016, *The Lab*.

Wevr, Inc., 2016, *TheBlu*.