

Firefly Island

Exploring intimacy in social VR



Master's thesis

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Abstract

Intimacy and intimate relationships are a core part of the human experience. Social virtual reality (VR) presents a novel opportunity for intimate interactions to emerge, and intimate relationships to be formed, as it is becoming an increasingly popular ecosystem in which people meet and interact with each other virtually. This thesis presents an exploratory look into how intimacy can be facilitated in social VR, by integrating theory and practice in the design of *Firefly Island*, a social VR world focused on intimacy. The world was designed, evaluated, and reflected upon in two iterations while following a *research through design* approach, with a focus on novel *affordances* or interaction possibilities enabled by social VR. The results of this thesis highlight unique social VR affordances that can help facilitate intimacy, and provide intermediate-level design knowledge that can be used by future designers and researchers to create better social VR experiences focused on intimacy.

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Introduction

It is an absolute human certainty that no one can know his own beauty or perceive a sense of his own worth until it has been reflected back to him in the mirror of another loving, caring human being.

— **John Joseph Powell, *The Secret of Staying in Love***

Intimacy is a concept that is core to the human condition. Intimate experiences play a crucial role in developing relationships and making us truly social beings (Reis, 1990). Throughout the years, technology has played an increasing role helping people maintain intimate relationships. Technology that supports and facilitates intimacy has been of particular interest to researchers in the domain of human-computer interaction (HCI). Hassenzahl et al. (2012) present an overview of past work related to intimacy in the domain of HCI, where they identify how designers try to create feelings of closeness and intimacy through technological artifacts. In their review, Hassenzahl et al. note how designing technology for intimate connection can be a worthwhile goal as it fulfils the crucial human need of relatedness. It is clear that with the development of new communication technologies, it also becomes important to look at how these technologies can give rise to new ways of intimate interaction and how they can shape intimate relationships.

In recent years, virtual reality (VR) technology has opened up new horizons as a medium for social interaction (Perry, 2016). In social VR, geographically separated people can embody virtual avatars in a 3D virtual world and communicate with one another with the help of VR head-mounted displays (HMDs). As social VR applications such as VRChat, AltspaceVR and Rec Room gain in popularity, more people are harnessing of the potential of social VR as a way to play and socialise. The success of social VR has encouraged a new line of research to be conducted in this realm. There is a growing body of research related to social VR, with past research looking into topics such as shaping pro-social behaviour (McVeigh-Schultz et al., 2019), communication modalities (Maloney, Freeman & Wohn, 2020; Tanenbaum et al., 2020), and harassment (Blackwell et al., 2019). As VR technology continues to mature and become more prevalent, it plays an increasing role in how we form and experience relationships online.

This thesis is an exploration of intimacy in social VR, with a focus on the unique interaction possibilities enabled by this emerging technology. By integrating theory and practice, this thesis aims to shed new light on how social VR facilitates intimacy, and through this gain insights on how to design better social VR experiences focused on intimacy.

1.1 Background

The precursor to this thesis is a VR stargazing app designed in 2020 for the course *Designing Interactive Experiences* at University of Twente. The course challenged students to use interactive technology to solve problems that people faced due to the COVID-19 pandemic. During the course, our team designed a social VR app aimed at helping people maintain intimate relationships when they were physically separated. Our solution was a VR stargazing app that could bring two people together under the same virtual sky, enabling a sense of shared presence even when they were physically apart¹. Working on this project made us realise the potential of VR as a technology that can enable intimacy and close connection at a distance unlike any other technology. This thesis was born out of the ideas that we explored in the stargazing app, and it expands on some of our original ideas and observations from the project.

Social VR allows for a whole new range of interaction capabilities compared to other communication technology. With the ability to embody virtual avatars and interact with other people in a 3D virtual environment, interactions in social VR have the potential to feel closer to face-to-face communication than in other mediums such as teleconferencing (Biocca & Levy, 1995). Although the detailed reproduction of face-to-face communication in VR is an alluring goal, social VR's unique capability to go beyond normal interpersonal communication is something that cannot be ignored. McVeigh-Schultz and Isbister (2021) dub this capability as having "social superpowers", where one has the ability to embrace novel forms of social interaction that do not need to follow the normal conventions and rules of everyday face-to-face communication. A simple example of this could be the act of saying goodbye in social VR, which could be as quick as pressing a button and disappearing instantly, perhaps a superpower that many have wished for time and again in real life. Such capabilities can be attributed to novel *social affordances* enabled by the medium. Here, an affordance refers to a relationship between a technology and its user where the technology provides or 'affords' the user the capability to perform an action (Norman, 1988). An

¹The Stargazing Experience by Jesse Lohman – <https://youtu.be/rLAg7IPbOEs>

example of such an affordance in social VR is the ability to embody a 3D virtual avatar. When designing interactions for upcoming technologies like social VR, making effective use of affordances can be invaluable. Zaff (1995) notes that applying the concept of affordances in design involves bridging the gap between *theory* and *practice*. The first part of this involves identifying affordances, which are then applied during design by actualising or realising these affordances to solve design problems in the next part. Here, the focus is not just on improving usability, but also on identifying novel interaction possibilities that push the medium forward and redefine existing conventions.

Huang and Bailenson (2019) highlight the potential of VR technology in the facilitation of intimate relationships. They note that the novel affordances enabled by the technology could have new implications on how people form and maintain intimate relationships using VR. Applying the concept of affordances when designing for intimacy in social VR can be a powerful way to bridge the gap between theory and practice. Theoretical knowledge on intimacy and VR technology can be applied in the design of social VR experiences to gain valuable insights about how intimacy and intimate interactions can play out in social VR. Knowledge gained in this way has the potential to transform future applications in social VR, as it could uncover affordances and interactions that were previously unexplored or underutilised.

1.2 Goals

In this thesis, we aimed to bridge the gap between theory and practice relating to intimacy and social VR. Our main goal was to understand **how social VR can facilitate intimacy between users**. We worked toward this goal in several steps. First, we aimed to build a theoretical foundation on intimacy and social VR through literature review. In the next step, we aimed to gain real world insights through self-usage and ethnographic study. Finally, we aimed to operationalise the insights gained in the previous steps through the design and evaluation of a social VR experience for intimacy. In this thesis, we focus on the unique affordances enabled by social VR which help in facilitating intimacy. By identifying the role of these affordances, we aim to generate *intermediate-level design knowledge* (Höök & Löwgren, 2012) that can be appropriated by future researchers and designers to create better intimate social VR experiences.

1.2.1 Research questions

The two main research questions of this thesis are:

1. *How can we integrate theory and practice in the design of a social VR experience for intimacy?*
2. *What role do social VR affordances play in facilitating intimacy?*

1.3 Approach

In this thesis, a *research through design* approach was followed to understand how social VR can facilitate intimacy. This approach focuses on generating new knowledge through the process of design and reflection, and making a research contribution through this (Zimmerman & Forlizzi, 2014). Throughout this project, design methods and processes were used to investigate the proposed research questions, and the entire process along with the insights gained along the way were continuously documented and reflected upon to produce new knowledge about intimacy in social VR.

Research through design

The term ‘research through art and design’ was introduced by Christopher Frayling (1994). Frayling points out that the activities of *art* and *design* can intersect with *research* and produce useful knowledge if the process of art/design is documented and the results are communicated. Zimmerman and Forlizzi (2014) expanded on this concept in the field of HCI research. They note that when designing an artifact, the *process* of designing the artifact and the insights gained *during the process* can be just as important as the final product. When a designer documents their process, along with their rationale for different design decisions and why certain things worked or did not work, they are creating new knowledge for future researchers and designers. The practice of *reflection* is also crucial when conducting research through design. Reflection involves carefully documenting the design process and introspectively evaluating design rationales, decisions, and outcomes. When a designer reflects on how they reinterpreted and reframed the original design problem or research question during the design process, they are capturing useful knowledge that can further future research.

Research through design is also a way for researchers to speculate about the future by probing into ‘what could be possible’. In the domain of human-computer

interaction (HCI), researchers can use this method to investigate challenges and opportunities posed by new technology. By solving existing challenges and imagining novel scenarios involving new technology through the application of design, researchers are able to understand how people interact and engage with new technology. Through this, researchers are able to envision how new technology can improve the state of the world, and actively shape a “preferred future” involving new technology (Zimmerman & Forlizzi, 2014).

1.4 Structure of this report

In this thesis, we tackled our research questions by first separately exploring the domains of *intimacy* and *social VR*. In [Chapter 2](#), we first look at what intimacy means and how it has been approached in past research by means of a literature review. [Chapter 3](#) serves as an introduction to social VR and its current state of the art through literature review and auto-ethnographic study of social VR platforms. This chapter also introduces the concept of social VR affordances and lists some of the affordances that are described in literature. [Chapter 4](#) connects intimacy and social VR by exploring what it means to be intimate in social VR. This chapter contains both theoretical and practical insights obtained by means of literature review and ethnographic methods consisting of focus groups and expert interviews.

The subsequent chapters focus on integrating theory and practice through the design of *Firefly Island*, a social VR world focused on intimacy. [Chapter 5](#) provides an overview of the world, including the motivations, ideation, and initial setup of the world. Chapters [6](#) and [7](#) describe the design and evaluation of the world and the different activities contained within it, which was done in two iterations. These chapters also present the reflections and design knowledge that were produced in each iteration. [Chapter 8](#) presents a general discussion about the results of our evaluations, along with our reflections on the process, approach, and future applications of the thesis. Finally, [Chapter 9](#) concludes by summarising the work done and presenting the research contributions that were generated during the course of this thesis.

Intimacy

This chapter is an exploration of the concept of intimacy. It also serves to define what ‘intimacy’ means in the scope of this thesis. We first look at past definitions of intimacy in literature and identify themes that constitute intimacy. Next, we look at how technology can facilitate and mediate intimacy, and examine strategies of supporting intimacy using technology. We also look at some of the challenges of attempting to mediate intimacy using technology. The contents of this chapter are based on the report written during the *Research Topics* stage of this master’s thesis. During this stage, literature review and hands-on exploration of social VR were carried out to gain foundational knowledge on the topic of *Intimacy in Social VR*.

‘Intimacy’ is a word that encompasses a multitude of meanings, including the emotional, physical, and sexual. Although it is often associated with sexuality and relationships, the concept of intimacy can go beyond these popular notions to involve deeply personal aspects such as the experience of one’s inner self and how one relates to the outside world (Sehlikoglu & Zengin, 2015; Stoler, 2006). In this thesis, we focus on the *interpersonal* conceptualisation of intimacy. Here, intimacy can be said to be the ‘closeness’ that people experience in a relationship through which they feel understood, validated, and cared for (Reis & Shaver, 1988). Our understanding of interpersonal intimacy need not be limited to romantic or sexual relationships; intimacy can refer to closeness between family, friends, or even strangers and people in non-normative relationships (Attwood et al., 2017; Koch & Miles, 2020). Among the many reasons why exploring interpersonal intimacy can be a worthwhile goal, Reis and Shaver (1988, p. 385) note that intimate relationships can have a positive effect on people’s health and well-being. Moreover, intimate relationships help to fulfill people’s social needs by facilitating self-validation, close connection, and affection.

2.1 Intimacy in literature

Although there is a large amount of literature on the topic, there is no widely agreed-upon definition for intimacy. As many researchers have observed, intimacy is notoriously difficult to conceptualise. Obert (2016, p. 26) notes that “*intimacy is so complex, and so difficult to achieve, because it is not a unified feeling-*

state; it is rather a number of discrete affects that coexist precariously.” On a similar note, Sehlikoglu and Zengin (2015) observe that the meaning of intimacy can be ambiguous as there are multiple elements to its formation, distribution and organisation. When exploring the concept of intimacy, it can be useful to look at past attempts at defining the concept.

2.1.1 Definitions of intimacy

Despite its ambiguity, there are many interpretations in literature of what intimacy means. Timmerman (1991) offers a concept analysis of past definitions of intimacy in scholarly literature and describes what differentiates it from other phenomena. In the paper, a theoretical definition of intimacy is derived from this analysis, where intimacy is described as a quality of a relationship with the prevailing conditions of *trust*, *closeness*, *self-disclosure*, and *reciprocity*. This approach of breaking down intimacy into its constituent conditions or themes is one that is seen in many attempts at defining intimacy. Moss and Schwebel (1993) examined 61 unique definitions of intimacy in past literature with the goal of developing a definition for romantic intimacy between individuals, and identified recurring themes that occurred in at least 50% of these definitions. They identified seven such themes which are listed in Table 2.1.

An exchange or mutual interaction (characterizing intimacy as a process that occurs between individuals).
In-depth affective awareness-expressiveness (the reception or expression of affect from and to another).
In-depth cognitive awareness-expressiveness (the reception or expression of cognitive material from and to another).
In-depth physical awareness-expressiveness (the reception or expression of physical acts from or towards another, ranging from interpersonal distance to sexuality).
A shared commitment and feeling of cohesion.
Communication or self-disclosure (disclosing or communicating information from any content domain to another).
A generalized sense of closeness to another.

Table 2.1: Themes found in past definitions of intimacy (Moss & Schwebel, 1993)

2.1.2 Intimacy themes

In line with the previously discussed approach where intimacy is described through its constituent themes, we identified recurring themes from the literature on intimacy. In order to ground these themes based on their relevance to interactive technology, we referred to Vetere et al. (2005), who developed a thematic overview of intimacy for application in the design of interactive technology that mediates intimacy. This section describes the themes that we identified.

Self-disclosure Self-disclosure refers to the communication of personal information and feelings by one person to another (Reis & Shaver, 1988). As Vetere et al. (2005) observe, “[i]t is during self disclosure that we ‘get to the heart of the matter.’” Self-disclosure can play a crucial role in the development of an intimate relationship (Robson & Robson, 1998). In a relationship, as one person gradually increases the amount of personal information they disclose, it can lead to the other person responding with equally increased levels of self-disclosure. Thus, it can play a role in the growth (or decline) of a relationship. This mutual nature of self-disclosure brings to our attention another major theme of intimacy—reciprocity, which is discussed next.

Reciprocity Reciprocity refers to the mutual interaction and exchange aspect in intimate relationships (Moss & Schwebel, 1993). Also called mutuality, this theme is rooted in the exchange and interdependence that exists between intimate partners. Timmerman (1991) notes that many of the other themes in intimacy such as closeness and trust are closely associated with reciprocity. Reciprocity need not be equal or symmetric between partners in a relationship. As a response to one’s behaviour, the other person may show similar behaviour (reciprocal interaction) or complementary behaviour (complementary interaction) (Kjeldskov et al., 2004).

Responsiveness Partner responsiveness is the quality of addressing and responding to the needs, communications, wishes and actions of a partner in an intimate relationship (Laurenceau et al., 1998). Responsiveness affirms the notion that one person’s interactions are received well by the other person and that the other shows concern and affection for them. It plays an important role in facilitating communication, and making participants feel validated and cared for in intimate interactions (Reis & Shaver, 1988).

Trust Timmerman (1991) notes that in past literature, trust is a theme that is mentioned as being necessary for intimacy. Trust refers to the feeling of safety that a person has when sharing thoughts and feelings with another. Past experiences with a person play a role in developing trust and intimacy (Timmerman, 1991). Timmerman also suggests that trust is related to *vulnerability* and opening up one's true self to the other. Recognising each other's vulnerability can strengthen trust in a relationship. Obert (2016) suggests that vulnerability is an essential component of intimacy and as one's vulnerability is revealed, it also reveals their capability for caring and exchange.

Expressiveness Vetere et al. (2005) suggest that expressiveness of interactions forms a central part of intimate acts. Expressive interactions refer to non-verbal exchanges that are playful and ambiguous. Such acts could emerge spontaneously and their meanings could be idiosyncratic and known only to the people interacting. *Creativity* and *humour* play a role in the formation of these interactions (Vetere et al., 2005). When analysing virtual intimacy in the online game *World of Warcraft*, Pace et al. (2010) observed that expressiveness and *ambiguity* enabled the emergence of nuanced intimate experiences that were often different from scripted interactions in the game.

Presence Presence refers to the noticeable existence or the feeling of another person being present, in either a physical or non-physical way (Register & Henley, 1992). The feeling of presence does not need to be limited to the context of any particular sensory modality, but it could be subjective and part of the broader experience of intimacy. Vetere et al. (2005) mention *presence-in-absence* as one of the results of intimacy where intimate participants felt a sense of the other even in their physical absence. Vetere et al. note that intimate participants often felt the need to stay in touch with their partner at all times, even when they are separated.

2.1.3 Types of Intimacy

In the literature on intimacy, there are a few different classifications of intimacy. Schaefer and Olson (1981) differentiate between, and empirically validate five types of intimacy: *emotional*, *social*, *sexual*, *intellectual*, and *recreational*. Here, *emotional intimacy* involves experiencing closeness through sharing feelings; *social intimacy* involves the closeness arising out of having common friends and being part of a social network; *sexual intimacy* involves sharing general affection

and/or sexual activity; *intellectual intimacy* involves sharing ideas; and *recreational intimacy* involves sharing mutual hobbies. With regard to self-disclosure of information, Morton (1978) differentiates between *descriptive intimacy* which relates to the disclosure of private facts, and *evaluative intimacy* which relates to the sharing of personal feelings or opinions.

Although traditional discourses on intimacy mostly explored romantic and sexual connections, newer discourses have explored intimacy in other types of relationships (Attwood et al., 2017). It can be interesting to note how the experience of intimacy can differ depending on those participating. Compared to the previously mentioned distinctions that focused on the nature of intimacy between participants, here the focus is on the relationship between participants. Based on this, we identified some noteworthy types of intimacy in literature, including *romantic intimacy*, *family intimacy*, *stranger intimacy*, and *intimacy with an object*. These are described below:

Romantic intimacy Romantic intimacy refers to intimacy between couples in a romantic relationship and it could include physical contact, sex, and romantic love. Moss and Schwebel (1993, p. 33) defined intimacy in romantic relationships as “determined by the level of commitment and positive affective, cognitive, and physical closeness one experiences with a partner in a reciprocal (although not necessarily symmetrical) relationship.”

Family intimacy Intimacy can be explored in the context of close family relationships, such as between a parent and a child. Dalsgaard et al. (2006) identified unique properties of parent-child intimacy that set it apart from other strong-tie intimacies. For example, they note that unity or a sense of affiliation is strong in this type of intimacy. Parent-child relationships can also involve unequal activities, such as a parent caring for and supporting their child.

Stranger intimacy Intimacy can also emerge among strangers. Koch and Miles (2020) explored the concept of stranger intimacy and broadly defined it as conditional relations of openness between unacquainted people through which “affective structures of knowing, providing, befriending or even loving are built” (Koch & Miles, 2020, p. 2). Stranger intimacy highlights that intimate relationships can be formed outside an existing network of friends, family, and loved ones.

Object intimacy Intimacy can be said to exist in a relationship between a person and an inanimate object. Fels (2000) notes that when a person has a high degree of intimacy with an object, they can effectively communicate ideas and emotions through the object as if it were an extension of themselves. An example of such intimacy would be the relationship between a skilled musician and their musical instrument. Object intimacy can also be seen in the embodiment of a tool or object.

It is essential to point out that the above categories are not comprehensive. Rather, they are meant to emphasise that intimacy and intimate interactions can arise in diverse types of relationships. When approaching the concept of intimate relationships, it is important to keep this diversity in mind. Rooney (2014) emphasises the value of approaching intimate relationships in an open-ended way, and not downplaying their complexity by preemptively assigning exclusive labels to them.

2.1.4 Intimacy as a process

Many researchers highlight the importance of not seeing intimacy as a static quality of a relationship (Reis & Shaver, 1988; Rooney, 2014; Timmerman, 1991). Rather, intimacy is a dynamic process and the level of intimacy in a relationship can change over time. Reis and Shaver bring attention to this by characterising intimacy as an interpersonal and transactional process. They present a model of intimacy (see Figure 2.1) that illustrates its continuous nature. In the model, intimacy plays out between A and B, who are two people engaging in a relationship. A and B's exchange can be seen as a continuous transaction of information and emotions, through which they influence each other's emotions and behaviour over time. It is to be noted that in this example, A has the role of the person expressing or disclosing and B has the role of the person listening or responding. However, these roles can be exchanged at any time during the process. The process itself can start at any of the multiple points in the model. Laurenceau et al. (1998) performed two studies that provide empirical support for this model of intimacy as a process.

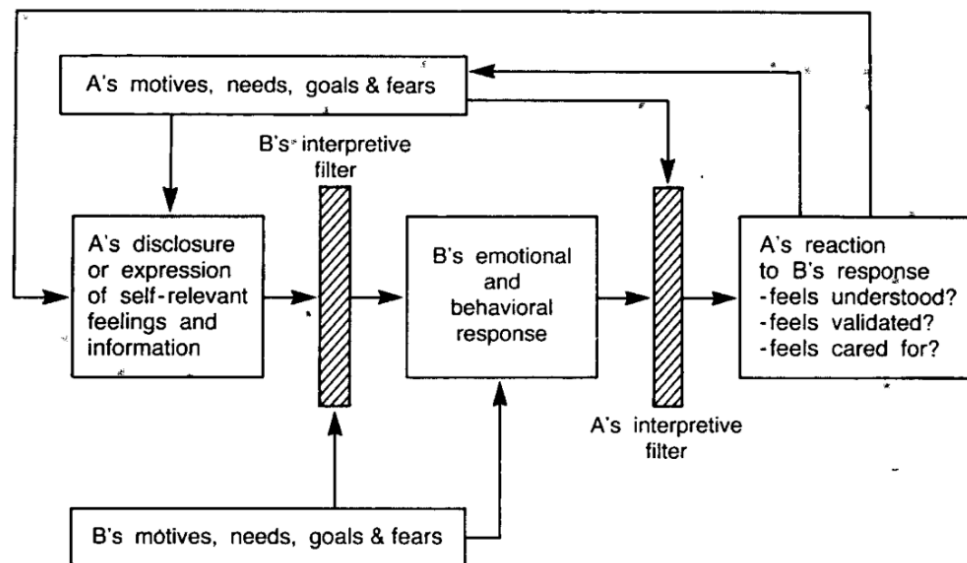


Figure 2.1: Model of intimacy as a process (Reis & Shaver, 1988, p. 375)

Focusing on what intimacy does

Rooney (2014) notes that when approaching the concept of intimacy in HCI, a focus on what intimacy does in a relationship might be more useful than focusing on what intimacy is or its definition. Rooney emphasises the importance of not reducing the complexity of intimacy by only focusing on certain acts or parts of it. Rooney also argues that fragmenting the experience of intimacy in this way limits HCI's potential and effectiveness in mediating intimacy. A focus on what intimacy does is seen in Reis and Shaver's model of intimacy, where they argue that for an interaction to become intimate, the participants must feel understood, validated, and cared for. Understanding refers to the participants' accurate perception of each other's feelings and needs; validation refers to the belief that the other person values and appreciates one's inner self as they themselves understand it; and caring refers to showing affection and concern for the other person (Reis & Shaver, 1988). As Rooney (2014) notes, focusing on this significance of intimate interactions between partners and what it means to them might be more meaningful when designing technologies to support intimacy.

2.1.5 Measures of intimacy

There are a few scales in the literature on intimacy that explore how to assess intimacy. Schaefer and Olson (1981) put forward the Personal Assessment of

Intimacy in Relationships (PAIR) inventory which offers an assessment of five types of intimacy: emotional, social, sexual, intellectual, and recreational intimacy. PAIR is a 36-item inventory that provides an assessment of the overall intimacy in a relationship in terms of perceived and expected intimacy. Hook et al. (2003) provide a critical look at three popular measures of intimacy, including the Miller Social Intimacy Scale, Fear of Intimacy Scale, and the PAIR inventory. They note that these measures when taken alone did not adequately cater to the multidimensional nature of intimacy. When taken together, they helped in assessing the main components of intimacy, which were identified as love and affection, personal validation, trust, and self-disclosure. Aron et al. (1992) developed the Inclusion of Other in the Self (IOS) Scale (Figure 2.2), which is a simple, single-item, pictorial measure of perceived closeness. It consists of a seven Venn-like diagrams, each having two circles with different degrees of overlap. Respondents select the diagram that best represents their relationship with a partner. The concept of ‘inclusion of other in the self’ suggests that in a close relationship, an individual sees some or all aspects of their partner as their own. As a self-reported scale, the IOS Scale makes use of an individual’s own *sense* of being interconnected with their partner.

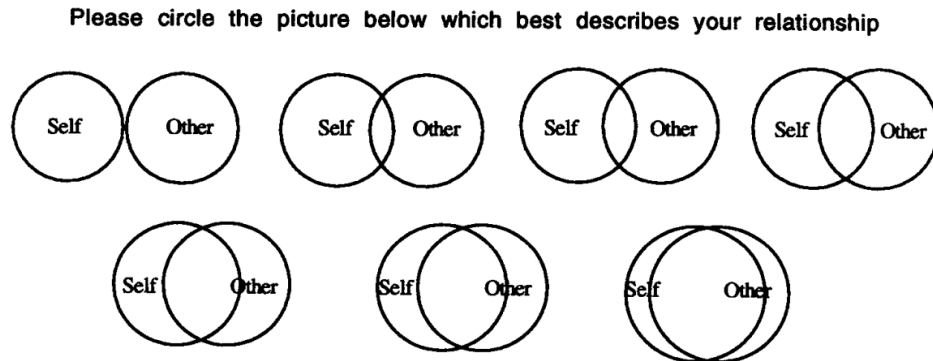


Figure 2.2: Inclusion of Other in the Self (IOS) Scale (Aron et al., 1992)

2.2 Supporting intimacy with technology

Intimate connections and technologies that support intimacy have been of growing interest to HCI researchers. Rooney (2014) emphasises the impact that HCI can have on social relationships through its conceptualisation and mediation of intimacy. HCI has the capacity to support novel and imaginative ways of contact between people which in turn can support intimacy between them. Over the years, many researchers have explored the ways in which technology can have an impact on social relationships. Robson and Robson (1998)

examined how intimate communication can occur using computers as a medium. Examining mainly text-based communication, they note that despite its shortcomings, computer communication sometimes enabled intimacy at a greater degree than in real life. They also note that such communication also presented dangers such as that of impersonation. Turkle (2011) observes that technology can redefine how intimacy is experienced as it allows more control over how and when we choose to express ourselves to others.

Perhaps the most impactful way HCI can impact human relationships is by designing technologies that are aimed at supporting intimacy. In the literature about such technologies, many have been designed with the aim of supporting long-distance relationships. Hassenzahl et al. (2012) reviewed 143 such technologies in past publications and outline the strategies that designers and researchers used to create a feeling of relatedness. They list six such strategies which are summarised in Table 2.2. Even though it is not an exhaustive list, it represents the multiple approaches that past HCI researchers have taken to support relatedness through technology. These strategies also demonstrate a link to the themes of intimacy that were discussed in Section 2.1.2.

Strategy	Description
Awareness	Creating a feeling of knowing your environment and the presence of other people and their moods in it.
Expressivity	Allowing people to express their affect and emotions in their own idiosyncratic way.
Physicalness	Mediating a feeling of physical intimacy (e.g., emulating actions such as hugs and stroking).
Gift giving	Enabling people to show their care and affection by giving gifts.
Joint action	Allowing people to carry out activities together thereby emphasising their interdependence.
Memories	Keeping a record of past activities and special moments in a relationship.

Table 2.2: Strategies of supporting intimacy through technology (adapted from (Hassenzahl et al., 2012))

Mediating vs. evoking intimacy

Gaver (2002) distinguishes technologies that mediate or communicate intimacy from technologies that evoke intimate reactions. Technologies that mediate intimacy do so by reproducing, facilitating, or imitating intimate emotions and actions. *Hug Over a Distance* (Vetere et al., 2005) is an example of such technology where the intimate act of hugging is recreated through

a connected system. Technologies that evoke or provoke intimacy, on the other hand, rely on triggering emotional reactions or simulating the effects of intimate communication without explicit communication of information or emotions. *Feather* and *Scent* (Strong & Gaver, 1996) could be examples of such technologies. Gaver notes that such devices could rely on evocative materials and mappings instead of obvious metaphors.

Gaver reflects that mediating and evoking intimacy could both be desirable approaches. The appeal of devices such as *Feather* lies in their use of rich, sensuous materials and their ability to evoke emotional responses. However, such devices may not be emotionally satisfying in the long run due to their limited interactive ability. Gaver notes that they could become clichéd like a greeting card. A device such as *Shaker* which allows richer interaction could allow for more possibilities and room for emotional experiences. *Hug Over a Distance* also allows for rich communication of the physical and sensuous act of hugging. However, as Rooney (2014) notes, equating intimacy with certain acts or activities comes with limitations. When technologies focus on purely mediating real life acts associated with intimacy, they run the risk of reducing the complexity and meaning of such interactions. For example, in *Hug Over a Distance*, many aspects of an actual hug such as the warmth and sense of physical presence of the other person are lost.

2.3 Challenges of designing intimate technology

Rooney (2014) carried out a thematic analysis of HCI's approach in supporting intimate communication. Rooney identifies five different themes based on approaches that HCI researchers have taken to support intimacy, and discusses the issues surrounding them. This section describes themes that Rooney presents.

Focusing on existing practices Many artifacts designed to support intimacy build on existing real life activities (e.g. hugging). Though this can be a starting point for designing such technologies, there are limitations associated with this approach. Rooney illustrates the use of the interaction of hand holding by Kaye and Goulding (2004) as an example. In their design concepts, Kaye and Goulding attempt to emulate the physical gesture of hand holding through connected devices. Rooney argues that while it may be possible to recreate the physical gesture, the context that surrounds the elicitation of such a gesture could be lost when doing so. Such an approach that focuses on recreating specific existing practices could be a reductive approach.

Focusing on technological capabilities Technology and the capabilities it offers can give rise to the creation of new functionality. Rooney argues that a focus on such capabilities should not sideline the characteristics of intimate contact it aims to support. For instance, in technology that aims to support intimacy between geographically separated participants, the focus should be on the participants' experience of being separated and having to rely on mediated communication rather than a focus on what is possible with the technology itself. The mere possibility of a technology should not be the only reason that it should be applied in an intimate relationship. Rooney notes that HCI research should be driven by the needs of the people it is designing for, "rather than any striving to create the technological lynchpin on which an intimate relationship rests" (Rooney, 2014, p. 890).

Constant contact Another approach that is used in supporting intimacy between geographically separated participants is to increase the level of contact between them, so that they have an increasing awareness of each other. An example of such an approach is the use of "avatar activity" which refers to symbols that represent the current activity of a remote user, often used in chat applications. Rooney notes that in an ongoing dynamic relationship between two people, such a feature could be assimilated into the evolving relationship to have new meanings. For example, there is the possibility of deceit by which people could display different symbols to different people at the same time. HCI researchers should keep in mind this possibility for assimilation when designing technologies to mediate intimacy. The challenge is how to design technologies such that their capabilities can be adapted in new ways according to the needs of the users involved.

Idealising intimacy Approaches that idealise intimacy tend to focus on specific types of communication between intimate participants. For example, in a technology designed to support romantic relationships, loving messages and acts could be the focus. Rooney points out that focusing on such idealised qualities of intimate relationships could downplay other aspects of the relationship which also play a role in the intimate relating between the participants. For example, mundane and everyday interactions play an important role in developing intimacy. Therefore, HCI researchers should take into account the broad meaning that intimacy could have when designing intimate technologies.

Prescribing intimacy When designing for intimacy, what constitutes intimacy could often be coloured by researchers' personal experiences and perspectives. When trying to understand what intimacy means to participants, researchers could develop an interpretative understanding of intimacy, which could underplay the complexity of intimacy. Rooney notes the importance of reflexivity when approaching the concept of intimacy, and not 'prescribing' what an intimate relationship is beforehand.

2.4 Finding a balance

As we grow accustomed to experiencing intimacy through technology, it becomes important to look at the implications this can have on our relationships both with other people and with technology itself. As Est (2014, p. 33) notes, connectivity in the internet age redefines what 'intimate' communication means to us. Intimacy is no longer just limited to family and friends who are traditionally close to us. Technology allows us to expand the scope of our intimate connections and allows for experimentation in ways that are not possible in real life. For example, Koch and Miles (2020) note how sex and dating apps allow people to encounter potential partners over a wider geographic region, while at the same time allowing for precise control in the filtering and screening of partners. Technology also allows us to selectively present and hold back aspects of ourselves when communicating with others as described in Walther's (1996) hyperpersonal communication model. In this section, we explore a few relevant themes relating to the implications that technology can have on intimate relationships.

Hyperpersonal communication model Walther (1996) developed the theory of "hyperpersonal communication" which suggests that computer-mediated communication (CMC) could transcend from interpersonal to "hyperpersonal" which could make it more desirable than face-to-face (FtF) interaction. Walther identifies the effects of CMC relating to four elements in the communication process—*receivers*, *senders*, *characteristics of the channel*, and *feedback processes*. *Receivers* often form an inflated "idealised perception" of the sender. In CMC, the subtle cues present in FtF interaction are missing, which leads to the receiver being highly sensitive to the minimal cues that are present. *Senders* in CMC have the opportunity to selectively present aspects of themselves in order to form favourable impressions, in what Walther terms "selective self-presentation". *Characteristics of the channel*, such as reduced communication cues and poten-

tially asynchronous communication in CMC contribute to this self-optimisation of appearance. Asynchronous interactions allow people to have greater control over their interaction with others. In CMC, *feedback* between the receiver and sender could magnify the effects of idealised perception and selective self-presentation through the process of behavioural confirmation, and this could have an effect on relationship development. Walther notes that due to the factors mentioned above, interactions in CMC can result in greater intimacy between participants than in FtF communication. Hian et al. (2004) provide evidence that relational intimacy can develop in CMC to a greater extent than in FtF interactions.

Redefining boundaries Est (2014, p. 33) notes how technology can affect intimate relationships by affecting how we cross and set boundaries. The use of social media has increased the amount of personal information we share with others, which could have negative effects such as ‘fear of missing out’. As Turkle (2011) observes, the opposite could also be true—people sometimes prefer texting over phone calls fearing that phone calls reveal too much. Social thresholds can be lowered by technology, such as in the case of apps such as Foursquare and Grindr. Francisco (2015) explored how video calling enables close contact between transnational family members. While this had the potential to mediate intimacy between separated family members, it could also open up the issue of surveillance, when children feel watched or scrutinised by their parents. Est also notes how actions performed through technology can lower our sensitivities, such as in the case of bomber drone pilots killing their targets without physical risk, possibly leading to a dehumanised perception of their enemies.

Vulnerability Vetere et al. (2005) note how intimate relationships can be strong, yet vulnerable. There is a potential for misunderstandings and these could have serious effects on the relationship. Vetere et al. suggest that when designing technologies to support intimacy, it is important to keep these unexpected breakdowns in mind. Technologies should mitigate against such breakdown and allow for repair when they occur.

Social virtual reality

This chapter takes a look at virtual reality (VR), and its potential to be a medium for communication and social interaction. Since our focus in this thesis is on the *affordances*, or interaction possibilities of VR which help facilitate intimacy, this chapter also elaborates on this concept and provides examples from the literature on VR. The final part of this chapter provides a look at the state of the art in social VR through self-usage of popular social VR platforms.

New and emerging technologies are often of interest to HCI researchers because of their potential to transform how we interact with each other and our environment. Virtual reality (VR) is one such technology. Gigante (1993) notes that one of the reasons VR has attracted great interest is that it has a wide range of applications in the fields of science, design, education, and entertainment, among others. Gigante also ponders about the dramatic impact VR could have on society as the technology matures and proliferates. In recent years, there has been a growing interest in VR as a platform for communication and social interaction (Perry, 2016). According to Perry, *social virtual reality* could refer to applications of VR that allow geographically separated people to interact with each other much like they would in real life, by taking the form of virtual avatars in virtual worlds. Commercial social VR platforms such as VRChat, AltspaceVR, and Rec Room are available on most popular VR head-mounted displays (HMDs), and data shows that a majority of VR users are interested in social experiences in VR (Koetsier, 2018). In this chapter, we will explore social VR and its implications while looking at current examples.

3.1 VR as a social medium

Current literature on social VR is preceded by research on traditional multi-user virtual worlds including early collaborative virtual environments (CVEs). Text-based multi-user dungeons (MUDs) are an early example of CVEs where users can navigate a text-based virtual environment consisting of electronically represented “rooms” which are connected to each other (Curtis & Nichols, 1994). Snowden et al. (2001) note that CVEs should aim to support four broad features—*shared context*, which includes shared knowledge of others’ activities,

shared artifacts, and shared environment; *awareness of others*, which means an understanding of others' activities, and a sense of co-presence; *negotiation and communication*, which includes negotiation of tasks in the environment, as well as conversations and interactions that sustain relationships in the virtual environment; and *flexible and multiple viewpoints*, which refers to multiple perspectives and representations in the virtual world needed to support the subjective views of different users.

Biocca and Levy (1995) offer an early look at VR as a medium for communication. They note that VR is often described as “the next logical step in the history of communication media” (Biocca & Levy, 1995, p. 127). Throughout the history of communication media, there has been a focus on developing interfaces that allow more sensory realism. With the increasing level of immersiveness and realism that VR provides, Biocca and Levy remark that it could become a general communication interface that combines the functions of the telephone, television, and personal computer. However, the most interesting aspect of such an interface could be its facilitation of interpersonal communication. VR offers a medium for interpersonal interaction that approaches face-to-face communication, with its increasing amount of sensory channels and realism. VR has the ability to transmit information about the movement of the body (kinesthetics), location of the body in space relative to others (proxemics), and touch (Biocca & Levy, 1995). Thus, it is clear that the VR has potential to serve as an immersive medium for interpersonal communication.

3.1.1 Social VR applications

In this thesis, we use the term ‘social virtual reality’ to refer to modern VR applications where people can communicate, collaborate and interact with each other in a virtual space through the use of VR head-mounted displays (HMDs), as described by Perry (2016). Examples include current commercial applications such as VRChat and Rec Room. McVeigh-Schultz et al. (2019, 2018) offer an overview of social VR applications that work in this context. They note that there is a variety of social VR applications based on several factors such as purpose, functionality, appearance, and interaction mechanics. Commercial social VR applications afford immersive, embodied, and spatialised experiences that allow different types of social interactions to emerge. For example, Rec Room has the Rec Center, which is a common area in its virtual world where players can encounter each other and team up to play games together.

Maloney and Freeman (2020) investigated what makes social experiences in VR meaningful to users. By conducting 30 in-depth interviews of social VR users recruited from online forums, they identified five types of activities that users found subjectively meaningful. The first type included *activities that made use of full body tracking in VR*. Having a virtual representation that closely mirrored their real body movements helped users to be more expressive. This also helped users to feel more closely connected and intimate with users around them. The second type of activity involved *experiencing mundane and everyday activities in new ways*. Participants highlighted sleeping in VR as one such activity. Falling asleep and waking up in a new virtual world was something that participants found enjoyable and even exciting, as it introduced a social aspect to a mundane, everyday activity. The third type of activity was those which *focused on self-improvement*. The high anonymity and immersion that social VR provided were especially relevant to activities such as practising social skills. Activities that helped to improve the mental state of users were also highly relevant to users. The fourth type of activity was those which *enabled cultural appreciation and understanding*. By allowing interactions with people from different cultures, social VR applications enabled people to learn about new cultures and appreciate them better. It also facilitated educational activities such as language learning together with native speakers. The fifth and last type of activity was those which *allowed users to engage in diverse immersive events*. The wide range of activities afforded by social VR, from entertainment to productivity was meaningful to users. The social aspect bolstered a sense of community and belonging when engaging in such activities.

3.2 Affordances in VR

Gibson (1979) coined the term affordances to refer to features that an environment provides or furnishes to an organism in that environment. Norman (1988) later expanded on this term in the context of HCI to refer to a relationship between the characteristics of an environment and an agent, such that it *affords* an opportunity for action when perceived by the agent. In essence, a feature of an environment affords an action to an agent provided that the agent has the capability to use that feature. Gross et al. (2005) note that affordance-based design in a virtual environment can be beneficial by helping users better perceive what actions can be done. When designing for virtual environments, it can be useful to identify what these affordances are and how they can be realised. Social VR offers several such affordances which allow its users to interact with

the virtual environment and with each other. In this section, we first explore the affordances that VR technology provides, followed by affordances that are specific to social VR.

3.2.1 General VR affordances

Steffen et al. (2019) explored the broad types of activities afforded by VR that motivated users to adopt VR technology. They present a framework of affordances in VR and augmented reality (AR) which consists of four main affordances (Steffen et al., 2019, p. 696). The affordances were derived based on the types of activities that were possible in VR in comparison to physical reality. The first affordance provided by VR is that of *diminishing negative aspects of the physical world*. For example, activities that entail physical risk in the real world can be virtualised to reduce the risk. Steffen et al. illustrate pilot training (for risky landings) in VR as an example of such an activity. VR can also be used to reduce mental or emotional risk, such as in the case of using VR for the treatment of post-traumatic stress disorder. The second affordance is that of *enhancing positive aspects of the physical world*. VR can be used to improve the outcome of real life activities. For example, VR medical training can improve a participant's sense of presence which can lead to better outcomes when performing actual surgery. The third affordance is that of *recreating existing aspects of the physical world*. For example, a virtual car dealership in VR can be used to reduce costs, while allowing customers to view automobiles without spending time and effort to travel to a physical location. VR can also open up opportunities for people to experience activities that they otherwise have no easy way to access (e.g. due to lack of skill), such as snowboarding or boxing. The fourth affordance is that of *creating aspects that do not exist in the physical world*. As VR worlds are not bound to the laws of the physical world, they open up more possibilities for activities. For example, VR allows applications where space-time linearity can be overcome. The popular VR game *SUPERHOT*¹ is a striking example of the use of this affordance.

Aside from the broad affordances based on activities that Steffen et al. explored, it is also useful to look at other types of affordances that VR provides. Shin (2017) identified different affordances that are relevant to VR learning environments (VLEs) and notes that the main ones are generalisable to other VR technology in their specific contexts. Shin identified four main affordances—*immersion*,

¹ *SUPERHOT* Gameplay Review by The Daily Dot – <https://youtu.be/MYIMAbn-SDE>

presence, empathy, and embodiment. The immersion affordance refers to the ability of VR to afford deep involvement of users with the virtual environment. Shin notes that immersion is not a quality that is given or pre-existing in VLEs but it arises as a result of a users interaction. Presence refers to the affordance that VR provides where users feel aware of being in a virtual environment. It could also refer to feeling the presence of or being connected to other users in the environment. The empathy affordance in VR allows people to understand others. By being able to closely convey other people's feelings or experiences, VR can stimulate empathy. Finally, the embodiment affordance in VR creates the feeling that a user's avatar is an extension of their physical body. Users are also able to embody experiences by immersing in them and feeling perceptual cues linked to those experiences.

3.2.2 Multimodal interactions

One of the main aspects that contribute to the sense of immersion in VR is its use of multiple input and output modalities. These modalities often involve multiple human senses, which allows rich sensory realism. Burdea et al. (1996) provide an overview of VR input-output modalities, many of which form the basis for modern VR systems. Position tracking is one of the main forms of input in VR. Head and body movements can be tracked in 3D space, often in six degrees of freedom (DoF). Visual feedback is one of the primary output modalities. This can be achieved by the use of screens in an HMD which is worn on the user's head. Visual feedback can be complemented with audio feedback. Audio feedback can be localised, meaning its origin can be located in 3D space. Haptic feedback is also an important output modality, which can provide tactile feedback corresponding to virtual interactions. Aside from these basic modalities, VR systems today can make use of more input-output modalities, such as facial expression tracking (Yu & Park, 2016), eye tracking (Whitmire et al., 2016), and even biofeedback (Schoeller et al., 2019).

3.2.3 Social VR affordances

Besides the general affordances that VR technology provides, it is of interest to look at specific affordances that social VR applications can provide. McVeigh-Schultz et al. (2019) note that social VR applications have given rise to new communicative affordances, such as voice indicators above virtual avatars to show who is speaking at a given moment. When considering such affordances,

it is useful to first look at the specific features in social VR that enable communication and interaction. Jonas et al. (2019) present a taxonomy for social VR application design that elucidates the features that social VR offers. They identify features of social VR divided into three main categories—those pertaining to *the self*, to *interaction with others*, and to *the environment*. An overview of these features is presented in Table 3.1. The first category consists of features that let users control their virtual representation or avatar. This includes features that enable the representation, customisation and manipulation of avatars in the virtual world. The second category consists of features that enable interaction between users in social VR. These features enable control over how people communicate, what types of communication is possible (e.g. verbal and non-verbal), and what activities facilitate social interaction. The last category consists of features pertaining to the virtual environment or space. This includes features that allow user manipulation of the environment, the spawning of user avatars, and the openness of the environment (public/private). The taxonomy presented by Jonas et al. provides a starting point for exploring affordances in social VR and studying how they facilitate social interaction among users.

Category	Features	Variations of Features
The Self	Avatar Representation	Partial Body Avatars, Full Body Avatars, No Avatar
	Avatar Customization	Preset Avatars, Appearance Customization, No Customization
	Avatar Manipulation	Full Body Tracking, Controller Tracking, No Tracking/Minimal
	Avatar Traversal	Teleporting, Walking, No Traversing
Interaction with Others	Communication Privileges	Muting Other Users, Blocking Other Users, Adding/Deleting Other Users In Contact Lists, Inviting Other Users to Private Worlds
	Communication Types	Voice, Text-Based, Physical Expression, Visualized Bio-Adaptive Feedback
	Activity to Scaffold Interaction	Events, Recreation, Virtual Prototyping, No Activity Scaffolding (Conversation Only)
The Environment	User Manipulation of Environment	Construct a New Virtual Space, Alter Physical Elements, No Environment Manipulation
	Spawning Area	Private Area Spawning, Social Area Spawning
	Openness of Environment	Public Environment, Private Environment

Table 3.1: Taxonomy of social VR features (Jonas et al., 2019, pp. 440–441)

3.2.4 Non-verbal communication

One of the features of social VR discussed in the taxonomy by Jonas et al. (2019) is full body/controller tracking. This allows social VR users to manipulate their avatars in different ways using their body, opening up a possibility for non-verbal communication. Tanenbaum et al. (2020) present an inventory of expressive non-verbal interactions that are possible in commercial social VR platforms. The inventory is divided into four categories: *movement and proxemic spacing*, *facial control*, *gesture and posture*, and *virtual environment specific communication*. The first three categories consist of the main forms of non-verbal communication in social VR, while the fourth category deals with forms of non-verbal communication that arise from unique constraints or lack thereof in virtual environments. Table 3.2 provides an overview of Tanenbaum et al.'s inventory. Maloney, Freeman and Wohn (2020) explored what makes non-verbal communication in social VR unique and desirable to users. In their findings, they note three main themes how non-verbal communication can be useful to users: *expression of body language in a more immersive and embodied way*; *similarities to face-to-face communication in real life*; and *as a natural way to start interaction with strangers*. Maloney, Freeman, and Wohn also note that non-verbal communication can give rise to new social interaction consequences. It affords users privacy and social comfort, and provides protection to marginalised users. For example, non-verbal interactions allow users to communicate without revealing their gender identity, protecting them from potential harassment.

3.2.5 Social mechanics

Social VR allows various mechanics that support social interaction between users. McVeigh-Schultz et al. (2019) describe a few examples of such mechanics, which include the use of emotes, multi-user gestures such as high-fives, and interactions such as adding a friend. The virtual environment in social VR can afford pro-social interactions through the use of concepts such as “social catalysts”, which refers to features or artifacts in the virtual environment that encourage users to interact and get to know each other. The embodiment aspect of VR also has implications for social interaction. For example, Tarr et al. (2018) studied how synchrony between users avatars in VR could result in greater social closeness between users. The ability to maintain a personal space bubble around one's avatar is another mechanic that is related to embodiment in social VR, that can affect how people interact with each other. Features unique to virtual environments, such as spawning a user avatar can also have an effect on social

interaction. McVeigh-Schultz et al. (2019) note that it is better to spawn new users away from the centre of public environments, so that they first have a chance to get familiar with the environment before interacting with others.

Category	Design Strategies
Movement and Proxemic Spacing	Direct Teleportation <i>Movement by teleporting to a selected target position</i>
	Analog Stick Movement <i>Using an analog stick to control movement</i>
	1:1 Player Movement <i>Player's movement in physical space is mapped to the virtual space</i>
	Third Person Movement <i>Similar to teleportation, but avatar already starts moving when selecting target</i>
	“Hot Spot” Selection <i>Movement limited to pre-determined hot-spots</i>
Facial Control	Expression Preset <i>Selectable or template facial expressions</i>
	Puppeteered Expressions <i>Ability to control or compose individual facial features (sub-category: lip sync)</i>
	Gaze/Eye Fixation <i>Ability to control eye fixation or gaze</i>
Gesture and Posture	Poseable/movable Appendages <i>Movement of head, torso, arms and legs in the virtual space</i>
	Dependent/Indirect Selection <i>When body movement is tied to other emotes or presets</i>
	Mood/Status/etc. <i>Behaviour that reflects the avatar's overall emotional state</i>
Virtual Environment Specific Non-verbal Communication	Multi-Avatar Interactions <i>Interactions made together with other players' avatars (e.g. high-fives)</i>
	Collisions <i>Physical interaction with objects or other players' avatars</i>
	Emotes <i>Preset animations to convey mood; often linked to other forms of non-verbal interaction</i>
	POV Shift <i>Ability to change the position of the camera in virtual space</i>

Table 3.2: Inventory of non-verbal communication in social VR adapted from (Tanenbaum et al., 2020, pp. 440–441)

3.2.6 Appearance of avatars and environment

Avatars in social VR allow users to represent themselves in the virtual world. Past research in social VR and CVEs identifies the appearance of avatars as a central theme in supporting social interaction (Freeman & Maloney, 2021; Schroeder, 2002, p. 7). Yee et al. (2009) explored how avatar appearance in a virtual world can change how people interact with each other. They highlight the impact of the *Proteus effect*, in which people infer their expected behaviours and attitudes from their avatar's appearance and then subsequently conform to these behaviours. In their study, they found that avatar height and attractiveness played a role in player performance. They also found that avatar height had an effect on how users behaved in a virtual task, and that this could also potentially carry over to subsequent face-to-face interactions. Freeman and Maloney (2021) looked at how avatars and self-presentation in social VR play a role in the formation of new identity practices and the generation of new social interaction mechanics. They note that self-presentation in social VR was constructed in two main ways: creating an avatar that was consistent with one's physical self; or constructing an avatar based on the social atmosphere of the platform. Many social VR users noted the value of considering their virtual appearance as being an extension of their physical self, and the importance of staying true to their physical appearance. Freeman and Maloney also identified *aesthetics*, *gender*, *race*, and *maturity* as four main aspects that social VR users emphasised when perceiving the self-presentation of others in the platform. For example, a visually pleasing appearance often led to positive impressions which in turn benefited social interaction. The perception and creation of self-presentation in social VR were also found to have an impact on users' understanding of their own self. For example, users who struggled with their gender identity found that social VR provided them with a way to explore and affirm their gender identity in an embodied way.

The appearance of the virtual environment in which social VR users interact can also play a role in shaping social interaction (McVeigh-Schultz et al., 2019; Schroeder, 2002, p. 7). McVeigh-Schultz et al. (2019) note the aesthetics of a virtual world shapes expectations and user behaviour. For example, people can associate a virtual world that looks like a tropical cove with feelings of being on the beach. The environments in social VR platforms like Rec Room are designed with specific goals in mind and to encourage certain types of behaviours. Environments like a virtual auditorium can elicit social behaviours that draw from their real life counterparts. The architecture of virtual spaces can

also instil a sense of safety. For example, an enclosed environment could make people feel more secure. Spaces can also be designed to support certain types of interactions. For instance, a circular table could be a “conversation anchor” by allowing people to gather and talk while being able to see each other at all times. McVeigh-Schultz et al. also note how many social VR platforms offer the ability to create custom environments, thereby offering users more agency in shaping the expectations and aesthetics of their environment.

3.2.7 Safety and privacy

Since most social VR platforms are free to use and open to anyone, their safety and privacy are central issues to consider. Past research in social VR has looked into issues such as harassment (Blackwell et al., 2019) and disclosing personal information (Maloney, Zamanifard et al., 2020). Blackwell et al. (2019) conducted interviews with social VR users and found that users’ definitions of harassment were subjective and highly personal. They found that some aspects of social VR, such as one’s gender identity made users more susceptible to harassment. Maloney, Zamanifard et al. (2020) note that disclosing gender identity, often unintentionally through voice, could potentially attract unwanted attention or scrutiny. Blackwell et al. note that affordances provided by VR also exacerbated some forms of abuse and harassment. For example, the ability to voice chat synchronously permits users to verbally insult each other in a more visible and immediate manner as compared to asynchronous text chat. Such abuse could also be ephemeral making it difficult to report and mitigate those acts. Embodied avatars and the sense of presence they provide could also serve as a means for physical harassment such as unwanted virtual touching or grabbing. Violations of personal space are also an important issue in social VR. Harassment in social VR could also materialise through the use of the virtual environment. For example, users could abuse customisable worlds to display sexual or violent content, and interactive objects could be thrown at other users. Blackwell et al. note that public social VR platforms such as AltspaceVR or VRChat have a higher potential for abuse as they focus on general social interaction between users who were often strangers.

With advances in VR technology, it becomes important to consider the effects VR can have on privacy. The increasing amount of personal information made available through VR can bring to attention novel issues. For example, Pfeuffer et al. (2019) explored how movement characteristics of users in VR can be used to uniquely identify them. In social VR, it is of interest to look at interactions

between users and the privacy issues surrounding them. Maloney, Zamanifard et al. (2020) conducted interviews with social VR users to explore issues relating to self-disclosure of personal information and privacy. They identified three patterns among users regarding self-disclosure. The first was that users used the concept of familiarity and anonymity to determine whom to share information with. Some users only shared information with people who were familiar with them. Others shared information only if they were anonymous. Users noted that sharing information provided them with an opportunity to find something in common with others, which led them to build connections with others. The second pattern identified was that users were often comfortable in sharing emotions and life experiences with others. Social VR provided users with a feeling of security to be able to share such experiences. For example, watching an emotional movie with others in social VR enabled users to openly share emotions together. The third pattern was that sharing certain types of personal information, such as age, gender, and location was a complex issue. Sometimes, intentional or unintentional disclosure of personal information opened up privacy risks. Maloney, Zamanifard, et al. note that users creating avatars that mirrored their physical appearance inevitably disclosed information such as height, race, and gender. Such disclosure could open up privacy risks such as stalking.

3.3 An exploration of social VR through self-usage

As social VR is a rich and emerging interactive paradigm, it is important to experience and understand the current landscape of social VR platforms. Loke and Schiphorst (2018) underscore the impact that self-observation and auto-ethnography can have when designing for others. They note that it is important to understand and empathise with other people's experiences, and getting a first-person perspective can be invaluable in doing so. Such first-person methods can also complement more traditional empirical methods. McVeigh-Schultz et al. (2018) made use of autobiographical design methods to take a look at the emerging realm of social VR, which was successful in drawing attention to key capabilities and issues. We take a similar approach to investigate the potential of intimate connection in social VR.

In this section, we provide an overview of major social VR platforms along with our experiences from hands-on exploration of some of these platforms. In exploring these platforms, our aim was to learn what it meant to be social in these platforms, what interactions and patterns set these platforms apart, and

how/if intimacy was supported by them. We also connect the findings from literature discussed in previously in this chapter with our experiences in social VR. Our method consisted of visiting each platform multiple times and making observations about our personal experiences in them. We mainly look at apps that are compatible with the Oculus Quest 2 HMD and are free-to-play.

3.3.1 Overview of social VR platforms

Rec Room Rec Room is a social VR platform developed by Rec Room Inc. that has a focus on play and games. The virtual world in Rec Room consists of various public and private spaces where players can take part in multiplayer games. The common area called “Rec Center” serves as a public space where players can meet each other, chat, play simple games, and team up to play other games. Rec Room offers a variety of original games for users to play, from team bases games like Paintball and Soccer, to cooperative adventures which players can play with others. Rec Room also enables players to create custom rooms through which they can create their own games. Avatars in Rec Room consist of friendly-looking simplified humanoid forms which can be customised by the player. Maloney, Freeman and Robb (2020) note that Rec Room is more popular among minors compared to adults.

VRChat VRChat is a social VR platform developed by VRChat Inc that has a large emphasis on user-generated content. One of the main features of VRChat is that it allows users to create completely custom avatars which can be varied in shape and size. The platform also emphasises the creation of custom virtual worlds where users can interact with each other. This allows like-minded players to come together and discuss topics they are interested in. McVeigh-Schultz et al. (2018) note that the open nature of VRChat allows users to express themselves in non-normative ways, which often gives rise to new social rituals and memes. VRChat is also cross-platform; it supports a wide range of HMDs and it even allows users without an HMD to log in and interact with the world through a PC.

AltspaceVR AltspaceVR is a social VR platform that was acquired by Microsoft in 2017 (AltspaceVR, 2017). It allows users to chat and interact with each other, but a large part of the platform is about hosting and attending live events. Avatars in AltspaceVR are customisable, and the platform allows users to create custom worlds to host their own events or meetings. With its focus on live

events, AltspaceVR allows thousands of users to attend an event together at the same time, allowing experiences such as live concerts with participants from all over the world (AltspaceVR, 2016). Compared to other platforms, AltspaceVR is varied in its focus as it allows for both fun activities and productivity at the same time. It is also cross-platform and allows users without an HMD to use the platform through a PC in “2D mode”.

Alcove Alcove is a family-oriented VR app for Oculus Quest and Oculus Go. The virtual environment in Alcove is in the form of a virtual home where family members can share experiences together. The different rooms in the home allow different activities such as games, virtual travel, and meditation. Alcove focuses on creating a private experience exclusively for family users. For example, it allows members to display private photos on the walls of the virtual home. Avatars in Alcove are shared with the Oculus platform, which allows the creation of customisable avatars.

vTime XR vTime XR is a VR and AR social platform developed by vTime Limited. Unlike many other VR platforms, vTime does not have a common public room for users. Rather, it has private rooms to which users can invite others or request to join. The focus is on creating private and intimate chatrooms which facilitate discussion on topics users have a common interest in. Avatars in vTime are human-like and relatively high-fidelity in appearance while offering a vast range of customisation options. The app allows limited movement options, and players are always in a seated position as the emphasis is on conversation.

Half + Half Half + Half is a multiplayer VR game developed by Normal VR. It features a surreal virtual world with multiple games and activities that players can take part in. Player avatars take the form of abstract humanoid forms of randomly assigned colours and characteristics. The game does not offer voice chat in public mode, but rather focuses on body language and non-verbal interactions for communication. This also makes the experience safer and more welcoming for new users and minors. The virtual world features a common space that consists of portals to different sub-worlds. The sub-worlds offer games such as hide and seek, and relaxing activities such as swimming, and gliding. Max Wiesel, the game’s creator, describes it as a virtual space where people are able to feel authentic connection by being emotionally close (Castro & Kover, 2020).

Facebook Horizon Facebook Horizon is an upcoming social VR experience with an emphasis on creation and play. Players can create virtual worlds together with others, and engage in multiplayer games and activities. Through its interactions, the platform aims to be a space where people can form meaningful connections with others ('Facebook Horizon Welcomes Its First Virtual Explorers', 2020). Avatars in Facebook Horizon have a cartoon-like humanoid appearance with a focus on fluid movements. The avatars also feature facial expressions and lip-sync that are derived from voice.

Neos Neos is a 'metaverse engine' developed by Solirax. It is a sandbox-like social VR platform which provides users tools and resources to create their own social VR worlds, avatars, and experiences within VR. Users are able to create 3D models in-game and program custom behaviour using the built-in visual programming system called LogiX. Neos focuses on creative collaboration where users are able to build custom creations together, and share it with the community. The platform features thousands of user-created worlds, avatars, and artifacts which can be retrieved and shared with other users with the help of an inventory system. Neos offers a high degree of flexibility, allowing integration with a wide range of HMDs, trackers, and third party VR solutions.

3.3.2 Self-usage report

For hands-on exploration, we mainly explored the apps listed above, with the exception of Facebook Horizon and Alcove. From the explored social VR, we grouped our observations and findings into themes that we identified based on the literature previously discussed. We compare and contrast our experiences below.

Onboarding

McVeigh-Schultz et al. (2019) note that onboarding plays an important role in supporting pro-social interactions in VR by getting new users comfortable in the virtual environment. All of the apps that we tried had dedicated onboarding flows which guided us through the initial steps of creating an avatar and getting familiar with the controls. In Rec Room, VRChat, and AltspaceVR (where there are many other users), the experience first started in a private space that was separate from the common areas with other users. This helped to get a grasp of the controls and basic interactions before starting to interact with others. vTime XR had an introductory tutorial that walked us through the features of

the platform. This tutorial made use of avatar guides with pre-recorded voice instructions. We felt that vTime's developers put a lot of attention into the onboarding process. The use of guide avatars also made the onboarding feel more personal. Half + Half had a basic introduction that showed the movement controls and features of the game. Here, the developers made use of a clever mechanic of first showing a clone of your own avatar that mirrored your movements. This made it easy to get familiarised with the virtual avatar and its movements, and quickly get started with the platform. Neos had an introductory world that made it easy to learn how the platform works. In addition to learning the controls, the world also made it easy to choose a starting avatar and find other interesting worlds to explore.

Avatar and Environment Appearance

Avatar creation and customisation was a central focus in almost all apps that we tried. Each platform approached avatars differently, and we felt that platform expectations and social interactions changed depending on the appearance of the avatars, confirming the Proteus effect. [Figure 3.1](#) shows representative avatars from the different platforms that we tried. Rec Room has customisable humanoid avatars that look friendly and approachable. Here, customisability is limited to aspects such as clothes, accessories, skin colour, and hair colour. The facial expressions of the avatar are shown in a simple 2D way without much definition, which makes the avatar look friendlier. We felt that this look was helpful in setting a playful atmosphere on the platform. vTime XR has humanoid avatars with a high level of detail. The avatar customisation options are extensive, with menus that went several levels deep. We felt that creating the avatar was a tedious task here, but there was also a button that randomly generated an avatar for you. vTime XR's detailed and more human-like avatar helped to set a serious mood that was helpful in the context of having intimate conversations.

We next looked at VRChat, which allows complete freedom in choosing your avatar, as you are not limited to preset options. Customisation in VRChat does not work like in other apps where you can choose avatar attributes. Rather, you are able to choose from hundreds of avatars in the game, most of which are user-generated. This allows for unique and eccentric avatars, which were often conversation-starters in the game. VRChat also has entire in-game worlds dedicated to choosing avatars. Neos also offered similar flexibility in choosing avatars, although avatar choices were more limited than VRChat. However, Neos had the advantage that avatars were more customisable, as one could



Figure 3.1: Avatars in (from left to right) Rec Room, VRChat, AltspaceVR, vTime XR, Half + Half, and Neos

edit every aspect of their avatar using in-game tools. Half + Half has abstract-looking androgynous avatars that are randomly generated. However, a lack of customisation did not negatively affect how personal the avatar felt to us. In fact, we felt a high level of embodiment with avatars in the game. This was due to how the hands behaved when in first-person view. While apps like Rec Room and AltspaceVR had avatar hands that were separate from the body, Half + Half had hands that were connected. The hands were also flexible and jelly-like. This concept worked well with the abstract avatar design and we often found ourselves looking down at our hands and moving them around.

The virtual environments we encountered were varied in appearance and function. Rooms in Rec Room are modelled in a retro aesthetic. The Rec Center (Figure 3.2) is reminiscent of a school or club common room and players' private rooms look like dorm rooms. Game worlds in Rec Room follow a similar aesthetic that emphasises friendliness and approachability. In VRChat and AltspaceVR, the private rooms are modelled as homes or apartments. VRChat takes a more realistic-looking approach, while AltspaceVR embraces a cartoony look. Custom worlds are a huge part of VRChat, and each world can have highly different looks. For example, Summer Solitude, one of the more popular hang-out spots is modelled after a high-rise apartment in a city. VRChat also has many sleep worlds which feature calming aesthetics. The world in Half + Half has a very ethereal and simplified aesthetic. For instance, it has a swimming game where the player can swim alongside other players in an underwater world with schools of fish. The worlds in Neos that we visited were mostly custom worlds that users created within the platform. The worlds were comparable to VRChat

in terms of appearance, although worlds in Neos tended to be more chaotic as they could be edited in real time. The environment in vTime XR consists of private seated rooms which can be customised. The platform offers a variety of environments and 360° backgrounds that users can choose from, such as tropical islands or even real cities.



Figure 3.2: Rec Center in Rec Room

Space and Navigation

All apps with the exception of Half + Half have private “home” rooms where users can first get acclimatised with the controls and environment. Upon exiting the dorm room in Rec Room, players are taken to the Rec Center, which is a common space for all players. The Rec Center has various features like a shop, a cafeteria, a basketball court, and various table tennis tables. The Rec Center aims to encourage encounters with other players. It is a central part of Rec Room that also serves the function of connecting players to other games and rooms. AltspaceVR, VRChat, and Neos also have common “hub” rooms similar to Rec Center, but they are not prioritised in the same way. These platforms put the common rooms in the same level as other public rooms. Many of the public rooms are functionally similar to the hubs, which makes highlighting the hub less important. vTime XR does not have public rooms, and has invite-only private rooms. The rooms in Half + Half can be shared either with other public users, or a private party of users.

Movement mechanics in social VR play an important role in navigating the virtual world. Rec Room, AltspaceVR, VRChat, and Neos all offer multiple ways

to move around. User comfort seems to be the main reason to provide multiple movement options. Analog stick movement offers a sense of realistic motion, but has the drawback of motion sickness. Direct teleportation is the main alternative to analog stick movement. In our experience with Rec Room and AltspaceVR, analog stick movement seemed comfortable at first, but it induced motion sickness when playing over a long period. Both platforms offer a feature that reduces the field of view (see [Figure 3.3](#)) when moving, which helps to reduce the problem of motion sickness. VRChat has no such feature, which led us to turn off analog stick movement and select teleportation instead. In-space navigation is very limited in vTime XR, as you can only move between seats in the virtual room. In Half + Half, the default movement mechanic is teleportation, but the sub-worlds in the have different mechanics. In the swimming world, you move by moving your hands in space as if you were swimming. In the hide and seek game, movement is accomplished by swinging your hands in a running motion. Once we got familiarised with these new mechanics, movement in the respective worlds felt very natural.



Figure 3.3: Reduced field of view during movement in AltspaceVR

In-app menus to browse all the available virtual worlds is a prominent feature of most social VR apps. In Rec Room, the menu pops out of a watch that your avatar always wears. The menu offers a way to search for worlds and find popular worlds. It also offers an interface for other in-app functionalities such as adding and removing friends. VRChat, Neos, and AltspaceVR also offer similar menus which can be easily accessed. All these apps also have a “go home” feature in the menu, which immediately teleports the user to their private room. In vTime XR, available rooms are displayed as a “connections” graph (Figure 3.4). This allows a quick overview of who is currently online and who they are chatting with. Here, you can also see users’ preferred topics and languages. Through this, users can select the rooms that they are most interested in. Half + Half does not have an in-game menu to navigate worlds, and instead relies on the common hub to connect people to sub-worlds in the game. We observed that players often used the hub to “recruit” other players to join a game with them.

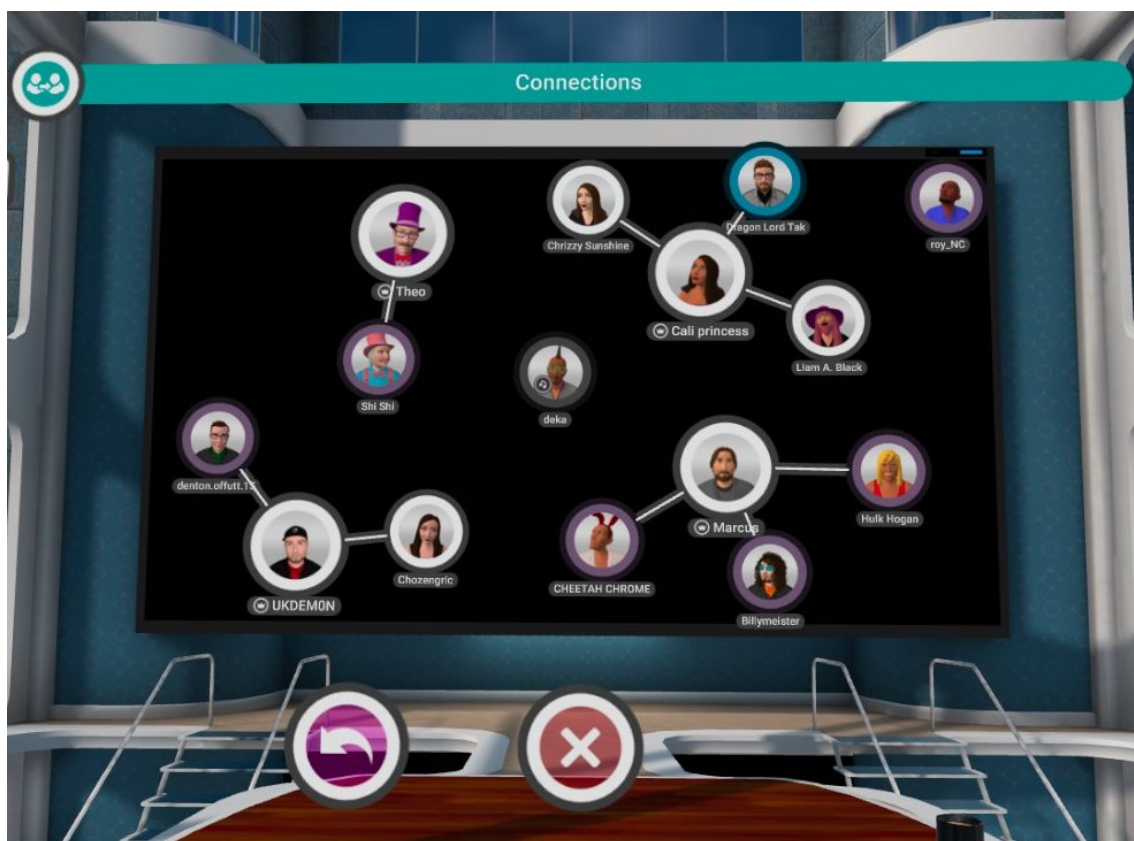


Figure 3.4: Connections graph in vTime XR

Types of Activities

The social VR apps that we tried each seemed to differentiate themselves by focusing on certain types of activities. Rec Room has an emphasis on multiplayer games; AltspaceVR on live events; VRChat on custom worlds and self-discovery; Neos on creation and collaboration; vTime XR on deep conversations; and Half + Half on lighthearted play. In our experience, these different types of activities attracted different types of crowds to each app. With its focus on games, we found that Rec Room had a lot of minors using the platform, agreeing with the findings of Maloney, Freeman and Robb (2020). Games in Rec Room were varied. There are team games like Paintball, which are fast-paced. There are also more exploratory games such as Isle of Lost Skulls which is a cooperative adventure that can be played with up to two other players. Rec Room also has more casual games like 3D charades and bowling. We felt that the variety of games ensured that there is something for everyone. Games in Half + Half are also similarly varied, but we noticed that a few games were more popular than others. The hide and seek game was particularly popular, and we found it very fun in my experience. This game had an interesting mechanic where the seeker's avatar would become much larger than the hiders, and they had to find the hiders who were scurrying about in a little world full of nooks and crannies.

While the live events in AltspaceVR looked promising, we did not experience any particularly interesting event that made the experience memorable. In one of the events that we attended, there was a movie being played in a virtual arena, with users occupying seats in front of the screen. However, the experience was fairly disconcerting, with users constantly moving in and out of the world and interrupting any immersion in the movie. There were also far fewer users online in AltspaceVR compared to Rec Room or VRChat, which led us to leave the app comparatively quickly after seeing that there was nothing to do. VRChat on the other hand has a variety of different worlds, with hundreds of users online at any given time. The different world themes made it interesting to explore what each world has to offer. For example, we spent a lot of time searching for the perfect avatar in multiple avatar worlds that VRChat had to offer. The themed worlds also make it easier to find people who have similar interests to you. For instance, *Japan Shrine* is a popular hang-out spot for Asian users and people interested in Asian culture. Neos also had multiple active worlds to choose from, although the options were far more limited compared to VRChat.

Verbal and Non-verbal Interactions

In our experience, verbal interaction was often the primary means of communication between users in social VR apps. All apps with the exception of Half + Half prioritise this aspect, and have features that present some level of control over verbal communication, such as muting users. The default setting in most apps had the microphone always on, highlighting the importance of verbal interaction. In Rec Room, verbal interactions are accompanied by visible cues including lip movement, and indicators that appear when someone is speaking. AltspaceVR, vTime XR, Neos, and VRChat also feature mouth movements when speaking, although in VRChat and Neos this depends on whether the custom avatar supports the feature. We felt that the real-time aspect of verbal communication added to the feeling of presence and being together with other users. However, this also has a potential for abuse, such as when a random player started using abusive language at others in Rec Room, or when a user played loud music through their microphone in VRChat. In Half + Half, talking to other players is only possible in a private party. When in a public party, user voices are replaced by cute “lalalala” sounds which help in conveying emotions, while avoiding potential abuse.

Aside from naturally emerging non-verbal interactions such as hand-waving, apps also feature interactions that are baked into the experience. Rec Room and Half + Half support a high-five feature that is accompanied by visual, audio, and haptic feedback whenever users perform a high-five. Half + Half has an intuitive way for players to mute themselves by moving their hand to their mouth. Many apps also feature emotes, which allow users to easily communicate emotions in a non-verbal manner. Emotes are often accompanied by matching facial expressions and body movements. In vTime XR, users can take a ‘selfie’ of themselves together with others in the room. In our experience, non-verbal interactions were popular in Rec Room to convey emotions after winning a game together. Neos offers the ability to spawn items in worlds, which we noticed gave rise to interesting physical interaction between users. For example, users could spawn wearable items such as hats and scarves, and also toys such as a bubble gun. We noticed that users played with each other using these objects, for example by putting a hat on another user’s head.

Social Mechanics

Interacting with other players is the most important aspect of social VR. While there are many features in social VR apps designed to encourage social inter-

action, people also often find their own ways to connect with other users. The Rec Center in Rec Room features a cafeteria that mostly serves an aesthetic purpose, without any actual function. However, we noticed that people often did little role-plays in the cafeteria where a server would stand behind the counter and take virtual “orders” from other users. Rec Room also features many “social catalysts” like water bottles and dart boards which encourages users to gather together and play. Another interesting ‘unscripted’ interaction that we encountered was in VRChat, where multiple users gathered together in one spot and made use of virtual pens to endlessly draw in 3D space. Their objective was to cause a large performance hit on their devices which had to render multiple users and their drawings, and this was obvious from their continuous chanting of “*kill all the frames!*”. This is a clear example of how the expressiveness theme discussed in [Section 2.1.2](#) could play out in social VR.

The environment often played an important role in encouraging social interaction. In the many sleep worlds of VRChat, we noticed that conversations often took a deeper direction, which could be a result of the calming ambience. In vTime XR, the environments often served as an ice-breaker in conversations as they were so varied and interesting. Environment features also play a role in bringing users together. For example, the common space in AltspaceVR has a campfire, and we noticed that users often tend to gather around the fire and talk. The building tools within Neos often encouraged users to get together to create something, or to solve an issue together.

Privacy and Safety

Features to ensure the privacy and safety of users are at the core of most social VR apps that we explored. Rec Room, AltspaceVR, and VRChat have a personal space bubble feature which makes a user’s avatar invisible if others enter their personal space. The extent of this bubble is also adjustable in all apps. The above-mentioned apps also offer features to self-moderate other users. Rec Room has a dedicated menu for comfort and safety which makes it easy to do this. From this menu, players can mute, block, or report other players. We personally used this feature to mute obnoxious players who were loud or used abusive language. Rec Room offers multiple features for user privacy and comfort, such as a feature to change the user’s voice pitch to maintain privacy. Neos offers the ability to kick or ban users from a world, however it did not offer an easy way of reporting other users.

VRChat has a dedicated safety menu which offers the ability to manage how other player appear to you. Moreover, VRChat has a “Trust system” aimed at reducing annoyances and harassment. There are different ranks of trust based on how long each user has used VRChat. Players can use the trust system to enable different “shield” levels based on trust which can be used to filter aspects of users with lower trust. For example, users can choose to block voice communication from users with lower trust. Figure 3.5 shows the Safety menu which contains controls for the trust system. Users’ trust levels are not explicitly displayed during normal gameplay, so we felt that it did not have a big impact during normal gameplay and social interaction.

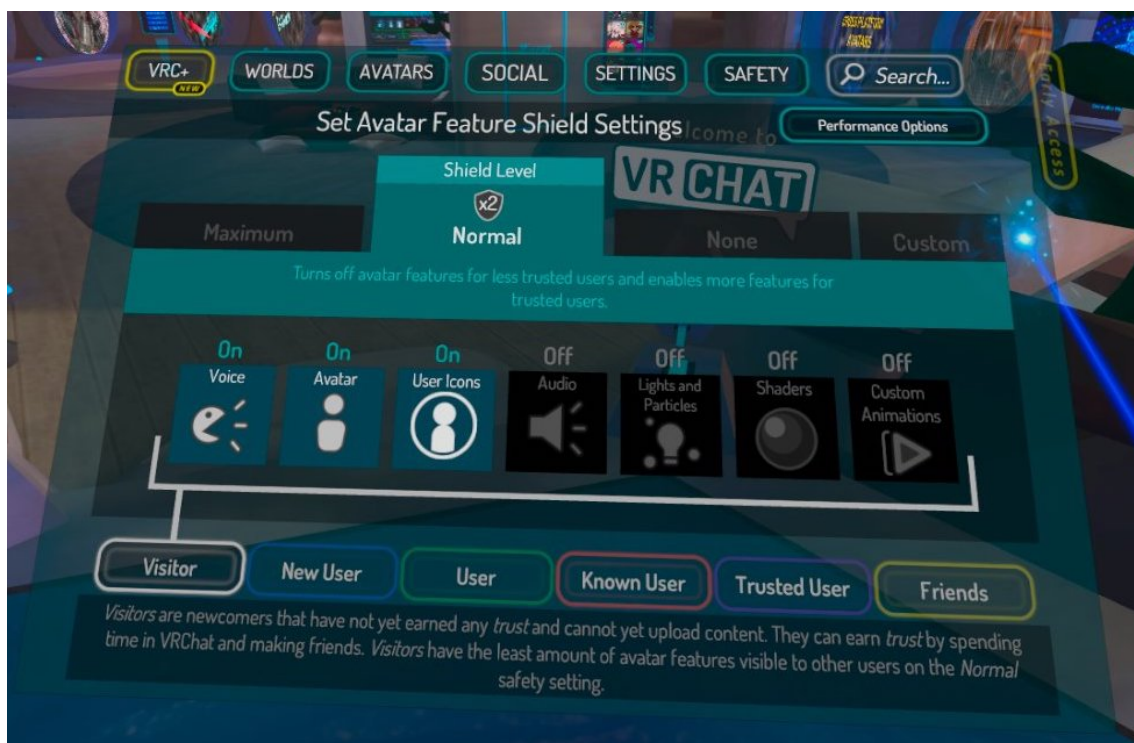


Figure 3.5: Safety menu in VRChat showing the trust system

How does social VR enable intimacy?

In the previous chapters, we separately explored the topics of intimacy and social VR. In this chapter, we connect the two and examine how social VR can enable intimacy. The first part of this chapter looks at past literature on the subject, while the subsequent parts supplement this theoretical knowledge through focus groups and expert interviews which give us real-world insights on what it means to be ‘intimate’ in social VR and how to approach the design of an intimate social VR experience.

4.1 Review of literature and current applications

In the literature on social VR, some researchers have broached the subject of intimacy and how it can be supported in VR. Zamanifard and Freeman (2019) explored how social VR can be used to support intimacy in long distance relationships. They collected online self-reports of couples using social VR platforms and conducted a qualitative analysis of this data. From this, they present three themes that show how social VR can play a role in supporting long distance couples’ social and emotional lives. The first theme talks about a *focus on embodied physical contact*. Social VR users valued the intimate interactions that were possible through the use of an embodied avatar. Interactions such as holding hands, looking at each other and reading facial expressions, and touching were all unique experiences that were possible with embodiment in social VR. The next theme was a *sense of co-presence* that social VR provided to couples. Zamanifard and Freeman note that maintaining a relationship as a dyad did not only depend on the two individuals involved. In social VR, couples could also involve others around them in how they develop their relationship. This sense of co-presence with others was essential in maintaining and enhancing a relationship. Finally, there is the theme of *replicating real life activities* in social VR. Couples felt that social VR allowed them to conduct everyday activities in the virtual world as they would in real life. However, this does not refer to any specific type of activity, but rather activities that were personal and natural to

the couple. Experiencing the mundane in a natural manner played a role in building a sense of connection between the participants.

Maloney, Freeman and Robb (2020) explored interaction dynamics between minors in social VR, and they note how these dynamics could give rise to a feeling of virtual intimacy and emotional closeness. They note that embodied avatars allow interactions that are close to face-to-face interactions in real life. Minors using social VR platforms often communicated through non-verbal interactions such as fist-bump and high-fives. They also often came up with unique and unusual interactions that developed intimacy and emotional closeness between those taking part. Maloney et al. note the example of two minors in Rec Room playing a game of “jump and catch”. One minor would jump off a balcony while the other would try to catch the first one. Such emergent idiosyncratic interactions helped to build friendship between minors in social VR.

4.1.1 Intimacy themes in social VR

In this section, we explore strategies that we identified in past literature that are relevant to how intimacy can develop, especially through the use of technology and social VR. When designing an intimate experience in social VR, these themes can act as a starting point to explore how intimacy can be supported.

Role of play Play and playful interactions could play a role in developing intimacy between people. When exploring intimate computing, Bell et al. (2003) note that “[p]lay provides a mechanism to experiment with, enter into, and share intimacy.” During play, people can be more exploratory and willing to reshape their expectations of other people and artifacts. Cornell (2015) notes that play provides an element of exploration and imagination in human relations, which can be conducive to the development of intimacy. In the context of designing technology to support intimacy, Davis et al. (2007) developed *Virtual Box* to support parent-child intimacy by incorporating elements of play. In *Virtual Box*, the (grand)parent would create digital content and hide it in a virtual box situated in a virtual floor-plan of their home. The child can then use a PDA to “find” the virtual box using visual and audio cues. Upon finding the virtual box, they can view the content and add their own content. Afterwards, they can hide the box for their (grand)parent to find. This creates playful reciprocal interactions between the participants. Davis et al. note that the use of play in *Virtual Box* resulted in the evoking of intimate feelings, and also the mediation of intimate expressions.

Continued communication When exploring intimacy in social VR, it is important to keep in mind that intimacy between users is not something that exists only in the virtual world. For instance, Pace et al. (2010) explored intimacy in *World of Warcraft* and they observed that intimate communication that developed in the game world often moved to instant messaging, calls and even physical meetings. The boundaries between the virtual and real world were often blurred in intimate relating. Maloney and Freeman (2020) note that continued communication both in and out of the virtual world is an important part of connecting people in social VR. Sustained communication helps to build relationships and form meaningful connections with others. Maloney and Freeman suggest a potential feature for social VR platforms that enables users to leave a message for others who are not currently online. Intimate experiences for social VR should support the continuous and dynamic nature of intimacy.

Expressiveness through ambiguity One of the themes of intimacy identified in Section 2.1.2 is that of expressiveness. Expressive interactions between intimate participants can be an important part of intimate relating. Vetere et al. (2005) note how expressiveness can be a result of ‘personal innovation’ and creativity in an intimate relationship. Pace et al. (2010, p. 240) identified that one of the key aspects of *World of Warcraft* that allows the development of intimacy is the presence of unresolved tensions. Unresolved tensions refer to ambiguities that the game does not provide clear resolutions for. Such unresolved tensions allow players to fill in the gap themselves through expressive interactions and thereby define the nature of their own intimacy. Expressiveness can be said to be different from play in that play has a focus on the process of exploration and experimentation, while expressiveness taps into ambiguities that a platform provides. When designing technologies for intimacy, it is important to foster this ambiguity by not establishing the meaning of interactions beforehand.

Mundane experiences Both Pace et al. (2010) and Rooney (2014) note the importance of mundane interactions in how intimacy emerges. Experiencing mundane activities together allows more memorable moments to stand out, which leads to the strengthening of intimacy. Zamanifard and Freeman (2019) note how replicating real life activities in social VR allows long-distance couples to form closer connections. Pace et al. note how mundane conversations can set the stage for deeper and more meaningful conversations to emerge. These previous findings highlight the importance of the mundane in developing intimacy between people.

Embodiment and presence The sense of embodiment and presence that social VR offers can play a key role in developing intimacy between users. Zamani-fard and Freeman (2019) note that embodied physical contact in social VR form an important part of intimate interactions between long-distance couples. Maloney, Freeman and Robb (2020) note how full body tracked avatars can create an enhanced sense of presence in the virtual world, making interactions closer to face-to-face communication. This gives rise to an increased potential for virtual intimacy and emotional closeness. Pace et al. note that even in non-VR virtual worlds such as *World of Warcraft*, embodied avatars can provide a sense of presence that is essential for intimate interactions. This highlights the crucial role that the embodiment aspect can play when designing social VR experiences for intimacy.

4.1.2 Intimacy in existing social VR applications

Among the apps that we encountered during our auto-ethnographic study discussed in Section 3.3, there were some apps that had an explicit focus on intimacy and/or intimate interactions. The first such app was *vTime XR*, where there was a strong focus on matching with people having similar interests. The matchmaking system in *vTime XR* allows people to selectively determine whom to interact with, which often led to more intimate conversations and deeper connection as compared to talking to randomly encountered strangers. The app also limits the number of participants who can be in a room at a time, which helps to reduce the amount of distractions. Further, the app only allows users to be in a seated position in one of the many predefined positions in the room, which emphasises the idea of “sitting down and diving into a conversation topic”. The second app with a focus on intimacy is called *Where Thoughts Go*. This is a social VR experience with an emphasis on anonymous intimate interactions. The virtual world in the app is filled with floating orbs containing voice recordings from users who have used the app previously. When a new user enters the virtual world, they are encouraged to share their own personal thoughts through a series of questions that gradually increase in depth as the experience unfolds. Users are also free to discover the recordings that others have left behind. The use of calming aesthetics and sounds in the experience, combined with the sense of security that is given by anonymity, encourages users to be introspective and vulnerable when sharing their thoughts.

4.2 Focus groups: What does it mean to be intimate in VR?

In the previous sections, we looked at how social VR can enable intimacy through a review of existing literature and a report of self-usage of social VR platforms. To supplement the knowledge gained through this and to gain real-world perspective on how people experience intimacy in social VR, focus groups were conducted with existing social VR users.

Focus groups were selected as the method to gain user perspective as it allowed us to gain in-depth qualitative insights, while also enabling discussion and discovery among participants on the broad topic of intimacy in social VR. Focus group sessions were conducted virtually in VRChat, with participants recruited from online social VR communities. Conducting focus group sessions virtually allowed us to provide a more natural setting given the topic of discussion, where participants could freely interact and converse with each other just as they normally would in social VR. Making use of the social VR platform in this way also helped us to gain useful insights on how such virtual focus groups could be conducted in future studies.

The focus groups were aimed at gaining user perspective on two main questions, which were derived from the main research questions. These were:

- i *How do social VR platforms enable users to connect in a meaningful way?*
- ii *How do users experience intimacy in social VR, and what are some examples of 'intimate' experiences in social VR?*

4.2.1 Method

Setup

Focus groups were conducted virtually in VRChat. VRChat was the preferred platform to conduct the focus groups because it had one of the largest user bases among the social VR apps considered (Lang, 2020). Participants who responded to the focus group invitations were allocated into three different sessions depending on their timezone and/or availability. 13 participants were recruited in total for the three focus group sessions. There were 5 participants each in sessions A and B, and 3 participants in session C. The focus group sessions were conducted during the months of June and July 2021.

At the time of the sessions, participants were invited to join a private instance in VRChat hosted by the researcher. The researcher performed the role of the sole moderator in the session. During the sessions, the moderator first gave a brief explanation of the study and the focus group structure. After this, the participants briefly introduced themselves in a round-robin fashion. This was followed by a moderator-led group discussion in a semi-structured format based on the focus group questions in [Appendix A](#). The average duration of the sessions was 1 hour and 15 minutes.

Before conducting the focus groups, an ethics approval was obtained from the EEMCS faculty at University of Twente with the reference number RP 2021-164.

Participants

Users who had previous experience in VRChat were invited to participate in the focus groups. Invitations were posted on the online discussion platforms Reddit and Discord, in communities frequented by VRChat users. The invitation message (see [Appendix B](#)) called for adult participants who have been using VRChat for at least a week to share their perspective by means of a group discussion. The information sheet provided in [Appendix C](#) was shared with users who responded to the invitation message. Among the 13 participants, 11 were male, one was non-binary, and one did not prefer to disclose their gender. Participants were of ages between 18 and 33 (average age 25.3). Informed consent was obtained from participants using the consent form given in [Appendix D](#). Participants did not receive any remuneration for taking part. [Table 4.1](#) provides a summary of the participants in each focus group session.

Session	Participant	Age	Gender	Experience
A	P1	30	N/A	16 months
	P2	19	Non-binary	6 months
	P3	24	Male	1 months
	P4	23	Male	16 months
	P5	29	Male	4 months
B	P6	22	Male	30 months
	P7	27	Male	2 months
	P8	31	Male	2 months
	P9	30	Male	500 hours
	P10	22	Male	18 months
C	P11	18	Male	1.5 months
	P12	33	Male	42 months
	P13	21	Male	5 months

Table 4.1: Summary of focus group participants

Data Collection

Limited personal information of the participants including age and gender were collected prior to the focus group sessions. A video screen recording of each VR session was made from the moderator's perspective for reviewing and taking notes later. Post-session notes were made to capture key points and observations from each session.

Data Analysis

Qualitative analysis was performed on the data gathered during the focus groups. This was done in two main ways:

1. The video recordings from the focus group sessions were transcribed and the transcriptions were analysed and annotated to identify themes relevant to intimacy and meaningful connection in social VR.
2. Findings from the focus group were compared with findings from literature and self-usage of VR platforms.

4.2.2 Findings

The main findings from the focus are presented in this section. The different themes identified from the analysis are divided into three categories that were derived from the focus group goals. The first category describes some of the motivations and reasons behind why people use social VR platforms. The second category describes different activities that people do in VR that helps them to connect with others. The last category looks at how social VR affordances play a role in enabling intimacy.

Motivations for using social VR

In the first part of the focus groups, participants were asked about their reasons for using the VRChat platform. Here, the goal was to understand what the VRChat experience meant to each participant. Participants shared their thoughts on what made VRChat personally enjoyable for them and what made them come back and spend time on the platform again.

Ability to meet people with similar interests/background Participants expressed that social VR enabled them to meet and connect with like-minded people who shared a common interest or background with them. For example,

P12 (33, Male) who is a content creator on YouTube, noted that connecting with the creative community was one of the reasons for him to start using VRChat:

“... the reason why I got into VRChat is the creative community, I’m part of the old internet back in like early 2000s with Newgrounds, and that was like a wild west of creativity, I’m an artist myself and I enjoy that community... where anything goes, you have the worst idea, the best idea, anything goes and you can share it with everyone, and I saw VRChat and I’m like ‘that’s where it is!’ I want in on that.”

Social VR also enables people to connect with others having the same cultural background or speaking the same language. P3 (24, Male) noted:

“Because I am from a Spanish-speaking country, I go to Spanish-speaking worlds and if somebody is speaking the language in the way that we’re speaking here in Chile, I immediately go to them and start speaking with them, like we are Chileans, ‘let’s go, vamos a ver’”

Social VR can also be a way for diaspora to reconnect with people from their community. P13 (21, Male), who is a university student living abroad noted:

“I’m originally Polish, but I live abroad so most of my friends are English-speaking they’re not Polish, I was able to kind of like reconnect with the Polish community which was quite amazing for me.”

Overcoming social/physical barriers Many participants mentioned that social VR was a way to overcome physical and social barriers they face when it comes to connecting with others. Social VR can be a way for people to meet and interact with others in ways that would be difficult in real life. P2 (19, Non-binary) pointed out that VRChat enabled them to choose exactly who they wanted to socialise with:

“... having this headset and having access to people outside my physical area, I’m able to pick and choose who I’m able to hang out with, and know that they are more like me than the people who are around me, because you know, I get to... choose. That creates an even closer social aspect than what I’m able to get right now in person just because of the wildly different thoughts and ideas in my area compared to who I am as a whole.”

Multiple participants pointed out that social VR helped them to overcome physical restrictions that were in place due to COVID-19. Social VR opened up a

way for many participants to keep in touch with friends and socialise with new people in a situation where they couldn't go out due to COVID-19 restrictions.

Participants mentioned that social VR enabled them to train and improve themselves for social situations. For people who experience social anxiety, VR allowed for self-improvement by providing more control over how they socialise. P8 (31, Male) noted:

“I have really bad social anxiety so I wanted to try and overcome it by interacting with people in virtual reality, and it seems to be helping quite a bit, it is the only place that I've been able to actually interact with people without feeling absolutely overwhelmed.”

Activities that help people to connect in social VR

One of the main points discussed in the focus groups was about activities that participants did in social VR which helped them to connect with other users. This was meant to throw light on participants' experience of intimacy in social VR. Participants were asked about how they interacted with the community, what worlds they preferred to explore, and about previous social VR experiences that they would consider to be intimate. In this category, we explore some of the activities and themes that arose from this discussion.

Nightclubs and drinking worlds Participants mentioned that nightclubs and drinking worlds were a good way to meet people and make new friends. P5 (29, Male) described that nightclubs were one of the reasons for him to start using VRChat:

“I could say I really like it even more than going out to parties in real life. I feel like it's so easy to meet people. When I go to parties in real life, I generally hang out with the same people I came with, maybe meet a couple of new people or something, but in VRChat every time I go out I feel like I'm meeting cool new people and making really cool experiences there.”

P1 (30) mentioned that they liked to spend time in the popular party world in VRChat called 'Drinking Night' because it was a way to meet new people and relax by drinking and talking with each other. P11 (18, Male) also mentioned this world and expressed: *“I've met the greatest people in probably Drinking Night”*.

Aside from meeting new people, nightclubs and drinking worlds can also be used to socialise with existing friends. P10 (22, Male) described an instance

where he introduced a real-life friend to VRChat by taking him to a party world which had various games like pool. He noted:

“We were both just amazed by how we were able to just relax together and play pool, just me and him, and there’s all these little cups and stuff around, I could go and pass him a drink, and you know this is a very expressive game of pool. There’s no nightclubs where I live so I’d never really get to experience that outside of VR, but I’m like ‘Man I could just do it in VR!’. It feels so real and that’s an intimate experience with my friend that I wouldn’t normally be able to get.”

Exploring new worlds With the multitude of worlds that social VR offers, exploring new and interesting worlds is an activity that many participants enjoyed. P12 (33, Male) mentioned that ‘world-hopping’ was an enjoyable activity where users would visit multiple worlds successively. Being an experienced user, he used this to connect with new users in the platform by showing them around:

“I walk up to them like, ‘Are you new to VRChat? Would you like a magical wonderful tour?’, and because I love world-hopping, I get to show these new people the most mind-blowing batshit insane worlds.”

P10 (22, Male) described how visiting a new fantasy world with his girlfriend with whom he was in a long-distance relationship was an intimate experience:

“My girlfriend really loves Studio Ghibli, and I took her to the Studio Ghibli world here in VRChat. It was just me and her, and you would have thought that I brought her to like Disneyland or something because her reactions and just her excitement for being able to see stuff in the Studio Ghibli world was priceless.”

Watching videos together Consuming media together is a shared experience that many participants enjoyed in social VR. VRChat and other platforms offer the ability to play video that is synchronised for all users, which enables a social viewing experience. Platforms also offer specific worlds focused on video content, many of which try to replicate a cinema experience in VR.

Participants noted that watching videos together was a way of connecting with other users. P5 (25, Male) mentioned that the VRChat world ‘Anime Apartment’ helped him to reconnect with a geographically separated friend, by allowing them to get together and watch anime. P3 (24, Male), who used to work in a cinema, noted that he frequented worlds that had video content. He high-

lighted that one of the most intimate moments in VRChat for him was watching a movie with a stranger and sharing an emotional moment:

“In my case the most intimate occasion I had was in the cinema where we were two people watching Interstellar, a very sad movie... we started talking about the movie and we started crying about the movie at the same time, like you know we’re feeling the same thing even if we are in VR.”

Role-playing A few participants mentioned role-playing as an activity that helped them to connect with others. In role-playing, users take on a personality that is different from their usual self. P4 (23, Male), who is a part of the furry community¹ where role-playing is a popular activity, noted that social VR allows for a very immersive role-playing experience:

“...we do a lot of role play, a lot of interactions, so like writing a story with other people and when you’re doing those things and when you’re hanging out, when you’re talking and you immerse yourself into that, that story you know, that role play, that interaction ... it’s just that VR has so much more expression, so much more visual feedback, it’s a lot easier for people to get super immersed to it”

P11 (18, Male) noted that the anonymity that social VR provided, combined with the temporariness of interactions with other users meant that one could role-play even in normal interactions:

“You can act how you want them to see you. You don’t have to be yourself all the time because the other people won’t meet you again, so you can just role-play”

Role of affordances in enabling connection

The focus groups also helped us to identify how unique social VR affordances can help people to connect and become intimate with others. In this category, we explore the main affordances that participants talked about.

Anonymity and safety Many participants highlighted that the anonymity provided by social VR helped them to connect better with other users. To many, the anonymity in social VR provided them with a sense of safety, which enabled them to open up more to others. According to P5, the anonymity that

¹The furry community refers to a subculture interested in anthropomorphic animal characters.

VRChat provided enabled people to talk about *“the real stuff that’s usually hidden behind layers of small talk”*. P5 also mentioned that many of the physical barriers present when socialising in real life were not present in social VR. He noted that one could approach any person regardless of age, cultural background, or religious beliefs, and attempt to find common ground between them. P2 expressed a similar point and noted that *“those physical barriers are just gone because it’s nothing but their personality and yours”*.

Participants also noted that being able to easily join and leave worlds provided them with more freedom when socialising. P1 highlighted that the ability to easily exit worlds provided an extra layer of safety and comfort:

“I feel like you can be a little more open and talk about stuff, it just it feels safer I guess, at any time you can just exit, you know take the headset off, then you’re back in the real world”

Group composition Participants had varying opinions about how groups and group sizes in social VR affected their interactions, especially when it came to intimate connection. For P6 (22, Male), one-on-one conversations were the preferred way to intimately connect with others:

“It’s fun being in a group but there’s something about one-on-one conversations with people that just hit way differently than when I’m talking to more people or in a group. You can just let out all the emotions because you can tell by the sound of their voice what they’re feeling, if they’re sad, excited, and it feels like you’re talking to them, like literally next to them IRL”

P9 preferred to socialise in smaller worlds that do not allow many people to join in, as it was easier for him to be more talkative in smaller groups. Similarly, P13 pointed out that he preferred to go to worlds that had around 10 users because *“if there’s only 10, they’re probably having good time talking to each other”*. P7 noted that it was difficult to talk and socialise in worlds that had a high number of users, especially if the users were all gathered together in a concentrated space. However, P7 and P8 mentioned that they gravitated more towards higher population worlds as they usually had more options for socialising. P8 noted:

“I actually do tend to go to the ones that have a lot of people, like you know 25 to 30 just because there’s so many different conversations going on that it’s a lot easier to pick out one that I can join”

This highlights the trade-off in group compositions where participants find it easier to socialise and connect with others in small groups, but it is also important to be able to find a suitable group, which might be easier in a world with a higher number of users.

P13 observed that users with similar avatars often tended to group together in VRChat:

“Avatars that are similar will tend to group off and be in a conversation, especially at eye level height, so like all the tall avatars are all talking to tall avatars and then there’s a couple of nanachis² over in the corner, like three of them having like a conversation.”

Immersion and Presence Participants emphasized that social VR made their interactions with others feel more immersive. P4 shared that VRChat allowed him to be more expressive, and that the visual and tactile feedback provided by social VR helped him to be more immersed in his interactions with others. P10 contrasted his experience with socialising in VRChat with that in the online role-playing game World of Warcraft:

“In VRChat you see people as though they were in real life and it just feels far more personable, like everybody looks more like a person instead of just an NPC that has a text box over their head, so you can get a lot more emotion. The memories just feel more solid because there’s just much more input”

In session C, participants discussed how it was harder to interact and connect with non-VR users who used VRChat in desktop mode. P13 described how such an interaction could lack immersion: *“Imagine having friend you could never high five, you could never do anything, they could just speak back, that’s it”*. Similarly, P12 shared that it was more difficult to get to know a person in VR based on their voice alone.

Participants also talked about how some interactions in VR enabled a sense of presence in the virtual world together with other users. P5 noted that watching anime together with his friend in VRChat was a completely different experience compared to watching together on a non-VR platform like Discord, as it felt more immersive and closer to real life. For P10, VRChat provided him a place

²Nanachis are part human, part animal characters originally from the anime series *Made in Abyss*. It is one of the many types of avatars that VRChat users can have.

to spend time together with his girlfriend. He noted that VRChat served as a shared space in their long-distance relationship:

“... because it’s a long distance relationship, this has been a place that we’re able to go and cohabitate in the same space, and we can take pictures and stuff together, and we can show that to our families and stuff as though we’re actually right next to each other.”

Physical/non-verbal interactions The physicality of interactions in social VR was a central component of intimacy for many participants. Being able to embody an avatar, perform physical actions and gestures, and to sense/imagine virtual touch all played a role in making interactions in VR more intimate. Participants mentioned various physical gestures and actions that they did in VRChat. For P5, something as simple as waving to another person and the other person waving back could be considered intimate. Gestures such as head pats and hugs were a common way to express care and affection for many participants. P1 mentioned how cuddling was a very intimate experience in VRChat:

“I’ve met a lot of friends that I’ve had, you know, gotten to that point where we can just cuddle each other and watch a video, or just be in a mirror, just talk about whatever, life and relationships and stuff, and that’s what I really enjoy about this game a lot”

Like P1, other participants also mentioned mirrors when talking about physical interactions. Mirrors are a common feature of many worlds in VRChat, and a few participants noted that users often liked to spend time around mirrors.

Participants also highlighted that the ability to feel virtual touch was something that made physical interactions more intimate. Many participants mentioned ‘phantom touch’ or ‘phantom sense’ as a phenomenon that enhanced physical intimacy in social VR. They described phantom sense as the ability to feel or imagine physical sensations corresponding to virtual touch. For example, P6 described phantom sense in a scenario where another user gives him a head pat: *“I get these warm sensations in my head, this warm fuzzy feeling”*. P2 mentioned how the ability to sense virtual touch helps to overcome the physical barriers of communicating over the internet:

“It helps bridge that, at least partially, because you’re able to feel someone hold your shoulder or give you head pats, or just hold you and tell you that you’re okay, and physical actions do so much more than just words and I feel like that’s a huge component with intimacy in VR”

While some participants mentioned that they had phantom sense, not all participants were able to feel virtual touch in this way. P9 noted that he was able to discover that he had the ability with the help of another user. A few also noted that it was possible to learn or ‘train’ this ability.

Avatars For most participants, avatars were a core part of their self-identity in VRChat. P4 shared that his avatar was a persona of himself, and that it allowed him to express and portray his personality to others. He noted that avatars often revealed clues to what kind of person someone was:

“... I feel like a lot of it is expressed through your avatar, and it’s actually really interesting because you can learn so much about someone just by looking at their avatar you know the things they added, or even just the sort of traits that they picked out, the ones that sort of appeal to them”

In session B, participants discussed how other people’s opinions could matter when it came to picking an avatar. P7 noted that he stopped using his previous avatar after being told that it doesn’t match his voice very well. P10 noted that his avatar choices could be influenced by others. For example, when taking photos together with his girlfriend, he preferred to use consistent avatars so that others could easily recognise him from the photos.

For many participants, it was important to be able to customise their appearance in order to fully represent and express themselves. P2 shared that they tended to use darker skinned avatars which corresponds to their actual skin tone. P2 also noted that they would often change avatars to express themselves in different ways depending on the situation. P1 had a custom furry-themed avatar that was tailor-made for them. They expressed that it represented who they were to others on the platform:

“I connect deeply to this to this avatar a lot, because it’s been customised and just a lot of work has been put into it, just every detail, I’ve put a lot of work into it, and so to me, it means a lot and when I’m showing it to other people, I want them to see me like this.”

Some participants even created their own avatars, or added custom features to their avatars themselves. P9 shared that he started making his own avatars as it was difficult for him to find compatible avatars that matched his body proportions, which was important to him when using full-body tracking. P8 said that he often added new features to his avatar and that this helped him to

connect with other people: “I like to show that off to people and get reactions out of them, and get more than more than just shallow small talk”.

Other affordances Participants mentioned that they used communication platforms outside of VRChat to keep in touch with other users on VRChat. For example, P1 noted that they used Discord to talk to friends about what to do on VRChat before actually getting on VRChat. P2 shared that Discord was a good way to keep in touch with users they met in VRChat, especially if they planned to meet again at a later point. P3 mentioned that he often used VRChat’s website to see which of his friends are online before getting on VRChat.

4.2.3 Discussion and reflection

The focus groups offered key insights into how social VR users experienced intimacy and social connection in VR. An important observation is that VRChat enabled participants to go beyond what they would normally be able to do in terms of social connection. By helping them overcome social and physical barriers, VRChat provided participants better opportunities to meet people who were closer to their interests. We can link this capability of social VR to the concept of *stranger intimacy* that Koch and Miles (2020) present. Stranger encounters in social VR have a greater potential to be more fulfilling, and have the chance to turn into meaningful and long-lasting connections. This can be ascribed to two main attributes of social VR, which reflect the line of thought of Koch and Miles. First, users have access to a large group of potential strangers, from which they are able to filter out and choose who they interact with. Here, social VR allows users to overcome constraints of geography, social class, and physical appearance to have encounters with more like-minded people. Stranger encounters in social VR also mean more freedom and safety, as people are not as physically or socially vulnerable. The second attribute concerns the affordances of social VR that allow for increased immersion and presence, where stranger encounters can be closer to face-to-face communication. Co-presence, physical interactions and even virtual touch can enable stranger encounters that feel more *proximate* and intimate than possible with other technologies.

Social VR offers a wide range of immersive experiences and activities that help users to connect with others. The VRChat worlds that participants described in the focus group reflect the types of VR experiences that Steffen et al. (2019) expanded upon (see Section 3.2.1). Worlds such as *Drinking Night* seek to replicate the real-world experience of nightclubs, with a virtual bar, music, and

party games. It is worth noting that such worlds can also enhance aspects of the physical world; for example, going to a drinking world enhances the experience of drinking while in VR. Another type of real-world inspired world is that of cinema worlds, where users are able to watch video content together and connect through this experience. Perhaps the greatest potential of social VR lies in their ability to create aspects and interaction capabilities that do not exist in the real world, in the form of surreal and otherworldly experiences. The Studio Ghibli world that P10 cited is an example of a surreal, fantasy experience that would only be possible in VR. Such worlds can have the potential to enable connection and intimacy in previously unimagined ways, which can be linked to the concept of “social superpowers” that McVeigh-Schultz and Isbister (2021) highlighted. As P12 mentioned, even the aspect of being able to go from one world to the other rapidly, in what is called ‘world-hopping’ (comparable to bar-hopping in real life), can be a way to connect with others. The point to highlight here is the choice that social VR provides in terms of the shared experiences that one can have with other users.

The focus groups also served to highlight how physical and non-verbal interactions in social VR can support intimacy. Gestures such as head pats and hugs are a way of enabling intimacy through *embodied physical contact*, as previously described by (Zamanifard & Freeman, 2019). Participants pointed out that acts such as cuddling someone, and physically reassuring someone by holding them were ways that they could be intimate with others in social VR. Participants also noted that being able to feel virtual touch through the VR sensation dubbed ‘phantom touch’ or ‘phantom sense’ made such acts even more intimate. A possible parallel for this could be the *rubber hand illusion*, where synchronised touch on a person’s hidden real arm and an aligned fake rubber arm could give them an illusion of ownership of the fake arm. Slater et al. (2009) explored how this illusion could be reproduced in VR with a virtual hand, even in the absence of synchronised tactile simulation on the real hand. Here, just the active movement of a person’s real hand along with corresponding movement of the virtual hand was sufficient to induce the illusion of ownership of the virtual hand. However, phantom touch as reported by our focus group participants also includes the ability to ‘feel’ virtual touch as physical sensations, a phenomenon for which we could not find a precedent in literature. At the moment of writing this report, this type of phantom touch in VR appears to be social VR lore, with participants having varying takes on how they experience it, which suggests that there are grounds for more scientific inquiry regarding the subject.

Custom avatars provided focus group participants a way to present their personality and identity to others in social VR. Most participants reported that they felt a strong sense of personal connection to their avatars, and that it was a core part of their self-identity in VR. The variety of avatar choices and the ability to have customised avatars was an aspect that we previously noted during self-usage of VRChat. Participants pointed out that this aspect allowed for better self-expression by bringing their real-life physical features into their virtual appearance, and also through other representations such as furry avatars which more closely fit their desired ways of self-presentation. In communities such as the furry fandom, avatars also helped to bring people together and help them connect. VRChat also enabled more freedom of self-expression by being able to switch between different avatars depending on situation and context. Unique and interesting avatars can sometimes also act as conversation starters, providing users a way to connect with others.

The focus groups also threw light on a few more aspects of social connection in VR. We found that participants found it easier to talk with others in smaller groups, where they had more opportunities for close connection. However, worlds with large populations often made it easier to find a group of people that one could join and interact with, since such worlds had many smaller sub-groups of people that one could choose from. Some participants mentioned that role-playing in VRChat was a way to connect with other users, by immersing themselves into a personality different from their usual self. Turkle (1994) previously pondered on the subject of role-playing in virtual worlds. Turkle notes that virtual worlds challenge the traditional notions of self-identity, where one has a single true identity or “real self”. Identity in virtual worlds can be more plastic, where role-playing allows people to explore multiple identities, with more freedom to create (completely different) versions of their own self. In social VR, the affordances of immersion and presence strengthen the experience of role-playing, while the safety and sometimes even temporariness of interactions make it possible to role-play more often. Another aspect of social VR that we encountered was *continued communication*, which Maloney and Freeman (2020) previously described. Participants noted that they used platforms such as Discord to keep in touch with VR users and even plan future VR sessions with them when they were out of VR. This highlights that continued communication can help to support and maintain intimacy even outside VR.

Reflecting on the focus group method

The focus groups provided us a way to learn about how existing users experience intimacy and social connection in VR. A definition for ‘intimacy’ was not provided to the users, and participants were encouraged to share their own experiences with intimacy and close connection in social VR. In addition to this, the questions also focused on aspects such as the community, interactions with new people, and activities that enabled close connection. The most valuable part of the focus groups was the interactions among participants, which allowed new topics to emerge, and differing opinions on the same topic to be brought to light. This allowed us to gain a holistic picture with more breadth of knowledge compared to a method such as an interview.

Our method is not without drawbacks, however. As the focus group participants were all VRChat users, the discussion was centred on VRChat. Other social VR platforms may enable different types of interactions and affordances, which could not be explored in our method. Participants who responded to the focus group invitations may not be fully representative of the VRChat community. As the invitations were shared with online VRChat communities on Reddit and Discord, only the users who were active on these communities were part of the focus groups. As Table 4.1 shows, most of the participants who responded were male. This also reflects the observation from our self-exploration of VRChat that the platform’s users are disproportionately male. The collective nature of the focus groups may have also prevented sensitive topics from being discussed fully. Sexual intimacy was not discussed in detail in any of the focus group sessions, despite ‘ERPing’ or erotic role-playing being a popular activity in VRChat³. Knowledge about such topics could have been better obtained through a one-on-one interview. In addition, the collective nature of the focus groups could have also introduced a degree of social-desirability bias in how participants responded to questions, which may have resulted in some topics not being fully represented.

4.2.4 Conducting focus groups in VR: Observations and takeaways

The focus groups conducted in VRChat were also a way to explore how to conduct ethnographic studies in VR. Previously, Ericsson (2016) briefly reported about how VR focus groups can enable global research while taking advantage

³How people ‘DO IT’ in VRChat!? (ERP) by PHIA – <https://youtu.be/7EwCsUFibsU>

of VR's capabilities such as embodied avatars and expression through body language. In our study, we found social VR to be an effective way to conduct focus groups, especially in our case since the topic of discussion was social VR itself. This section describes our observations and hypotheses about what makes VR focus groups effective, which we hope will help future researchers who use social VR for similar ethnographic studies.

To conduct the focus groups, we made use of the VRChat world *Spirits of the Sea*, created by the user Maki Maki. The world is in the form of a house with magical sea creatures flying around it. The focus groups were conducted in the main living room of the house, which featured an open empty space with a huge window overlooking the ocean. We chose this space as it had a cosy atmosphere for participants to gather in and have a discussion. The open view of the ocean on one side also ensured that the space did not feel too cramped, as seen in [Figure 4.1](#). The presence of warm ambient lights, and comforting piano background music also added to the atmosphere. There were also a few interactive elements in the world, including colourful pens to draw in 3D space, and items like cushions which could be moved around. One of the main reasons to choose this world was that it was a highly popular world in VRChat, and many users were familiar with it. We hypothesised that the *familiarity* and *cosy atmosphere* of the world would encourage better discussion and self-disclosure among participants, as opposed to an unfamiliar and cold test environment.

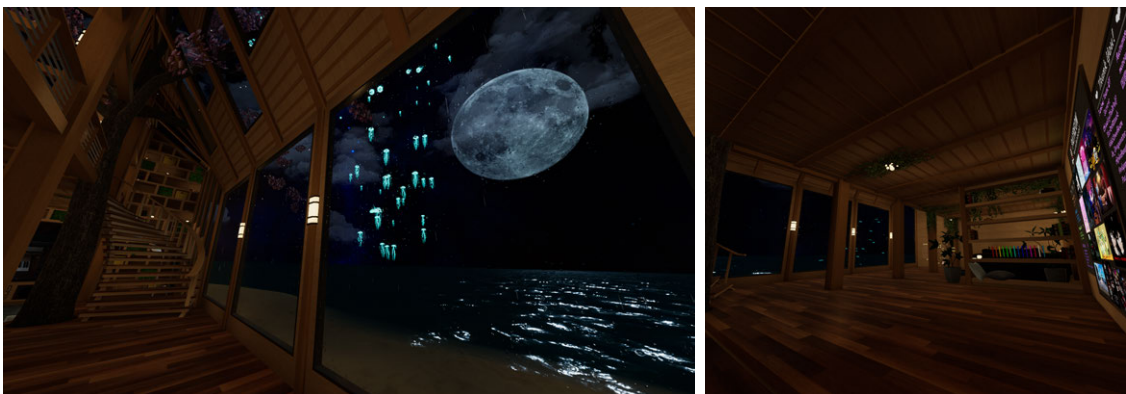


Figure 4.1: *Spirits of the Sea* world in VRChat where the focus groups were conducted

During the sessions, participants were welcomed and made to feel at home in the environment. Participants did not know each other beforehand, and they joined individually at the time of the session. In some cases, there was a period of waiting until all participants had joined the session. We observed that participants had different ways of passing time while waiting. Some participants started to have a conversation with others, about topics such as their avatars

or other worlds in VRChat. Some others made use of the interactive elements in the world to pass time, such as drawing with the brushes in the world. One participant grabbed a Rubik's Cube that was in another part of the house and started to solve it. During the discussion, participants gathered together in a circle at the middle of the open space in the world. While most participants' avatars were in the standing posture, some participants who had full-body tracking sat down with their avatars.

One of the participants had a full-body tracked avatar with facial tracking, which allowed for very expressive speech and realistic body movements. This enabled them to be more involved in the discussion using their facial expressions and body language. Other participants even complimented this participant on their appearance. Participants made use of the interactive elements even during the focus group discussion. For example, one of the participants grabbed a cushion and sat down on it, which prompted others to do the same. In another example, one of the participants played with an interactive crab toy in the world while they were talking. In our experience, such objects in the focus group environment had the potential to act as social lubricants that McVeigh-Schultz et al. (2019) report about, or just provided participants with something to play and fidget with. Participants also used other affordances during the sessions. The ability to change avatars was used during discussion to demonstrate different avatars that participants used. In one of the sessions, participants added each other as friends at the end to keep in touch with each other even after the session.

As some participants mentioned, social VR's anonymity, safety, and higher level of control allowed them to *overcome social and physical barriers*. This aspect of social VR can be used to advantage when conducting ethnographic studies such as focus groups in VR. For example, it can allow people who experience social anxiety to share their thoughts in a more comfortable manner when compared to a face-to-face method. Social VR can also enable communication that is closer to real life with participants from around the world compared to forms of communication lacking embodiment.

4.3 Expert interview: Community, co-creation and connection in Neos

Out of the social VR platforms that were discussed in [Section 3.3](#), Neos offered the most versatile tools for building and prototyping a social VR world. For this reason, it was the preferred platform for developing the experience that is described in the next part of this thesis. To gain a better understanding of the platform and its community, we interviewed an experienced member of the community who had a history of organising and hosting creator events in Neos.

The main goals of the interview can be summarised as follows:

- i *Understand how to approach the design of an intimate experience in the context of Neos and its community*
- ii *Identify activities and affordances that enable social connection and intimacy in Neos*

4.3.1 Method

Setup

The interview was conducted in a virtual session in Neos. The expert was invited to join two of the researchers involved in this thesis in a private session to take part in the interview. A semi-structured format was followed based on questions that were prepared in advance (see [Appendix E](#)). The interview took about an hour to complete.

Before conducting the interview, an ethics approval was obtained from the EEMCS faculty at University of Twente with the reference number RP 2021-164.

Interviewee

The invited interviewee was an experienced community member who regularly organised creator events in Neos, including a weekly event called *Creator Jam*⁴ and a yearly competition called *Metaverse Maker Competition (MMC)* with the aim of encouraging users on the platform to collaborate and create. The interviewee regularly interacted with the community in Neos, and therefore had valuable insights and perspective on intimacy and social connection in Neos.

⁴*Creator Jam* is a weekly event in Neos where users from all over the world come together to create a virtual world based on a different theme or idea each week.

Data Collection and analysis

A video screen recording of the VR interview session was made from one of the researchers' perspective. After the session, the recording was re-watched and a rough transcript which captured relevant points was made. The qualitative data obtained in this method was grouped based on both the initial questions and the topics that emerged during the interview. The findings were then reflected upon to create useful insights for this thesis.

4.3.2 Findings

This section presents the findings from the expert interview, categorised into themes. The themes highlight how Neos can support intimacy and allow intimate interactions to emerge. They also serve as pointers to use in the design of an intimate experience within Neos.

Social connection in Neos

Shared experiences Social VR offers users the potential to create and engage in their own preferred types of experiences. In Neos, the tools provided by the platform enable users to easily discover and create such experiences. With the ability to collaborate with other users, and with the freedom to craft their own shared experiences, Neos enables users to connect with each other in their own unique, preferred ways.

Easier social interactions In Neos, social interactions can be easier to initiate and carry out compared to real life. For example, users can open a video and watch it together with others very quickly and with minimal effort. Often, the environment in Neos offers many opportunities for users to come together and interact with each other. Events such as *Creator Jam* provide people with a shared experience that enables connection:

“... giving people an excuse for something to talk about is much better than saying like ‘Oh the weather is nice today’ or so that they can look and say well ‘That’s an interesting sculpture you’re making’ and this is something that I’ve seen in Neos from the very beginning, it’s like ‘Oh really, well this is what I’m working on’ and then you have this very nice beginning dialogue just to talk about something that’s personal ...”

Users have more control over how they interact with others in social VR. Users who experience anxiety or communication problems have the ability to choose their own pace of participation, which lowers their threshold for engaging in social activities.

Friendly community The active community in Neos strives to make it a safe and welcoming space for new users. This is exemplified through *Creator Jams* where new users are given a friendly environment to learn more about Neos, while also giving them an opportunity connect with others in the community:

“There’s a lot of times people will come and say ‘I’m not a creator’, ‘I can’t do anything’ and you’re like ‘Okay, that’s all right, we’re here to help and teach’ and they’re like ‘Oh, I’ve had a question! What about this thing...’ and then that opens them up to be able to have a reason and that’s something that’s been uniquely within the Neos culture ...”

Affordances in Neos

Co-creation One of the defining features of Neos is the ability to build and create collaboratively in VR. For example, users can build virtual worlds together while being in a shared virtual space:

“... one of the things I like personally and it’s very Neos-centric right now at least, is building worlds together. I love that stuff is everyone’s, it’s almost like decorating a house, like ‘Oh, hold on, I’ll grab this and move this over here’ or if you’re working on a shared drawing or shared painting but instead it’s a three-dimensional space ...”

Events such as *Creator Jam* realise the potential of co-creation in VR by giving users a platform to create together in diverse ways, often enabling social connection through this. For example, past editions of *Creator Jam* called ‘Build Battles’ focused on bringing users together and giving them constraints on how they could build:

“... with Build Battles when you have about three hours to create a game or an environment or something else based on a limited set of objects, people don’t have much time to do something, but there’s been a lot of nice creations out of that small time crunch and people usually form groups ... you have this kind of shared stress with someone else but not like a negative stress just more fun pressure ...”

Saving memories Neos has an inventory system that allows users to save and retrieve objects or worlds. These objects can often signify a shared history for users. Being able to go back and relive such shared memories gives users an opportunity to connect:

“... when you have some kind of memory that you can actually pull out of your inventory or come visit, it’s really nice to have that kind of mark, say like ‘Do you remember that time when we built this table together and added all the functionality’... and you can really have a lot of moments that can be encoded within the object itself”

More control over environment It is possible for users in VR to have more control over environment factors such as sounds. For example, in a virtual concert, there is a possibility for every user to individually control how loud the music is. Neos offers tools that make this possible. In another scenario, users in Neos can make use of ‘whisper bubbles’ which allow them to have private conversations without others overhearing.

Versatility in expression Neos offers many tools which let users customise how they express themselves in social VR. Aside from having wide support for full-body tracking, facial tracking, and eye-tracking, Neos also allows users to build custom ways of self-expression. For example, a user could add a feature to their avatar where they can express emotions, agreement, or interest through colour changes in the avatar. Similarly, users can add custom gestures or facial expressions to their avatar that they can trigger. World elements can be programmed to dynamically respond to user inputs such as audio or movement. This lets users offset shortcomings and aspects that are lacking in the social VR environment such as subtle non-verbal cues and micro-expressions that are usually present in real life.

Neos also supports integration of third-party devices such as heart rate monitors, which allows for more ways of expression:

“... with heart monitors, people connect it up to themselves, and then having them connected to their partner’s heart monitor know what their heart is doing and or have stuff that’s dealing with their heart monitor in their eyes, so as they’re closer to each other and their heart rate is getting larger that their eyes change, maybe color or shape, and other types of things ”

Creative social affordances Users can make use of the tools in Neos to craft custom social interactions that can affect how they interact with others. For example, an intimate couple could make use of permission systems that only allow each other to perform certain actions their avatars. Such possibilities can also introduce novel interactions that can bend social norms:

“... people set up special devices on themselves so to everyone else it sounds like they’re speaking a foreign language or something else, but to each other and they’re speaking completely clearly which is really interesting.”

Physical intimacy Social VR enables physical intimacy by letting users be close to each other in a virtual space and feel each other’s presence. This feeling of presence is enhanced for some people with phantom touch, who are able to ‘feel’ virtual touch:

“... in VR, if you look in the mirror and then while someone’s touching you, your brain—eventually—not for everyone—to different varying degrees—will associate the body they have in VR with the body in real life as far as like either a sense of pressure or heat ...”

Social VR also enables users to be sexually intimate in VR, through virtual sex and activities such as sexual role-play or fetish play. Although Neos does not allow the display of adult content or depiction of sexual acts in public sessions, it is still possible to do so in private sessions. The sandbox-like nature of Neos allows users to explore various ‘kinks’ and fetishes, or even act out sexual fantasies such as body inflation or vorarephiliac fantasies which cannot usually be acted out in real life. Sexual intimacy in VR can also be aided by the integration of internet-connected sex toys which let users feel physical sensations corresponding to their actions in VR.

4.3.3 Discussion and reflection

The expert interview gave us insights into how the Neos platform supports social connection and intimacy, and how to approach the design of an intimate experience in Neos. A central feature that makes Neos stand out from other platform is that of co-creation in VR. Everything from the environment to user avatars can be created and manipulated while in VR, which makes *creation* a shared experience with potential for social connection. Neos has a culture that is strongly centered around co-creation, and events like *Creator Jam* and *Metaverse Maker Competition* highlight this. In addition to creating things, users in Neos

can share their creations with the community with the use of the inventory system. Here, the point to highlight is that it is not just a completed world or experience that can provide a means for intimacy and social connection, but also the entire *process* of creating and activating such an experience.

The community in Neos plays a central role in making it a positive and welcoming space for new users. The community serves to make new users comfortable on the platform by easing them in, providing help where necessary, and positively empowering them. McVeigh-Schultz et al. (2019) previously highlighted how community can play a role in encouraging pro-social behaviour in VR. They also noted how learning from others can be a powerful way to introduce new users to a platform or experience. When designing an experience in Neos, it can be useful to consider how new users will encounter it, and how the existing community can be included to make it a positive experience for all users.

The unique affordances and capabilities offered by Neos (mentioned in [Section 4.3.2](#)) can be utilised when creating an experience for intimacy. For example, the inventory system can provide users a way to save souvenirs or memories from a shared intimate experience in VR to reminisce later. Neos also offers wide support for external devices such as facial trackers and heart rate monitors which allows for multi-modal expression and interaction. With the increased level of control over the environment and avatars that is possible in Neos, such devices can be integrated seamlessly to create novel, immersive experiences for intimacy. Physical intimacy is also a core part of intimacy in VR, which can be enhanced by the phenomenon of phantom touch. Though not encouraged in public settings, Neos also allows users to be sexually intimate by enabling them to explore sexual fantasies in a private VR setting.

4.4 Expert interview: Role of play and persuasion in intimacy and social connection

[Section 4.1.1](#) mentioned how play and playful interactions could have a role in developing intimacy. To further explore how play can be used to facilitate intimacy and social connection, we interviewed an industry expert who specialises in designing interactive technology which uses play and playful persuasion to motivate people and change their behaviour in a positive way.

The main goals of the interview were:

- i *Understand how play and playful persuasion can be used to facilitate intimacy and social connection*
- ii *Gain insights on how to approach the design of an intimate experience that uses playful elements*

4.4.1 Method

Setup

The interviewee was invited to join an online video conference to participate in the interview. The interview followed a semi-structured format based on questions that were prepared in advance (see [Appendix F](#)). The interview session lasted an hour.

Before conducting the interview, an ethics approval was obtained from the EEMCS faculty at University of Twente with the reference number RP 2021-164.

Interviewee

The interviewee was an industry expert who had a background in designing interactive systems using concepts of play. The interviewee is also the founder of an organisation that focuses on using play and games to positively impact people's behaviour.

Data collection and analysis

The video conference session was recorded for review. The interview was re-watched later to make notes and create a rough transcript which captured relevant points. Relevant quotes were also transcribed from the recording. During analysis, the qualitative data obtained was grouped into topics based on the interview goals. This was followed by a reflection of the findings to obtain useful insights.

4.4.2 Findings

Play and playful persuasion

Why play? Play can be considered as the first language for humans. Young children learn about the world around them through play, which fosters exploration and curiosity. Intrinsic motivation is a significant component of play, where people are motivated from within to do an activity for the satisfaction

or pleasure derived from doing the activity itself, rather than being driven by external reasons.

Playful persuasion Playful persuasion is the technique of using playful elements and games to change people's behaviour such that the change is enjoyable to them and they are intrinsically motivated to do it.

Physical play Physical interactions and use of the body is an important aspect of play. When designing for intimacy, physical aspects such as touch and tactility can be beneficial:

"I think it's one of the most important things, the physical element—both by using your body but also something that's present and visible in the real world, and that's something I usually miss in the virtual world because it also serves as a presence—a reminder—something that's physically there."

The interviewee noted the example of a physical installation that encouraged strangers to make music together by making use of their body movements, while being separated by a flexible screen, resulting in increased intimacy between them:

"... the interesting part was because people couldn't see each other, but they had to move in a synchronous way, it was really intimate because you were touching each other's body, but also one of two had to start guiding and the other had to follow, so it was quite cool to see..."

Designing with playful elements

Free play Open-ended play or free play that can elicit exploration can be advantageous when designing for social connection. Free play can be facilitated by providing rules that can be broken or adapted by people playing. In a multi-player game, this can result in the players reinventing the game together such that they can remain playing for longer, leading to more varied and sustained opportunities for connection between them.

Onboarding It can often be challenging to explain a game or playful interaction to a new person, in the process often known as onboarding. Sometimes, it can be useful to design the interaction such that users are already playing as they encounter the interaction through a cycle of exploration and discovery. In such cases, it is important to design the experience such that the player is not

overwhelmed or underwhelmed, and the right amount of interest or ‘flow’ (see Chen (2007)) is maintained. However, depending on situation and context, it might not always be possible to design an onboarding experience in this way. In some cases it might be more appropriate to explain the interaction through an explanation or demo (e.g. video). Sometimes, it can even be beneficial to have a social element during onboarding, where players can discover rules and explain them to each other.

Situation and context In experiences that facilitate social play, the context of the experience as well as the relationships between users who take part in it can be factors that affect the experience. For example, an installation in a dark corridor can elicit different social behaviour compared to one that is situated outside in the open. Similarly, people may behave differently depending on who they are with—the behaviour of a group of strangers can be different compared to that of a group of friends. When designing an experience for social connection, it can be useful to focus on how such an experience can affect users’ relationships keeping in mind the surroundings and context of interaction.

Active triggers When designing for social connection, it can be useful to include ‘active triggers’ which encourage interaction between users, often through a shared memory or connection. For example:

“... if people can somehow recognize that the other person has played the same game or the same experience, that’s a trigger for conversations ...”

Such an active trigger could be in the form of a souvenir or photograph, which could remind users of a particular experience, or could even be used to invite others take part in the same experience.

Cooperation Cooperative play can provide many opportunities for social interaction and connection. Games that require the players to be interdependent can foster communication in ways that cannot usually be achieved by, for instance, a competitive game where players play independently. However, it is also important to carefully balance factors such as difficulty of play. If a game is too difficult, it could lead to frustration and breakdown between players, while on the other hand an easy game could make players lose interest.

4.4.3 Discussion and Reflection

The interview examined how play and playful persuasion can be used to facilitate intimacy. The core components of play include intrinsic motivation, curiosity, and exploration. When designing playful interactions for intimacy and social connection, there are a few key considerations. Free play is an important aspect, where players are given rules that can be adapted or broken to suit their own personal ways of playing. This can be linked to the theme of *expressiveness* that we previously discussed in [Section 2.1.2](#). Wilson (2011) previously explored how games can be designed in an intentionally ‘incomplete’ or ‘broken’ manner to encourage emergent, expressive interactions between players. In a similar way, we can provide better opportunities for social connection and thereby intimacy in a social VR experience by designing expressive ways of playing. Perhaps traditional outdoor games played by children can also be a source of inspiration when designing for such expressive play.

The process of introducing a game or playful activity can also be an opportunity for intimacy to evolve, by encouraging interdependence and cooperation in this process. A shared memory or connection of an experience can be a useful way of introducing an ‘active trigger’ for interactions between people. This can be compared to the strategy of *memories* that (Hassenzahl et al., 2012) present, where intimacy can be facilitated by employing memorabilia or shared memories to re-experience a past event. We also identified that physical play can be a powerful tool when designing playful interactions, especially for intimacy. Although VR lacks the same physical sensations and tactility of the real world, there is scope to make use of the affordance of embodiment to enable physical play in VR.

5 Firefly Island: Towards a social VR experience for intimate connection

This chapter focuses on applying the knowledge and insights obtained from the previous chapters towards the design of a social VR experience called Firefly Island. The experience consists of a prototype virtual world which was developed over two iterations in the social VR platform Neos. In this chapter, we establish the context and premise of Firefly Island, including design goals, motivations, and decisions that led to the creation of the virtual world. This chapter also provides an overview of the implementation and development process of the prototype in Neos.

5.1 Introduction

The main goal of this thesis was to understand how social VR can facilitate intimacy between users. As introduced in the research questions in [Section 1.2.1](#), this was done not only through literature review and ethnographic study, but also through the design and evaluation of a social VR experience for intimate connection. In the previous chapters, we gained knowledge about intimacy, social VR affordances, and about how people experience intimacy in social VR platforms. In this and the forthcoming chapters, we apply that knowledge in the design and development of an intimate social VR experience called Firefly Island.

Firefly Island is a virtual world for two people in VR, designed with the aim of enabling them to connect in an intimate and meaningful way. During the design of Firefly Island, we made use of previous knowledge and insights to explore how social VR affordances can be used to facilitate intimacy. Building upon that knowledge, we aimed to get new insights on how intimacy can be experienced in social VR, and how to design future social VR experiences for intimacy and close connection.

5.2 Goals

Firefly Island was designed to be a social VR experience for two people with a focus on intimacy, containing multiple activities that users can experience together. One of the main goals when designing Firefly Island was to understand the role of affordances in facilitating intimate connection between users. We aimed to explore how affordances can be realised when designing a social VR experience, especially one that is focused on intimacy and close connection. Each activity in the world was designed to make use of social VR affordances for intimacy that were identified earlier during literature review and field research. The activities were designed to help support intimacy by linking to and incorporating elements from the constituent themes of intimacy that were identified in [Section 2.1.2](#).

The activities in Firefly Island were designed such that they can be experienced by a broad range of users, including strangers meeting for the first time. By highlighting elements of intimacy such as interdependence, expressiveness, and self-disclosure, the world aimed to bring users closer to each other as they progress through its activities.

5.3 Design process

During the design of Firefly Island, we followed a *research through design* approach (described in [Section 1.3](#)) in which we continuously documented and reflected on the design process. During the design phase, we made use of both theoretical knowledge and insights gained during field research and self-usage.

An iterative design process was followed in which the prototype world was designed and evaluated in two iterations. The first part of design focused on setting up an environment that made up the virtual world in which different activities could be implemented. The two iterations that followed made use of this environment to explore social VR affordances through activities aimed to support intimacy. The prototype created during each iteration was evaluated with actual users, and the results were analysed and reflected upon to investigate the research questions. This iterative process helped us to reinterpret our research questions and develop a better understanding of the answers as we designed and evaluated the iterations. The iterations also helped us to refine the prototype world such that it could be a finished world in Neos with a focus on intimate connection between users. Although there was some overlap in the design of the environment and the separate activities contained within it,

in this chapter we first describe the setup of the overall environment, and in the subsequent chapters we describe the design of specific activities within that environment and how they were improved in each iteration.

5.4 Background and ideation

5.4.1 Concept-based design

Since exploring the role of affordances was one of the main goals of Firefly Island, we chose to structure the world such that it would consist of multiple (related) interactive artifacts or activities, each realising one or more social VR affordances. This allowed us to focus on individual affordances through these activities which made up the overall experience of the world. When designing these activities, we found it useful to focus on specific *concepts* around which activities could be designed. Concepts were formulated by focusing on specific affordances or intimacy themes that could be manifested through each activity. Some of the concepts were inspired from previous observations from self-exploration of social VR platforms [Figure 5.1](#) shows some of the concepts that were put forward initially. While these do not represent full activities, they served as starting points which helped to formulate the activities that were developed in the prototypes.

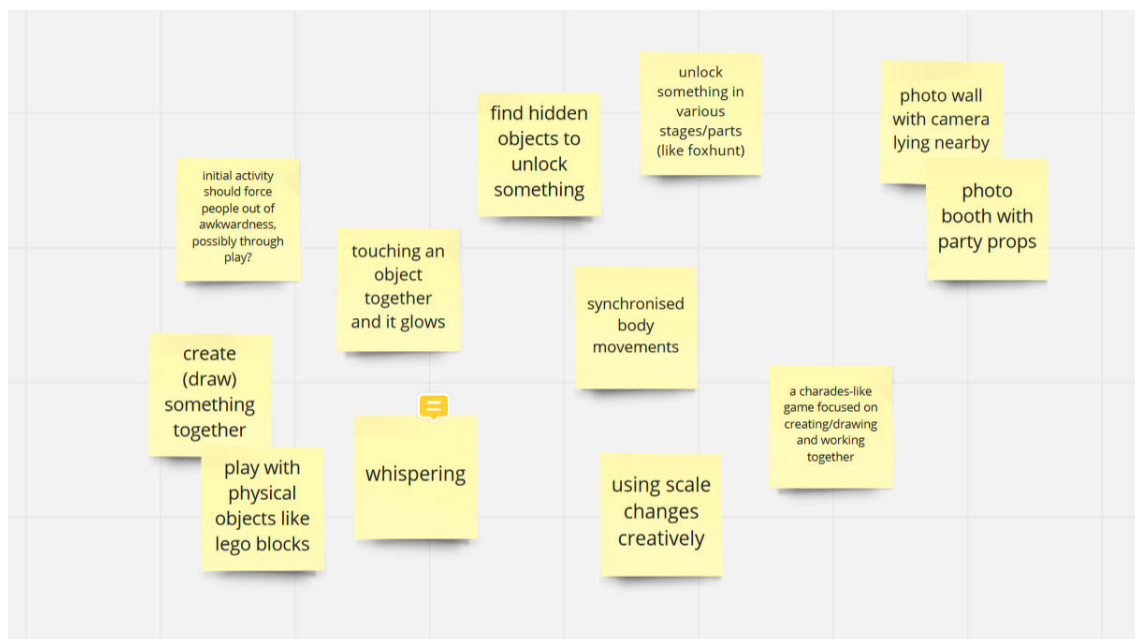


Figure 5.1: Activity design ideation



Figure 5.2: Design values that were formulated to guide activity design

To guide the design of the activities in the world, we formulated a set of design values. The design values were meant to support the design process by bringing attention to certain principles or concepts that the design should encompass. Our design values were not created all at once, and were uncovered throughout the process of ideation and design, by reflecting on why certain ideas would or would not work for the experience that we aimed to create. The four design values that we formulated are shown in [Figure 5.2](#), and are briefly described below.

Simplicity While it is possible to create complex interactions in a virtual world, we aimed to keep the core idea behind each activity fairly simple. This was so that the activity could be easily grasped by users, and so that it could be feasible to develop using the tools available in Neos.

Replayability One of the goals of the world was to make it a destination that users could visit more than once. Therefore, activities were designed with their replay value in mind, such that users could enjoy them in repeated visits to the world.

Expressiveness An expressive activity that lets users adapt and enjoy the activity in their own idiosyncratic ways was more preferable to us over a rigid and unadaptable activity. As described in [Section 2.1.2](#), expressive interactions form an important part of intimacy.

Responsiveness Activities were designed such that they supported the theme of responsiveness. This means that the activity allowed users to address and respond to each other's actions, encouraging interdependence and awareness of each other.

5.4.2 World-building

One of the first steps during the design of the world was to establish a setting and theme around which activities could be designed. In game design, worlds that have a unifying theme can result in much more powerful experiences (Schell, 2008). To identify such a theme, we explored different concepts that could form the backdrop or 'lore' of the virtual world. An early concept for the world is described in the synopsis below:

"The two visitors wake up from cryogenic sleep in a spaceship and they are informed that they are about to enter the last leg of their spaceflight, where they enter a new unexplored galaxy. To make the final preparations for this, they have to complete some final tasks around the ship, which they have to work together on. Upon completing these tasks, they witness the sublime spectacle of entering a new galaxy which no one has ever seen before."

By defining the setting and common theme in this way, the goal was to connect the activities together such that they felt cohesive to the users. Several ideas were explored in the process of determining a setting/theme for the world. [Figure 5.3](#) shows some of the initial ideas that were explored. Some of these ideas were based on past personal experience or inspired by video games and other popular culture. Some others were based on concepts previously encountered in literature. For example, the idea of using visually warm colors was based on the findings of Baek et al. (2018) (this is discussed further in [Section 5.5.2](#)). While many different ideas were considered, we chose to develop an idea for a world involving fireflies which is discussed in the next section.

A magical world of fireflies

From the many ideas that were explored, different elements were combined to create the theme of the world. Ideas such as the use of magical elements, visually warm colours, and an island landscape were all brought together in the final theme. However, the central theme that tied together the world was that of fireflies. The idea of a living, breathing environment that users could

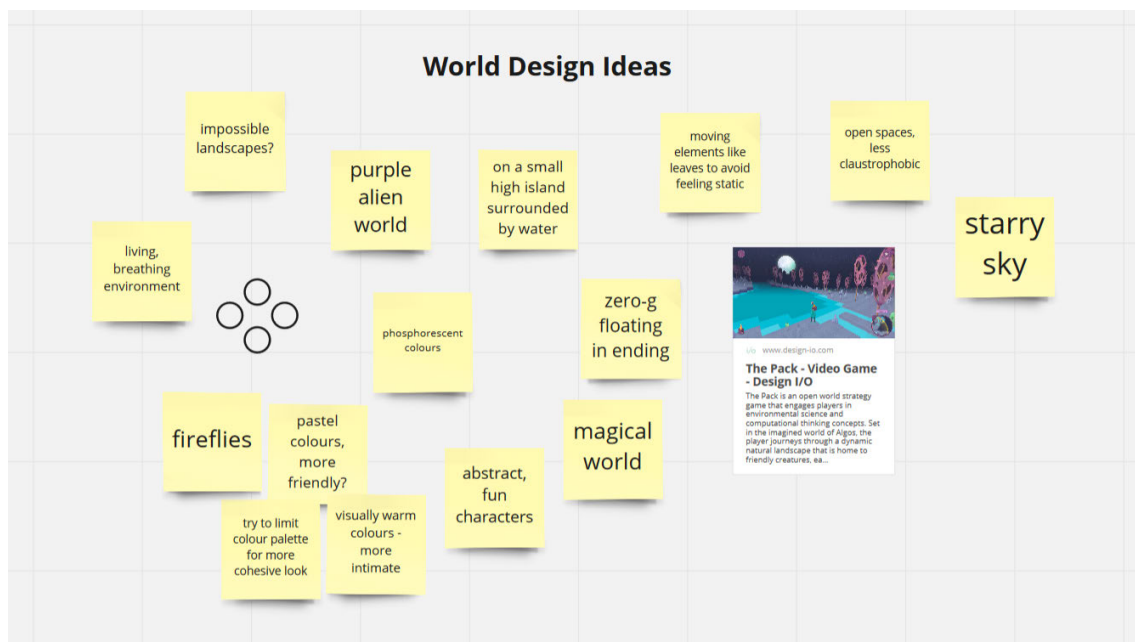


Figure 5.3: World design ideation

interact with was a concept that was put forward during initial ideation, and fireflies were a way to make this possible. Aside from this, there were a few other reasons why a world with fireflies would be fitting for the goals of our prototype world:

1. For many, fireflies can evoke nostalgia and childhood memories, and also spark feelings of joy and wonder. Their magical and ethereal qualities are the reason why fireflies are revered in many cultures around the world (Lewis, 2016).
2. Fireflies can be visually striking. With their abilities to bring a landscape to life, they can provide a memorable experience to people.
3. Firefly catching can be a playful activity that can be enjoyed by strangers and familiar people alike. It can also enable physical play by requiring people to move in (virtual) space.
4. Having a unifying theme with fireflies also opened up the possibility of designing activities around related concepts, such as catching fireflies and keeping them in a jar.

To further explore how a world with fireflies could look like in VR, we looked at existing social VR worlds. As VRChat had a large number of user-created worlds, we looked for firefly worlds in VRChat. Figure 5.4 shows the worlds that

we explored. Exploring these worlds provided us with inspiration for how our prototype world could look like, and gave us a look at how such a world could be visually striking while evoking nostalgia and wonder.

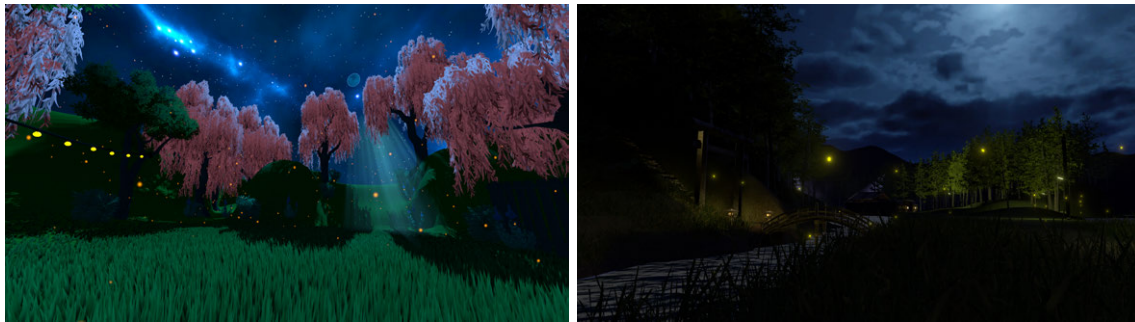


Figure 5.4: Firefly worlds in VRChat (from left to right): *FireFly Meadow* by Squeeshy, 螢火の道 -Fireflies' Nostalgia- by Awai

As noted by Steffen et al. (2019), VR allows the possibility of creating aspects that do not exist in the physical world. Realizing this, our theme also included the use of magical elements and interactions which would not usually be possible in real life. Tying together the themes of magic and fireflies, the final unifying theme was created which is outlined in the following synopsis:

“The two visitors visit a remote island that is surrounded by a peaceful and calm sea. Among the many magical wonders of the island are its fascinating fireflies that appear each night. As the visitors explore and discover the hidden secrets of the island, a shared bond grows between them that makes the island come alive.”

5.5 Designing the environment

5.5.1 Mood board

After a theme was established for the prototype world, the next step was to create a visual style that defined the appearance of the world. A mood board was created for this purpose by collecting visual inspiration from various sources. Images were collected mainly by means of a web search, and also from other media such as films. The keywords used when searching for images were derived from the main theme. Figure 5.5 shows the mood board that was created, and the caption lists the keywords used. From the pictures in the mood board, a colour palette was created to act as a guideline when designing visual elements in the world. Aside from visual inspiration, the mood board also helped to inspire certain elements and activities that were included in the prototype world.

For example, image 4 from the mood board inspired the addition of floating lanterns, which are discussed in [Section 6.4](#).

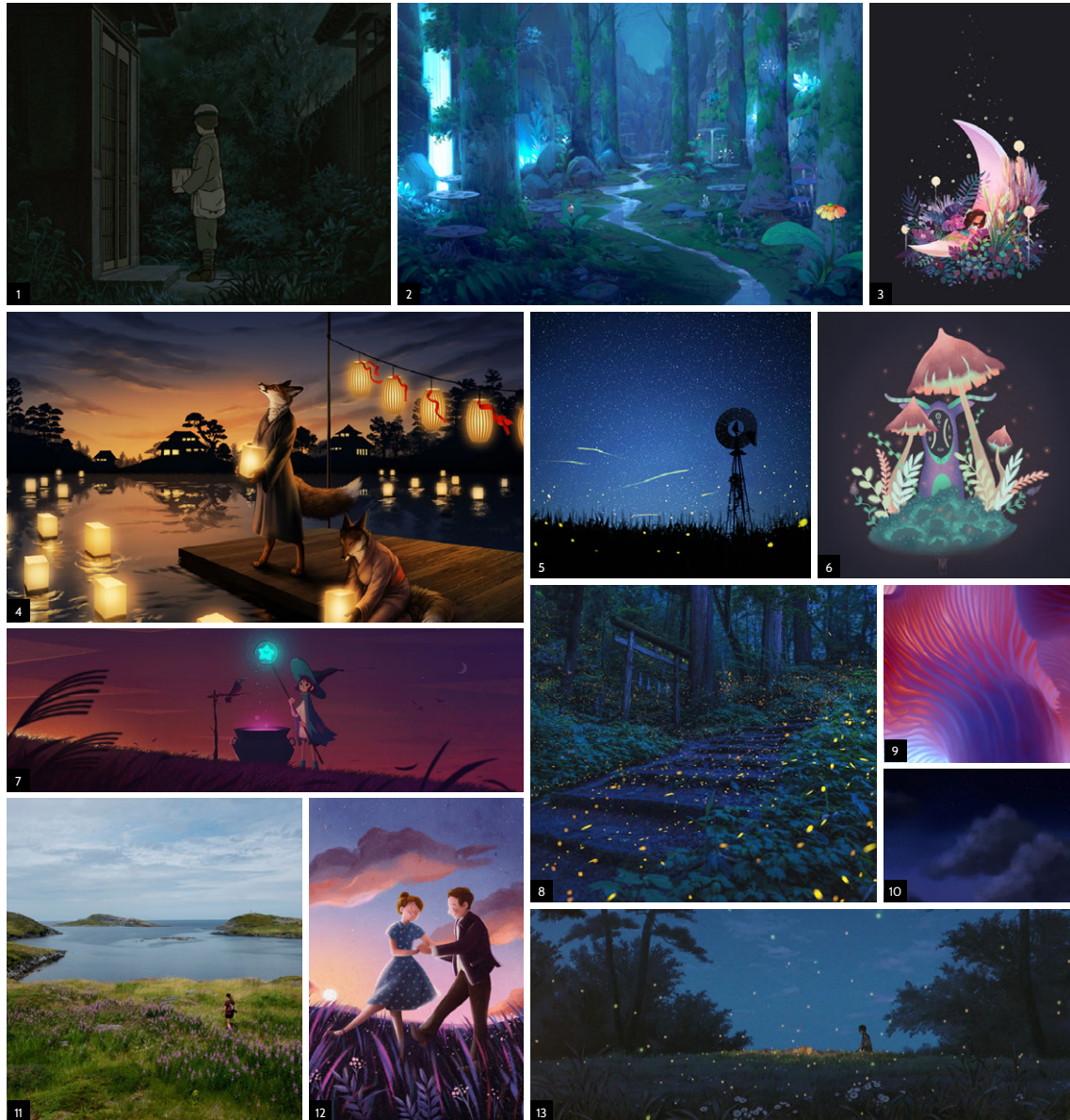


Figure 5.5: Mood board (Keywords: *fireflies, night sky, magical world, island, ethereal, otherworldly landscape, magic nature*)

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13. Takahata, I. (Director). (1988). *Grave of the Fireflies*[Film]. Studio Ghibli.

5.5.2 Atmosphere

During the design of the prototype world, the atmosphere or ambience of the virtual environment was an important aspect that was taken into consideration. To highlight the fireflies that would be part of the environment, a nighttime atmosphere was chosen for the prototype world. This choice was also strengthened by the findings of Naz et al. (2017), which suggest that darker virtual environments can increase the perception of intimacy of space. Figure 5.6 shows a photo that was taken in an early version of the prototype world where the night environment can be seen. The choice of brightness of the environment was also influenced by other factors. For example, we noticed that if the environment was too dark, photos taken in the world had a lower visibility. To balance the brightness of the environment, we explored different ways to introduce more light in the environment without taking away from the nighttime atmosphere, such as adding a moon and stars to the night sky, adding clouds to contrast against the dark sky, and adjusting the brightness of the skybox.

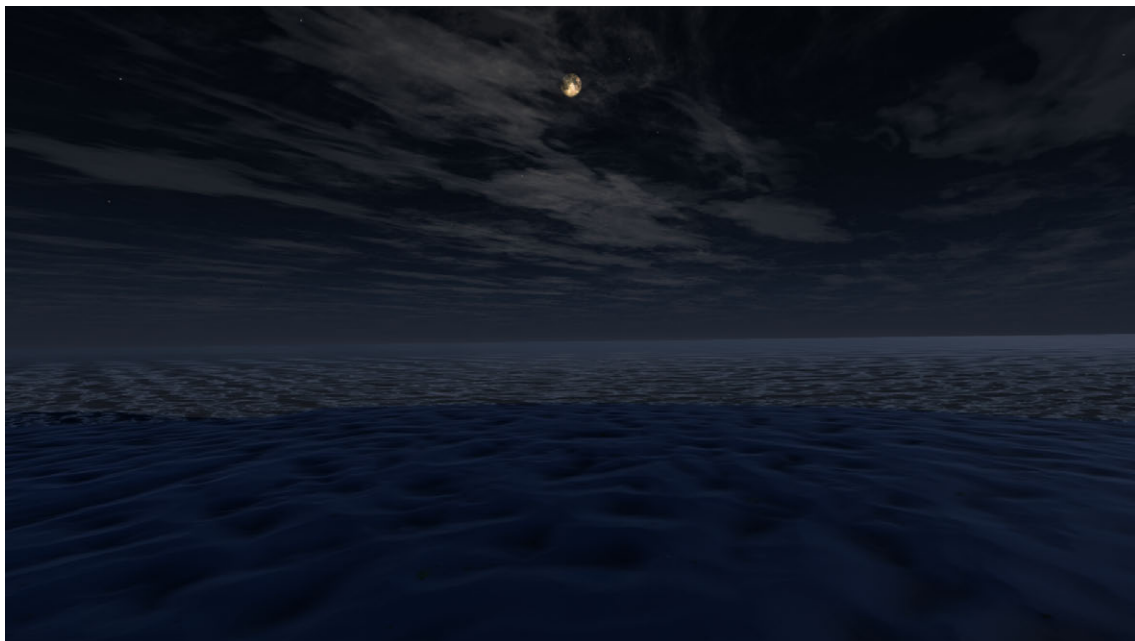


Figure 5.6: Night atmosphere in an early version of the prototype world

Colour temperature was another aspect that was considered when designing the environment. Naz et al. (2017) suggest that using cooler colours such as blue or green can increase the feeling of calmness in a virtual space. This was desirable for our prototype world, as an environment that induced calmness and relaxation could possibly lead to greater intimacy between users. In contrast to this, the use of warm colours was also considered as a way to induce feelings of

closeness. IJzerman and Semin (2010) suggest that increased social closeness can be associated with physical sensations of warmth. Baek et al. (2018) expanded on this in the context of retail interior design and their findings suggest that *visual warmth* can affect customers' intimacy and approach intentions towards a store. Baek et al. found that customers with higher relational needs were more likely to shop at stores designed with visual warmth. In our design, we experimented with colour temperature by combining both warm and cool colours in the environment.

While the environment was predominantly designed with visually cooler colours, we made use of visually warm elements that contrasted with the environment. For example, the fireflies provided visual warmth when compared to the cooler surroundings. When choosing a colour for the skybox (and by extension the environment¹), we chose a shade of blue that was slightly warm. While the original shade of blue we used was from the colour palette in Figure 5.5, we adjusted the colour to a slightly warmer shade of blue-green that felt less harsh and improved visibility in the virtual environment compared to the original blue. Figure 5.7 shows how the original colour (left) and the adjusted colour (right) affected the appearance of the environment.



Figure 5.7: Comparison of colour temperature of the skybox—before (left) and after (right)

5.5.3 Landscape

An important factor that was considered early during world-building was how to use space in the virtual world. Since virtual worlds are not bound by physical limitations, they have the possibility of taking a variety of shapes and sizes (Steffen et al., 2019). In our case, since the world was meant for two users, we hypothesised that a smaller world would allow users to be more aware of each

¹The lighting system in Neos takes into account the colour of the skybox when determining the lighting for the environment.

other, enhancing the feeling of presence. Aside from size, the layout of the world and the activities contained within in were also factors to consider. In an early concept of the world, we explored dividing the world space into sections, each consisting of a separate activity. This would allow users to progressively explore the world by ‘unlocking’ parts of it as they completed activities, a mechanic Schell (2008) terms as *gateways*. However, we did not use this mechanic in the final world and instead opted for a world where users had more choice over how they completed activities. This could better support our vision of a world that enabled open-ended, expressive play as discussed in the expert interview in [Section 4.4](#).

Once the main theme of the world was established, we sketched how a world encompassing such a theme could look like. Based on the mood board and the ideas shown in [Figure 5.3](#), we arrived at the concept of a small island surrounded by water. Such a landscape had the advantage of being small enough so that users would be constantly aware of each other, while being open and spacious enough so as to not feel restrictive. [Figure 5.8](#) shows an initial sketch that was made to work out what the landscape could look like and how activities could be laid out in it. The island was drawn in the shape of a crescent moon inspired by the mood board. Users would spawn at one end of the island, and there would be a path from the spawn point connecting the different sections or activities of the island.

The environmental features that were part of the island were added at various stages during the design process. Aside from the fireflies, elements such as grass, rocks, and flowers were added and improved upon throughout the iterations. We also experimented with adding trees to the landscape, but later decided against them as they worked against the open and spacious feeling that we aimed for. However, we added a tree at the far end of the island as an interactive element which is elaborated upon in [Section 7.1.4](#). Other elements added to the landscape include a large firefly jar (see [Section 6.2](#)), a mirror (see [Section 6.3](#)), a dock (see [Section 6.4](#)), and a campfire (see [Section 7.1.1](#)). Some of these elements, such as the firefly jar and mirror were created with specific interactions or activities in mind. Some others, such as the flowers and campfire were initially added for aesthetic appeal, but were updated to be interactive at a later stage. A sign containing a welcome message and copyright attribution text was added at the location where users spawn into the world.

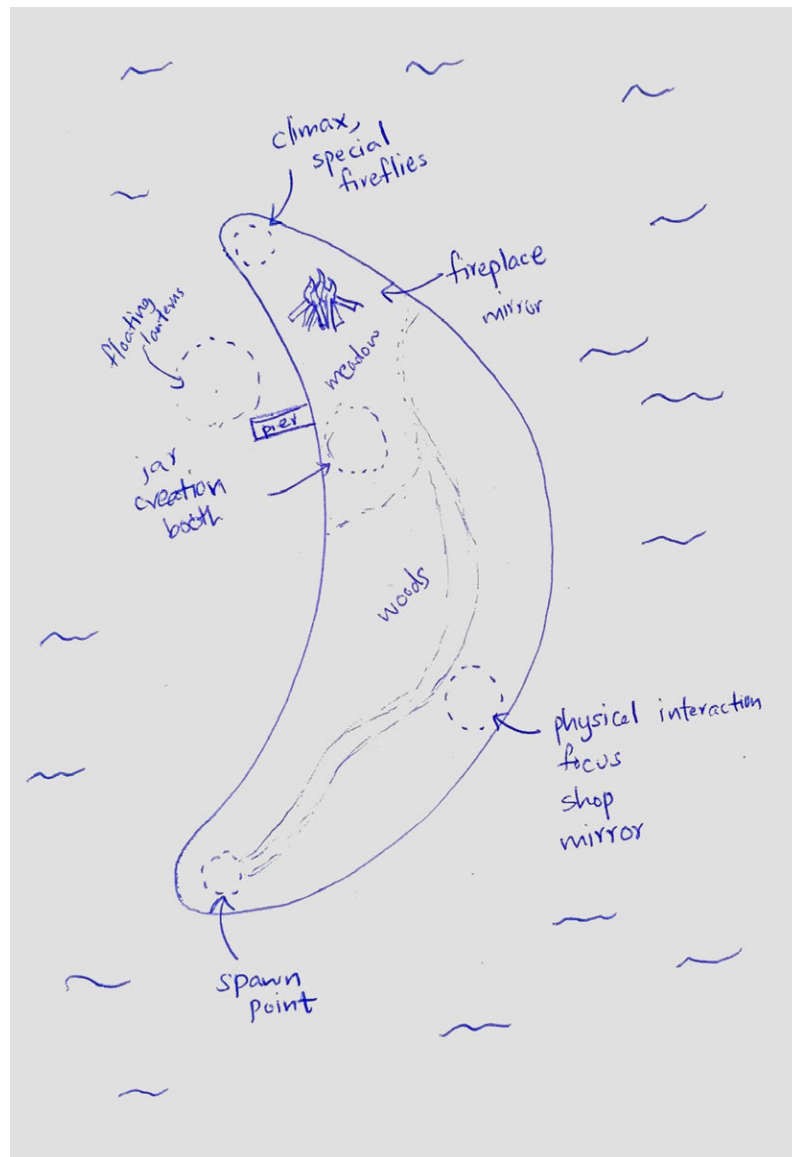


Figure 5.8: Initial sketch of island landscape showing how activities could be laid out on it

5.5.4 Immersiveness

We explored a few ways to make the virtual environment feel more immersive. Adding subtle movement was one way of doing this, as it helped to prevent the environment from feeling static and lifeless. This was accomplished by the randomised slow movement and flashing of fireflies, and the slight bobbing motion and animation of the water surrounding the island. Other possibilities for subtle movement included grass waving in the wind, and clouds slowly moving through the sky. However, these could not be implemented as they were technically infeasible at the time of developing the world.

Sounds were also essential in making the environment feel more immersive. A background sound loop composed of the sounds of waves lapping the island shore, and crickets chirping in the night added to the ambience of the world. The volume of background sounds was kept low to ensure that they were not overbearing. Sounds were also used in other ways to increase immersion, such as in the voice-reactive tree (see [Section 7.1.4](#)) which responded to user voices.

5.6 Building the world in Neos

The prototype world was built using the world-building tools in the social VR platform Neos. Neos allows for real-time collaborative world building in VR, where world elements can be created and manipulated while being in the world itself. Edits made in the world are instantly visible to all users in the world, which helps in making prototyping faster. This also removes the need for external editing and programming for a large part of world development.

Although Neos supports the creation of basic 3D models through primitive shapes and procedural meshes, more complex models can be imported from 3D graphics software such as Blender. [Figure 5.9](#) shows the 3D terrain that was modelled in Blender and then imported into Neos. During world development, we made use of both custom-made models and models that freely available from the internet for use in the elements that were part the world. Once models are imported into Neos, their appearance and other characteristics can be edited using in-world tools.

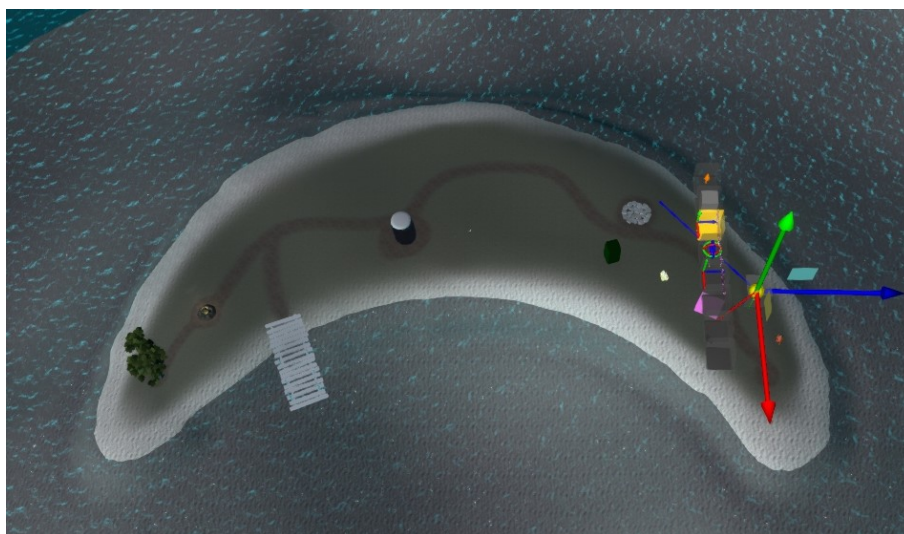


Figure 5.9: 3D terrain of Firefly Island

Design Iteration 1

In the previous chapter, we established a theme and setting for an intimate social VR world called Firefly Island. Using this as a foundation, the next step was to design and build activities in the prototype world which the aim of facilitating intimacy between users in the world. This chapter describes the first design iteration where we flesh out the prototype world with activities and interactive elements, making use of social VR affordances that were identified previously. The prototype world that resulted from this iteration was evaluated with social VR users. This chapter also presents the observations and discussion from the evaluations, and concludes by summarising the design knowledge that was obtained during the first iteration.

Firefly Island was developed in an iterative process where experiential prototypes of the world were designed and evaluated. This allowed us to apply insights from previous chapters during the design process, gain first-hand knowledge about why certain things did or did not work, and then use this knowledge to further refine the world in the next iteration. The world was designed and evaluated in two iterations. The main goal of the first iteration was to design activities in the island that could bring users closer to each other and foster intimacy between them through interdependence and self-disclosure. The sections that follow describe the different activities that were designed in this iteration.

6.1 Exploring play with a hide and seek game

Catching fireflies

An in-world activity that was derived from the main theme established in [Section 5.4.2](#) was that of catching fireflies. In real life, firefly catching is a playful activity that fosters curiosity and exploration in people. As a popular activity among children, firefly catching also evokes nostalgia and instils a sense of wonder (Lewis, 2016). In our prototype world, we explored how this activity could be adapted to a virtual environment. Such an activity was suitable for our world as it provided us an opportunity to explore the role of play in developing intimacy.

Including firefly catching as one of the first activities in the prototype world allowed us to use play as a mechanism to help people enter into intimacy. Here, play and playful elements had the potential to act as an ‘ice-breaker’, helping users get familiarised with each other before they explored other parts of the world. In a past study, Depping et al. (2016) note how games can be more effective in building trust compared to social tasks that do not involve play. On a similar note, we argued that including a social game as an early activity in the world could be an effective way to build intimacy between users.

Designing a game mechanic

Although firefly catching is an enjoyable activity, many of the characteristics that make it enjoyable in real life could be lost when such an activity is translated to a virtual environment. For example, the tactile, physical experience of catching a firefly with one’s hand would be difficult to recreate in a convincing way with current VR technology. Moreover, catching otherworldly glowing insects is a very unique and ethereal experience in real life, while it could be just another one of the vast possibilities in a virtual environment. We realised that simply recreating such an experience in our prototype world might not give users the intrinsic motivation that could make it enjoyable for them.

To provide a more enjoyable experience to users, we explored game mechanics for a firefly catching activity involving two users. One of the first mechanics that we explored was that of providing rewards for collecting fireflies. Here, we envisioned firefly catching as a way to unlock other activities in the world. Each user would have to catch fireflies separately, and once they had a sufficient amount, they could bring their fireflies together and ‘fuse’ them together to unlock a new activity in the world. Such a reward could be a way to motivate users to keep catching fireflies. However, during early testing, we realised that this was a naïve approach that did not work well for our goals, for the reasons explained next.

Intrinsic motivation was a core aspect of play that was missing from a reward-based approach to firefly catching. We realised this during informal testing within the research team. Although the act of catching fireflies was a novelty at first, this novelty quickly wore off and the rewards did not provide enough motivation for continued play. This was exacerbated by the fact that the rewards were unknown, abstract activities in the world. Further, the act of unlocking an activity by the users ‘fusing’ their fireflies together was originally imagined as a way to introduce interdependence between users. However, we noted that

this was not very effective, as users could play independent of each other for the most part of the activity when they were catching fireflies.

Hide and seek mechanic

After discovering the shortcomings of the reward-based game mechanic described earlier, we asked ourselves how we can make the firefly catching activity support intrinsic motivation and better interdependence between users. Previously in [Section 3.3.2](#), we described the hide and seek game in the social VR platform Half+Half. This stood out to us as a striking example of interdependence between users, as the hiders and seeker constantly had to react to each other's actions. We noticed that this game was enjoyable even when there were only two people playing it. Taking inspiration from this, we explored how we could design a hide and seek game around the activity of catching fireflies.

One of the first challenges of implementing a hide and seek game in Firefly Island was determining a hiding mechanic for the hider. The island was a small place without many environmental features to hide behind, so a conventional hiding mechanic could not work well in our case. As a solution to this problem, we considered a mechanic where the hider would turn invisible when they were hiding. To tie in this mechanic with firefly catching, it was designed such that the hider would have to keep catching fireflies to remain hidden. In this mechanic, each firefly that the hider caught would grant them invisibility for a short period.

Once the hiding mechanic was identified, we explored a mechanic that would allow the seeker to counteract the hider's ability. This was imagined as an ability that could cancel out the hider's invisibility and 'reveal' them. However, as this was a powerful ability, it had to be designed such that the seeker could only use it in moderation. This ability was again designed in conjunction with firefly catching in the following way: the seeker catches fireflies to build towards or 'charge up' their special ability which would allow them to reveal the hider. To use the ability, the seeker would have to catch a certain number of fireflies each time. Limiting this ability in this way would allow the hide and seek gameplay to be paced such that it would be enjoyable to both players. We designed the seeker's ability as a projectile in the form of a shooting star that would shoot out of the seeker's firefly catcher and follow the hider until it collided with them and revealed them. This allowed us to physically represent the cause and effect of the seeker's ability, which would be helpful in facilitating playful learning through exploration.

Realising the activity in Neos

The first part of implementing a hide and seek game involving firefly catching was to set up fireflies in the environment, and design a mechanism that would allow players to catch fireflies. Fireflies were added to the environment in the form of small glowing spheres that had a randomised motion. They were also programmed to flash at random intervals. [Figure 6.1](#) shows the fireflies with the island's landscape in the background. Firefly catching was aided by designing 'firefly catchers' that allowed users to catch and collect fireflies. Following the magical theme of the island, the firefly catchers were designed in the form of magic wands with a glass orb at the end where users could keep the fireflies that they caught. [Figure 6.2](#) shows a firefly catcher containing some fireflies.



Figure 6.1: Fireflies in the island's landscape

We explored a few techniques to make the firefly catching activity more rewarding and intrinsically motivating. One way was to provide auditory feedback whenever a firefly was caught, in the form of a random musical note. Musical notes were selected from a set of notes in the same scale, which made the notes sound harmonic when played in succession. The rationale behind providing auditory feedback in this way was that it would encourage users to make music together by catching fireflies. The sounds were also a way to augment the sense of presence, as users could hear each other catch fireflies. In the hide and seek game, this could be used to provide the seeker hints about the hider's location. Visual feedback was also used to make firefly catching feel more engaging. This

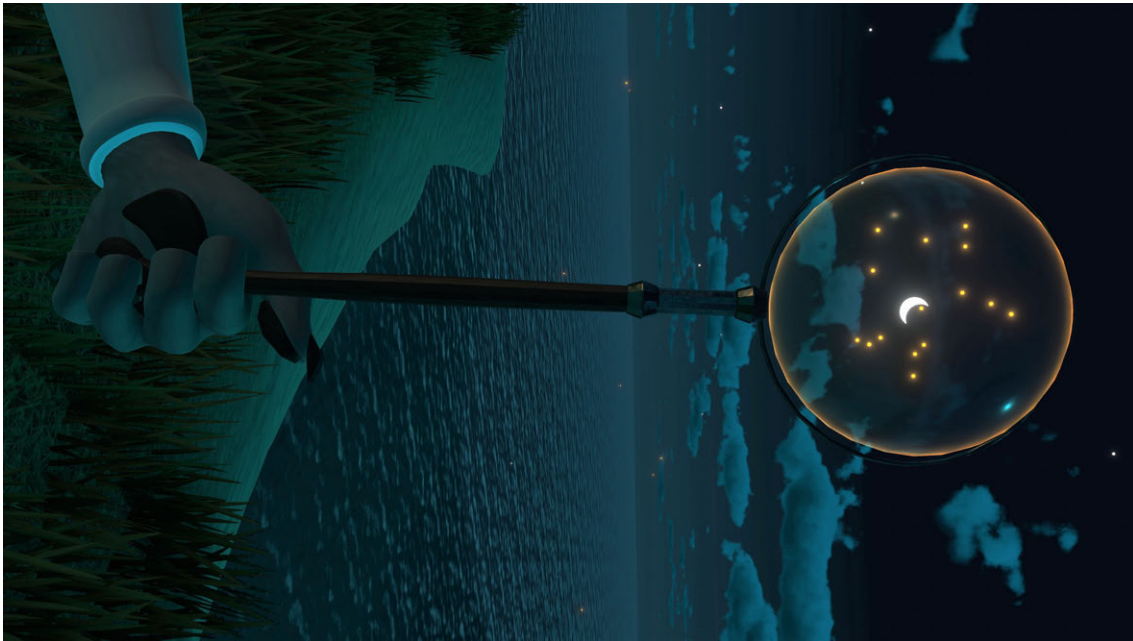


Figure 6.2: Firefly catcher containing some fireflies

was done through a particle effect every time a firefly was caught. Further, users are also able to see how many fireflies they caught in the firefly catcher's orb, which could encourage them to grow their collection by catching more fireflies.

The hide and seek game was implemented in rounds, where each player would alternately take the roles of hider and seeker. To start a round, the players would bring their firefly catchers together, which starts a round timer. The round timer was displayed in the world as shown in [Figure 6.3](#). Once the round starts, each player has to catch fireflies to gain 'energy' that allows them to use their abilities. The duration of invisibility for the hider, and charge build-up for the seeker are dependent on their energy level that is displayed visually on the firefly catcher as shown in [Figure 6.4](#). For the hider to win the round, they have to evade the seeker for the duration of the round. The seeker could win the round by touching the hider's body with their firefly catcher. Once the round is completed, player roles are swapped.

Another challenge when designing the hide and seek game was to determine how to communicate the rules of the game to new players. This is related to the concept of onboarding that was discussed in [Section 4.4](#). While players could discover the firefly catching mechanism through exploration, the abstract rules of the hide and seek game still needed to be explained to them. While addressing this problem, we considered how it could be used as an opportunity to bring the players together. For this, we conceptualised a common object



Figure 6.3: Hide and seek round timer



Figure 6.4: Energy level displayed in a circular indicator

that would bring players physically close together, and encourage interactions between them such as one person reading the rules and explaining it to the other. This object was realised in the form of a rule book that the players could open and read. [Figure 6.5](#) shows the rule book and its contents. In addition to explaining the game, the book also allowed users to adjust a round's duration and manually switch the hider and seeker roles. This was implemented by adding interactive buttons to the book.



Figure 6.5: Hide and seek rule book

6.2 Co-creation with firefly jars

Section 4.3 introduced how the ability to co-create in a shared space can be a powerful affordance in social VR. To investigate how co-creation can help support social connection and intimacy, we designed an activity in the form of a firefly jar making use of this affordance in the prototype world.

A personalised firefly jar

Catching fireflies and collecting them in a jar is a nostalgic activity for many. Taking inspiration from this popular activity, we designed a mechanism that allowed users to collect the fireflies that they caught. This was done by placing a large Mason jar in the world where users are able to deposit their fireflies. As shown in Figure 6.6, the jar was made a prominent feature of the landscape to highlight the theme of the world and to encourage users to collect fireflies.

In addition to being a way to collect fireflies, we made use of the firefly jar to explore the affordance of co-creation and the ability to save memories in social VR. To do this, we designed the firefly jar to be a *canvas* in which users can create art, and place objects and memories. Upon creating their own personalised firefly jar together, users would be able to save it to their inventory. This builds on the previously discussed idea of taking a souvenir or saving memories from a particular shared experience.



Figure 6.6: Large Mason jar for co-creation

Realising the activity in Neos

The firefly jar was placed at the location shown in the map in [Appendix K](#). To add fireflies to the jar, users would have to first catch fireflies and then touch the jar with their firefly catchers. This action would transfer fireflies from the firefly catcher to the jar. The mechanism to allow co-creation and saving the jar was set up close to the main jar as shown in [Figure 6.7](#). This consisted of a pedestal with a smaller jar, and a collection of drawing tools. Using the provided tools, users are able to create artwork in the main jar. Once the personalised jar is created, the artwork in the main jar is copied to the smaller jar. To trigger this copying mechanism, both users would have to bring their hands close to the small jar. By designing this action such that it required the combined effort of both users, we aimed to reinforce the shared value of the jar between the users. Once the personalised jar was created, users would be able to save a copy of it by grabbing it.

Communicating the concept of the firefly jar to users was a challenge that we encountered during implementation. Although the concept could be easily explained with text similar to the hide and seek game, we sought a more playful way to accomplish this. In doing so, we designed the activity such that users would be able to discover the concept through exploration. First, the firefly jar was made a noticeable feature of the landscape to evoke curiosity and encourage users to interact with it. By placing drawing tools next to the jar, we



Figure 6.7: Pedestal with drawing tools and smaller jar

intended to help users associate the two together. The concept that users could create art in the jar was hinted at by pre-drawing a simple smiley face in the jar. To communicate the idea of users bringing their hands close to the small jar, we placed a pictogram next to it as shown in [Figure 6.7](#). In addition to this, the small jar featured a glowing pattern on its lid that reacted to user hands. When users brought their hands close to the jar, the pattern would glow. However, the pattern would only be completed when both users' hands are close to the jar. The glowing pattern is shown in [Figure 6.8](#). By utilising these hints, we aimed to make users experiment with the jar's mechanism and discover its working in a serendipitous manner.

6.3 Exploring physical interactions using mirrors and wearable items

One of the observations from the focus groups discussed in [Section 4.2](#) was that mirrors were points of interest in social VR worlds. Users spent time in front of mirrors, often together with other users. Mirrors were also mentioned



Figure 6.8: Glowing pattern on small jar which completes when both users bring their hands close to it

in conjunction with physical interactions. In the prototype world, we saw an opportunity to design an activity making use of mirrors. Through this, we aimed to shed more light on how mirrors could play a role in facilitating intimacy and social connection.

During self-exploration of social VR platforms, we noted the potential of wearable items in encouraging close interactions between people, especially in Neos. Interactive props and wearables could act as shared objects that bring people together through their novelty and interactivity. Wearable items could encourage physical proximity and interaction, for example when a user helps another user to put on a virtual hat. Inspired by this, we designed an activity using wearable items to encourage physical interactions. Combining the elements of wearables and mirrors, we initially came up with the concept of a virtual photo booth activity where users are able to try out various props and wearables in front of a mirror. We later adapted this concept to better fit the theme of the world by linking it to the magical theme of the world. This was done by exploring the concept of interactive witch hats that users can wear on Firefly Island.

Realising the activity in Neos

The activity was implemented in Firefly Island at the location shown on the map in [Appendix K](#). The location consisted of two hats placed in front of a mirror. As a monolithic mirror seemed out of place in the island landscape, it was set up such that the mirror gradually appeared as users got close to it. This interaction also had the advantage of users serendipitously discovering the mirror. The hats were placed as shown in [Figure 6.9](#). The placement of the hats was intended to make users curious and encourage them to approach it. When users approach the hats, this would make the mirror appear, providing users with the incentive to try on the hats in front of the mirror.



Figure 6.9: Hats placed next to mirror

Even though the hats appear ordinary at first sight, a hidden interaction was added to them that is revealed once users are wearing them. The material of the hat contains a unique visual pattern that glows when the user wearing the hat is physically close to the other user. This was designed to be an interdependent interaction where one user's hat is influenced by the presence of the other user next to them. [Figure 6.10](#) shows this mechanism in action. In addition, this interaction also had the potential to bring users physically close together in the virtual space, providing an opportunity for physical interactions between users.

6.4 Designing a space for conversation and self-disclosure

In [Section 2.1.2](#), self-disclosure was discussed as one of the core themes that constitute intimacy. In order to explore how social VR environments can foster self-disclosure, we designed a space in Firefly Island with the goal of facilitating self-disclosure through conversation.

A relaxing dock

During initial world design, a dock was added to the island as an environmental feature. The addition of the dock was inspired by image 4 from the mood board shown in [Figure 5.5](#). The dock was deemed to be a feature that fit the island



Figure 6.10: Hats glowing when users are close to each other

landscape well, that also provided a space for users to be together. The dock could also act as a *conversational anchor* by bringing users together in a space, a concept that McVeigh-Schultz et al. (2019) previously reported about. In addition, the ambience provided by a dock surrounded by water could provide a calm and relaxing environment that could be conducive to conversation and self-disclosure. Taking inspiration from the mood board, we also saw the opportunity to design an activity where users could place floating lanterns in the water together. Such an activity could give users the ability to influence the appearance of the virtual environment by adding their own personal touch.

The dock provided a space where users could sit down in the virtual environment. The ability to be seated in a social VR environment was one that was mentioned in the self-usage report in Section 3.3. While platforms like VRChat and AltspaceVR did not explicitly support the ability for users to be virtually seated, they could still sit down using full-body tracking or with custom features on their avatar. Neos provided the ability for users to sit down using "avatar anchors" which could be added to virtual objects like chairs or seats. It was also noted that the conversation-centric platform vTime XR exclusively used seated mode for all users. When designing the dock, we saw the opportunity to take advantage of this affordance of being able to sit down virtually, and investigate how it could facilitate conversation.

Implementation in Neos

The dock was added at the location shown on the map in [Appendix K](#). It was placed further along at end of the island as a place for users to relax after completing other activities on the island.

Avatar anchors were added which allowed users to sit down at the end of the dock. To highlight the presence of these avatar anchors, visual indicators were added on the dock as shown in [Figure 6.11](#). Users are able to interact with the avatar anchors to sit down. When setting up the avatar anchor in Neos, the positions of the avatar's hips and feet can be specified, which allows the ability to determine the exact pose that a user's avatar will take when they are seated. [Figure 6.12](#) shows two users making use of the avatar anchors to sit down at the dock. The positioning of the avatar anchors allowed users to be physically close to each other when sitting side-by-side.



Figure 6.11: Visual indicators showing avatar anchors

Lanterns were placed at each side of the dock. These lanterns were “instanced”, meaning users could obtain infinite copies of the lanterns by grabbing it. The lanterns were scripted to float, such that they would float away once a user placed them in the water surrounding the island. The interactivity of the lanterns were not explicitly explained to users in any way. Rather, this was hinted at by placing a few floating lanterns close to the dock as shown in [Figure 6.13](#). Users are able to place an infinite amount of lanterns in the water, allowing them to ‘light up’ the environment as shown in [Figure 6.14](#).



Figure 6.12: Users sitting on dock

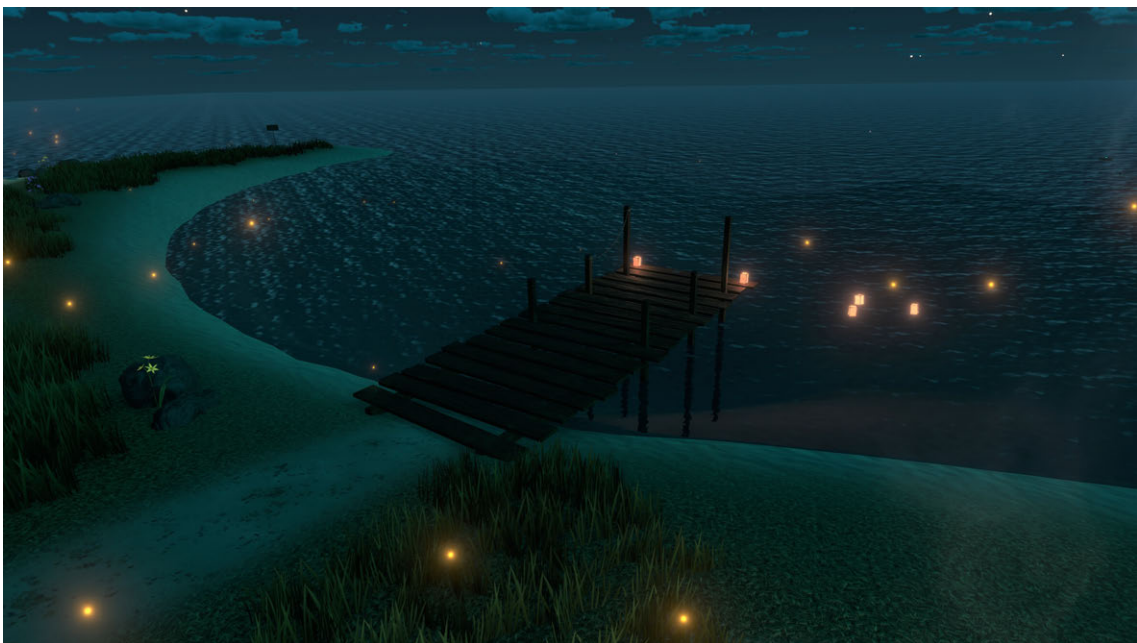


Figure 6.13: Dock with floating lanterns next to it

6.5 Evaluation

The first iteration of Firefly Island was tested in 5 evaluation sessions, each consisting of two participants. Evaluations were conducted in an open-ended manner, where users first explored the prototype world on their own, which was followed by an interview with the researcher. By structuring the session in



Figure 6.14: User-placed floating lanterns in the water

this way, we aimed to reduce the effect that the researcher's presence could have on the participants' experience of intimacy in the world. The sessions and interviews were captured by means of video screen recording. The prototype evaluations aimed to capture insights on how Firefly Island could help in facilitating intimacy and social connection between users, and what role social VR affordances played in doing so. Further, the evaluations sessions allowed us to validate design decisions and to extend our knowledge on intimacy in social VR.

The main objectives of prototype evaluation were as follows:

- i *Understand how the social VR affordances realised during the design of the first prototype could help in facilitating intimacy and social connection.*
- ii *Identify novel social VR affordances that could potentially help facilitate intimacy.*

6.5.1 Method

Setup

As the prototype world was created in the social VR platform Neos, we chose to conduct evaluation sessions with participants from the Neos community. This had the advantage that users were already somewhat familiar with the

platform, and did not need to be guided on basic platform navigation and usage. Each session consisted of two users who agreed to participate together beforehand. Evaluation sessions were virtual sessions where users used their own VR equipment to participate remotely. A total of 5 evaluation sessions were conducted during the period between August and September 2021.

At the time of the sessions, participants first joined a generic empty world where they were briefed on the general procedure by the researcher. Following this, they entered the prototype world together without the researcher. Once the participants were in the world, they did not have to follow any set procedure. The experience had an emphasis on exploration where participants were free to explore and discover different parts of the island in their preferred order. No time limit was imposed on the experience. Instead, participants were informed that the world could be fully explored in approximately 20 minutes, but they were free to stay for a longer period. Participants were asked to notify the researcher once they felt that they had fully explored the world. Once this was done, the researcher joined the same world and carried out a semi-structured interview with the participants based on the questions in [Appendix G](#). During the evaluation sessions, participants took on average 43 minutes to explore the prototype world on their own. The post-session interviews had a similar average duration of 44 minutes.

Before conducting the evaluations, an ethics approval was obtained from the EEMCS faculty at University of Twente with the reference number RP 2021-197.

Participants

Participants in the prototype evaluation sessions were prior social VR users who had experience with the Neos platform. Invitations for participation were posted on the online discussion platform Discord, in the community specific to Neos (see [Appendix H](#)). As each evaluation session would be conducted with two participants, users were given the choice of inviting their own preferred co-participant, or being matched with another user who signed up to participate. The information sheet shown in [Appendix I](#) was sent to users who responded to the initial invitation message. Informed consent was obtained from confirmed participants using the consent form given in [Appendix J](#).

Data Collection

As the focus of the evaluation was only on participants' subjective experience of intimacy in the prototype world, and how the world affects their closeness

to each other, no personal information other than their Neos username was collected from them. As a way to measure closeness to each other, participants were asked to complete the Inclusion of Other in the Self (IOS) Scale assessment (Aron et al., 1992) (previously discussed in [Section 2.1.5](#)) before and after they experienced the prototype world. This allowed us to approximate the degree of closeness between participants, and how the prototype world affected this.

Qualitative data formed a large part of the data collected during the evaluations. As the researcher would not be present when participants explored the prototype world, one participant from each session was asked to create a video screen recording of this part of the session. These recordings were later shared with the researcher. For the post-session interviews, video screen recordings were made by the researcher. The recordings were later used for review and analysis.

Data Analysis

Data collected from the prototype evaluations sessions was analysed in two stages. First, the video recordings of the evaluation sessions were watched by the researcher to observe participant behaviour. Based on these observations, notes were made pertaining to how users interacted with different activities and how they made use of social VR affordances in the prototype world. In the next step, the video recordings of the post-session interviews were watched and relevant themes were identified from them. Representative quotes were also captured and transcribed when analysing the interviews. To improve the prototype in the second iteration, the results from the first evaluations, including both observations and direct feedback from participants, were considered and reflected upon.

6.5.2 Results

The main results of the prototype evaluation consist of both observations from the evaluation sessions and relevant findings from the post-session interview. The video recordings made during each evaluation session provided a rich source of insights about how users perceived and made use of different elements in the prototype world. The post-session interviews provided more context about user actions and their rationale for these actions. Users also provided suggestions and feedback for improvements to the prototype world, which were considered for the second iteration.

Session	Participant	Pre-session closeness	Post-session closeness
Session A	P1	5	5
	P2	5	5
Session B	P3	4	6
	P4	4	5
Session C	P5	2	5
	P6	2	5
Session D	P7	3	3
	P8	4	5
Session E	P9	4	5
	P10	4	5

Table 6.1: Participant closeness before and after the prototype evaluation sessions, measured using the IOS scale

The results helped us to evaluate how successful each activity in Firefly Island was in facilitating the intimacy themes they were designed for, and how the actualised affordances played a role in supporting connection and intimacy. In addition to this, our observations also helped us to uncover new insights about affordances and interactions that we did not explicitly design for. These should be seen in the light of the unique and idiosyncratic nature of each evaluation session and the users participating in them.

Inclusion of Other in the Self (IOS) Scale assessment

To obtain context about the participants' pre-existing degree of closeness, an IOS Scale questionnaire consisting of a single item was administered to them prior to the evaluation sessions. This assessment was repeated after participants completed the session to identify how the prototype world affected their perceived closeness. [Table 6.1](#) summarises the results of the IOS scale assessments.

General observations

In all sessions, participants spent a longer period of time exploring the island than our original estimate of 20 minutes. [Figure 6.15](#) shows a breakdown of the sessions showing the different activities that participants did. As seen in the figure, participants in each session explored the island's activities in different orders, and spent varying amounts of time in different parts of the island. Aside from utilising the activities build into the island, participants also spent time doing other things, such as having a conversation or playing with objects in Neos. These are represented by the grey bars in the breakdown. Participants

used their own preferred avatar when exploring the island. User avatars in all sessions were humanoid in appearance, with varying sizes and features.

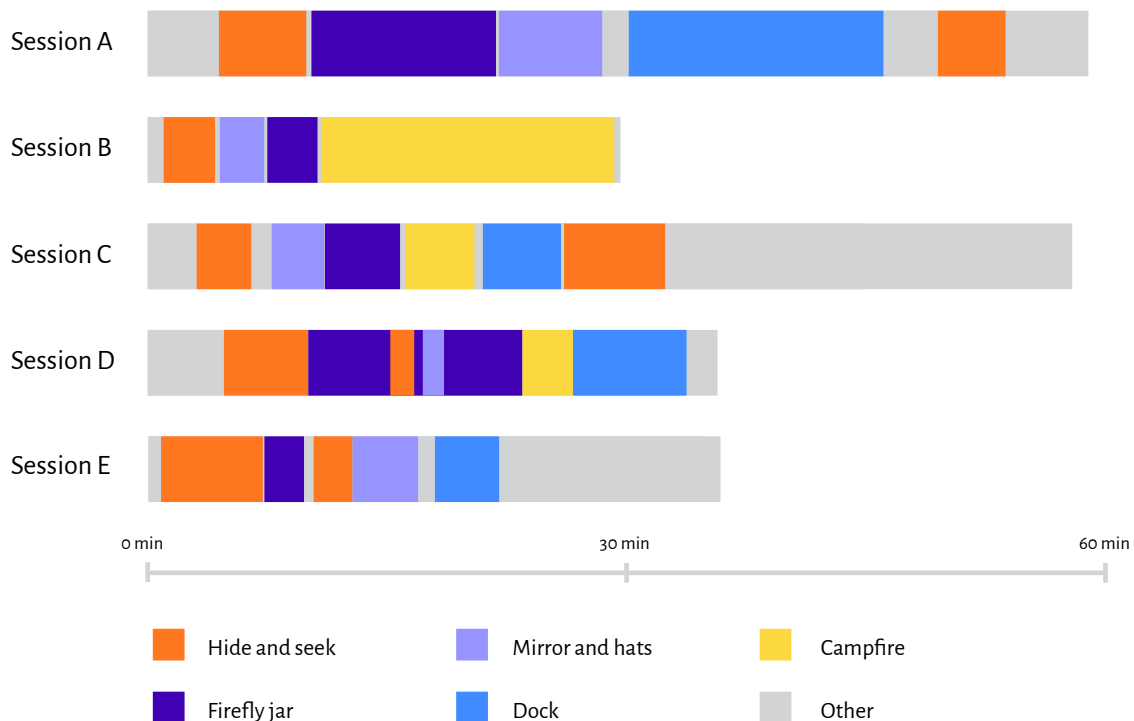


Figure 6.15: Breakdown of evaluation sessions in first iteration

World characteristics and activities

Hide and seek Being the foremost activity on Firefly Island based on its location, all participants encountered the props for the hide and seek game early on, including the book and the firefly catchers. In all sessions, one of the users picked up the book and started reading its contents out loud, while the other listened or scanned along. In session C, participants found the book hard to read because of the cursive typeface that was used in it. In this session, while one user tried to read the book out loud, the other helped them to decipher illegible words. Participants in session B used the scaling capability in Neos to make the book bigger such that it was easier to read. Session C participants also realised that they could do this, but only after they had read the book. In session A, participants spent a few moments together admiring the visual detail on the book.

In session C, participants preferred to explore the island first before playing the hide and seek game. In the other sessions, participants tried out the game immediately after reading the book. In all sessions, participants played at least

two rounds of hide and seek. When playing the hide and seek game as a seeker, some participants noticed that they could still hear the sounds that the hider made even when invisible, and used this to their advantage. This included the sounds of the hider catching fireflies, as well as their voice. During the interview of session B, P4 remarked about the hider catching a firefly “... *you can actually hear them too when that happens, so it was a sign for me whenever you hit them, and I was like ‘oh that’s where he is!’*”. In some sessions, participants playing as the hider intentionally tried to remain silent so as to not give away their position. However, P2 noted how it was difficult to stay silent as a hider: “*I tried to stay silent but when somebody’s chasing you down and actually getting to where you are, it’s a little hard to stay silent*”. In session D, P8 noted that as the hider, they could have used their voice to taunt or mislead the seeker.

There were some serendipitous moments during gameplay, such as in session C where the hider accidentally ran into the seeker, causing the seeker to win unintentionally. The seeker’s special ability involving the shooting star also resulted in some interesting moments. In session B, P3 tried to evade the shooting star by running away from it. In session C, P5 tried to stand behind the tree on the island hoping that the shooting star would hit the tree instead of their body. Participants in session E initially encountered a bug when they tried to play hide and seek, which caused the hider to win the round before the timer ran out. In this session, participants did not get a chance to use the shooting star as a seeker. However, this did not stop them from enjoying the game, and they remarked later during the interview that hide and seek was one of their favourite parts of the experience. P10 noted “*Although it didn’t really work that well, it was still interesting when it worked, it was fun that he disappeared and you had to find based on sounds and everything where he was*”. Participants in session D also encountered some bugs during gameplay, but they kept playing despite this.

In some sessions, participants really enjoyed the activity of simply catching fireflies apart from playing hide and seek. P5 noted “*at the end we weren’t even playing the game anymore, we were just picking up fireflies*”, to which P6 added “*we were going around trying to get the fireflies because there is a nice chime sound, with the animation*”. They also noted that it was enjoyable to be able see all the fireflies that they caught within the firefly catcher’s orb. In session A, P1 used the firefly catcher to playfully ‘bonk’ P2’s head.

Firefly jar In sessions A and B, participants quickly realised that bringing their hands close to the smaller jar caused the contents of the main jar to be copied into it. The pictogram that was placed next to the small jar worked well to communicate this interaction. In these sessions, participants used the brushes to draw in the main jar, and created their own personalised jars using the copying mechanism, which they saved to their inventory. However in the other three sessions, participants were not able to fully understand how the jar worked. In session C, participants noticed that the pattern on the smaller jar's lid glowed when they brought their hands close to it. However, they did not bring their hands close enough to trigger the copying mechanism. In session D, participants spent a long time trying to work out what the jar did, without any success. They did not approach the mechanism in the way that we intended. Instead, they first grabbed a copy of the smaller jar and then tried to put their hands close to the grabbed copy, which was unsuccessful in triggering the copying mechanism.

Even though some participants were not able to work out the jar's intended purpose, they found other ways to have fun with it. In session C, both participants were thrilled about the brushes that were part of the jar activity, and they spent some time looking through all the provided brushes, trying each one out. They also play-acted a scenario where one of them was stuck in the jar. In sessions A and B, participants wondered what would happen if one of them was in the jar when they triggered the copying mechanism. However, they were unsuccessful in triggering the mechanism when they were in the jar as they had to be close to the smaller jar in order to do this. Participants in session D used the brushes to draw funny eyeglasses on each other's faces, and took pictures of each other with those eyeglasses. In an example of expressive and creative play, participants in session E spent a significant part of their time playing with the brushes to draw elements in the world itself, and not just in the firefly jar. Here, P10 used the brush to draw a rainbow 'track' in the world, while P9 worked on drawing a futuristic car to drive on that track. P10 made the track extend all the way to the limits of the world, and attempted to walk along the track to the world limits. [Figure 6.16](#) shows the rainbow track and the car.

The ability to add caught fireflies to the jar was obscure to many participants. However, a few discovered this by accident when they ran through the jar when holding their firefly catchers. In some sessions, participants tried to catch fireflies using the small jars that they could grab from the firefly jar activity, although this was not a programmed feature. Some participants found it difficult



Figure 6.16: Rainbow track and car drawn by participants in session E

to reach the pedestal with the small jar, as it was too high for their avatar. In this case, they had to either scale their avatar to be bigger, or use another locomotion mode which allowed them to fly. During the interview in session A, participants suggested that the pedestal could be lowered. They also suggested a feature where the personalised jar would remember the two users that created it and react to them in a unique way.

Mirror and hats Participants discovered the mirror as they approached the hats that were placed next to it. In most sessions, participants tried on the hats in front of the mirror, and helped to adjust each other's hats so that they fit correctly. Helping each other put on the hats provided an opportunity for users to be physically close to each other, which resulted in them discovering the hat's hidden glow in a serendipitous manner. In session B, participants took photos of each other wearing the hats to show each other how they fit. The hats also resulted in playful interactions between participants in session B, where they tried to poke each other with the point of the hat. Upon discovering the hat's glowing pattern, P3 adjusted their avatar colour to match the colour of the hat's glow. In session C, P6's avatar had purple highlights which matched the hat's colour, a fact that P5 pointed out to them during the session.

In session D, although the participants tried on the hats, there was no clear moment when they realised that the hat glowed when they got close to each

other. In other sessions, participants noticed the hats glowing even when not standing in front of the mirror, for example when sitting together on the dock. In some instances, the hats helped to complement and even encourage physical interactions such as head pats, boops, and kisses between participants by glowing whenever they got physically close.

Most participants did not spend a long time in front of the mirror. P3 noted *“you hear jokes about people sitting in front of mirrors for extended periods of time... personally I don’t see myself as doing that, yes there’ll be cases where I sit down and talk to people, often it’s around a prop”*. Some participants shared their thoughts on why mirrors were useful in VR. P7 mentioned that mirrors often provided more awareness of space in VR, and viewing objects in a mirror often complemented direct vision of those objects. They also noted that mirrors were a way to reduce the *tunnel vision* effect that VR headsets often had as a result of limited field of vision. Participants in session E shared that mirrors helped them to get used to their virtual body. P10 noted *“it’s the effect of seeing yourself as something you want to be, but cannot be in real life, so you spend as much time as possible looking at yourself”*. P9 similarly shared that mirrors helped *“to reinforce a certain version of yourself”*.

Dock Many participants found the dock an enjoyable location to spend time in. About the dock, P5 noted *“I feel like the part where you feel really close to the other person is just sitting on the dock with feet in the water”* and about the lanterns *“I think they set the mood, makes it more serene and chill, it has a calming effect, you feel like you want to talk about your life and stuff”*. In most sessions, the dock succeeded in providing a relaxed environment which led to participants having a conversation when sitting on it. However, participants in session B did not go to the dock at all, and spent more time talking around the campfire. Although not all participants discovered that they could put floating lanterns in the water, it was a delightful discovery for the ones that did in sessions A and C. In session A, P1 and P2 put out numerous lanterns in the water after discovering the feature. P1 went a step further and edited the lantern material using Neos’ tools so that all lanterns would match the colour of their avatar, in what could be described as a way to be more intimate with the environment. P1 noted that the dock was their favourite aspect of the island during the interview.

Although many participants sat down on the dock using the provided seats, the avatar anchors did not work well for all participants’ avatars. In session A, P1 noticed that their posture was slightly crooked when sitting down, and tried to

manually adjust it using built-in tools in Neos. In session C, P6 also noticed that their avatar's posture was off, and tried to fix it. During this, P6 accidentally fell into the water and P5 tried to pull them out of the water, which led to an amusing moment where both of them fell into the water at the same time. In session D, both participants had full body tracking. Here, P7 used the avatar anchor to sit down, while P8 lay down on P7's lap. P7 shared during the interview that they used different body postures in VR combined with full body tracking: *"It depends, if I'm doing something that's more active I might probably be standing, if I'm doing something that's a bit more laid back, and doesn't involve reaching your hands as much I might prefer to be sitting, and if I'm mostly stationary, like having a heart-to-heart conversation, I might lay down because it's more comfortable"*.

Atmosphere and environment During the post-session interviews, participants described the island's atmosphere as relaxing. P4 described the atmosphere as *calm, zenful*, and as *"a place to not think about work, it's a place to relax"*. P4 also remarked that Firefly Island was the kind of world that they would set as their home world in Neos. P5 noted that the sounds in the island, especially that of catching fireflies were very calming: *"I would legit just lay down and listen to the fireflies"*. P7 shared that the atmosphere felt *relaxing* and *private* and described that it felt *"kind of like we're on our private little island, in a way like you're on a holiday and you can lie down and enjoy the sound of the waves lapping on the shore"*. In session E, P9 noted that the fireflies reminded them of a *"calm, forest kind of environment"* to which P10 added that it reminded them of the experience of going camping.

Some environmental elements played a larger role than what they were originally designed for. For example, the *decorative flowers* placed around the island attracted the attention of many participants. In session A, P2 took a picture of a flower remarking how beautiful it looked. Many participants touched the flower closest to the spawn point in the world, thinking it could be an interactive element. In session C, one of the flowers reminded P6 of a game that they played, which led them to have a conversation about the game standing around the flower. During the interviews of both sessions A and C, participants suggested that the flowers could be made pickable so that users would be able to make a bouquet or put flowers on each other's hats. In addition to trying to interact with the flowers, participants tried to climb the tree that was placed at the end of the island to see if it was interactive.

In session B, participants spent a long time having a conversation around the *campfire* on the island. This was despite the fact that the campfire was non-interactive. The campfire reminded P3 about their time as a Scout, and this led them to have a conversation about it during which P4 revealed that they were also a Scout. P3 shared during the interview *“we talked about our history in Boy Scouts together, I reminisced over how the fire reminded me of sometime I went camping, I served as a camp counselor, we had a good time here, we kinda lost track of time I guess”*. While talking around the campfire, both participants made their avatars crouch to make it appear like they were sitting around the fire. During the conversation, P4 spawned an interactive campfire from their inventory and placed it over the already existing campfire. Using this, they were able to roast marshmallows as they talked around the campfire. The campfire on Firefly Island also worked as a conversation starter in sessions C and D. In session C interview, P5 noted how the campfire reminded them of another world in Neos, which prompted a conversation about that world. In session D, participants shared their real life experiences with campfires while standing around the fire.

Other observations

Locomotion modes and scaling Neos supports different locomotion modes that let users to choose how they move in virtual space. For example, the *physical/walk* locomotion mode allows user avatars to move in a way similar to real-life human locomotion, where the avatar moves on the ground obeying physical laws. Neos also has other modes, such as a *fly* mode which allows flight, a *noclip* mode which allows users to pass through objects, disregarding physics, and a *teleport* mode which allows for quick movement while reducing motion. Most participants used the physical/walk locomotion in Neos when in Firefly Island. P9 noted that this locomotion mode felt more natural and was more suitable for the landscape of the island: *“If it’s a world that’s somehow physical and supposed to be to an experience, I tend to prefer physical, obviously if there’s a floor, sometimes in Neos you get crazy worlds in which physical doesn’t make sense, when you’re just building or in a different mode”*. In some cases participants opted to use other modes such as fly locomotion, for example to reach fireflies that were higher up. Some participants also had avatars that allowed for novel means of locomotion. For example P1’s avatar had a mode which allowed them to ‘zoom’ around the world at very high speeds. P10 could fly by flapping their avatar’s hands like a bird.

In some situations, participants had to adjust the scale of their avatar during the experience. In session E, P9 noted that they had to scale themselves down

to P10's avatar size as it was more preferable to talk at a similar height. In some other case, participants had to make themselves bigger to be able to reach certain elements in the world, such as the pedestal which contained the smaller firefly jar.

6.6 Discussion and reflection

6.6.1 Affordances

The observations that we made during the evaluation sessions were categorised broadly based on how they related to different social VR affordances. In this section, we discuss the broad categories of affordances and how participants made use of them during their experience on Firefly Island.

Environment

Elements that react to user presence In the social VR environment, elements that react to users in unique ways can be used to guide users and make them feel more connected to the environment. An example of such an element is the glowing pattern on the lid of the firefly jar (see [Figure 6.8](#)). Here, we made use of a dynamic effect where the jar reacted to both users' presence and hinted that they needed to work together to achieve the goal of making their own personalised firefly jar. During the evaluation, we noticed that the pattern was successful in bringing users together and making them experiment with the jar mechanism. Some participants even suggested how such an interaction could be more unique and personal if the custom-made firefly jar remembered the specific users who created it and reacted only to them.

Environmental features as social catalysts As McVeigh-Schultz et al. (2019) note, environmental features can act as *social catalysts*, allowing interactions to emerge between users. We noticed this at several instances during the evaluation sessions. Elements such as the campfire, flowers, and dock all acted as conversation starters by either triggering a memory or connecting to real life experiences, e.g. having conversations around a campfire. Environmental features also have the potential to act as ice-breakers, by taking the pressure of interaction between users away from each other and instead channelling it through a shared object. On Firefly Island, the hide and seek game enabled this through the use of the rule book as a shared object that users had to focus their attention on. The book allowed interactions to naturally emerge between users,

such as in the case where one user read out the rules to the other, or in the case where both users were trying to decipher the illegible typeface together. Here, we noticed that the visual detail on the book was beneficial in evoking users' curiosity and making them want to examine it.

Ability to transform the environment Social VR users have the ability to dramatically transform their virtual environment through their actions, in ways that would be unimaginable in real life. In Firefly Island, the ability to place floating lanterns in the water was a way of exploring this affordance. In session A of the evaluations, participants made use of this ability to place hundreds of lanterns in the water, essentially lighting up the ocean around them. P1 took this further by making the colour of the lanterns match their avatar's colours after they were placed on the water. In session E, participants made use of brushes to creatively transform the environment, and make a 'rainbow road' that extended to the limits of the world, as seen in [Figure 6.16](#).

Objects and artifacts

Saving memories As mentioned in [Section 4.3](#), Neos offers users the ability to save virtual objects to their inventory, allowing them to retrieve it at a later point. Participants used this affordance to save their personalised firefly jars and other elements in the world as souvenirs. A customised object such as the firefly jar that has high personal value can remind users about their shared experience, and act as an embodiment of their relationship.

Taking pictures Being able to take pictures is an affordance in social VR, just like in real life. Participants often made use of this affordance on Firefly Island to take pictures of themselves and of the environment. Gestures like the 'finger photo' gesture in Neos, which allows users to take a picture by simply making a photo frame gesture (see [Figure 6.17](#)) with their virtual hands, can make it easier and more accessible to take pictures in VR. Pictures once taken can also be saved and shared with others, which is an example of how the previously discussed affordance of saving memories can be utilised. Social VR environments for intimacy can be designed to encourage users to take pictures together. The dock in Firefly Island was an example of how the environment can serve to bring users together in a shared space to take pictures together.

Visual storytelling In session B, we observed that participants made use of virtual objects to demonstrate ideas and concepts when having a conversation.



Figure 6.17: Hand gesture for taking a picture in Neos

The ability to spawn virtual objects instantly using their Neos inventory can be used to visually convey ideas and supplement verbal communication. This affordance unlocks potential for rich visual storytelling in social VR.

Co-creation The ability to create things together and work on shared objects is a powerful affordance of social VR. Tools like brushes allow users to easily create virtual objects in a 3D space that is shared with other users. On Firefly Island, participants used brushes to create customised firefly jars, and even to augment the world by drawing decorative elements such as the rainbow track as seen in [Figure 6.16](#). In Neos, co-creation is not just limited to brushes, and it extends to entire virtual worlds which can be created through collaboration. Users in social VR have the potential to bring their unique ideas to life by collaborating on the creation of artifacts, avatars, and virtual worlds.

Mirrors As we discovered from the focus groups discussed in [Section 4.2](#), the use of mirrors is an intriguing aspect of social VR. Including a mirror as part of Firefly Island allowed us to explore why mirrors are popular in social VR. During the post-session interviews, participants shared why mirrors were useful to them in VR. Mirrors have the potential to increase awareness of a virtual space, as they could serve to complement direct vision in VR which often has a limited field of view. Moreover, mirrors can enhance the feeling of embodiment by

helping users get accustomed to their virtual body, especially in the case of new and unfamiliar avatars.

Objects inspired by the real world When having objects in the virtual environment that are inspired by real-world objects, users also expect them to behave in a corresponding way. On Firefly Island, users tried to pick decorative flowering plants that were placed around the island, and tried to climb the tree that was part of the island. Such objects can also serve to help users associate them with real-life activities, such as in the case of the campfire prompting participants to sit around it and have a conversation. When including such objects in a virtual world, it can be useful to consider how users would interact with them, and design them to take advantage of users' expectations carried over from the real world.

Non-verbal interactions

Physical gestures During the evaluation sessions, many participants made use of physical gestures such as head pats, boops, and hugs. In session D, P7 shared that head pats are popular in the furry community, even among strangers, as people are not as physically vulnerable in VR: *"The fact that we're in VR, we're not as vulnerable as we are IRL, that also makes a lot of people more open to strangers, there's nothing you can do to hurt me especially because I don't have phantom touch, the most that you'd be able to do is like a screech in my ear or a flashbang"*. In addition, avatars can be programmed to react to physical gestures like head pats or boops. Participants in session D pointed out that virtual ears or hair on an avatar can move in response to another user touching them, and a user's avatar can make a sound on being booped. Such interactive elements increase immersion, making physical gestures more rewarding in VR.

Locomotion modes and body posture Participants pointed out the locomotion modes that they used in VR were often influenced by the type of world and environment that they were in. For more physical-inspired environments, as in Firefly Island, the *physical/walk* locomotion mode which was closer to human locomotion was preferred by most participants. Other modes such as the *fly* mode were used in particular situations where they were needed, for example to reach something that was high up. Avatar posture in VR was also discussed in the interviews. When sitting down using virtual seats, it was important to many participants that their avatar's posture correctly matched their expectations. In some cases, participants preferred to match their real body posture with that of

their avatar in VR. Users with full body tracking noted that they used different postures such as standing, sitting, and lying down depending on the situation. Users' virtual avatar posture and scaling can even be influenced by other users around them, such as in session E where participants preferred their avatar to be at a similar height when having a conversation.

Other affordances

Livestreaming In VR, users have the ability to broadcast their virtual experience to a non-VR audience using platforms such as Twitch. During session A, P2 livestreamed their Neos session on Twitch, while interacting with viewers through text chat. This is an example of how interactions in a social VR experience can extend beyond just users in VR. McVeigh-Schultz et al. (2019, p. 9) highlighted this affordance of "*bridging VR and the outside world*" where social VR users can share their experience with others, especially with those that they already know. Maloney and Freeman (2020) also previously noted the possibility for *continued communication* with people both inside and outside VR, and livestreaming can be considered an example of this.

6.6.2 Intimacy on Firefly Island

From the evaluation sessions, we identified several ways that the prototype world helped to support intimacy and intimate interactions between participants. Exploration and discovery was a major part of participants' experience on Firefly Island, as most of them were visiting the world for the first time. The island had many elements and activities that were not explicitly explained to participants beforehand, and it was up to them to discover these elements. We observed that this led to interesting moments during the sessions where participants figured out elements together. For example, discovering that the hats glowed when they got close to each other was a delightful moment for participants. Here, it was not just the experience of discovering the hidden glow that was delightful, but also that of discovering it *together*. This highlights the role of *interdependent exploration and discovery* in supporting intimacy. Other parts of Firefly Island also included this element of interdependent discovery. The hide and seek game was something that participants had to explore and understand together for it to work successfully. For example, the rule book helped to make even the process of learning the game an interdependent action.

Some parts of the island were successful in helping participants be *physically proximate*. When participants were trying on the hats in front of the mirror, we

observed that they often helped each other to adjust their hats. Wearable objects such as hats can be tricky to put on one's own avatar in VR, because of the limited awareness of one's virtual body, and limitations of tracking equipment. Due to this however, such wearables can serve to encourage physically proximate interactions between users. In the case of the hats, they also rewarded participants when they came close to each other, which sometimes encouraged more physical proximity and gestures such as head pats and kisses. The dock on Firefly Island was also effective in bringing participants close together. By helping them be physically proximate, the dock even encouraged some participants to take a picture together at that spot. During the interviews, participants also mentioned other ways that could help encourage physical proximity in Neos, including teaching someone how to perform a physical gesture in VR, and helping them set up their avatar.

Some world elements were also effective in facilitating intimacy through *self-disclosure*. For example, participants in session B spent a significant amount of time having a conversation around the campfire. The campfire acted as a trigger for conversation, by connecting to real-life experiences. In session C, conversation and self-disclosure played a large role in helping participants connect with each other, and world elements such as the flowers and campfire were influential in triggering these conversations.

Session E illustrated how expressive play can emerge in social VR. Participants in this session used the brushes that were part of the firefly jar to transform the entire island by creating a rainbow track as seen in [Figure 6.16](#). While the participants had a lot of fun doing this, they also had the notion that they were "breaking the rules" of the session by doing what they were not supposed to do. This is an example of how *open-ended and expressive play* can support intimacy.

6.6.3 Reflecting on world design and activities

Firefly Island was designed to be a world to bring two people closer together in social VR and help them connect in an intimate and meaningful way. The atmosphere of the world played an important role in achieving this goal. Participants had a positive view on the island's atmosphere, and they shared that it induced a calm and relaxed mood. The suggestions by Naz et al. (2017), including the use of cool colours in the atmosphere combined with the darker night environment were crucial in building such an atmosphere. Moreover, the design of the world and its atmosphere encouraged users to explore and discover the activities on

the island together, by minimisation distractions and allowing them to focus on each other.

The hide and seek game was designed as an ice-breaker, to help participants become comfortable with each other through play. Being one of the first activities on the island, most participants played the hide and seek game first, and many even played multiple rounds. The simple act of collecting fireflies was also an enjoyable aspect to many participants. In some sessions, participants even worked together to fill the firefly jar. However, the co-creation aspect of the firefly jar was less successful. Participants fully understood the functionality in only two out of five evaluation sessions. The fact that users could draw in the large jar and make a copy of their drawing in the smaller jar was rather hidden, and participants had difficulty in working out the mechanism. Despite this, having the brushes next to the firefly jar still encouraged participants to co-create, albeit not within the firefly jar. Improving the discoverability of the firefly jar mechanism could have elicited better results from the firefly jar's co-creation aspect. However, the firefly jar served to highlight the potential of the inventory system, and the ability to save memories in supporting intimacy in social VR.

6.7 Design knowledge

In this section, we recap the design knowledge that was gained during the first iteration.

1. Giving users something to do together, especially through activities that encourage interdependent discovery and play can be a form of ice-breaking, easing users into an experience. Activities in Firefly Island such as the hide and seek game illustrate this.
2. Providing users opportunities for taking photos together, or capturing a shared experience can be a way to build shared memories.
3. Environmental features can act as social catalysts by encouraging conversation and self-disclosure. For example, elements such as campfires can be added to social VR worlds to facilitate conversation.
4. Providing opportunities for idiosyncratic expression and personalisation through elements in social VR worlds can bring users closer to the world and to each other.

5. Social VR users can have different VR equipment having varied capabilities, such as full-body tracking and facial tracking. User avatars can also have different characteristics. When designing an intimate experience, this can be kept in mind to make sure that the experience ensures parity and that users are not left out as a result of lacking capabilities.
6. Physical interactions in VR can be complemented by accompanying visual feedback. This can be used to guide users towards specific actions or even encourage physical proximity and physical interactions. The hats in *Firefly Island*, which glow when users wearing them get close to each other are an example of this.
7. Virtual mirrors in VR can be advantageous in providing enhanced awareness of virtual space. Mirrors can also serve to reinforce a user's virtual self-image and sense of embodiment in their avatar.
8. Users' choice of movement and locomotion modes in VR can be influenced by their virtual environment, the type of activity that they are doing, and their real body posture.
9. A user's avatar is an important part of their VR experience and can be highly personal to them. In a social VR experience, it can be advantageous to provide users the ability to use their own avatar or give an option to choose their preferred type of avatar.

Design Iteration 2

This chapter describes the second iteration of Firefly Island, where we build on the prototype that was developed during the first iteration. During the evaluation of first iteration, we gained valuable insights about how people make use of social VR affordances for close connection and intimacy. We also identified potential improvements to the prototype world not only based on the observations from the evaluation sessions, but also through direct feedback from participants. In the second iteration, we aimed to refine the prototype world based on our findings from the first evaluation, and build towards a more complete experience.

7.1 Interactive elements in the island

We first take a look at how features of Firefly Island's environment were better integrated for intimacy and close connection. Many of these environmental features were added mainly for aesthetic appeal and to make the world look more complete. For example, the flowers in the island landscape, and the campfire were all non-interactive elements in the first prototype. However, during the evaluation, we noticed participants trying to interact with these features, and making use of them in ways that we did not originally plan for. In addition to this, during the interviews participants gave us direct feedback on how these features could be enriched with interactivity. For the second iteration, we saw an opportunity to make better use of these environmental features in realising our goals for Firefly Island.

7.1.1 Campfire marshmallows

The campfire on Firefly Island was originally a non-interactive environment element in the first prototype. Despite this, we observed that it played a role in supporting social interaction between users, such as in session B where the campfire was influential in sparking a conversation between participants, leading them to spend a long period of time around it. McVeigh-Schultz et al. (2019) previously noted the role that environmental features such as campfires could play in shaping social interactions, by acting as *social catalysts* or *social lubric-*

ants. In order to fully realise the potential of the campfire in Firefly Island, we designed more interactivity around it.

As we observed during the evaluation sessions, the campfire could act as a place for conversation, allowing intimacy to emerge through self-disclosure. We hypothesised that making the campfire experience more fulfilling could encourage users to spend more time around it, potentially leading to more conversation. As roasting marshmallows is a popular activity around a campfire, we considered adding this functionality to the campfire. This was inspired by the participants in session B who spawned their own interactive campfire on top of the preexisting campfire in the prototype world, which allowed them to roast marshmallows. To make the experience complete, we also designed seats around the campfire. In the first prototype, users did not have a way to sit around the fire in an natural way, so they had to resort to other ways of sitting down, such as crouching.

To implement the activity of roasting marshmallows, roasting sticks were placed around the campfire. Users could pick up the sticks and hold them above the fire, which triggered a sound effect and roasting animation. The roasting mechanism was derived from a prefabricated public campfire made available by a member of the Neos community. For sitting down, two seats were placed around the campfire in the form of wooden logs. Users could sit down on the logs by interacting with them. The seats were implemented using the avatar anchor system that was previously described in [Section 6.4](#). [Figure 7.1](#) shows two users sitting around the campfire while roasting marshmallows.

7.1.2 Picking flowers

Flowers were placed at different locations on Firefly Island as shown on the map in [Appendix K](#). During the evaluation sessions from the first iteration, we observed that the flowers were one of the first things that captured users' interest. Many users paused to try and interact with the flowers, or simply admire them. However, the flowers served no other purpose than just being decorations in the first prototype. Although their addition to the prototype world was inspired by the real world, they had none of the characteristics of real flowers aside from appearance. As we observed during the evaluation, the flowers inadvertently acted as signifiers for interactivity. When users tried to interact with the flowers, they were left disappointed.



Figure 7.1: Users sitting around the campfire

To address the missed potential of the flowers, we added the ability to pick flowers in the second iteration. This was inspired by direct feedback by participants from the first evaluation. As described in the previous chapter, participants from session A suggested that the flowers could be made interactive such that users could pick flowers and place them on each other's avatars. We realised that such a feature had the potential to introduce rich, interdependent and expressive interactions between users. We hypothesised that one user being able to place flowers on the other user's avatar could prompt physical interactions between them, and encourage the other user to reciprocate. Further, discovering this feature as a result of their natural curiosity could be intrinsically rewarding to users.

The ability to pick flowers was implemented in a similar way as the lanterns in [Section 6.4](#), where users were able to obtain flowers by grabbing the flowering plant model. Once picked, flowers can be attached to a user's avatar by placing them anywhere on the avatar's head. Due to technical limitations, flowers could only be placed on one predetermined part of the avatar. We chose the head as it seemed to be the most natural place to put a flower. [Figure 7.2](#) shows a user picking a flower, and [Figure 7.3](#) shows flowers placed on an avatar.



Figure 7.2: A user picking a flower on the island



Figure 7.3: Flowers placed on an avatar

7.1.3 Taking photos at the mirror

We previously noted how the affordance of taking photos in social VR could play a role in supporting intimacy. In multiple evaluation sessions from the first iteration, participants used photos as a way to capture funny and memorable moments from the time they spent together on Firefly Island. Platforms such as

Neos and VRChat make it easy for users to take photos through built-in camera functionalities. In Neos, users can take photos with a virtual camera that they can spawn using their inventory, or with a hand gesture that can be performed quickly at any time. Photos taken can be easily saved, retrieved, and shared with other users by using the inventory system. In the second iteration of Firefly Island, we decided to further explore the affordance of taking photos in social VR by integrating a camera functionality to the mirror in the world.

The photos that participants took during the previous evaluation sessions were all taken of participants' own accord, and were not part of any activity on the island. While some participants took photos, we also noted that not all sessions had photos taken in them. We wondered if explicitly designing a mechanism to take photos in the world would be effective in helping users utilise the affordance of taking photos. In such a mechanism, it would be desirable to have both users visible together in the photo. We envisioned the mirror (discussed in [Section 6.3](#)) as an ideal location to implement such a photo-taking interaction. During the first iteration, we noted that the hats placed next to the mirror were effective in bringing users close to each other physically in front of the mirror. As this was a potentially intimate moment, being able to capture this moment could be a way of capturing users' togetherness during the experience. Keeping this in mind, we implemented a mechanism which allowed users to take photos in front of the mirror.



Figure 7.4: Photo taken using the mirror appearing in front of mirror

The photo-capturing mechanism was added in the form of a camera button on the mirror. On pressing the button, users would hear a 3-second timer sound effect after which their photo would be taken. Photos are taken from a hidden camera placed in the centre of the mirror, facing the users. The reflection that users saw on the mirror provided them an approximation of how the photo would look. Once captured, the photo spawns as a physical object in front of the mirror when users can then save. [Figure 7.4](#) shows a photo that was captured using the mirror, with the camera button visible at the back.

7.1.4 Voice-reactive tree

In the first iteration of Firefly Island, we added a tree at the end of the island as shown in [Figure 7.5](#). The tree was originally inspired by the idea of a ‘firefly tree’ in which fireflies live and mate with each other. Being the only tree on the island, it could be a potential location for an activity designed for intimacy. Although we did not add any interactivity to the tree in the first iteration of the island, we observed that many participants tried to climb the tree and look for hidden secrets in it during the evaluation sessions. This made us wonder how the tree could be made an interactive element that could have a special significance to users.



Figure 7.5: Tree on Firefly Island

One of our initial ideas for the tree was to make it a ‘whisper tree’, where users would be able to whisper messages into the tree and the tree would remem-

ber them. We imagined this as a playful activity that could foster expressive interactions between users. In addition to this, we also played with the idea of making the tree a reactive, living part of the environment that responded to the presence of users on the island. This was inspired by the work of Dagan and Isbister (2021), who explored how to design technologies with ‘needs’ that support social interaction between people. Dagan and Isbister note that *animism*, or the attribution of a living spirit to things could be used as a way to give users a sense of connection with a technology. When exploring how we could apply the concept of animism to the tree on Firefly Island, we realised that *making the tree grow* in response to users’ presence was a natural way to do this.

Making the tree reactive was also a way to incorporate animism. Drawing from our original idea of a ‘whisper tree’, we imagined a tree that would react to users’ voices. Here, the tree would glow brighter in response to a user speaking next to it. In our final implementation, we combined these elements such that the tree would react and grow in the presence of users’ voices. This is comparable to the concept of Synergistic Social Technology (SST) described by Dagan and Isbister (2021), in that the tree has a ‘need’ that is fulfilled by users speaking while being close to it.

7.2 Emoji fishing

In Section 6.4, we discussed the design of the dock on Firefly Island as a place for conversation and self-disclosure. The dock was designed to act as a relaxing location where users could sit down and talk. While the dock did not feature any intentional design elements that persuaded users to talk to each other, it provided an environment conducive to conversation by giving users a place to sit down together with minimal distractions around them. The dock was successful in this regard during the first evaluations, and many participants used it to sit down and talk. During the post-evaluation interviews, some users suggested that the dock could be even more interesting if there was something to do when sitting there. We asked ourselves how we could design an activity explicitly focused on encouraging conversation and better self-disclosure between users.

A fishing activity

In session B of the evaluation sessions, participants suggested that a fishing activity could be an interesting addition to the dock on Firefly Island. Such an activity could make the dock experience more interactive by giving users something to do while sitting on the dock. While the floating lanterns were already

existing interactive element, it could not provide a sustained experience as users could eventually grow bored of it. We observed this in the first iteration—although many participants were initially excited to discover that they could place lanterns on the water, they did not continue the activity for long. A fishing activity had the potential to be a sustained activity where the act of waiting for a catch, and the curiosity of what the catch would be meant that users could enjoy such an activity for a longer period of time. As the original intention of the dock was to be a place for conversation, we aimed to design the fishing activity such that it could foster better self-disclosure and through this intimacy.

While it would be possible to implement a realistic fishing activity, this was not our goal. Our focus was not on the fish or the act of fishing itself, but on how such an activity could draw users' attention to each other through interdependence and self-disclosure. In addition, the unique possibilities in VR meant that we could go beyond just replicating a real-world fishing activity. In one of our initial ideas, we pondered a fishing activity where instead of fish, users would catch *questions* that prompted them to talk about a certain topic. We previously noted in [Section 4.1.2](#) how the social VR app *Where Thoughts Go* used questions to prompt users to talk about deeply personal topics. In the popular social game *21 questions*, people use questions as a way to get to know each other intimately. In our case, we reflected on how 'catching' questions in the fishing activity could be a way to encourage self-disclosure. While questions were an effective way to focus attention on a particular subject and get precise answers, they also had the potential to feel forced on someone, where there is pressure to answer the question. Another challenge was to formulate questions that were general enough for all participants irrespective of their preexisting relationship, and to have enough questions so that it could be a sustained experience without repetition of questions. We also considered how the visual aspect of 'catching' a question could look like. In real-life fishing, the appearance of a fish, including attributes such as size and colour can provide immediate visual feedback and gratification. This could be more challenging for questions where they are made of text that users had to read. A possible solution to this was to hide the questions in physical objects that could be caught such as colourful containers or even fish.

Iterating on our previous line of thought, our next concept for a fishing activity involved catching emoji instead of fish. Emoji are pictographs representing an emotion, object, or symbol that are commonly used in text-based messaging and social media. Including emoji as the 'catch' in the fishing activity was attract-

ive as they could be used as prompts for conversation. The Unicode standard defines over 1,500 unique emoji covering a diverse variety of subjects. When used as prompts, emoji had the potential to provide users a nearly endless supply of topics to talk about. Emoji prompts also have the advantage of not being too specific like direct questions, which meant that users can choose their own level of self-disclosure. Further, as emoji are visual elements, they could provide a more fulfilling experience for the fishing activity with immediate visual feedback. The large number of possible emoji would also add an element of curiosity to the activity, as users would be curious about what they are going to catch next. Such an activity could be playful and intrinsically motivating in addition to facilitating self-disclosure.

Although catching emoji could be an enjoyable activity in itself, we needed a way to make them act as prompts and encourage users to talk about them. For this, we devised different mini-games that users could play with emoji. The games that we designed were simply suggestions that users could choose to play. We felt that having this choice was an important aspect of supporting the theme of expressiveness, where users are not forced to do something. Users could choose to ignore the mini-games entirely, and play with emoji in their own ways. While designing these games, we realised that they could be varied, each catering to different levels of intimacy. While some games could have an emphasis on conversation and self-disclosure, others could be more fun and light-hearted. The 5 games that we devised are listed below:

Emoji stories In this game, players have to create a story together using emoji. As each person catches an emoji, they try to explain how the new emoji fits into the story.

Colour sorting A simple but relaxing game where players sort each emoji they catch based on its colour.

Name a tune! For each emoji that a player catches, the other person has to name a song related to that emoji. If they cannot name a song, the first player wins. This game also works for movies, books, games, etc.

Emoji diorama In this game, players create a picture combining all the emoji that they catch. Creativity is key.

That reminds me! Each time a player catches an emoji, they have to try and think of what the emoji reminds them of. This is a simple game focused on conversation.

Realising the activity in Neos

Emoji fishing was implemented using fishing rods that were placed on the dock. [Figure 7.6](#) shows the fishing rod. Users can pick up the fishing rods and interact with them to catch emoji. To cast the fishing rod, users either had to press a button on their controller, or rotate the reel on the fishing rod. Once the fishing rod was cast in the water, users had to wait a random amount of time between 90 seconds for a random emoji to be caught. Once an emoji was caught, this was indicated by playing a sound effect and making the fishing line shake. Users can obtain the emoji by reeling it in by again rotating the reel. Caught emoji were in the form of a flat plane containing an image texture. Users are able to grab the emoji and manipulate it in the virtual space. We used emoji images from the Google Noto emoji set (Google, [n.d.](#)). After removing duplicate emoji such as those depicting variations of the same emoji, there were 1,374 unique emoji to catch. The final set depicted a wide range of subjects including emotions, people, animals, food, and other things. [Figure 7.7](#) shows emoji that were caught using the fishing mechanism.

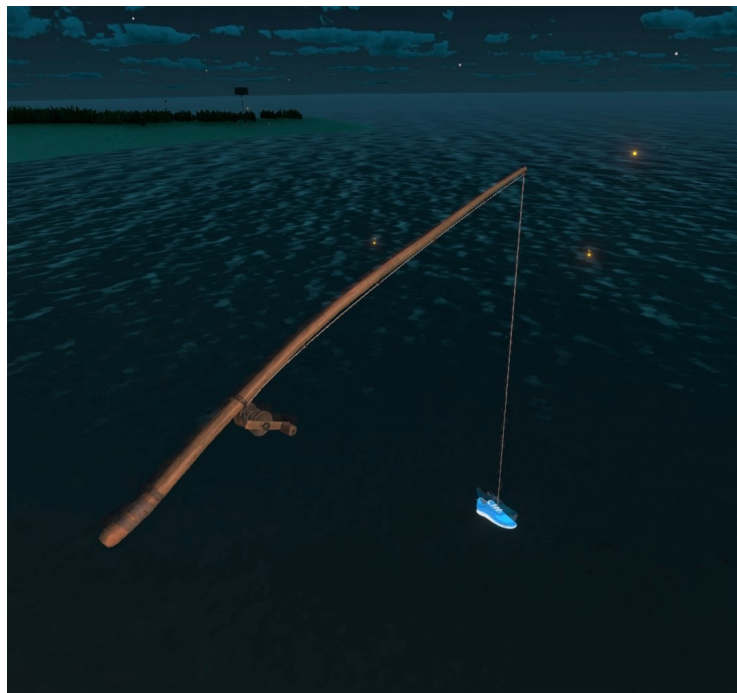


Figure 7.6: Fishing rod for Emoji fishing

To convey the mini-games that we designed, we used a similar approach as the hide and seek game through the use of a book. The book was placed on the dock, and it provided an introduction to the fishing activity including the mini-games. Figure 7.8 shows the book's contents.



Figure 7.7: Emoji caught during emoji fishing



Figure 7.8: Book that explains emoji fishing mini-games

7.3 Evaluation

Evaluation sessions were conducted for the second iteration of Firefly Island in the same way as the first iteration. A total of 6 evaluation sessions were conducted, each consisting of 2 participants. The evaluations sessions aimed to capture insights on how Firefly Island could help in facilitating intimacy and social connection between users, and what role social VR affordances played in doing so.

7.3.1 Method

Setup

As in the first iteration, evaluation sessions were conducted with participants from the Neos community. The sessions followed the same setup as the first iteration, as described in [Section 6.5.1](#). A total of 6 evaluation sessions were conducted during the period between October and November 2021. During the evaluation sessions, participants spent on average 64 minutes exploring the prototype world on their own, while the post-session interviews had an average duration of 50 minutes.

Before conducting the evaluations, an ethics approval was obtained from the EEMCS faculty at University of Twente with the reference number RP 2021-197.

Participants

Participants were users who had prior experience with the Neos platform. An invitation to participate in the evaluation sessions was posted in the Discord server specific to Neos. As in the first iteration, users were given the choice of inviting their own preferred co-participant, or being matched with another user who signed up to participate. Users were provided with an information sheet ([Appendix I](#)) and informed consent form ([Appendix J](#)) prior to participation.

Participants P3, P9, and P10 from the evaluation in the first iteration participated again during the second iteration, but with different co-participants. P9 also participated in two separate sessions of the second set of evaluations. The participant identifiers of the recurring participants are kept consistent in the report of the second evaluations for clarity.

Session	Participant	Pre-session closeness	Post-session closeness
Session F	P11	4	5
	P12	5	6
Session G	P10	1	2
	P13	2	4
Session H	P14	5	5
	P15	6	6
Session I	P9	6	6
	P16	4	6
Session J	P3	3	5
	P9	3	5
Session K	P17	3	4
	P18	7	7

Table 7.1: Participant closeness before and after the prototype evaluation sessions, measured using the IOS scale

Data Collection and Analysis

Data collection and analysis were carried out in the same manner as the first iteration (see [Section 6.5.1](#)).

7.3.2 Results

Inclusion of Other in the Self (IOS) Scale assessment

[Table 7.1](#) summarises the results of the IOS scale assessments from the second iteration.

General observations

[Figure 7.9](#) shows a breakdown of the sessions showing the different activities that participants did. As in the first set of evaluations, participants did activities in different orders and spend varying amounts of time on each activity. The grey sections of the breakdown represent the time that participants spend doing things that were not connected to any activity. For example, participants in session G spent a significant amount of time exploring different avatars and interactive objects in Neos spawned using their inventory while in the prototype world.

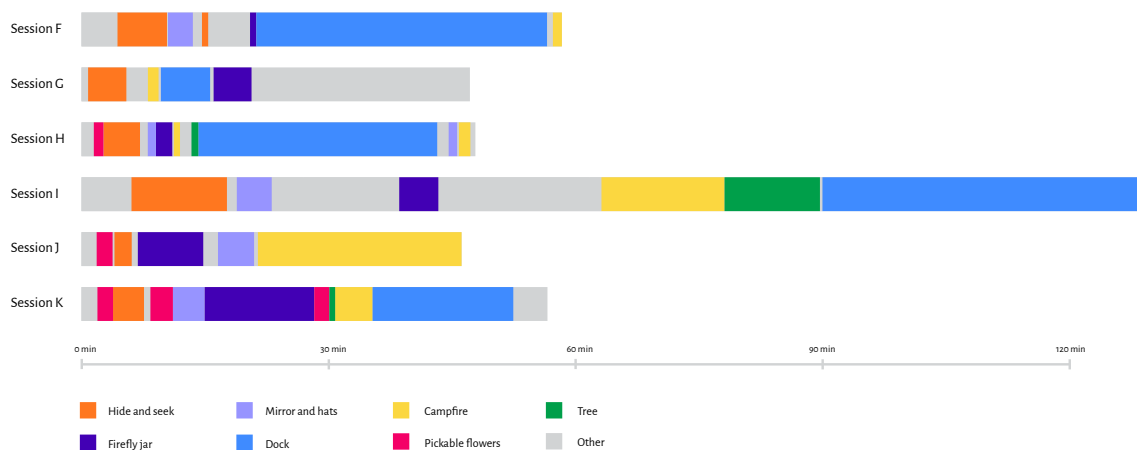


Figure 7.9: Breakdown of evaluation sessions in second iteration

World characteristics and activities

Hide and seek In all sessions, participants encountered and played the hide and seek game early during their experience. While some participants made sure they understood how to play the game with the help of the book, others experimented with the firefly catchers before reading the rules in detail. In session F, participants picked up the firefly catchers and unknowingly started a round before they read the rules in detail. In this session, they playfully hit each other with the firefly catchers, leading to a few amusing moments where the seeker won the round automatically. After this, they took a closer look at the game rules and played more rounds in a normal way. Even after playing a few rounds, the participants continued to catch fireflies casually as they had a conversation. In session G, P10 opened the book and explained the rules to P13, having already played the game before during the first iteration. However, P13 still had to read the book on their own to fully grasp the game mechanics. In session I, P9 encouraged P16 to read the book on their own, trying not to reveal too much about it since P9 had already played the game before. In session J, since both participants had previous knowledge of the game from the first iteration, they did not read the book thoroughly. Rather, they skimmed through it and immediately started a round. During the post-session interview of session J, P9 noted “*I already knew the rules, but I thought it was just nice to pop it open*”. In a few of the sessions, participants made the book bigger so it was easier to read.

Participants found unique ways to enjoy the hide and seek game. In session I, P16 as hider tried to stay behind P9 (seeker), while trying to ‘steal’ the fireflies the seeker was about to catch. However, this strategy backfired by actually making it easier for the seeker to win the game, as it was easier for the seeker

to touch the hider's body. In this session, participants also noted that hearing the hider's voice was sometimes useful to pinpoint their location. Participants in session K shared that it was easier to win as a seeker, because of the seeker's special ability. In session J, participants did not spend a lot of time on the game, having already played it before during the previous iteration. Here, they played a quick round before moving on to explore the rest of the island.

Firefly jar There were only two sessions where participants used the firefly jar for co-creation and making their own personalised jars. In session J, as both participants had previous knowledge of how the jar worked, they both grabbed the brushes and made art in the jar. P3 drew their personal logo, while P9 made an abstract drawing of a lightning cloud. P3's logo led them to have a conversation about the logo's origin and how P3 made use of it within Neos. In session K, participants drew a large heart in the jar and placed one of the decorative flowers from the island in the jar, slowly discovering how the jar mechanism worked along the way. In both these sessions, participants saved a copy of the personalised jars they created. However, in both these sessions participants did not use the ability to add fireflies that they caught into the jar, as they did not discover it.

In other sessions, although participants did not use the firefly jar for its intended purpose of co-creation, they made use of the jar and brushes in different ways. In sessions F and H, participants discovered the fact that they could add fireflies to the jar, which led them to catch more fireflies so that they could fill up the jar. P14 shared during the interview: *"We had fun with the fireflies, we didn't do much with the actual drawing, neither of us are much of artists"*. In session G, P10 showed P13 how different brushes worked, since P13 was relatively new to Neos. After this, P10 spent a considerable amount of time showing P13 the different things in Neos, including avatars, interactive objects, and memes. In session I, participants used the brushes to draw different objects, although *outside* the firefly jar. P9 used the brushes to create a diamond ring which they gave to P16. In return, P16 also made a ring and they then took a picture wearing their new rings. In this session, participants spent a long time playing with the brushes as they talked about different things. At various points, they used the brushes to explain or illustrate parts of their conversation. At one point, P16 discovered a glitch in the firefly jar which caused users to be able to jump very high while standing inside the jar. The participants likened this to a trampoline and spent some time playing around with the glitch together, in a clear example of how expressive play could emerge between users.

Mirror and hats The hats were effective in bringing participants physically close together to experiment with the hat's hidden glow. As in the first iteration, participants helped each other to put on the hat in some sessions, which led them to discover the hidden glow. During the interview of session H, P14 noted how the hats worked in unexpected ways: *"....it was funny because at one point I was trying to come up behind him, and he was able to notice that I was behind him because the hats lit up"*. In session I, as P9 already had previous knowledge about the hats, they explained to P16 how it worked. In this session, P16 remarked to P9 about how well their avatar's colour (green) complemented the purple colour of the hats. In session K, participants hugged each other immediately after discovering that the hats glowed with each other's presence. In session G, participants did not approach the mirror or hats at all, as they were occupied with other things during their experience.

Participants also made use of the mirror to take pictures together. P17 shared during the interview: *"It was basically like a fitting room almost, you plop on the hat, you're checking it, checking their hat or whatever, and like 'Okay there's a camera button let's take a picture', and that's basically how it went"*. In session J, participants struck poses in front of the mirror and took pictures of themselves. In session I, participants wanted to take a picture holding their firefly catchers, so they first collected some fireflies using their catchers which they could then showcase in the picture. In this session, participants stood in front of the mirror when they were drawing with the brushes and having a conversation. In session F, participants did not take any photos at all during their experience. During the interview, P12 shared: *"We were mostly talking, we actually don't get to spend too much time together, because we're busy so this was nice just to like sit and talk"*. Some participants noted that they did not spend a long time in front of the mirror. P14 shared that they used their personal mirror that could be easily accessed through the Neos menu: *"Part of it is that I think both me and him have in our Neos dash, we have our own personal mirror that we can pull out at any point, so we don't tend to spend time in front of mirrors just because we have our own if we ever need it"*. In session K, P18 shared that they did not spend much time in front of the mirror: *"we're here to do a thing, why am I gonna sit in front of a mirror..."*.

Dock and Emoji Fishing Participants made use of the dock and the activities contained within it in different ways. In session F, P11 discovered the book which explained the emoji fishing activity, and showed it to P12. They read through all the mini-games and chose their favourite ones from the list. They then sat down on the dock using the avatar anchors and played emoji fishing. During

the interview, P11 noted that the colour sorting mini-game was the easiest thing to do. P12 agreed *"It was comfy because we decided to go for an RGB color sorting"*. P12 also added that some of the emoji were awkward: *"We tried to figure out if we could tell a story or like reminisce on the emoji, but frankly it was a bit weird because it was like a wheelchair, blood, a face-palm, but it was fun it was nice to just talk about stuff and fish for the emoji"*. During their time on the dock, P12 spawned a mirror using their inventory and placed it in front of them. P11 remarked during the interview: *"[P12] is really good at knowing where to put mirrors, so that way you can look at each other and be able to talk eye to eye without having to be there, so she put one in front of where the fishing was which was really nice"*. In session G, although participants tried out the emoji fishing activity, they did not spend a long time doing it. Since P13 was new to Neos, they were focused on figuring out the functionality of the fishing rods, with P10 guiding them and talking about other fishing worlds in Neos.

In session H, participants found a creative way to play emoji fishing. After initially understanding the concept of the activity with the help of the book, they proceeded to have fun in their own idiosyncratic way. During their experience, they spent the most time on the fishing activity. Here, P15 made numerous copies of the fishing rod such that they could catch a large number of emoji at the same time. They then split up their roles such that P14 caught emoji and described each emoji out loud, while P15 worked on categorising the emoji, as seen in [Figure 7.7](#). P15 later explained during the interview: *"We were just kinda having fun with it, we didn't have a plan"*, to which P14 added *"There wasn't a lot of thought put into it, it was just like 'Hey what happens if we duplicate the fishing rod?' and we were like 'We're getting a lot of emoji, let's just grab them all!'"*.

Participants in session I played an intriguing version of the mini-game 'Emoji Stories'. Here, P16 discovered the fishing book and gave it to P9, who read it out loud. They initially decided to make a diorama with the emoji, and tried out the fishing rods. After getting acquainted with the activity, they started to develop a story using the emoji that they caught, trying to fit in each new emoji into the story. Here, the participants enjoyed the activity by creating a bizarre yet hilarious story. P9 later described the story *"There was this village that was ruled by a prince and a princess, and they were having a banquet, they were trying to make a giant go away using a fan, but they accidentally made a giant tornado, and there was this astronomer that was watching this and calling for help, who had a little pet turtle and a little chick assistant. There was a chivalry coming for help, together with a dolphin holding an axe..."*. Some of the emoji that participants caught during the

session also led them to have a conversation about them. For example, catching a pancake emoji prompted them to talk about the last time they ate pancakes and what they liked about pancakes.

In session K, participants did the emoji fishing activity before discovering the book that explained the mini-games. Here, they caught emoji and tried to figure out what they meant. As the world was focused on intimacy, they imagined that the emoji were meant to represent an intimate relationship, and tried to fit the emoji into this scenario. For example, they imagined that a balance scale emoji could represent balance in a relationship, and an onion emoji could represent the fact that a relationship has layers. In session J, participants did not approach the dock, as a result of which they did not try emoji fishing. In some sessions, participants were able to discover that they could place floating lanterns in the water. In session K, P18 noticed that there were already some lanterns floating in the water, which led them to discover that they could put additional lamps in the water. P18 described that the atmosphere of the dock as 'comfy', and added *"it makes you feel like no one's gonna disturb you there, I felt like I could be alone with her here, not too much going on, just water, just chill"*. In session F, P12 suggested that it would be more satisfying if the lanterns would 'plop' onto the surface of the water instead of users having to place them there.

Environmental features The ability to *pick flowers* in the island was added in the second iteration. We observed that placing one of the flowers close to the spawn point encouraged participants to try to interact with it. After discovering that they could pick flowers, participants in session K proceeded to collect all the different kinds of flowers on the island. They placed the flowers on each other's heads and tried to make a decorative bouquet. Upon later discovering the witch hats, they placed the flowers on each other's hats. At one point, P18 tried to take a picture of P17 wearing the flowers at the exact moment that P17 was also trying to take a picture of the other, resulting in an amusing serendipitous moment. In sessions F and I, participants did not discover that they could pick flowers. While this was revealed to them during the interview, they immediately tried to pick flowers and put it on each other's head. In session J, P9 tried to put a flower on P3's head, having already discovered the functionality in the previous session. P3 however did not reciprocate this action, and they did not interact with the flowers for the rest of the session. Similarly, in session G, although P10 discovered the ability to pick flowers, they did not attempt to put them on their co-participant. This could have been due to the fact that there was little pre-existing closeness between them.

Participants also made use of the *campfire* on the island. In some sessions, participants played with the ability to roast marshmallows, but did not spend much time next to the campfire. In other sessions, participants spent time by not only interacting with the campfire, but by also having a conversation around it. In session I, after playing with the campfire's functionality, participants sat down around it and had a conversation involving significant self-disclosure. P16 later shared during the interview *"I think campfires are just sort of a natural really nice place to have a conversation at, it's very nice to just sit around and watch the flames, even play around with the marshmallows"*, and P9 added *"The sound is kind of soothing and relaxing and that also helps"*. In session J, P3 who had previously participated during the first iteration, noticed that the campfire was now interactive. In this session, participants spent a significant duration of their experience talking around the campfire. When talking to P9, P3 used the inventory system to spawn items and even images from the web to illustrate what they were talking about. Participants in session K play-acted by attempting to feed each other burnt marshmallows in a humorous exchange.

Only a few participants noticed that the tree on the island was voice-reactive. In session H, participants noticed this as they got close to the tree. They also noticed that the tree was growing slightly as they spoke. Here, they tried to make the tree grow faster by making funny sounds. In a serendipitous moment in session I, participants simultaneously discovered that the tree was reacting to their voice while they were in the middle of a conversation around the campfire. This encouraged them to approach the tree and climb it. In this session, the tree also acted as a catalyst for a conversation. P16 remarked during the interview: *"My favourite moment was when [P9] and I were climbing the tree over there, and all the stuff we did in it, like we were just talking about climbing trees in real life and he was taking photographs of me"*. Participants in session K similarly attempted to climb the tree when they discovered that it was voice-reactive. In session F, the participants only noticed the tree's interaction during the interview. P11 suggested *"You have to make it so it's like an intimate world, as you share more together, as you walk through a forest, it all grows, that would be beautiful"*.

Atmosphere Participants generally liked the island's peaceful atmosphere. P14 noted that the atmosphere *"gives you that nighttime feel without actually sacrificing visibility"*. In session I, participants described the island's atmosphere as *relaxing* and *magical*. P16 shared *"It's a wonderful place to be, and it's very relaxing, like somewhere you'd want to go in the evening ... it feels like somewhere you'd want to go on vacation at dusk"*. In session K, P17 spawned a video player to play

ambient music while they were fishing for emoji. During the interview, P17 noted *"We're sitting here and it feels very relaxing but it just feels like it's missing like a romantic zing to it, and so I was like what if we added music"*. P18 shared that the world's atmosphere was quite similar to that in their home world in Neos: *"Very cozy, it literally reminds me of my home world, because that's how I would like it, like this hits the spot for me, perfectly"*. In session F, P12 noted that ambient sounds in some worlds could be intrusive, but this was not the case on Firefly Island: *"with the crickets and stuff right now it's just perfect"*.

Other observations

Locomotion modes and scaling As in the first iteration, most participants used the physical/walk locomotion for the most part, with some exceptions where fly locomotion was used in cases where they wanted to reach something high up. In session H, both participants had bird-like avatars with wings that allowed them to fly by flapping their wings. In this session, P14 initially had a smaller avatar compared to P15. During the experience, P14 scaled themselves up to match the size of P15. P14 shared that they usually preferred to remain small as it allowed for interesting interactions like others being able to grab their avatar and move them around like a toy. In session I, P9 scaled themselves down when they were drawing a house with the brushes to be able to stand in the miniature house that they drew.

Phantom touch During the interviews, some participants described their experiences with phantom touch. P12 mentioned that mirrors played a role in helping them experience phantom touch. They shared a few reasons for using mirrors in VR: *"Mostly I use it because I wanna see if my eye tracking is acting up, or you know my hands and stuff, but also because it's easier if somebody comes near me from behind, and then they touch me or hug me I'm gonna feel that then, without that I'm not gonna feel anything"*. In session H, participants discussed how one could fake the ability to feel phantom touch to enliven social interactions. P15 shared (about P14): *"He doesn't have phantom touch, he likes to fake it to get a reaction out of others"*. P14 elaborated on this further: *"Like he said, I don't have it at all, but he's also correct in that I tend to, you know if someone comes up, and they're picking me up or throwing me or something, I'll kind of play along, I'll be a good actor, because I just think it leads to more interesting interactions, because it's no fun if someone is picking you up and starts shaking you and you're just sitting there like 'It does nothing to me'"*.

7.4 Discussion and reflection

7.4.1 Affordances

The observations that we made during the evaluation sessions were categorised broadly based on how they related to social VR affordances. In this section, we discuss the broad categories of affordances that were newly uncovered in the second iteration.

Environment

Having a custom personal environment In many social VR platforms, it is possible to have a personal ‘home’ world. Platforms like Neos and VRChat allow users to set a custom home world that is suited to their personal preferences. In Neos, there is even more customisability and users can make their home world exactly how they want it to be. During the evaluation sessions, multiple participants mentioned that Firefly Island could make a good home world. P14 remarked *“This is the kind of world that I could definitely see someone making their home, it’s a comfortable environment, there’s some little things to do, there’s activities you can do if you bring friends over, it’s just chill, it’s kinda what people look for in a home”*. The ability to have a custom personal area in social VR is an affordance that can also potentially support intimacy. For example, a romantic couple could have a shared space with high personal value to them, that could be symbolic of their intimate relationship.

Avatars

Avatar interactions Avatars in VR can have unique interactions with other users’ avatars or actions. Participants in session H had bird-like avatars that spawned a feather particle effect when they touched other users with their wings. They also had a unique ‘boop’ interaction on their avatar that made a sound when other users touched their noses. Interactions such as these can be programmed to respond to specific users or actions, which unlocks potential for new types of intimate interactions to emerge. For example, a user’s avatar could change colour when their partner’s avatar is close to them, and it could even react to their partner’s voice.

Switching avatars Being able to switch between many avatars in VR allows for more flexibility of expression. During the interview in session J, P3 noted that being an avatar creator, they had multiple custom-made avatars that they could switch between. In VR, users can choose to use different avatars depending on

situation and context. Avatars can be inspired by users' real-life appearances, by what they want to be in VR, or a mix between the two. Switching avatars could also be a way to switch between roles or personalities that a user wants to embody.

7.4.2 Intimacy on Firefly Island

The evaluation sessions that were part of the second iteration strengthened some of our previous observations, as well as revealed new insights on how the world helped to support intimacy between participants. An important theme to highlight is that of *expressiveness*, which was exhibited in many sessions. Participants made use of the world and its activities in unique, idiosyncratic ways to derive their own pleasure from them. Some of these instances were a result of the open-ended design of the activities, such as in emoji fishing in session I where participants made their own story using emoji. In other instances, participants created their own opportunities for expressive play, for example by 'breaking' the emoji fishing activity by duplicating the fishing rods, or by exploiting glitches in the world for fun. Expressiveness was also demonstrated in some sessions through the unique sense of humour and peculiarity of interactions between participants.

Some activities that participants did during the evaluation sessions were examples of how intimate interactions can play out in social VR. In session I, participants engaged in little role-plays by pretending to barter with each other the diamond rings that they created using brushes. Similarly in session K, participants play-acted by pretending to eat marshmallows and attempting to feed each other burnt marshmallows. Although not fully role-playing, these examples points to the potential of *role-playing as an intimate interaction in VR*. The diamond rings can also be considered an example of *gift-giving*, which Hassenzahl et al. (2012) identify as a theme of intimacy. Showing or teaching something to another user can also be a way for intimacy to emerge. We observed this in session G where one of the participants was new to Neos. The participants had no acquaintance prior to the session, and here the development of closeness between them was mainly through teaching moments where the more experienced participant showed new functionalities and tricks to the other. In this case, the teaching moments also acted as an ice-breaker by diverting the participants' interaction efforts towards a shared object or experience rather than directly on each other.

Some sessions highlighted the importance of *responsiveness* as component of intimacy (previously discussed in [Section 2.1.2](#)). Responsiveness was evident in session I where participants completed the session in a slow and intricate manner, by listening to each other, giving each other space, and making sure that the other person is fully enjoying themselves. Another intimacy theme which was highlighted again was *self-disclosure*. Elements on Firefly Island such as the campfire and emoji fishing were effective in encouraging self-disclosure and conversation.

Participants in session G were total strangers who only met prior to the evaluation session, as evident from their self-reported closeness in [Table 7.1](#). Here, we observed that participants did not make use of many of the activities in the world beyond superficially trying them out. Rather, they spent a longer time exploring other things such as different avatars and memes in Neos, especially since P13 was new to Neos. We wonder if it was a lack of intrinsic motivation that prevented participants from doing the in-world activities together, and if designing activities with more explicit goals (such as a high score) would have been more effective in this case.

7.5 Design knowledge

In this section, we recap the design knowledge that was gained during the second iteration.

1. User avatars in social VR can be programmed to have unique interactions with other user avatars. This can be utilised when designing intimate experiences to enable special interactions between intimate participants.
2. Encouraging learning and teaching opportunities between users can be a way to foster interdependent interaction and intimacy.
3. Virtual wearable items such as the hats and flowers on Firefly Island can be used to encourage physical proximity and physical interactions between users.
4. When designing activities for self-disclosure, it can be essential to keep open-endedness in mind such that users are comfortable with self-disclosure without feeling forced. In Firefly Island, the fishing activity provided prompts for conversations, but users had the freedom to ignore these and enjoy the activity in their own way.

5. Allowing opportunities for users to go against the rules can be a way of enabling expressive play. Even glitches and breakdowns could potentially be an opportunity for expressiveness and connection.
6. Users often expect world elements in social VR bearing similarity to real-life objects to behave in a similar way. The use of such elements can help to trigger real-world social behaviour in VR. On Firefly Island, sitting around the campfire, climbing the tree, and picking flowers and putting it on another user's head are all examples of this.

Discussion

In this chapter, we discuss the significance of the results of this thesis. We first take a look back at our *research through design* approach and reflect on how it was useful in helping us answer our research questions. Then we discuss what we learned throughout the process of designing and evaluating Firefly Island, and reflect on what worked well and what could have been done better. Next, we discuss how our approach helped us to explore novel and unique affordances and highlight relevant affordances that can help facilitate intimacy in social VR. We conclude this chapter by discussing the implications of our results, and reflect on directions for future work related to this thesis.

8.1 Research through design process

The main research question of this thesis asked *how* we can integrate theory and practice in the design of an intimate social VR. Our focus on the *how* was a consequence of the research through design approach that we followed in this thesis. We did not only focus on generating results, but also on documenting and reflecting on the *process* of designing Firefly Island. In chapters 5 to 7, we documented our methods, processes, and design rationales while designing Firefly Island. Through this, we captured useful design knowledge by not only highlighting what worked out, but also documenting aspects that were not successful. Reflection was also a central part of the research through design approach. In the iterative process of designing and evaluating Firefly Island, reflection helped us to identify new design opportunities, re-evaluate our design choices, and obtain new design insights. This helped us to provide an enriched perspective from which to approach the design of an intimate social VR experience.

Following the research through design approach was highly relevant for the subject of this thesis, as social VR is a relatively new field of study. Zimmerman and Forlizzi (2014, p. 178) point out that research through design can be a way for designers and researchers to actively shape the future of a technology by “understanding the world that should be brought into being”. Our approach brings us closer to a preferred future state for intimacy in social VR by allowing

us to investigate how intimacy can play out in a social VR setting, and design an experience for intimacy based on both previous knowledge and our own vision.

8.2 Designing and evaluating Firefly Island

The activities on Firefly Island were designed to explore how intimacy can be facilitated in a social VR world, and to identify and make use of social VR affordances for intimacy in doing so. The realisation of the activities in the world was done in such a way that users could choose which activities to explore and in what order. During the evaluation sessions, we observed that participants made use of this flexibility to step in and out of activities throughout their experience. Designing the activities in this way helped to *encourage exploration*, with participants often wondering what else the world had to offer after trying out each activity. We also observed that in some cases participants spent a longer amount of time on one activity, and that some parts of the island were even skipped entirely in some sessions. Here, giving users this flexibility allowed them to optimally enjoy activities that were interesting to them. This connects to the aspect of free play or open-ended play that we discussed in [Section 4.4](#).

The setup of the world and evaluation sessions also warrants some discussion. As a social VR world for two people, Firefly Island only looked at how intimacy can be supported between two users in an isolated social VR setting. However, as Zamanifard and Freeman (2019) note, intimacy between two people in social VR can also often involve other people external to their relationship. The sense of co-presence that social VR enables with other users also affects how a dyad experiences intimacy. In our evaluation, we were unable to examine the effects of this. This also brings to attention the related point of continued intimacy in social VR. As we previously discussed in [Section 2.1.4](#), intimacy is not a static quality of a relationship, but a continuous process. In our evaluation sessions, we only looked at how social VR can facilitate intimacy in the short duration of each session, while ignoring the larger implications of continued communication that social VR enables. However, some of the limitations of what we could learn through the evaluations were offset by the findings from the focus groups in [Section 4.2](#), which showed us how intimacy in social VR can play out in a wider sense that not just limited to two users in a private world.

While the open-ended nature of the evaluation sessions were successful in providing freedom and flexibility to participants, there were also a few limiting factors that were a result of the test environment. Although users were

not given a time limit within which to complete the exploration part of their evaluation session, some participants were worried that they were taking too much time for the session. This makes us wonder if their experience on the island could have been more fulfilling if there was no seeming necessity to finish the session. On the contrary, this also brings up the question of how an intimate experience with a predefined 'end' point could be different in terms of supporting intimacy. Another effect of the evaluation sessions to be noted is that of recording the sessions. Although participants self-recorded the evaluation sessions, the fact that they were being recorded could have had an effect on their behaviour. While participants in some sessions talked openly about deeply personal subjects, some sessions had little or no self-disclosure between participants. This could have been due to various other reasons, but recording the sessions might have also played a role.

Our method of watching and analysing self-recordings made by the participants is also something that can be reflected upon. The recordings were an effective way to indirectly observe participants' actions while they were on Firefly Island without compromising their privacy and comfort. It allowed us to watch and re-watch the sessions later in order to get a close look at how participants made use of activities on the island. However, watching the sessions later also posed the challenge of understanding the specific context of sessions, which were sometimes unique and idiosyncratic depending on the participants. For example, during the interview of one of the evaluation sessions, the participants remarked that they had a unique sense of humour where interactions between them were sometimes sarcastic, and that this might be difficult to decipher in the recordings. Despite this, the recordings allowed us to focus on how participants made use of activities, and identify affordances that supported intimacy even though some contextual clues might have been lost.

Finally, it is also important to note that our observations are mainly from the Neos platform. While many of the affordances that we discussed can be applied to other platforms, there are aspects that could be unique to Neos and its users. For example, the affordance of co-creation is possible in VRChat through brushes, but Neos takes this to a greater level by enabling users to create entire worlds together in VR. It should also be noted that Neos attracts a different demographic of users compared to other platforms, which could have had an impact on our evaluation. We have observed during self-exploration that with the level of customisability and power that Neos offers, it attracts more advanced

users than casual users. The participants who responded to our invitations were also mainly users that are active in the Neos Discord community.

8.3 Facilitating intimacy on Firefly Island

As an intimate social VR world, Firefly Island was successful in helping participants feel closer to each other as evident from the IOS scale scores from each iteration. In the world, our focus was on facilitating interpersonal intimacy where participants felt closeness by feeling understood, validated, and cared for, as defined by (Reis & Shaver, 1988). We made use of the intimacy themes described in [Section 2.1.2](#) to achieve this goal during our design of Firefly Island. It is essential to point out that focusing on these themes allowed us to design the world as a general experience that was not limited to participants of any particular type of relationship, such as a romantic couple. The evaluation sessions saw friends, acquaintances, and even strangers coming together in an intimate experience. *Expressiveness* was a crucial part of making the experience work for different types of users. Designing with ambiguities and open-endedness allowed participants to experience their own flavour of intimacy, where a large part of their enjoyment was gained from what they made of it themselves. This was observed in activities such as emoji fishing, where participants had the freedom to enjoy the activity in their own way.

We also observed unexpected ways in which users can be intimate with each other. For example, participants playing with a glitch they found with the firefly jar in one session, and others ‘cheating’ in the emoji fishing activity by duplicating their fishing rods were both examples of how intimacy and play does not always need to go by the rules. In another session, the act of showing the other person how to use Neos features formed a large part of how the participants connected with each other. These instances highlighted how intimacy can emerge in new and unexpected ways.

In addition to the activities and world elements, the very aspect of *bringing two participants together* for a study on intimacy also played a role in helping participants feel more intimate with each other. Participants in many sessions chose their co-participant to do the evaluation together with. For some, it served as a way to strengthen their relationship and to get to know each other better. For example, P3 from session J shared during the interview that experiencing the world together with P4 in session B strengthened their acquaintance, and that they kept in contact more often as a result of it. For some participants,

the premise of the evaluation session provided them an opportunity to discuss personal thoughts about intimacy itself. For example in session F, participants disclosed their pre-session IOS scores as they were exploring the island, which led to more self-disclosure between them.

8.4 Focusing on social VR affordances

The second research question in this thesis focused on identifying how social VR *affordances* can help facilitate intimacy. Focusing on affordances was a way of investigating the potential of social VR to enable new kinds of intimate experiences. This allowed us to explore how social interaction in VR can go beyond face-to-face communication, throwing light on novel interaction possibilities that can push the medium forward. As McVeigh-Schultz and Isbister (2021) point out, taking advantage of unique affordances has the potential to transform how we communicate with each other, giving us “social superpowers”. The focus groups in [Section 4.2](#) revealed how existing social VR users already make use of these affordances for close connection and intimacy. When designing Firefly Island, we were able to realise some of these affordances through the activities in the island. For example, the mirror in Firefly Island was a result of us learning about the popularity of mirrors in VRChat through the focus groups, which allowed us to further explore how mirrors can help facilitate intimacy. By focusing on the unique affordances of social VR in this way, we were able to highlight the role of these affordances such that future designers and researchers can make use of them to create better intimate experiences.

During the development of the world, we were able to directly make use of some of the novel affordances of social VR. For example, using the Neos platform allowed us to make use of the affordance of co-creation in VR. Some of the environmental elements on Firefly Island such as the campfire were co-created modular elements that were made available by other users on the platform. In this way, we were able to take full advantage of the collaborative capabilities of social VR, which even encouraged us to return the favour and make elements in the world available to others for use and modification. We also observed during the evaluation sessions that some users made use of the tools in Neos to edit parts of the island to make their experience on it better. This highlights that when creating an experience in a platform such as Neos, it can perhaps be useful to keep its open nature in mind, and acknowledge that users can tinker with world at any time.

8.5 Future work and application of design knowledge

By designing and evaluating a social VR world focused on intimacy in this thesis, we were able to highlight novel and unique affordances of the medium that support intimacy. Although we identified many key affordances, more design and research work needs to be done to further explore aspects that we were only able to touch upon. For example, the affordance of phantom touch is a powerful way to bring a physicality to intimate interactions in VR. Although we were able to highlight this affordance, more work needs to be done to determine how people experience it and how it can be utilised when designing intimate experiences in VR. Similarly, we noted that mirrors can enhance the sense of embodiment and provide enhanced awareness of space. Future studies could explore this aspect in detail to understand the impact of mirrors in social VR spaces and work out how to integrate them into intimate experiences.

The design result of this thesis, which is a prototype world in the social VR platform Neos has the potential to act as a tool for future studies about intimacy in social VR. Specific elements or activities in the world such as emoji fishing can be used in related future studies. For this purpose, the world has been published on the platform such that it is freely available for future designers and researchers to work with. In addition, casual users have the ability to explore the world and its activities together with a partner for their own enjoyment. The open nature of Neos also allows other users to make derivatives of the world or use elements from the world in their own creations.

Knowledge gained from this thesis can be used by future designers to create novel social VR experiences focused on intimacy, such as new dating experiences in VR, or cooperative VR games. The findings presented in this thesis could potentially be extended applied to broader social VR worlds that are not just limited to two users in an isolated setting. The ideas and activities that we explored in Firefly Island can also serve as an inspiration to future designers who want to create intimate social VR experiences.

Conclusion

This chapter briefly summarises how we have answered the research questions put forward at the start of this thesis, and reiterates the design knowledge that was gained through the design and evaluation of Firefly Island.

9.1 Answering the research questions

How can we integrate theory and practice in the design of a social VR experience for intimacy?

During the course of this thesis, we integrated knowledge from theory and practice in the design of Firefly Island, a social VR experience designed to facilitate intimacy or close connection between people. In the first part of this thesis, we explored the concept of *interpersonal intimacy* and identified themes that constitute intimacy (see [Section 2.1.2](#) for an overview of these themes). We then moved towards learning how VR can enable intimacy and social connection by exploring the concept of *affordances* in VR and through self-usage of social VR platforms. Here, an affordance refers to a relationship between a technology and its user where the technology provides or ‘affords’ the user the capability to perform an action (Norman, 1988). An example of such an affordance in social VR is the ability to embody a 3D virtual avatar. We gained real-world insights on what it means to be intimate in social VR by conducting focus groups and expert interviews. Through this, we learned about existing social VR users’ experiences of intimacy, and how to approach the design of an intimate social VR experience. We also identified social VR affordances that help facilitate intimacy and pinpointed *play* as means to foster intimacy.

In the second part of this thesis, we combined the previously gained knowledge to design and develop Firefly Island. The world brought together multiple activities that realised social VR affordances to facilitate specific themes of intimacy, such as self-disclosure and expressiveness. Some of the activities in the world include a hide and seek game making interdependent play, a co-creation activity focused on creating a memory jar, and an emoji fishing game designed to facilitate self-disclosure and open-ended play. The world was designed, evaluated, and reflected upon in two iterations, where each

iteration highlighted novel social VR affordances for intimacy, and provided useful design knowledge and insights that can help to further future design and research endeavours in the topic of intimacy in social VR. Our approach also emphasised the value of documenting methods, processes, and design rationales, and reflecting upon them in a *research through design* methodology.

What role do social VR affordances play in facilitating intimacy?

Through ethnographic study and the design and evaluation of Firefly Island, we identified novel social VR affordances that can help facilitate intimacy. The affordances identified early on were integrated during the design of the world, which provided us new insights on how these affordances can be utilised when designing for intimacy in social VR. The social VR affordances that we identified in this thesis are briefly listed below:

1. The *anonymity and safety* provided by social VR gives users more freedom when socialising, and allows them to open up more to others.
2. The visual and tactile feedback provided by VR can make social interactions more *immersive*, and give users a sense of *shared presence*.
3. *Physical gestures and actions* are a central part of intimacy in VR. To some users, being able to ‘feel’ virtual touch through the phenomenon of *phantom touch* is also something that makes physical interactions more intimate.
4. *Mirrors* in VR have the potential to enhance physical interactions by increasing awareness of one’s virtual surroundings, and enhancing the sense of embodiment in an avatar.
5. Avatars are a core part of self-identity in social VR. *Customisable avatars* allow users to fully represent and express themselves to others.
6. User *avatars can have unique interactions with other users’ avatars*, which can support unique intimate interactions between them.
7. Social VR offers *versatility in self-expression* through affordances such as facial tracking and eye-tracking. In addition, users can use their avatar and even world elements to express emotions, agreement or interest in multi-modal ways.
8. The virtual environment and elements in the environment can play a role in supporting intimacy by acting as *social catalysts*, or by reacting to users’ presence in unique ways.

9. Users have the capability to *co-create*, and even transform their virtual environment together in dramatic ways.
10. An inventory system in social VR which allows users to save virtual objects and retrieve them later can be a way of saving *shared intimate memories* and reminiscing about them later. The ability to take photos is a similar affordance that makes it easy to save and share memories.
11. Users have the ability to make use of virtual objects to visually convey ideas and supplement verbal communication, enabling *rich visual storytelling* in social VR.
12. In social VR, there is the possibility of (intimate) *communication that bridges VR and the outside world*. For example, users have the ability to livestream their virtual experience, or keep in touch with friends made in social VR through external channels such as Discord.
13. Social VR users can have *intimate virtual spaces* such as 'home worlds' that could be shared with another person.

9.2 Design knowledge

In this thesis, we obtained useful design knowledge that can be appropriated by designers and researchers to create future intimate experiences in social VR. We present the design knowledge that was gained during the course of designing and evaluating Firefly Island in this section:

1. Giving users something to do together, especially through activities that encourage *interdependent discovery and play* can be a form of ice-breaking, easing users into an experience. Activities in Firefly Island such as the hide and seek game illustrate this.
2. Providing users opportunities for taking photos together, or *capturing a shared experience* can be a way to build shared memories.
3. *Environmental features can act as social catalysts* by encouraging conversation and self-disclosure. For example, elements such as campfires can be added to social VR worlds to facilitate conversation.
4. Providing *opportunities for idiosyncratic expression and personalisation* through elements in social VR worlds can bring users closer to the world and to each other.

5. Social VR users can have different VR equipment having varied capabilities, such as full-body tracking and facial tracking. User avatars can also have different characteristics. When designing an intimate experience, this can be kept in mind to make sure that the *experience ensures parity* and that users are not left out as a result of lacking capabilities.
6. Physical interactions in VR can be complemented by accompanying *visual feedback*. This can be used to guide users towards specific actions or even encourage physical proximity and physical interactions. The hats in Firefly Island, which glow when users wearing them get close to each other are an example of this.
7. User avatars in social VR can be programmed to have *unique interactions* with other user avatars. This can be utilised when designing intimate experiences to enable special interactions between intimate participants.
8. Encouraging *learning and teaching opportunities* between users can be a way to foster interdependent interaction and intimacy.
9. *Virtual wearable items* such as the hats and flowers on Firefly Island can be used to encourage physical proximity and physical interactions between users.
10. When designing activities for self-disclosure, it can be essential to keep *open-endedness* in mind such that users are comfortable with self-disclosure without feeling forced. In Firefly Island, the fishing activity provided prompts for conversations, but users had the freedom to ignore these and enjoy the activity in their own way.
11. Allowing opportunities for users to go against the rules can be a way of enabling *expressive play*. Even glitches and breakdowns could potentially be an opportunity for expressiveness and connection.
12. *Virtual mirrors* in VR can be advantageous in providing enhanced awareness of virtual space. Mirrors can also serve to reinforce a user's virtual self-image and sense of embodiment in their avatar.
13. Users' choice of *movement and locomotion modes* in VR can be influenced by their virtual environment, the type of activity that they are doing, and their real body posture.
14. A user's avatar is an important part of their VR experience and can be highly personal to them. In a social VR experience, it can be advantageous

to provide users the *ability to use their own avatar* or give an option to *choose their preferred type of avatar*.

15. Users often expect world elements in social VR bearing similarity to real-life objects to behave in a similar way. The use of such elements can help to *trigger real-world social behaviour in VR*. On Firefly Island, sitting around the campfire, climbing the tree, and picking flowers and putting it on another user's head are all examples of this.

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Appendix A: Focus group questions

1. How long have you been using VRChat?
2. What is VRChat to you?
3. What are some of your favourite things to do in VRChat? / Most memorable moments in VRChat?
4. Could you describe your experiences with the VRChat community? What kind of people do you meet and hang out with?
5. How frequently do you encounter/interact with new people in VRChat?
6. How do you decide if someone is trustworthy? How would you make yourself seem trustable?
7. How do you communicate with friends in VRChat?
8. What is the challenging part of being social in VRChat? What do you find frustrating/lacking?
9. What are some of your favourite worlds to hang out in VRChat? What do you like about these worlds?
10. How important is your avatar to you?
11. What avatars do you like to use? How often do you change avatars?
12. Can you recall an experience where you really connected with another VRChat user and felt close with them? (What aspect of VR helped you to feel close in this way?)
13. What is a unique part of VR, compared to real life that helps you to connect with others?
14. What part of VRChat makes you want to come back/feel like you belong?

Appendix B: Focus group invitation



deka 21/06/2021

Hey everyone!

I'm a master's student working on my thesis on the topic Intimacy in Social VR. In my research, I'm looking at how social VR apps like VRChat can enable meaningful and authentic connection, be it between couples, friends, family, or even strangers. To get to know more about this topic from the community, I am conducting focus groups (group discussions) with VRChat users who have already spent some time in the game.

I would love to have people who would like to share their experiences and perspectives on the social aspect of VRChat. Some specific points that I would like to discuss include the kinds of social activities you enjoy in VRChat, your experiences with meeting people and making friends in VRChat, and your perspective on "intimate" or close connections in social VR.

If you have thoughts to share on this topic, and if you would like to hear your fellow participants' views through a friendly discussion, you are most welcome to participate. The discussion would not take more than an hour, and it will take place in a private world in VRChat, so it would be much like hanging out in-game!

If this sounds interesting to you, please send me a DM! A small note that you have to be 18 or older to participate. Your participation does not require you to reveal your name or real-life identity, as you would be addressed only using your VRChat username.



2

Appendix C: Focus group information sheet

RP-2021-164

Date: 20-06-2021

Information Sheet - Focus Group

Faculty of EEMCS
University of Twente

Project Title: Master Thesis - Intimacy in Social VR

Researcher: Savio Menifer, s.menifer@student.utwente.nl

Supervisor: Dr.ir. Robby van Delden, r.w.vandelden@utwente.nl

Thank you for considering to participate in my master's thesis research! Please read the following information carefully before participation.

Purpose of research

The purpose of this research is to understand how social VR can facilitate intimacy and intimate interactions between its users. Specifically, we aim to identify how social VR affordances can play a role in facilitating intimacy not just between romantic partners, but also between friends, family, and even strangers. During the research project, a co-operative social VR activity for two users will be developed, with the aim of supporting intimate connection between them. Through the design of this social VR experience, we aim to gain insights on how to create more intimate social VR experiences.

You are invited to participate in a focus group that will be conducted virtually in VRChat. The purpose of the focus group is to understand existing social VR users' past experiences and perspectives about intimacy and close connection in social VR. Your participation in this focus group will help in the design of the intimate social VR experience mentioned above.

Procedure

You will participate in a facilitated discussion about intimacy and close connections in social VR with 3-5 other participants. You will be given an informed consent form prior to participation in the focus group. The discussion will take place virtually in the social VR platform VRChat, and you will use your voice to participate in the discussion. A moderator will be present to ask questions and facilitate the discussion. The session will take up to 60 minutes, with a short break at 30 mins.

Questions asked during the focus group will concern your past experiences with social VR. For example, questions could be related to what you would consider an intimate experience in social VR, how you make friends in social VR, and what shared activities you enjoy doing in social VR.

Risks

Some users might experience motion sickness arising from the use of a VR headset. If you experience motion sickness or discomfort at any time during the session, you are advised to end your participation.

During the discussion, there is a possibility of you disclosing personal information that might change your future interactions with other participants in the focus group and/or involved researcher. You are advised to only disclose information that you are comfortable sharing with other participants and the researcher. You can also refuse to answer specific questions without giving any reason.

Data Collection

Limited personal information including your gender and age will be collected during the research. Your VRChat username will be collected for the purpose of inviting you to the session. Any information you share will **not** be linked to your username in the research output.

Your real name, location, or other personally identifiable information need not be disclosed at any point during the research. During the focus group session, you will be addressed by your VRChat username.

Video screen recordings of the virtual session will be made for review. The recording will contain your virtual appearance and voice. The recordings will not be used or published as such in any part of the research. The recordings will be stored securely for the duration of the research (12 months) and will be

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accessible only to the researcher and the research supervisor. Relevant parts of the recordings will be transcribed, and optionally information you share may be anonymously quoted in the research report and related publications. All data collected in this research will be processed anonymously.

Participation

Participants must be 18 years or older. Your participation is entirely voluntary and you may refuse to participate in the research without giving any reasons. You may also end your participation at any time by leaving the session and may also refuse afterwards (within 24 hours) to allow your data to be used for the research. There will be no remuneration for participation.

Contact Person:

If you have any questions about the research, please contact the researcher at s.menifer@student.utwente.nl.

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the department of EEMCS (ethicscommittee-cis@utwente.nl).

Before participating in the research, you will be given a consent form. Please read it carefully and make sure to ask any questions you might have before participating!

Appendix D: Focus group consent form

Informed Consent – VR Chat Focus Group

Thank you for participating in my study! Please read the following information and indicate your consent using the form options.

* Required

Taking part in the study

I have read and understood the study information ([https://drive.google.com/file/d/154ZpDU2tT1tXLcjE75tCvm5Eh1mbsuAP](https://drive.google.com/file/d/154ZpDU2tT1tXLcjE75tCvm5Eh1mbsuAP/view)) dated 20-06-2021. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves talking about personal experiences in social VR, that a video recording of the virtual session will be made of which relevant parts will be transcribed as text, and that the recording will be destroyed after 12 months.

I understand that limited personal information including my gender and age will be collected during the research.

Risks associated with participating in the study

I understand that taking part in the study involves the following risks:

Motion sickness or discomfort associated with the use of a VR headset.

Disclosure of personal information that might change future interactions with other participants in the focus group and/or involved researcher.

Use of the information in the study

I understand that anonymised information I provide will be used for the design output of the master's thesis project, in the research report, and in related publications.

I understand that personal information collected about me that can identify me, such as [e.g. my VRChat username or digital representation], will not be shared beyond the study team.

Consent to be Audio/Video Recorded

I agree to be recorded virtually in VRChat, and I am aware the recording includes my digital representation (avatar) and voice.

1. Please indicate your consent: *

Mark only one oval.

- ☐ I consent to the above
☐ I do not consent to the above

2. I agree that my information can be quoted anonymously in research outputs (optional)

Mark only one oval.

- ☐ Yes
☐ No

Additional information for study

3. What is your age?

4. What is your gender?

Please choose an option, or if you prefer to self-describe, please use the last option.

Mark only one oval.

- ☐ Female
☐ Male
☐ Non-binary
☐ Prefer not to say
☐ Other: _____

5. What is your VRChat username? *

Appendix E: Interview questions

Introduction

1. Could you tell me a bit about yourself, and how would you describe your relation to Neos and its community?
2. Are you active on social VR communities other than Neos?
3. What do you love about the social aspect of Neos i.e. the community?

Social connection

1. What are some activities in Neos that bring people together, and enable bonding between them?
2. What aspects of VR do you think help people to connect and grow closer? What makes VR better than say chatting on Discord, or having a video call?
3. When it comes to different types of users, e.g friends vs strangers, do you think there is a difference in the types of activities they enjoy?
4. What are some things that are unique to VR, that would make social interaction in VR better than real life?
5. What is the challenging part of being social in a VR environment? What is still lacking?

Intimate interactions

1. What would you describe as an example of an 'intimate interaction' in Neos?
2. Are there any worlds focused on intimate interaction, or close connection between people?
3. Examples of people using things in the way they are not meant to be used?
4. ERP and sexual intimacy in Neos

Avatars and worlds

1. How do people use their avatars and their body to express emotions?
2. Do you see more possibilities on how you use your body e.g. haptics, full body, facial tracking?

3. Other ways to communicate emotions in VR?
4. Designing worlds to evoke specific reactions/emotions

Creator Jam (CJ)

1. How do you make new people comfortable in a CJ? What are some good icebreaker activities?
2. How does co-creating and sharing the environment lead to bonding between people?
3. What other parts of CJ help people to bond?
4. Any instances where things did not go according to plan/evolved into something completely different in a CJ?
5. What are some examples of CJs that had a focus on social interaction, or interesting social mechanics?
6. How has it been working with the international community in Neos? Have you noticed any cultural differences in how people connect with other?

Appendix F: Interview questions

Introduction

1. Could you tell me a bit about yourself, and how would you describe your work that you do the field of playful persuasion?
2. What made you interested in using the concept of play, especially when combined with interactive technology?

Playful persuasion

1. How would you describe playful persuasion?
2. What are the ways in which you have used play to persuade people to do something?
3. How can persuasive play be used to support social connection, or closeness between people?
4. How does physical play and the use of your body contribute to better social connection?

Intimacy

1. Can you recall an example or an installation that you worked on which supported intimacy between people?
2. Was it designed for a specific group of users, such as friends? How would you approach designing for different types of relationships between people?
3. In your experience, what are some playful interactions that encourage closeness between people?
4. How do you design for free play? How can you ensure that players do not lose interest in the installation after a while?
5. How do you communicate your game or interaction to potential players?
6. How can you design for sustained connection between people even after interacting with your experience?
7. Have any of your installations focused on competition between participants? How can you balance competition vs cooperation when designing social games?

Appendix G: Prototype evaluation interview questions

Discovery

1. How did you feel going into the world together?
2. What was it like discovering the different parts of the world?
3. How did you figure out the hide and seek game?
4. Was there any part you were not able to figure out?
5. How did you go through the different parts of the island? Were you able to agree on what to do together?

Appearance

1. What do you feel about the aesthetics and atmosphere of the island?
2. What did you feel about the size of the world?
3. What was your favourite part/least favourite part of the world?
4. Would you visit this world again if it was a published world?

Affordances

1. What locomotion mode did you use when in the island?
2. Did you use full body tracking?
3. Did you use avatar scaling at any point in the world?
4. Did you take photos at any point?

Fireflies

1. What did you think about the firefly catching interaction?

Hide and seek game

1. Did you enjoy playing the hide and seek game?
2. What did you like/dislike about it?
3. Would rather play as a hider or seeker, why?
4. What would you change about the game?
5. What role did voice and sound play when playing the game?

Hats and mirror

1. How did you discover the meaning of the hats?
2. Did the hats make you come physically closer to each other?
3. Did you spend any time in front of the mirror?

Jar creation

1. How did you discover the jar creation interaction?
2. Did you spend time creating your own custom jar?
3. Did you like what you ended up creating?

Pier

1. Did you discover the floating lamps mechanic?
2. What did you like about it?

Avatar

1. Did you change avatars during the session?
2. Why did you select the avatar that you used?

Appendix H: Prototype evaluation invitation



deka 31/08/2021

Hey everyone! Would people be interested in playing a hide and seek game in Neos and helping me out with my master's thesis research?

I'm a student at University of Twente in the Netherlands, where I'm currently working on my master's thesis on the topic *Intimacy in Social VR*, in which I'm exploring how social VR can facilitate meaningful and close connections between people. My research focuses on how social VR affordances can play a role in facilitating close connection, and how to make use of these affordances when designing social VR interactions to bring people closer to each other.

Over the past month, with guidance from my thesis supervisor [@Robby van Delden](#), I've created a prototype world as part of my thesis which is meant to be a two-player experience within Neos. The world contains a hide and seek game, along with some other interactive elements for players to discover. I'm planning to conduct an initial prototype evaluation, and for this I would like to invite members from the Neos community to try out the experience and share their thoughts and feedback on it.

If you would like to participate in this prototype evaluation, you can do so together with another person of your choice (they could be anyone — a friend, partner, family member, or even a stranger). You would sign up together as a pair. If you want to participate and cannot find a co-participant, I can try to match you with someone else too. During the session, you will first experience the prototype world in VR together with your co-participant, followed by an interview where I will ask you questions about your experience. The session can be scheduled at a time convenient for both of you, and it would take not more than an hour.

If this sounds interesting to you, please send me a DM and I can give you some more information, and answer any questions you might have!



Appendix I: Prototype evaluation information sheet

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Information Sheet - Focus Group

Faculty of EEMCS
University of Twente

Project Title: Master Thesis - Intimacy in Social VR

Researcher: Savio Menifer, s.menifer@student.utwente.nl

Supervisor: Dr.ir. Robby van Delden, r.w.vandelden@utwente.nl

Thank you for considering to participate in my master's thesis research! Please read the following information carefully before participation.

Purpose of research

The purpose of this research is to understand how social VR can facilitate intimacy and intimate interactions between its users. Specifically, we aim to identify how social VR affordances can play a role in facilitating intimacy not just between romantic partners, but also between friends, family, and even strangers. During the research project, a co-operative social VR activity for two users will be developed, with the aim of supporting intimate connection between them. Through the design of this social VR experience, we aim to gain insights on how to create more intimate social VR experiences.

You are invited to participate in a focus group that will be conducted virtually in VRChat. The purpose of the focus group is to understand existing social VR users' past experiences and perspectives about intimacy and close connection in social VR. Your participation in this focus group will help in the design of the intimate social VR experience mentioned above.

Procedure

You will participate in a facilitated discussion about intimacy and close connections in social VR with 3-5 other participants. You will be given an informed consent form prior to participation in the focus group. The discussion will take place virtually in the social VR platform VRChat, and you will use your voice to participate in the discussion. A moderator will be present to ask questions and facilitate the discussion. The session will take up to 60 minutes, with a short break at 30 mins.

Questions asked during the focus group will concern your past experiences with social VR. For example, questions could be related to what you would consider an intimate experience in social VR, how you make friends in social VR, and what shared activities you enjoy doing in social VR.

Risks

Some users might experience motion sickness arising from the use of a VR headset. If you experience motion sickness or discomfort at any time during the session, you are advised to end your participation.

During the discussion, there is a possibility of you disclosing personal information that might change your future interactions with other participants in the focus group and/or involved researcher. You are advised to only disclose information that you are comfortable sharing with other participants and the researcher. You can also refuse to answer specific questions without giving any reason.

Data Collection

Limited personal information including your gender and age will be collected during the research. Your VRChat username will be collected for the purpose of inviting you to the session. Any information you share will **not** be linked to your username in the research output.

Your real name, location, or other personally identifiable information need not be disclosed at any point during the research. During the focus group session, you will be addressed by your VRChat username.

Video screen recordings of the virtual session will be made for review. The recording will contain your virtual appearance and voice. The recordings will not be used or published as such in any part of the research. The recordings will be stored securely for the duration of the research (12 months) and will be

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of the interview will be transcribed, and optionally information you share may be anonymously quoted in the research report and related publications. All data collected in this research will be processed anonymously.

Participation

Participants must be 18 years or older. Your participation is entirely voluntary and you may refuse to participate in the research without giving any reasons. You may also end your participation at any time by leaving the session and may also refuse afterwards (within 24 hours) to allow your data to be used for the research. There will be no remuneration for participation.

Contact Person:

If you have any questions about the research, please contact the researcher at s.menifer@student.utwente.nl.

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the department of EEMCS (ethicscommittee-cis@utwente.nl).

Before participating in the research, you will be given a consent form. Please read it carefully and make sure to ask any questions you might have before participating!

Appendix J: Prototype evaluation consent form

Informed Consent – Prototype Evaluation

Thank you for participating in my study! Please read the following information and indicate your consent using the form options.

* Required

Taking part in the study

I have read and understood the study information (<https://drive.google.com/file/d/13U-ZuyEvCwFU11UQebTbax8fSBKtgBCq>) dated 30-08-2021. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves participating in the evaluation of a prototype which is in the form of a co-operative game world in Neos VR. I understand that the evaluation will be followed by an interview, that a video recording of the interview will be made of which relevant parts will be transcribed as text. Optionally, a video recording of the evaluation session will be (self) made and shared with the researcher. I understand that the recordings will be stored securely for the duration of the research (12 months) and will be accessible only to the researcher and the research supervisor, and that the recording will be destroyed after 12 months.

Risks associated with participating in the study

I understand that taking part in the study involves the following risks:

Motion sickness or discomfort associated with the use of a VR headset.

Use of the information in the study

I understand that anonymised information I provide will be used for the design output of the master's thesis project, in the research report, and in related publications.

I understand that personal information collected about me that can identify me, such as [e.g. my Neos VR username or digital representation], will not be shared beyond the study team.

Withdrawing from the study

I understand that I can withdraw from the study at any time, without having to give a reason, and that in this case all study data associated with me will be deleted.

I understand that I can refuse afterwards (within 24 hours of participation) to allow my data to be used for the research.

Consent to be Audio/Video Recorded

I agree to be recorded virtually in Neos VR, and I am aware the recording includes my digital representation (avatar) and voice.

1. Please indicate your consent: *

Mark only one oval.

- ☐ I consent to the above
☐ I do not consent to the above

2. I agree that my information can be quoted anonymously in research outputs (optional)

Mark only one oval.

- ☐ Yes
☐ No

3. I agree to create a screen recording of the evaluation session to share with the researcher (optional)

Mark only one oval.

- ☐ Yes
☐ No

4. What is your Neos VR username? *

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the department of EEMCS (ethicscommittee-cis@utwente.nl).

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Google Forms

Appendix K: Map of Firefly Island

