User-Environment Relations

A Postphenomenology of Virtual Reality

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Scientific environment

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Abstract

In HCI, interaction is traditionally understood as something that occurs *between* the pre-given entities of a human user and a technological object. The technology of Immersive Virtual Reality (VR), in particular, forces us to reconsider these presuppositions, as the human user and the virtual environment mutually shape each other in the relations constituted between them. *Postphenomenology* seems to be a promising candidate to account for the complexities of VR mediation as it takes a more holistic view, attending to how technologies mediate human beings' lifeworlds. As virtual environments are not just tools we interact with or use, but environments in which we exist and through which we are shaped, postphenomenology seems to offer a promising perspective for furthering our understanding of how VR takes part in altering our experience of who we are in relation to our worlds.

This doctoral dissertation presents an inquiry into how postphenomenology can be constructively used to gain a qualitative understanding of user experience in Immersive VR. The dissertation presents theoretical, methodical and empirical contributions. Theoretically, the human-technology relation that VR constitute is introduced as *user-environment relations*. Through an analysis of the human-technology relation that VR constitutes, it is demonstrated how researchers can benefit from a postphenomenological understanding of VR as well as how VR prompts a reconsideration of traditional postphenomenological categories of human-technology relations. Methodically, it proposes the VR Go-along method as an approach to qualitatively assessing the user experience as mediated in the constituted user-environment relations. Empirically, this dissertation presents a qualitative and explorative in-the-wild study of Immersive VR use over two months, where the VR Go-along is utilised to inquire into the participants' user experience as mediated in the constituted user-environment relations.

This dissertation serves as a reflexive account of the author's inquiry into the use of postphenomenology to provide an understanding of Immersive VR mediation. It demonstrates the mutually beneficial relationship between postphenomenology and Immersive VR and illustrates how postphenomenological inquiries into Immersive VR mediation can be conducted. Throughout the dissertation, it is argued that researchers

can gain a more holistic understanding of how VR mediates user experience by attending to how the user experience in Immersive VR is mediated in the constituted user-environment relations. The contribution of this dissertation serves as a preliminary inquiry into how postphenomenology can be fruitfully employed in HCI to understand and inquire into the user experience in Immersive VR and the relations to which it gives rise.

List of publications

1. Joakim Vindenes & Barbara Wasson. *A Postphenomenological Framework for Studying User Experience of Immersive Virtual Reality*, Frontiers in Virtual Reality. 2021. Front. Virtual Real. 2:656423, 15 Pages. http://doi.org/doi:10.3389/frvir.2021.656423

2. Joakim Vindenes & Barbara Wasson. *Show, don't tell: Using Go-along Interviews in Immersive Virtual Reality*. In Designing Interactive Systems Conference 2021 (DIS '21), June 28-July 2, 2021, Virtual Event, USA. ACM, New York, NY, USA, 15 pages. https://doi.org/10.1145/3461778.3462014

3. Joakim Vindenes & Barbara Wasson. *Constructing Hermeneutical Relations: A Postphenomenological Inquiry into Immersive VR Memory Palaces* (Submitted, 2022)

List of Abbreviations

Abbreviation	Definition
VR	Virtual Reality
MR	Mixed Reality
MOL	Method of Loci
VMP	Virtual Memory Palace
HCI	Human-Computer Interaction
PI	Place Illusion

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Part I

The summary

1. Introduction

Phenomenological investigations of place highlight the inseparability of place and human subjectivity (Donohoe, 2017). The places where we dwell, work, and get together—where we live our lives—have a great impact on our experience and on our particular way of being-in-the-world. Through the places we inhabit and furnish, we define our selves in the way we exist in relation to them. We have places of peace, rest and healing, and of preoccupation or struggle. We have symbolic places of monumental meaning, but also "un-places," such as airports or service stations, merely implicitly symbolising our state of transition (Trigg, 2012). Through our designing of places, we imbue them with moods, feelings, roles, and in many ways ourselves.

With the increasing availability and technological advancement of Immersive VR technologies, the mediating roles of place, or *virtual environments*, have become relevant for research. Whether these environments are designed for learning, communication, entertainment, or treatment, they all present us to places; places in which we will be immersed and present. For design, acknowledging the role that places take in mediating our subjectivity involves also seeing the question of which virtual environments we want to inhabit, as a question of who we want to become. The design of places involves, by proxy, the design of subjects.

For Human-Computer Interaction (HCI), the design of immersive virtual environments in which humans embody avatars challenges the traditional concepts used to understand the user experience of interaction. Within HCI, interaction is traditionally understood as something that occurs *between* the pre-given entities of a human user and a technological object (Verbeek, 2015a). In studying user experience in Immersive VR, it may be worthwhile to re-consider the presuppositions of these entities as the human user and the virtual environment mutually shape each other in the relations constituted between them. Beyond interaction, Immersive VR also challenges the closely related notion of "use." For VR technologies in particular, it makes sense to "drop the term 'user' and refer to the 'participant'" (Slater and Sanchez-Vives, 2016, p. 3) as the distinction between the technology, user, and context of use is entangled. Virtual environments are not just tools we interact with or use, but environments in which we

exist and through which we are shaped. Thus, the new human-technology relations that this technology enables could benefit from theoretical perspectives that are more adequately suited to account for the complexities of VR mediation. For HCI, any such theoretical perspectives can act as a ground for both analysis and design, and at a more foundational level, theoretical perspectives contribute to an understanding of the problems and opportunities that the field is exploring. For HCI, moving towards theoretical perspectives that highlight our technological entanglement can redirect our "moral deliberations about desired futures from questions of impact to questions of who we want to be" (Frauenberger, 2019, p. 22).

The objective of this dissertation is to explore the potential of *postphenomenology* (Rosenberger and Verbeek, 2015) as a framework for understanding and inquiring into VR mediation. Postphenomenology seems promising for this task as it takes a more holistic view of user experience by attending to how technologies mediate human beings' lifeworlds. Postphenomenology is a philosophy of technology that sees technologies as mediators or co-constitutors of human-world relationships (Verbeek, 2005b). It purports the view that the design of technological objects is also the design of human subjects (Verbeek, 2015a) and understands what is being designed not as a thing, but as a *relation* in which the human subject and her world is constituted and mediated by the technology.

Postphenomenology is particularly promising for understanding VR mediation as it combines insights from phenomenology with an empirical and pragmatic focus. It takes its empirical data from phenomenology, investigating experiential phenomena from an embodied, first-person point of view. Postphenomenology further borrows from phenomenology the notion of *intentionality* as the bridge between subject and object; we are always already involved with the world, and this involvement is an essential aspect of what it means to be human. Turning back to the phenomenology of place, which VR mediates access to, phenomenologists would argue that to conceive of place objectively is to move away from place rather than to approach it. It stresses that our understanding of place is necessarily embodied. It is always situated; always seen from *somewhere* (Merleau-Ponty, 2002, p. 77).

For the purposes of this dissertation, however, it is not just the phenomenology of place that is relevant; it is the *mediation* of the places we encounter through technology. It is here that postphenomenology finds its particular relevance for VR technologies as it considers how technologies mediate our actions and experiences. Postphenomenology notably adds to phenomenology the perspective of technologies as mediating the intentional relation between humans and their worlds. Although it subscribes to the

notion of intentionality, that subjectivity and objectivity arise mutually—that all consciousness is directed towards something—postphenomenology stresses that this intentionality is mediated by technology. It understands technologies as mediating human subjectivity and world objectivity in the intentional relation constituted between them. By embodying glasses, for instance, I become a human-with-glasses, and the world is, in turn, perceived differently. Similarly, news media and social media shape our perceptions of, and engagement with, our selves and the world. Different technological media have different ways of mediation, each presenting or highlighting some aspects of experience while diminishing others. This magnification/reduction structure pertaining to all media is also present in the medium of Immersive VR. When we put on a VR Head-Mounted Display (HMD), we embody avatars and tools through which we interact; however, our intentional relation is mediated towards the virtual environment, whereas the real world is mainly concealed; it is perceptually and attentively in the background. The result is that VR mediates both our subjectivity as an embodied user and the objectivity of our experience, i.e., the virtual environment towards which we are directed. As postphenomenology is mainly concerned with the role of technologies in mediating the subjectivity and objectivity of experience, it emerges as a relevant perspective for understanding the process of VR mediation.

Motivated by the seeming suitability of postphenomenology to address the challenges that HCI face in regards to how Immersive VR technologies should be understood and approached, this dissertation explores two overarching research questions:

1. How can postphenomenology inform our understanding of the user experience and human-technology relations of Immersive VR?

2. How can we inquire into the user experience as constituted in user-environment relations?

By addressing these research questions, this dissertation serves as an exploratory inquiry into how postphenomenology can be employed in the study of the user experience that arises in Immersive VR relations.

1.1   Contributions and Overview of Dissertation

This section provides an overview of the dissertation and its research contributions. First, in section 1.1.1, a summary is provided for each individual article comprising this
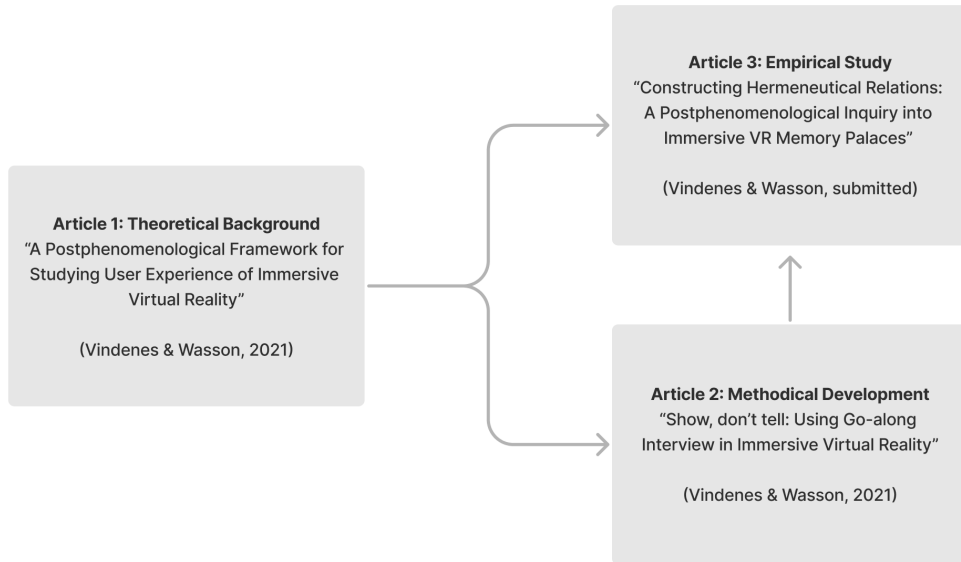
Figure 1.1: Display of the relationship between the articles comprising this dissertation

dissertation. When each article has been introduced, section 1.1.2 will demonstrate how these articles together prepare the theoretical, methodical and empirical contributions of this doctoral dissertation.

1.1.1   Summary of Articles

In summary (see Figure 1.1), Article 1 provides a grounding theoretical exploration of the synergies between postphenomenology, HCI and Immersive VR. Article 2 draws on these theoretical insights in presenting the development of the VR Go-along method, a method for gathering contextual, phenomenological accounts of relations to virtual environments. Article 3 further draws from both the theoretical insights in Article 1, and the VR Go-along method presented in Article 2, in order to present an empirical study of VR use over a period of two months. Here, the VR Go-along method is used to inquire into participants' relations to a personalised VR Memory Palace, and postphenomenological theory is utilized in a discussion of the findings of the study. In the following sections, each article is summarised in some more detail.

Article 1

Titled *A Postphenomenological Framework for Studying User Experience of Immersive Virtual Reality*, this article presents a postphenomenological framework for describing

what happens phenomenologically under the mediation of VR technologies. Dealing in particular with examples of VR intervention research, the article argues the centrality of experience in the effectiveness of these interventions and that, therefore, frameworks are needed for describing and analyzing the mediations brought by various virtual world designs. In presenting the framework, the article positions the medium of Immersive VR in relation to identified human-technology relations in postphenomenological literature, but also develops new postphenomenological categories of human-technology relations that are specifically tailored to account for the complexities of VR mediation.

The article argues that the medium of Immersive VR constitutes an embodiment-alterity relation; we embody parts of the technology (e.g., avatars and tools) and stand in an alterity relation to other aspects that the technology represents (e.g., environments, objects, social actors). This overarching human-technology relation that VR constitutes is termed *user-environment relations* and serves as an envelope in which more intricate and particular user-environment relations can be described. In demonstration of the adaptability of the framework, the article analyses the user-environment relations of a selected variety of intervention research that presents virtual worlds with ontologies radically different from the real world. In *subjectivity-objectivity inversions*, for instance, the user (subjectivity) can relate to themselves as another (objectivity) or another as oneself. In *subjectivity-objectivity synchronizations*, the boundary between the user and the environment can be blurred, or heavily linked; constituting a feedback loop from which the aim is to produce harmony between the inner life of the user and the virtual environment that is experienced. The main idea that the article presents, is that within the postphenomenological understanding of technologies as co-constitutors of subjectivity and objectivity, the mediator itself must be understood as doing this in *two* respects. Firstly, the mediator gives rise to a *user* that stands in relation to an *environment*. The experience of being a particular user in relation to a particular environment, might in turn have an effect on how the user, as human, stand in relation to their world (e.g., a mother embodied as a child in a virtual intervention, might gain a new perspective on mother-daughter relations). In conclusion, the article explores the potential synergies of VR research and postphenomenology, and acts as preliminary and preparatory work on how the mediation of VR technologies can be understood from the perspective of postphenomenology.

Article 2

Titled *Show, don't tell: Using Go-along Interviews in Immersive Virtual Reality*, this article presents the VR Go-along method as a method for exploring the user experience

and user-environment relations of Immersive VR applications. Regular Go-along interviewing is an emerging qualitative research method used to provide a contextualized understanding of a participant's experience, characterized by having the researcher and interviewee go together to a location relevant to the research. The VR Go-along is essentially the same, however, the environment is virtual and the dyads are represented as avatars. The article begins by grounding the exploration of the VR Go-along in related HCI work. Here, the relevance of ethnographical research methods in HCI is presented, and the Go-along is compared and contrasted to methods such as Think-Aloud Protocols, psychophenomenological elicitation research methods, the Media Go-along, as well as interviewing with props. Having situated the research, the article introduces the VR Go-along method as a method combining traversal, observation, and semi-structured interviewing in a virtual environment. By analysing ten VR Go-along interviews conducted inside our participants' Virtual Memory Palaces (VMPs), it is shown how the interlocutors' shared presence in the virtual environment established a common ground beneficial for communication. Being in VR enabled our participants to demonstrate interactions spontaneously and, by providing a guided tour, show us relevant objects and locations in their VMPs. Relevant to the concept of user-environment relations presented in Article 1, the VR Go-along method literally allows researchers to query and observe the user in relation to the virtual environment and further allows for interactions to be observed as embedded in the virtual environment. The article serves to present the VR Go-along method and demonstrates how our participants utilized the virtual environment and their avatars' interactions affordances during the conducted VR Go-along interviews. The article argues the method as an effective tool for eliciting contextual, phenomenological accounts of virtual environments.

Article 3

Titled *Constructing Hermeneutical Relations: A Postphenomenological Inquiry into Immersive VR Memory Palaces*, this article presents an in-the-wild study of Virtual Reality Memory Palaces in a context of self-initiated studying by students over two months. The rationale behind the study is that VR adaptations of the mnemonic Method of Loci—while showing promising results in terms of increasing mnemonic capabilities in experimental studies— have not been studied over time in a context of self-initiated studying. For this reason, the ecological validity of these results can not be verified, as previous research has not looked at the issues and opportunities that emerge when VMPs are to be incorporated into students' everyday lives, routines, and practices. In order to explore what the tool becomes in such a context, we gave ten participants

a VR Head-Mounted Display through which they could access and furnish their own personal VMP over a two month period. For this study, we did not give the participants strict instructions. This was done intentionally in order to invite participants to use their developing tacit knowledge and expertise to create their own use cases, a process we conceive of as a participatory speculation method from which to gain directions for future research and design. The article highlights individual and contextual factors that come into play when a VMP is approached as a personal project in the midst of an already-established study routine. Based on the interview data, we discuss how our participants experienced making sense of their VMPs in their study context and highlight issues and opportunities for future more contextually-laden research into the effects of VMPs. The research is presented as a postphenomenological inquiry into the mediating effects of VMPs, where the primary interest lies in what relationship the students develop to their VMP.

1.1.2   Contributions

The exploratory inquiry that this dissertation presents delves into how postphenomenology can be employed to understand and study the user experience of Immersive VR. The inquiry is performed from theoretical, methodical, and empirical angles.

   Theoretically, Article 1 presents a framework for understanding the human-technology-world relations that VR constitute (Vindenes and Wasson, 2021a). In presenting this theoretical framework, it is demonstrated how research on user experience in VR can benefit from postphenomenological theory, but also how the technology of VR prompts us to reconsider postphenomenological categories. The contribution of this theoretical work is the insight it provides into the suitability of postphenomenology to describe and understand the user experience of immersive VR.

   Methodically, Article 2 presents an adaptation of the Go-along interviewing method to Immersive VR as a means to gather contextualized understandings of participants' virtually mediated experiences (Vindenes and Wasson, 2021b). With the theoretical insights that postphenomenology brings to the understanding of Immersive VR, there follows the challenge of how one should inquire into the user experience as mediated in the constituted user-environment relations. The underlying rationale for conducting Go-along interviews in Immersive VR is that the user and the environment can not be regarded as separate entities; they should be understood as they emerge in their interrelations. Based on the findings from the research, Article 2 argues that the VR Go-along

method is a useful tool for eliciting contextual, phenomenological accounts of virtual environments where embodied interactions can be seen in relation to, or as embedded in, the virtual environment. The principal contribution of this paper is the rationale, recommendations and guidelines that it presents for HCI researchers to conduct Go-along interviews in Immersive VR.

Empirically, Article 3 presents a qualitative and explorative in-the-wild study of Immersive VR use over two months. This study utilizes the VR Go-along method presented in Article 2 and also draws insights from the theoretical framework elaborated in Article 1, and as such, further demonstrates the contributions of these works of research in terms of understanding, use and applicability. The principal empirical contribution of this paper is the insight it provides into the becoming of a VMP in a context of a self-initiated study regimen.

1.2 Background, Motivation and Personal Reflections

Postphenomenological inquiries are pragmatic, and the knowledge they generate must be seen in the context of their engagement with the challenges they try to solve. Not only are research participants' contexts and personal involvements relevant here, the research is also situated in a particular context and guided by researcher motivations. In order to situate my research inquiry, I here provide a few notes on my own motivation for undertaking this research. What motivated the research in this dissertation was my own first experience of creating a virtual world and the subsequent immersion in it. At first, the virtual world is conceived of as a thought, an idea. Later, through design, it is implemented as software before it finally is presented as an encompassing environment. My own experience of developing for the medium of VR altered my perspectives on the potential of computing technologies to provide experiences of worlds that could be differently structured than our own, with the unique possibilities that result from this. VR allows for a radically novel way of designing for *experiences*, not as one interactive artefact among others, but by providing its own "world" towards which we might develop relationships. It was thus my own lived experience which created an interest in the phenomenon of creating and relating to virtual worlds.

My own first experience of creating and immersing myself in virtual environments was during the work I did as part of my master's thesis (Vindenes et al., 2018). I wanted to approach user-generated VR Memory Palaces with the aim of allowing the creation of meaningful and personal virtual environments. It was not, however, a strict sense of

the potential utility of this environment as a tool or a means to an end that fascinated me in this process, but the experience of creating and being immersed in that creation. I found that answering what the medium of VR "was" for me to be hard to pinpoint and describe. Since then, I have been an avid user of VR technology and have had a broad set of experiences in a myriad of virtual worlds. From my own experiences, I have increasingly come to believe that it is important to gain an understanding of the power that virtual worlds have in shaping us and re-framing our relationship to the real, as well as the virtual, worlds in which we exist.

My interest in accounting for the experience of VR made me dive into phenomenology, which eventually led me to decide on postphenomenology as the theoretical framework of my doctoral research. I found postphenomenology to gather three important pillars for my research: (1) philosophical, theoretical grounding in experience; (2) focus on the impact of technologies as mediators of human-world relations; and (3) being empirically oriented with a pragmatic focus compatible with HCI research. Moreover, I found that VR was a particularly interesting case for the postphenomenological lens because of the interweaving ontologies of the real and the virtual, both of which could be informed by the postphenomenological perspective. In short, what motivated this research was my own experience of living and relating to the horizons of real and virtual environments, which generated an interest in the phenomenon of Immersive VR meditation.

1.3 Dissertation Structure

This dissertation serves to subsume the individual contributions of the aforementioned articles under the united aim of my doctoral research project. Based on these theoretical, methodical and empirical contributions, the dissertation provides a discussion of the potentially constructive role that postphenomenology can serve in studying user experience in Immersive VR. This discussion is concerned with how postphenomenology can inform our understanding of the user experience and human-technology relations of Immersive VR, as well as how we can inquire into the user experience as it is constituted in these user-environment relations.

The doctoral dissertation is divided into the Extended Abstract (Part I) and the Articles (Part II):

Part I comprises 6 chapters.

Chapter 1 introduces the topic of the dissertation, its contributions, and the under-

lying motivation guiding the research.

Chapter 2 introduces phenomenology, postphenomenology and philosophy of technology, addressing the compatibility of these philosophical perspectives with HCI research. Here, the dissertation is grounded in theory and related work.

Chapter 3 details the methodology of the research presented in this dissertation.

Chapter 4 reports the findings from three articles: Article 1, which presents the theoretical perspective on how VR constitute user-environment relations (Vindenes and Wasson, 2021a); Article 2, which shows how the VR Go-along can be used to inquire into contextualized experiences of Immersive VR (Vindenes and Wasson, 2021b); and Article 3, which present findings from an empirical study of Immersive VR use under the lens of postphenomenology.

Chapter 5 provides a discussion based on the findings reported in chapter 4. Here, the research questions are addressed in a discussion of the constructive role that postphenomenology may serve in research, both for understanding and analysing as well as its methodical relevance for research inquiries.

Chapter 6 concludes the dissertation and outlines directions for future work.

Part II comprises the three articles on which the dissertation is based. All papers included in this research were co-authored, with me as the first author, implying that I contributed the most.

During my doctoral scholarship, I published four additional articles that are not included in this dissertation. The other publications include: Vindenes et al. (2018), Flobak et al. (2019), Vindenes and Gynnild (2020) and Nyre and Vindenes (2020).

2. Background

This chapter presents the theoretical foundations of this research. First, phenomenology is introduced in order to lay the foundation for postphenomenology. Here, introductions to the thought of the phenomenological philosophers Edmund Husserl and Martin Heidegger are given, with some clarifying passages from Maurice Merleau-Ponty. In introducing the thought of Heidegger, a brief introduction to Heidegger's Philosophy of Technology is also provided. Having accounted for phenomenology, postphenomenology is introduced, from the starting point of how it differs from Heidegger's philosophy of technology. Once the theoretical background as postphenomenology has been introduced, a discussion of the compatibility of postphenomenology and the multidisciplinary field of HCI is provided. Here, the history of the theoretical landscape of HCI is introduced, and it is shown how HCI and postphenomenology can complement each other. Illustrating their complementary features involves going in to related work that employs postphenomenology in studying user experience of interactive artefacts.

2.1 Phenomenology

Phenomenology can be defined as the study of "structures of consciousness from the first-person point of view" (Smith, 2018, p. 1). Phenomenology *starts* from experience. In this sense, phenomenology can be likened to the Zen notion of "Beginner's mind", emphasizing a return to experience and away from established concepts: the phenomenological philosopher "is a perpetual beginner" (Merleau-Ponty, 2002, p. xv). Within this overarching definition, however, phenomenology has historically undergone several developments and various philosophers understand it differently. This section introduces the phenomenology of Edmund Husserl, before moving on to how it is further developed by Martin Heidegger. In introducing Heidegger's thought, his philosophy of technology is also introduced as it allows an important comparison to postphenomenology—also a philosophy of technology—which understands technologies in a related, but crucially different, way.

2.1.1 Edmund Husserl

Phenomenology was founded by Edmund Husserl, who was skeptical of the assumptions of the positivist science tradition and wanted to approach a new science that could reach a true objectivity. By means of Husserl's 'transcendental phenomenology', the phenomenologist should be enabled to "develop a radically unprejudiced justification of his (or her) basic views on the world and himself and explore their rational interconnections" (Beyer, 2020, sect. 1, para. 4). Husserl's approach was skeptical in the Cartesian sense, and sought his objective of true knowledge in a foundationalist way: no assumptions could be allowed that were not founded directly through experience. For this reason, Husserl rejected, or at least "bracketed", Kant's famous dualistic distinction of phenomena (the appearance) and noumena (the things themselves). Husserl's mission "to the things themselves" was thus an attempt at a journey towards objectivity through experience. By identifying the structures of the phenomena themselves, he wanted to approach essential structures of consciousness. According to Husserl, one's assumptions had to be "bracketed", i.e., "the phenomenological description of a given act and, in particular, the phenomenological specification of its intentional content, must not rely upon the correctness of any existence assumption concerning the object(s) (if any) the respective act is about" (Beyer, 2020, sect. 5, para. 2). For Husserl, this is the "epoché" or the "phenomenological reduction", which must be performed before attempting to reach the "essential structures". What is bracketed can since, to a degree, return, but in a "radically altered form, in which their ontological independence of the transcendental ego is denied" (Schacht, 1972, p. 297). For instance, the status of the world can be acknowledged, but not as independent from experience.

Epistemologically, then, we can say that in phenomenology the existence of things are seen interrelationally. The phenomenology of Husserl is concerned with "the description of essences or essential structures of consciousness and essential types of things" (Schacht, 1972, p. 298). To reach these, one must bracket one's assumptions to go from the 'natural standpoint' to the 'phenomenological standpoint', and as Schacht (1972) describes: "restrict [oneself] to the consideration of the phenomena which constitute [one's] 'flow of experience' qua phenomena" (p. 299). When objective reality as we know it in our natural attitude is bracketed, there is nevertheless a flow of experience that can not be bracketed or "meaningfully doubted" (Beyer, 2020, sect. 6, para. 9).

Husserl's objective was largely epistemological in a search for a new foundationalist science, where the foundation is grounded in the experience as attended to without

prejudice. Although Husserl set out to break away from the subject–object distinctions by bracketing the natural attitude, his writings still show a "vestigial Cartesianism" (Ihde, 2016, p. 62). Although this to a certain extent is attributable to the fact that he began with the vocabulary of the philosophy he wished to deconstruct, "the vestigial original language carries its own momentum" (Ihde, 2016, p. xiiii). Ihde (2016) writes that "...although in the *Cartesian Meditations* Husserl seeks to change this model into the directional intentionality in which phenomena are not mental events, it is still the case that *ego* remains a subject and what is focal and forefront is *consciousness*" (p. 129-130, emphasis in original). Verbeek (2015) writes, however, that phenomenology "did not remain a philosophy of consciousness. Husserl's followers, and even the later Husserl himself, came to believe that phenomenology needed to be more fully extended and worked out than a philosophy of consciousness" (p. 109). Although Husserl can be said to have posited an interrelational ontology, this "became more concrete and existentialized with both Heidegger's Dasein as 'being-in-the-world' and with Merleau-Ponty's embodied or incarnate version as *etre-au-monde*" (Ihde, 2008, p. 7, emphasis in original).

It is on this point in particular that the emphases of Husserl's and Heidegger's philosophies differ.

2.1.2 Martin Heidegger

Student, and later successor of Husserl's professorship, was Martin Heidegger. Initially working with Husserl and a fine candidate to understand his work, Heidegger broke with Husserl's phenomenology on the release of his magnum opus *Being and Time*. Though he still used the term "phenomenology" as the approach in his investigation of Being, he used it differently. As noted above, the interrelational ontology of phenomenology became more clear with Heidegger's "being-in-the-world", which highlights how human beings cannot separate themselves from the world. Heidegger's view was that humans were "embedded in their world to such an extent that subjective experiences are inextricably linked with social, cultural, and political contexts" (Lopez and Willis, 2004, p. 729). Heidegger's phenomenology is thus not just concerned with the content of human subjectivity, but also with "what the individual narratives imply about what he or she experiences every day" (Lopez and Willis, 2004, p. 729).

Further, Husserl and Heidegger had different objectives. Heidegger's ambition was not to establish a new science. He wanted to account for the Being of beings, and so his task was ontological rather than epistemological. Phenomenology, as he defined it, was,

however, his approach in this endeavour. Whereas Husserl's initial aim was towards a new foundationalist science, Heidegger's approach was non-foundational. Heidegger starts with the intentionality of consciousness also as involvement; Dasein—the being-in-the-world particular for human beings—is "always already" involved in the world with care.

Although scholars disagree on whether Husserl's transcendental ego could be said to be "worldless"—and this certainly varies between the early and later Husserl—what is certain is that Heidegger's phenomenology is distinguished from Husserl's in that it emphasizes, and is more concerned with, 'the natural standpoint'. This is not to say that Husserl regarded the natural standpoint as unimportant, however, this was not initially the focus of his philosophy. So whereas phenomenology for Husserl can not be performed unless one goes from the natural standpoint to the phenomenological one, for Heidegger this is in a sense reversed. Schacht (1972) writes:

> "For Heidegger, on the other hand, it is precisely with such matters that the phenomenologist must begin—with things as they are experienced 'for the most part', with other people as we are related to them 'for the most part', and with the way people live 'for the most part'. And when he goes beyond the description of the way people live 'for the most part' it is not to leave the natural standpoint at all, but rather to describe a different way in which it is possible to live and to relate to things and other people at that standpoint" (p. 307)

If Husserl's and Heidegger's perspectives shall each be regarded as phenomenology, phenomenology spans widely. If phenomenology is concerned with reaching a true objectivity through identification of essences, as well as being concerned with illuminating our pre-objective relations to our surrounding world, what grounds is there for referring to both of these concerns as "Phenomenology"? In his praised preface to *Phenomenology of Perception*, Merleau-Ponty (1945/2002) raises the issue of the seemingly contradictory phenomenologies of Heidegger and Husserl:

> "[Phenomenology] is a transcendental philosophy which places in abeyance the assertions arising out of the natural attitude, the better to understand them; but it is also a philosophy for which the world is always 'already there' before reflection begins [. . .] It is the search for a philosophy which shall be a 'rigorous science', but it also offers an account of space, time and the world as we 'live' them [...] One may try to do away with these

> contradictions by making a distinction between Husserl's and Heidegger's
> phenomenologies; yet the whole of *Sein und Zeit* springs from an indication
> given by Husserl and amounts to no more than an explicit account of the
> 'natürlicher Weltbegriff' or the 'Lebenswelt' which Husserl, towards the
> end of his life, identified as the central theme of phenomenology, with the
> result that the contradiction reappears in Husserl's own philosophy" (p. viii,
> emphasis in original)

Merleau-Ponty (1945/2002) thus sees the approaches of Heidegger and Husserl as
related and in harmonious sequence: "Heidegger's 'being-in-the-world' appears only
against the background of the phenomenological reduction" (Merleau-Ponty, 2002, p.
xvi), whose most important lesson it teaches "is the impossibility of a complete reduc-
tion" (ibid, p. xv).

So what, then, is phenomenology according to Merleau-Ponty? Merleau-Ponty
writes that phenomenology "tries to give a direct description of our experience as it is,
without taking account of its psychological origin and the causal explanations which
the scientist, the historian or the sociologist may be able to provide" (p. vii). Not
definable by "counting up quotations", Merleau-Ponty writes that "[w]e shall find in
ourselves, and nowhere else, the unity and true meaning of phenomenology [. . .] Phe-
nomenology is accessible only through a phenomenological method" (1945/2002, p.
viii).

Heidegger's Questioning Concerning Technology

Phenomenology can thus be seen to span widely, but for postphenomenology, it is
Heidegger's and Merleau-Ponty's focus on our wordly entanglement which is the most
relevant. As phenomenologists have been concerned with how our lives are experienced
'for the most part' in this manner, phenomenologists have naturally also been attentive
to how tools and technologies take part in shaping our everyday existence. In paving
the way for postphenomenology, which could be considered the ultimate example of
this interest, an introduction to Heidegger's philosophy of technology is useful. This is
because postphenomenology acknowledges and builds on insights from his philosophy
of technology but, at the same time, stands in stark disagreement with some of his
essential points.

Heidegger's philosophy of technology is derived chiefly from his 1954 essay *The
Question Concerning Technology* (Heidegger, 2013). In the essay, Heidegger discusses
how technology re-frames, or *enframes*, the world for human beings. The best way

to approach Heidegger's point is perhaps to address his statement that "the essence of technology is by no means anything technological" (p. 4). We see that Heidegger is generally not critiquing technology in the form of particular artefacts, but Technology in its *essence*[1]. This essence, for Heidegger, is seen as a particular *revealing* or disclosure of the world. Heidegger broadly separates between two kinds of revealing that various technological realisations bring about. For instance, Heidegger writes of windmills as *bringing-forth*. Although windmills draw energy from the wind, they do not extract the energy for storage as is done with coal; the wind can still "do its thing", being as-it-is. This is not the case with *challenging-forth* technologies. In the production of coal, the "earth now reveals itself as a coal mining district..." (p. 14); it is reduced to being a means to our end, and we can not see it as it is. It is through such challenging-forth technology that our relationship towards the world is enframed, and the difference between these two kinds of technologies is how, and as what, the world is revealed. Our not being able to see things as they are outside of this technological way of seeing is deeply problematic for Heidegger.

Heidegger's primary concern is that the challenging-forth revealing of Technology is a way of seeing that is not regarded as such. He pinpoints the essence of technology to *the rule of enframing*, which "threatens man with the possibility that it could be denied to him to enter into a more original revealing and hence to experience the call of a more primal truth" (p. 28).

2.2   Postphenomenology

Heidegger's criticism of technology is insightful in how it sees Technology as mediating human subjectivity in its intentional relationship towards the world. It is, however, hard to imagine any of the technological inventions we are dependent on today escaping Heidegger's scrutinising gaze. It is, in other words, hard to conceive of Heidegger's philosophy as constructive or pragmatic. This is mainly because his philosophy of technology is metaphysical more than it is practical—discussing Technology instead of technologies—and further, when his discussion draws from particular technologies, it displays a personal, romantic preference for particular kinds of technologies (Ihde, 2010). It has little to offer for those who want to understand the mediations and human-technology relations of particular technologies.

Postphenomenology rejects Heidegger's essential view of technology. It argues technologies as anti-essentialist and purports there are many "*varieties of technolog-*

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[1]This essential view of technology is typically denoted by capitalizing the first letter of the word.

ical experience" (Ihde, 2010, p. 120, emphasis in original). The view that technology cannot be addressed as "one thing" has motivated the "empirical turn" of postphenomenology (Achterhuis, 2001) to engage with science, new technologies and direct, concrete experiences of these technologies. So although postphenomenology maintains an interest in how technologies mediate our way of seeing the world, it does not deal with "*The* question of technology" (Ihde, 2016, p. 114, emphasis in original). Rather, it "modestly and more pragmatically deal[s] with 'questions of technologies'" (ibid, p. 114). In doing so, it also claims to be "more phenomenological" as it attends to concrete experiences with a variety of technological artefacts (Ihde, 2008, p. 2).

The main reason why Heidegger's philosophy of technology is rejected is thus, first and foremost, that it is not very constructive. The critique is that the more overarching, general and essentialist view may blind us to the nuances of how particular technologies mediate our human-world relations in different ways. Ihde (2010) writes:

> "What is needed is not a rejection of the deep and essentially phenomenological insights into technology as a culturally embedded phenomenon with its different gestalt features, but a deepening and more complex appreciation of all of the facets of our technologically textured mode of life" (p. 84)

Postphenomenology can, in this sense, be described as a marriage of pragmatism and phenomenology. Aagaard (2018) explains how "...postphenomenology was coined to sever connections to later Heidegger's one-size-fits-all account of Technology and to Husserl's subjectivist notion of consciousness" (p. 5). This point should be nuanced, however, as postphenomenology adopts much from Heidegger. Verbeek (2005) writes how Heidegger "opens up an important perspective on technology" (p. 8), but one which is "not sufficient to adequately analyze concrete technologies" (p. 8). Heidegger saw "the relation between technology and the way in which human beings interpret and engage their world" (ibid, p. 9), an insight central to postphenomenology today. To illuminate the Heideggerian heritage of postphenomenology, we can turn to the postphenomenological philosopher Peter-Paul Verbeek.

In his book *What Things Do*, Verbeek (2005) draws attention to the earlier Heidegger's assertion that "The thing things" (Heidegger, 2000, p. 174). What Heidegger means by this verbalization of the noun is that the thing must be understood in terms of what it does, "without being reduced to something non-thingly" (Verbeek, 2005b, p. 47). Verbeek's critique, however, is that reducing things to something non-thingly is also exactly what the later Heidegger is doing in his technology essay. In Heideg-

ger's later works, "[t]hings are no longer investigated for the ways in which they make practices possible and thereby disclose a world" (Verbeek, 2005b, p. 89). Verbeek (2005) finds ground in the earlier Heidegger's *Being and Time*, however, for developing a philosophy of technology that indeed *is* concerned with "what things do." In Heidegger's tool analysis in Being and Time, where he discusses the embodiment of tools, such 'handy' or 'ready-to-hand' objects are described exactly in terms of what they do, phenomenologically; "they give human beings an access to being and thus shape the world that gathers around them" (Verbeek, 2005b, p. 85). In the embodiment of a hammer, the hammer disappears and reveals to us a different world through this embodiment. In the embodiment of a hammer, we do not focus on the hammer but on the nail. Here, what the hammer *does* is seen in terms of how it shapes our worldly perception and involvement. The hammer itself disappears in our involvement with it so that, as an object, it can be defined only negatively: it is only by breaking that the hammer is objectively present ('present-to-hand'), as this brings the referential structure in which the tool served its role to the foreground. When it can no longer be *used* and *acted through*, the object draws attention to itself as such, and the world that it revealed is broken down. So while the earlier Heidegger opens up for a philosophy of what things, i.e., concrete technological artefacts, do, the later Heidegger expands on how technologies reframe our world, although the latter was discussed from an ontological perspective rather than an ontic one. Nevertheless, it was Heidegger who "opened the door to postmodernism by approaching being as changeable rather than static, and thus the 'essence' of things as contingent, resting on a historically determined conception of being" (Verbeek, 2005b, p. 73). So while postphenomenology is very much in agreement with the earlier Heidegger in that "The thing things," and seeks to elucidate how various technologies give rise to various ways of being-in-the-world, it rejects the essentialist and reductionist view of technology of the later Heidegger, which purports Technology as a way of seeing the world.

2.2.1   The emphasis of postphenomenology

Postphenomenology can thus be conceived of as a pragmatic and phenomenological philosophy of technology. With its phenomenological roots, postphenomenology understands humans and technologies as inseparable and views technologies as co-constituting human subjectivity and world objectivity (Rosenberger & Verbeek, 2015). Concerned with empirical data, postphenomenology is pragmatic and, giving heed to its phenomenological origins, it draws its data from experience. Postphenomenology views neither subjectivity nor objectivity as separate, pre-given entities; instead, it sees

them arising out of mediation processes. Postphenomenology holds a non-neutrality thesis in that it rejects the notion of technologies as clear-cut tools that can be reduced to the function to which they are designed; instead, it sees technologies as multi-stable. For instance, a small weather widget on one's laptop does not merely transmit information; in so doing, it mediates a different awareness of the world (Wiltse and Stolterman, 2010). Postphenomenology adopts from phenomenology the notion of intentionality as an invariant of experience; all consciousness is consciousness of something. Subjectivity and objectivity, experiencer and experienced—what Husserl referred to as the noesis and the noema—are two distinct ends of the polarity of experience. However, postphenomenology stresses the role that technologies have in *mediating* this intentional relation, affecting how the subjectivity-objectivity dynamic is revealed.

Postphenomenology, as a praxis-oriented phenomenology, was established through the works of philosopher Don Ihde. Ihde (2010) sought a nuanced and "more phenomenological" (p. 128) technology understanding than what was left by Heidegger's essentialist and reductionist technology criticism (Heidegger, 2013). An expanding group of scholars now contribute to the postphenomenological approach of studying the ever-expanding role of technologies in our lives, most notably Peter-Paul Verbeek, who extends Ihde's postphenomenological thought in his theory of technological mediation (Verbeek, 2005b). In the following sections, an account of Don Ihde's human-technology relations is provided, followed by descriptions of other human-technology relations identified by Peter-Paul Verbeek, as well as Verbeek's experiential and existential perspectives on technology.

2.2.2 Ihde's Human-Technology Relations

Don Ihde identified four structures of human-technology-world relationships (see Table 2.1). The first of these he calls *embodiment relations* in which humans merge with the technology, where the combination of human and technology relate to the world. In embodiment relations, there is transparency, as when we look through our eyeglasses or talk through the phone. In this case, the technology is a part of the subjectivity in the relation, and the world is experienced through the technology. Famous philosophical examples here include Merleau-Ponty's feathered hat[2] and Heidegger's hammer. Second, he discusses *hermeneutical relations*, where humans "read off" an abstract representation by a computer, such as a weather forecast or an MRI scan. In hermeneu-

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[2]In Merleau-Ponty's *Phenomomenology of Perception*, we find the example of a woman who has 'embodied' her feathered hat so that she is able to, without calculation, navigate through narrow doorways without breaking the feather.

Table 2.1: **Human-Technology Relations Diagram (Ihde, 1990)**

Embodiment relation	(human - technology) → world
Hermeneutic relation	human → (technology - world)
Alterity relation	human → technology (world)
Background relation	human → (technology/world)

tical relations, humans relate to how the technology represents the world. In this case, the technology belongs to the world (objective) in the relation and reveals the world in a certain way. Third, in *alterity relations*, the technology does not necessarily represent the world in the same manner, but it is in the foreground. In alterity relations humans interact with technology directly within its own system, a common example being interaction with an ATM or a calculator. Here, the world withdraws into the background while the technology is in focus; the technology does not highlight or, necessarily, re-frame the world. Lastly, Ihde (1990) discusses *background relations* where the technologies are an implicit condition affecting the environment, partly serving as the context in which we find ourselves. Here, a typical example is how heating systems or air conditioners affect the world and set the stage where we perform but are not in themselves an object of focus. Here, also, the technology blends with the world. Ihde (1990) illustrates his embodiment, hermeneutic, alterity, and background relations through diagrams indicating on which poles, subjective or objective, the technology primarily is 'situated', with arrows indicating intentionality (see Table 2.1).

These categorisations show how technologies can vary vastly from either being an extension or alteration of our subjectivity, to representing the objectivity of the world, or vaguely having an impact on both from the background.

2.2.3   Verbeek's Human-Technology Relations

The human-technology-world relations identified by Ihde are not exhaustive as to include all possible relations. Verbeek has further identified several human-technology relations enabled by newer technology developments, such as fusion, immersion, and augmentation (see Table 2.2). For instance, fusion relations refer to the fusion of human bodies and technologies, not as in embodiment, but in physical fusion where technologies merge with the body (e.g., embedded pacemakers.) Further, the augmentation relation refers to the extra layers of experience enabled by Augmented Reality (AR) technologies. While wearing AR glasses, the human has an embodiment relation with the glasses, which present the world, but she also stands in a hermeneutical relationship to what the AR glasses present. The intentionality involved in this human-technology

Table 2.2: **Verbeek's Human-Technology Relations Diagram (Verbeek, 2015b)**

Augmentation relation	(I – Technology) → World → (Technology – World)
Fusion relation	(I / Technology) → World
Immersion relation	I ←→ Technology/World

relation can be said to be 'bifurcated'; the "relation consists of two parallel circuits" so that "[o]ur attention is increasingly divided between two parallel tracks" (Verbeek, 2015b, p. 219 - 220).

Finally, the immersion relation can be understood as a more active version of Ihde's background relation, where the environment and the technology become merged (Aydin et al., 2019; Verbeek, 2005a). It is more active in the sense that the environment is aware of human beings and actively interacts with them. The result is that human beings are directed toward technologies, and the technologies are in turn directed toward them, resulting in a "reflexive intentionality" (Verbeek, 2005a, p. 7) where humans can enter into new relations towards themselves through the technology. Although this relation is referred to as an "immersion" relation, in the context of this dissertation, I should note that Verbeek (2011) does not use the word "immersion" in order to relate it to VR technologies in particular. As examples of immersion relations, Verbeek (2011) describes smart toilets that analyse excrements and provide health reports or beds that can detect whether somebody falls out.

2.2.4   Verbeek's Experiential and Existential Perspectives

Beyond human-technology relations, there is the question of how our technological relations re-frame our worlds in particular ways. Extending on Ihde's human-technology relations, Verbeek (2005b) discusses two perspectives of postphenomenology: an experiential perspective and an existential perspective. Whereas the experiential perspective is concerned with how we perceive and interpret the world, the existential is concerned with our being-in-the-world; how this involvement is mediated. Within the experiential, technology can be seen as either amplifying or reducing certain aspects of the world, which he calls transformation. As for the existential, the technology can be seen as inviting or inhibiting specific actions or ways of being in the world, which he refers to as a translation. An illustrative example of said perspective on technological mediation can be drawn based on the work of Ems (2019), who writes how the Old Order Amish view technologies as non-neutral in terms of their moral and ethical impact and therefore do not use mobile phones. Drawing on Verbeek's language, we could say that the Amish have an existential perspective on mobile phones as inviting certain kinds

of behaviour that they find immoral. Another perhaps more relatable example, focused on experience, is how mobile apps for running, or other means of personal informatics, transforms how physical workouts are experienced. Ohlin and Olsson (2015) discuss how the runner's experience is transformed through an embodiment relation in which the application reduces the focus on bodily experience, and amplifies focus on pace. In other words, the application mediates the feeling of exhaustion. Moreover, the activity of running can be said to have become "existentially translated to include the post-run analysis" (p. 5) as when the user has become habituated to data accompanying the activity, "...running does not willingly happen without it" (p. 5). The perspectives that Verbeek presents show how technologies can re-frame the ontology of our world by disclosing it in a particular way, as well as how technologies can re-frame our involvement in it.

To summarize, postphenomenology is a philosophy of technology that is concerned with what technologies *do*; what active parts they take in mediating the lifeworlds of human beings.

2.3   Human-Computer Interaction

Having introduced postphenomenology, I move on to discuss how VR can be approached (post)phenomenologically in the multidisciplinary field of HCI. As both postphenomenology and HCI are empirically oriented, there is great potential for synergy. HCI needs theoretical disciplines to ground their work, and postphenomenology needs empirical accounts of technology relations. This section provides a brief history of the field of HCI and accounts for how phenomenological perspectives, and recently also postphenomenological perspectives, have been increasingly utilised.

2.3.1   The Waves of HCI

Although the field of HCI is relatively young, due to the significant development of new computational artefacts, it has undergone several paradigm shifts since its emergence at the beginning of the 1980s. These paradigm shifts (Harrison et al., 2007) or waves (Bødker, 2006) are useful for placing the direction of the field in terms of its focus and underlying theories and will be described in this section to provide a background for the contribution of this dissertation to the field.

First Wave

As a new field, HCI sprang out of engineering. The studies often involved one human and one computer or system, and the aim was to reduce human errors in the interaction with complex systems, for instance in an airplane cockpit (Wiener, 1989). In the beginning, the focus was very practical and designers and researchers aimed for an optimal fit between man and machine through ergonomics and a focus on human factors (Harrison et al., 2007), where the human could be conceivedof as a 'cog in the overall machine.' Thus, the design goal for interactive systems was usability, that the technologies should be "effective, efficient, engaging, error-tolerant, and easy-to-learn" (Fallman, 2011, p. 1052). According to Bødker (2015), the first wave of HCI was driven by models and "focused on the human being as a subject to be studied through rigid guidelines, formal methods, and systematic testing..." (p. 24). Fallman (2011) writes how various information processing theories were adopted in order to create models of people and their motivations to be used in design, such as Norman's theory of action (Norman, 1986). Although this entailed adhering to the user, the user was conceived of in a rather abstract manner, and the human was, for these purposes, understood in a limited sense.

Second Wave

The second wave of HCI, however, had an increased emphasis on, and experimentation with, theory. Bannon (1991) describes the shift to the second wave as one "from human factors to human actors" (p. 1). In focusing on the increasing utilization of computing technologies in work settings, the understanding of humans widened to include multiple users and multiple applications, and thus, to a certain extent, also involved contextual inquiries. The focus 'zoomed out' from just focusing on the single human interacting with the single computer to instead considering teams working on particular tasks involving multiple applications. Adapting to this new focus involved a radically expanded set of methods and theories from which to understand interaction. Theoretically, researchers looked to situated action, distributed cognition, and activity theory, as well as participatory design, prototyping, and contextual inquiries when it came to analysis and design (Bødker, 2006). These contexts were still primarily work-oriented, however, and were usually centered around particular established teamwork processes in work environments.

Third Wave

In the late 1990s and early 2000s, information technologies increasingly made their way outside the domains of work and into everyday life. Interacting with computers was no longer something isolated to certain contexts, and its use could no longer be evaluated with the same 'success criteria'. This shift towards ubiquitous computing required new theories of understanding human-computer interaction and new methodologies for its study. The dawn of ubiquitous computing was challenging as it extended the scope of inquiry enormously. One now had to "design for people that were not at work, who did not appear in distinguishable groups or other well-defined circumstances, who did not have well-defined tasks at hand, and who may have a completely different culture..." (Fallman, 2011, p. 1052). Harrison et al. (2007) named the paradigm that emerged to address the issues that the previous paradigms were ill-equipped to deal with "situated perspectives" (p. 1). In embracing this broadened use of computing, interests moved towards the phenomenological; focusing on experiences, values, and meaning. There was an increased focus on the contextual aspects, or the situatedness, of HCI problems, not only within work and learning contexts but in all facets of everyday human lives. This meant that HCI also encompassed "non-work" and "non-purposeful" activities (Bødker, 2006). As computing became more ingrained in the everyday lives of humans, there emerged a need to also understand it in terms of the varying contexts in which it occurred. Undertaking such inquiries under the guiding theories and methods of the first and second paradigms is not possible as the guiding theories and methodologies within these paradigms require concrete task problems, which is "precisely what non-task-oriented approaches are intended to question" (Harrison et al., 2007). As a response, the third paradigm takes a broader perspective wherein interaction is seen as a way of meaning making.

Seeing interaction as a way of meaning-making means, for instance, that successful criteria of information systems cannot necessarily be made in advance and then be "checked off" in an evaluation. Harrison et al. (2007) writes how "... we must ask questions about what it means for a system to be 'good' in a particular context — a question that quickly brings us to issues of values" (p. 8). Similarly, Bødker (2006) writes how "we [need] to do technological experiments to understand which questions to ask" (p. 26). For example, she writes how "the iPhone moved from a fancy telephone to, for example, a highly individual 'poetry machine,' in the hands of one of the interviewees" (p. 26). This way of research is more open-ended and explorative as it attends to how the technologies are used and experienced in context. In the third paradigm, the task

of the designer is to investigate "the design of integrated and holistic experiences set in context, rather than of individual artifacts or components" (Buchenau and Suri, 2000, p. 425).

Entanglement HCI

Beyond the third paradigm, however, we are potentially in the midst of a new paradigm shift or "wave" of HCI. Frauenberger (2019) writes how "HCI as a field is grappling with its knowledge production practices and their representations" (p. 13). He argues that third paradigm HCI, "with its focus on situatedness, values, and embodiment, is ill-equipped to deal with the increasing ontological uncertainties that technologies such as virtual reality, artificial intelligence or neuro-implants pose" (Frauenberger, 2019, p. 21). He suggests "leaving user-centered design behind and develop agonistic, participatory speculation methods to design meaningful relations, rather than optimising user experiences" (Frauenberger, 2019, p. 22). Although Frauenberger (2019) argues against optimising user experiences and moving away from user-centered design, this naturally does not involve abandoning user experience as data or in any other way completely disregarding user experience. Frauenberger (2019) is concerned with "designing *meaningful* relations that are enacted as part of our ongoing re-configuring the world" (Frauenberger, 2019, p. 21, emphasis in original). The entanglement approach is not a move away from experience—after all, there has to be someone for whom a relation can be experienced as meaningful—rather, it designates a move away from optimising user experience of designed things as a success criterion in and of itself.

Regarding epistemology, Frauenberger (2019) writes that current HCI attempts a middle-ground between studying particular instances and developing generalised theories. He writes that this reduces the quality of the studies of particular instances and yet it fails to hold up to the scrutiny of scientific, generalisable knowledge. The problem, therefore, is that "[w]ithout finding a theoretical basis on which these two kinds of knowledge can be treated in the same way, it is impossible to construct a continuum or to occupy a middle ground" (Frauenberger, 2019, p. 14). As an alternative, he cites Barad (2007), who argues for an *onto-epistemology*, where "any knowledge production is tied to this intra-action and the resulting phenomena, i.e., knowledge production is a material practice that produces facts that are reliably performed within given configurations" (Frauenberger, 2019, p. 15). This is very compatible with postphenomenology and its pragmatic focus where "knowledge is created through [...] *use practice*" (Frauenberger, 2019, p. 15, emphasis in original). In relevance to this, Verbeek (2005) writes how "Postphenomenology can be viewed as an offshoot of phenomenology that

is motivated by the postmodern aversion to *context-independent truths*..." (p. 113, emphasis added). A rejection of context-independent truths means there is not here a constant object of study (such as a VR application). Instead, in the case of an evaluation of a VR application, the evaluation "will enact phenomena that are dependent on the configuration of the apparatus" (Frauenberger, 2019, p. 15). To exemplify this, Frauenberger (2019) discusses an imaginary artefact called "Flow" and writes how "an interview study will make Flow a cultural artefact, a controlled user testing study in the lab will make it a functional tool, and a long-term diary study might make it an artificial sense of people. We are not just studying different phenomena, we are studying different things, possibly with varying boundaries" (Frauenberger, 2019, p. 15). Therefore, this perspective sees the research process as the creation of "configurations that enact certain phenomena" (Frauenberger, 2019, p. 12). Here, upkeeping the constant variables of human and technology can be inimical to understanding how they are being mutually shaped in their interrelations in the various contexts of use. It is, in other words, because of the increasingly fuzzy relationship between humans and technology that the traditional distinction between humans and technologies in studies might be problematic; it is not clear "where the human ends and the technology starts" (Frauenberger, 2019, p. 2). In answer to this problem, Frauenberger (2019) posits the adoption of "entanglement" theories with relational ontologies that are better equipped to deal with this interrelation to act as underpinning theoretical frameworks for HCI. He writes that although the adoption of Heidegger's phenomenology sought to overcome mind-body dualism through embodiment, entanglement theories "take this line of thought one step further by [...] asking which active contributions tools make to what humans do" (Frauenberger, 2019, p. 4). In entanglement theories, "knowledge neither stems from an objective, inanimate reality, nor is it entirely fabricated in the social realm or language" (Frauenberger, 2019, p. 4). Rather, what entanglement theories describe is "a reality that is co-constituted in materially discursive productions" (Frauenberger, 2019, p. 4). As examples of entanglement theories, Frauenberger (2019) introduces Latour's Actor-Network Theory (Latour, 2005), Postphenomenology (Verbeek, 2015a), Object-Oriented Ontologies (Bogost, 2012) and the notion of Agential Realism (Barad, 2007), and discuss their current use in HCI studies.

It is postphenomenology that is the theoretical framework of this dissertation. The strength of the postphenomenological perspective is that it can draw attention to how our being-in-the-world is mediated by technologies. Here, again, what is at the centre of the inquiry is not so much user experience isolated as a success criterion, but rather an exploration of how we as humans (can) exist in relation to the world and the role which

technologies have in this relation. In moving toward this focus, there is a redirection from "questions of impact to questions of who we want to be" (Frauenberger, 2019, p. 22). This shift in thinking might allow HCI to adopt a more holistic perspective toward the relationship between humans and technology. Frauenberger (2019) writes, for instance, that "The mobile phone has not merely met requirements or fulfilled needs. It has not just extended our capabilities or opened up the possibilities for new social practices. It has made us different people" (Frauenberger, 2019, p. 12). Broadening towards a more holistic focus of entanglement can allow for a richer perspective on our relations to technologies, how they shape us, and how this, in turn, alters how we shape them.

2.3.2 Situated Perspectives or Entanglement HCI?

It should be mentioned that although postphenomenology is an excellent example of an "entanglement" theory in HCI, it is not inconceivable to see postphenomenology as compatible with the values and goals also present in third wave HCI. In their *Technology of Experience*, a book that argues the centrality of lived and felt experience in our technology relations, McCarthy and Wright (2004) posit a pragmatist view where "any knowledge we have is dependent on the technology, circumstances, situations and actions from which it was conducted" (p. 17). McCarthy and Wright (2004), in line with the pragmatist John Dewey, sees "experience [as] constituted between self and object" (p. 17). Again, the subtle nuance is not to ignore the experience of self and object but to see how these are constituted in *relation* to each other. Pragmatism, as postphenomenology, "starts with experience and, by committing to a holistic, relational worldview" (McCarthy and Wright, 2004, p. 54). Even with regards to the "ultimate questions" of the role that HCI should serve, the ideas that Frauenberger (2019) present are not necessarily new. In the closing remarks of *Understanding Computers and Cognition: A New Foundation for Design*, Winograd and Flores (1986) write about ontological designing, where "we are doing more than asking what can be built. We are engaging in a philosophical discourse about the self - about what we can do and what we can be" (p. 179). This is not to say that any difference that Frauenberger (2019) draws between third and fourth wave HCI is meaningless, but to pinpoint the earlier origins that called for the adoption of interrelational ontologies that understand the experience of, and relations to, technologies as situated, which we are now seeing being increasingly taken up in HCI studies.

2.3.3   Postphenomenology in HCI

Arguably then, it is within the fourth paradigm of HCI, of entanglement, that postphenomenology can be a complementary perspective from which to understand how we relate to and experience particular technologies in particular contexts. While the research in this dissertation focuses on user experience, it sees this user experience as arising in technologically mediated relations.

Postphenomenology and HCI have in common that they are both concerned with technologies and how humans relate to them (Hauser et al. (2018a). Several researchers are framing their contributions to HCI as postphenomenological inquiries, investigating the mediating effects of their designed artefacts (Hauser et al., 2018b; Wakkary et al., 2017). For instance, Hauser et al. (2018a) frame these inquiries as "doing postphenomenology" or "doing philosophy through things" (p. 459). Wakkary et al. (2018) write of the potential synergies between HCI and postphenomenology that "HCI and design research can deeply engage the matter of technological mediation empirically" (p. 10). The focus of HCI on design artifacts and innovative empirical methodologies can "[augment] existing postphenomenology methods for studying technologies" (Wakkary et al., 2018, p. 10), and for HCI, the adoption of postphenomenological perspectives can help us "to form a deeper understanding of people's experiences and relations with technology" (Hauser et al., 2018a, p. 459).

So far, postphenomenological studies are usually run in accordance with Research Through Design (RtD), where the research product or the knowledge generated through it is approached in a postphenomenological manner. For instance, an emerging approach has been to deploy artefacts for people to live with in their everyday. Framed as "material speculations," such as The Tilting Bowl (Wakkary et al., 2018), the Table-non-table (Hauser et al., 2018b), and Morse Things (Wakkary et al., 2017), the artefacts are deployed in households for extended periods, after which the mediation effects of the artefacts on the subjects and their worlds are investigated.

In their annotated portfolio, Hauser et al. (2018a) describe the role of the researcher in postphenomenological inquiries as (1) choosing the participants of the study (humans), (2) crafting and evaluating the technological research product (mediator), and (3) choosing the environment of deployment (world/environment). These three constituents—human, mediator, and world—are the fundamental considerations for researchers who want to study technological mediation. For instance, Wakkary et al. (2018) had six trained philosophers living with a counterfactual artefact called the Tilting Bowl. The counterfactual artefact was designed as part of a material speculation

approach to design research. They define a counterfactual artefact as a "fully realized functioning product or system that intentionally contradicts what would normally be considered logical to create given the norms of design" (p. 1). By consciously countering norms, the idea is that it is possible to study "alternative existences (or what-ifs) as lived-with realities" (p. 1). Wakkary et al. (2018) provide an analysis of the human-technology relations that the Tilting Bowl gave rise to, and show how the findings demonstrate the relevance of the postphenomenological perspective to "fundamentally and broadly understand how people engage digital artifacts" (p. 1).

Hauser et al. (2018) describe the deployment of another counter-factual artefact, the Table-non-table, a table-like structure made up of a stack of 1000 sheets of white paper on an aluminum chassis, that moves in a small radius a few times each day. By reflecting on how their interpretations of the artefact evolved over time through several field employments, the authors critically discuss the relationship of theory and design artefacts in HCI. By providing an in-depth account of their reflections throughout the deployments, the authors display how empirical studies' theoretical groundings "can be enacted and embodied to reveal new insights on a design artifact that, in turn, can shape how studies of it are conducted and analyzed" (Hauser et al., 2018b, p. 10).

Another study on counter-factual artefacts is presented by Wakkary et al. (2017). The researchers applied a thing-centered, material speculation approach to design *Morse things*, "sets of ceramic bowls and cups networked together to independently communicate through Morse code in an Internet of Things" (p. 503). Morse Things were deployed in the households of six interaction design practitioners and researchers for six weeks. After the deployment, a workshop was conducted to discuss the role of Morse Things and "ultimately the gap between things and people" (p. 503). The idea of the study was to highlight how there is not only interaction between ourselves and technologies, there is also interaction *between* our various artefacts. Here, the authors reflect on living with IoT things and provide insights into the gap between things and humans.

In light of these "counterfactual artefacts", we can perhaps find another argument that we are currently transitioning to a fourth wave of HCI. While Wakkary et al. (2018) in their study of the counterfactual "Tilting Bowl" refer to their work as an "argument by example", this display of relevance has similarities to what Bødker (2006) observed in the transition from second to third wave HCI as "artistic statements to provoke us" by "rebels profiling the third wave" (p. 6). Counterfactual artefacts are, as the name implies, artefacts that go against norms of what people would traditionally wilfully design; they are purposefully purposeless (Wakkary et al., 2015). Hauser (2018) also

writes how the table-non-table "was given a specific functionality but which is not in service of human use" and was created to "divert from assumptions around use-centric, utilitarian ideas of technologies and design" (p. 78).

Harrison et al. (2017) writes how "A paradigm shift [...] can be identified when problems and issues that used to be marginalized have moved to the center" (p. 3). As Hauser (2018) writes in her doctoral dissertation, counterfactual artefacts serve to set aside the focus of human-centeredness in HCI as this focus might "obscure aspects of the understanding of humans, technology, and the relations that come about between them" (p. iv). Here, the human-centeredness of third wave HCI is laid aside rather explicitly to let more marginalized and otherwise obscured aspects of human-technology relations come to the center stage, a perfect example of what Harrison et al. purports that paradigm shifts can be identified by. In their paper on Morse Things, for instance, Wakkary et al. (2017) ask what a human-centered approach might hide with respect to the relations we have with technology and explore this through a thing-centered approach to investigate human-technology relations. They argue that there are limitations to the human-centered perspective in designing for IoT and that "a better understanding of the nature of connected things would arise from a better understanding of the complex and ambiguous relations between things and humans" (ibid, p. 504).

In the current postphenomenologically influenced HCI work of counterfactual artefacts acting as "arguments by example"—as in the transition from 2nd to 3rd wave HCI—one might similarly ask how entanglement HCI could move beyond "arguments by example" into "[developing] a productive, reflexive practice..." (Bødker, 2006, p. 6). Time will tell how the potential fourth wave might move beyond the "art-focused breakdowns" (Bødker, 2006, p. 6) acting as proof of philosophical concepts, into discovering how entanglement theories might influence HCI more broadly. As is the case for all potential paradigm shifts, this would involve a broader sedimentation of theoretical understandings of HCI from this perspective, which is exactly what such arguments by example contribute towards.

3. Methodology

This doctoral dissertation presents an account of exploratory research carried out to investigate the feasibility of postphenomenology as a constructive perspective in studying the user experience of Immersive VR. As this dissertation itself purports, this involves seeing the user experience as mediated in user-environment relations. This chapter details the methodology of this research project as a whole and subsumes each research article under their united relevance to this aim. This aim can be formulated more explicitly by re-iterating the research questions of this thesis. Here, the first research question is concerned with how postphenomenology can *inform* our understanding of the user experience and human-technology relations of Immersive VR, whereas the second research question is concerned with how we can *inquire* into the user experience as constituted in user-environment relations.

In terms of the chosen methodology for investigating how postphenomenology can inform and help us to inquire into the user experience of Immersive VR, the research presented in this dissertation is *qualitative*, e.g., the empirical data analyzed has been video recordings of interviews. This qualitative approach is characterized by the use of phenomenological and ethnographical research methods. Phenomenologically, the object of study has been the first-person experiences of the research participants, and ethnographically, the approach has been for the researcher to visit virtual environments that are only really understood by the participants who constructed them and whose relation to the environment is what is of interest for the research.

This chapter discusses the methodology of the dissertation generally in two sections. First, I present my approach of conducting qualitative research, discussing how the qualitative approach relates to (post)phenomenology and ethnographical research methods. Here, I also provide the rationale for the exploratory approach towards answering the RQs. When the overlying methodology has been presented as qualitative and explorative, a methodological overview of the methods employed in each particular study is presented in their respective sections.

3.1   Qualitative Research

HCI research is often qualitative (Subramanian et al., 2021). Due to our complex entanglement with technologies, "there are many complex, socially based phenomena in HCI that cannot be easily quantified or experimentally manipulated" (Adams et al., 2016, p. 138). While, for instance, experimental studies with quantitative measurements certainly could be (and have been) performed to study the effects of a virtually mediated Method of Loci, Article 3 of this dissertation presents a *qualitative* study of the virtually mediated Method of Loci, with a focus on bringing contextual factors to the foreground. Here, I was motivated to look into the complexity of what happens when such a tool is incorporated into the messy everyday of students where factors are hard to quantify. Here, the 'devil in the details' could be at risk of being abstracted through the adoption of a quantified approach. There is also the factor that my research is exploratory, which I detail in the next section. When the overall purpose is exploratory, it can be challenging, if not impossible, to define the right quantitative variables beforehand. The strictness of focus that follows from a quantitative approach, therefore, makes the method incompatible with the rationale behind exploratory research. Concerning user experience and human-technology relations, a quantitative approach might obscure the more subtle details of our experience and engagement with technologies.

Commenting on qualitative research in HCI, Adams et al. (2016) write that "the emphasis is not on measuring and producing numbers but instead on understanding the qualities of a particular technology and how people use it in their lives, how they think about it and how they feel about it" (p. 138). As an example here, Article 1 explains how user experience in studies is usually approached by measuring closely interrelated aspects as isolated psychometric variables, e.g., presence and virtual embodiment. The utilization of numeric variables to measure experience is then distinguished from a qualitative approach where the experience is understood from the perspective of post-phenomenology. Here it is argued that this broader qualitative perspective can offer a more holistic understanding of experience than what isolated constructs can offer. The point is not to replace useful constructs such as presence and embodiment, but to highlight what can be gained by also seeing the mediation effects through a qualitative lens where the presence and embodiment of the user is approached in terms of how they take part in mediating a particular user-environment relation. Thus, the qualitative approach attends to the same experience but under another lens, describing it *in terms of* the arising subjectivity and objectivity in experience.

3.1.1 Exploratory Research

Within the overarching qualitative research framework, the research presented in this dissertation carries a strong mark of being exploratory. An explorative approach was deemed appropriate because postphenomenological perspectives toward VR technologies are quite new. For this reason, theoretical compatibility was assessed and further enhanced (Article 1), new approaches to the studying of user experience in VR were explored (Article 2), and, in the gathering of empirical data utilizing the VR Go-along method and the postphenomenological framework (Article 3), the approach was open and explorative in order to gain a broader understanding of issues and opportunities at this preliminary stage. The exploratory nature of the study in Article 3 was also deemed appropriate due to the lack of previous research on VMPs in real-life settings, where postphenomenology can provide a clarifying lens for discovering and outlining the implications of context on VMP use as part of a participant's everyday. In this empirical study, instead of having a narrower focus on confirming or rejecting a particular hypothesis, our approach generated a broad set of findings that can be avenues for further research by providing qualitative insight into a particular configuration of contextual technology use. In Article 3, we discuss how our explorative focus even extended to the task of the participants: we wanted to invite them into the role of exploring various trajectories for use, adapting their use approach based on the knowledge they developed by using the VMP in their contexts over time. In relation to the postphenomenological notion of 'multistability', we saw this as an open inquiry-driven approach (Hauser et al., 2018a) allowing the VMP to find its stabilities in context, from which we could gain further directions of research. This means that we did not want the task that we gave the participants to hinder their ability to contribute with their own ideas. In the article, we explain how this approach can be compared to participatory design processes wanting to utilise the participants' tacit knowledge in the exploration of a design or use case, and relate this to Frauenberger's idea of "participatory speculation [methods] to design meaningful relations" (Frauenberger, 2019, p. 22), as well as to the idea of "technology probes" in HCI; artefacts that are defined by their flexibility more than their usability (Hutchinson et al., 2003).

A broader focus is also descriptive of the exploration of the VR Go-along interview in article 2, where we broadly examine the modes of communication that the VR Go-along interview enables in comparison with traditional Go-along interviews. Furthermore, the VR Go-along method is in itself an explorative method for conducting semi-structured interviews, where the mobility allows for spontaneous reactions, ques-

Article	Data Collection	Analysis	Participants	Length
#1	Selective literature review	Theoretical analysis	0	2 years
#2	Go-along interviews	Thematic analysis	10	1 week
#3	Go-along interviews, sit-down interviews	Qualitative mediation analysis	9	8 weeks

Table 3.1: **Methodological Overview of Dissertation**

tions and answers, where the environment in which the interview is conducted can take part in shaping the course of the interview.

Central for the reason as to why the research in this dissertation is qualitative and explorative is that it is concerned with user experience as it emerges in contextualized technological relations.

3.2   Methodological Overview

Having introduced the overall methodological approach towards the research as qualitative and explorative, this section provides a more specific presentation of the research methods employed in the articles comprising this dissertation. The section is divided into three sub-sections respective to the articles.

3.3   Theoretical Development: Article 1

In order to analyze the compatibility of the theoretical perspectives of postphenomenology with Immersive VR mediation, Article 1 presents a theoretical inquiry into how the VR medium is to be understood from the perspective of postphenomenology. This research was undertaken to bring to light the extent to which postphenomenology could analytically and categorically account for the virtually mediated experience of Immersive VR technologies, and is directly related to the research question of how postphenomenology can inform our understanding of user experience and human-technology relations in Immersive VR. The process of inquiring into what human-technology relation that VR constitute was philosophically approached through questions and reflections on lived experience of re-lating to VR. After a theoretical grounding and presentation of postphenomenological literature, the article argues an overarching structure of the human-technology relation that VR technology gives rise to. When the overarching human-technology relation has been presented and argued for, the article goes beyond generality towards presenting and analyzing a variety of particular instances of such user-environment relations, by analysing intervention research postphenomenologically. Here, studies were handpicked to ensure a variety of designs and purposes

within the intervention categorization. Intervention research was chosen because of the great variety in the structured relations that is constituted between the user and the environment by the application. By analyzing such a varied selection of user-environment relations, I avoid treating VR as "one thing" in an ideal way, and rather attend to the multistability of the medium in the way that it can give rise to various "ontological" structuring.

3.4   Methodical Development: Article 2

Beyond the underlying theoretical and foundational questions of postphenomenology and user-environment relations, there is the question of how one should gain access to empirical, phenomenological accounts of Immersive VR mediation. This is directly related to the second research question, which asks how we can *inquire* into Immersive VR user experience as it is constituted in user-environment relations. Article 2 explores and exposits the VR go-along method as part of a pilot study in preparation for the empirical user study described in Article 3. The research was conducted in order to explore methodological and logistical concerns before inviting participants to partake in a larger study.

In postphenomenological inquiries, context is seen as essential. We do not just regard physical and social environments as contexts, virtual environments can also be contexts in their own right. In relation to how experiences and relations must be understood in light of the context in which they occur, we can reiterate the emphasis of the the phenomenological heritage of postphenomenology from philosophers such as Merleau-Ponty and Heidegger, or the pragmatical heritage of postphenomenology from Dewey; what is of interest is not the organism in isolation, or the environment in isolation, rather, it is the organism-environment or the environment-organism, as neither really exist without the other. Thus, in the process of ideating how to gain an understanding of our participants' experiences, a sensible idea emerged that involved observing and interviewing the research participant in the virtual environment of interest. This is of relevance to the user experience of VR in particular, but also human-computer interaction in general. Take for instance the study of embodied interaction. As is discussed in the article, Luff et al. (2013) argues that conceptions of embodied interaction that is only considering the bodily interaction is insufficient as the interaction takes place *in relation* to the environment (Luff et al., 2013). Similar motivations was what sparked researchers, in ethnographical studies, to conduct "Go-along" interviews, where the participant is not removed from the context of relevance—but immersed in

it—during the interview. The approach of conducting VR Go-along interviews can therefore be seen as studying, i.e., observing and querying the "user-environment". To investigate the feasability of VR Go-along interviews to inquire into the user experience of being in, and interacting with, Immersive VR, we conducted ten such interviews in VR and analysed modes of communication thematically. The analysiswas performed using inductive coding in a bottom-up approach, meaning that we did not have any pre-conceived theory or categories after which we evaluated or sorted the data in the analysis. The guiding focus in the analysis was how the participants chose to communicate about their experiences. In analysing the video material, we were able to assess what kind of data we could get by utilizing the method, and whether the approach would enable us to study the participants' experiences as they exist and emerge in their relation to the virtual environment.

3.5   Empirical Research: Article 3

In the final research article of this dissertation, an empirical study was conducted to investigate the potential roles that Immersive VR Memory Palaces can serve in the everyday of students. In contrast to the pilot study where the participants had only one week to interact with the virtual environment, this study spanned across eight weeks. This increased lapse in time was made in order for the participants to have time to develop a genuine relationship to the environment while trying to use the application constructively as part of their everyday. This we regard as a timely exploration of what role Method of Loci-adaptations can serve outside of the lab. As has been demonstrated in previous research, VR adaptations of the Method of Loci are effective for memorizing information. Based on shorter, in-lab exposures, however, we can not learn about the viability of using the tool as part of students' everyday. In order to extend our knowledge on the potential of this tool, I chose to perform an in-the-wild inquiry (Chamberlain et al., 2012), which allowed a whole new set of challenges and criteria to emerge for exploration. An in-the-wild approach was chosen out of interest in how this tool would find its role in relation to everyday practices. By conducting the research over a longer period of time, we were also able to eradicate any 'honeymoon phase' or 'novelty effect' from our findings; the increased timelapse and choice of context allowed the tool to show its hurdles just as much as its opportunities, as they arose in the (sometimes failed) incorporation into the everyday of the students. In studying the impact of a particular technology on the lifeworld of human beings, studying the application in its relevant context is of the essence. By conducting the research

in-the-wild, participants could use the tool in their home over an extended period of time, where this time horizon allowed the task to be conducted as part of their every-day. This is a radically different setting than shorter, in-lab studies where participants are set to memorize a given number of arbitrary items. Using the tool over time as part of their everyday requires a different kind of involvement—a projectuality towards the virtual environment—where the participants project (or fail to project) themselves towards the virtual environment and incorporate (or fail to incorporate) the tool into their everyday.

The data gathering process comprised four interviews with each of the participants; one physical interview at the start when they picked up their equipment, two VR Go-along interviews at different intervals of the study period; and one final, closing interview when they handed in their equipment. The first interview was held in the beginning of the study, when the participants came to pick up the head-mounted display. Here, the objectives of the study were presented as well as the logic and rationale behind the Method of Loci. We also highlighted that our interest would not be in a strict measuring of memory retention, rather, our approach was explorative and qualitative.

The first VR Go-along interview was conducted in the virtual environment after 4 weeks, after the students had had some time to get going with their task. The second VR Go-along interview was conducted after they had had the equipment for 8 weeks. These interviews were semi-structured where we used objects and their creations in their VMPs as cues for the conversation, in addition to more overall questions of how they found the process to be, when they used it during the day, etc. The final physical interview when they handed in their equipment was more retrospective in nature and occurred in the weeks after the participants had stopped spending time in their VMPs. Here, we asked about how they experienced the overall process of participating in the study.

In conclusion, the methodology of this dissertation hitherto presented was chosen in order to exploratorily and qualitatively inquire into how postphenomenology can inform our understanding of, and allow us to inquire into, the user experience and human-technology relations of Immersive VR.

4. Findings and Discussion

Having discussed the methodology for this research project as a whole, this chapter presents a summary of the articles with an emphasis on the results, findings and contributions. The findings of each article is presented in their respective sections 4.1-4.3 before section 4.4 presents the contributions of the project as a whole by engaging in a discussion of the research questions presented in Chapter 1. Here, the chapter enters into a broader discussion of the relevance of postphenomenology for inquiring into the user experience of Immersive VR based on the findings that this dissertation presents. Finally, a discussion of the epistemology of postphenomenology and its relation to HCI is presented in order to situate the contributions and knowledge claims of this dissertation.

4.1   Theoretical Findings & Contributions

Article 1 (Vindenes and Wasson, 2021a) analyzes the user-environment relations of Immersive VR interventions: virtual worlds that have been designed with ontologies radically different from the real world. That these are interventions means that they are designed with the intent of intervening and effectuating positive cognitive changes, effectively "changing the self". Metzinger (2018) writes how "... VR technology has the potential to increasingly *change* what many philosophers, including Edmund Husserl and Jürgen Habermas, have traditionally called the 'life-world' of human beings" (p. 14, emphasis in original). As the change of self in these interventions, of who we are in relation to our worlds, is caused by the experience of virtual worlds of differently structured ontologies, the article argues that frameworks are needed for describing and analyzing the relations and mediations brought by various virtual world designs.

The principal contribution of this article is a postphenomenological framework for understanding, describing and analysing relations and mediations brought by Immersive VR technologies. In order to lay the grounds for this framework, postphenomenology is thoroughly introduced before a discussion of what human-technology relation VR constitutes is provided. Through this discussion, it is shown how VR constitutes an

overarching embodiment-alterity relation which we refer to as *a user-environment relation*: part of the medium is embodied and takes part in altering the user's subjectivity, and this 'virtual subjectivity' (Gualeni and Vella, 2020) stands in relation to the alterity of the environment. The user does not just stand in a relation to the virtual environment, however; she is 'doubly situated'; as human, her experiences in the user-environment relation also alters her relationship to the real world. In this way, the mediations occur *within* VR as a user-environment relation and *outside* VR as an altered human-world relation. This general structure of user-environment relations is substantiated by an analysis of a variety of VR intervention applications that show various ways in which the subjectivity/embodiment and objectivity/alterity poles can interrelate, most notably subjectivity-objectivity synchronizations and subjectivity-objectivity inversions.

Through this analysis of user-environment relations, the article contributes a display of the compatibility and analytical suitability of postphenomenology to account for the experiential constituents of the virtually mediated experience. It displays various ways that Immersive VR can structure experience in terms of what is embodied as subjectivity, what is related to as objectivity, and how these two poles can interrelate in various ways. In the overarching methodology of this dissertation, this study lays the groundwork that demonstrates the compatibility of postphenomenology and the study of user experience in VR. The article illustrates the potentially constructive role that postphenomenology can serve in VR research on user experience, and contributes new postphenomenological categories of human-technology relations.

4.2   Methodical Findings & Contributions

In article 2 (Vindenes and Wasson, 2021b) an adaptation of the Go-along method for Immersive VR is presented. The traditional or non-mediated Go-along interview is "a form of in-depth qualitative interview method that, as the name implies, is conducted by researchers accompanying individual informants on outings in their familiar environments, such as a neighborhood or larger local area" (Carpiano, 2009, p. 5). In other words, the method is used to provide a contextualized understanding of a participant's experience as it emerges in their relation to a place.

The principal contribution of this article is the outlining and demonstration of the 'VR Go-along method'. Thus, the article explores an adaptation of the Go-along method to Immersive Virtual Reality. The article starts by situating the method through a comparison to other contextual inquiry methods in HCI, such as think-aloud protocols, psychophenomenological elicitation methods, and other ethnographic research

methods. The method is then demonstrated by performing ten Go-along interviews in Immersive VR in self-created Virtual Memory Palaces that participants had used for one week. Video recordings from the interviews were thematically analyzed based on participants' modes of communication, from which three themes in how our participants chose to communicate in the VR Go-along interviews were identified: (1) demonstrating interactions; (2) referencing virtual content; and (3) non-verbal communication. Generally, our findings show how the interlocutors' shared presence in the virtual environment established a common ground beneficial for communication. By conducting the interviews co-located in the immersive environment, our participants could spontaneously demonstrate interactions, and, by providing a guided tour of their VMP for the researcher, the participants could show us objects and locations in their VMP relevant to their experience. The analysis of the ten conducted Go-along interviews revealed the approach as beneficial for gaining an understanding of the users' experiences with, and their subsequent developed relations to, the virtual environment.

In order for the article to introduce the VR Go-along method thoroughly, we explicitly state the tenets of the method as we have come to understand utilize them, as follows: (1) The researcher should be immersed together with the participant in an environment of relevance; (2) The researcher should move around together with the participant in the virtual environment during the interview and be open to the possibility of the environment informing and shaping the interview; and (3) The researcher's role should be that of a visiting guest, and the focus should be on what the environment means for the participant. In addition to these tenets, the article contributes recommendations based on our own experiences of conducting VR Go-along interviews. Here, we advise researchers to (1) keep a loose structure, (2) having a checklist as a backup, (3) utilizing the mobility across the environment or the interface, and (4) being aware of nonverbal communication. These recommendations are detailed and nuanced in the article itself.

Beyond the analysis of modes of communication during our Go-along interviews, the stated tenets and recommendations, the article substantiates its contributions by presenting an epistemological discussion in regards to whether information retrieved from an embodied user in Immersive VR is comparable to information retrieved from a physically present participant co-located with the researcher. Here, it is clarified how this depends on the research questions involved and whether they are concerned with 'virtual subjectivities' and virtual worlds as such. We also detail how this depends on the configuration of the medium in question.

The contribution of this paper, i.e., the rationale, exposition and demonstration of

the VR Go-along interview, is particularly relevant for researchers conducting studies in which the digital context wherein the participants are immersed is important for situating their experiences. Examples highlighted in the paper include remote work collaboration, VR learning environments, cultural heritage, virtual tourism, as well as emerging social VR worlds such as VRChat and Altspace VR. Beyond this, the method can be fruitful for researchers studying embodied interaction in virtual environments as the method allows for the researcher to observe the users' interactions as embedded in the virtual environment. The article shows the method as a promising tool for eliciting contextual, phenomenological accounts of virtual environments.

4.3   Empirical Findings & Contributions

Article 3 describes an in-the-wild study where students used an Immersive VR Memory Palace over the course of eight weeks. As research on VMPs is traditionally performed in the lab, this kind of research cannot facilitate any deeper involvement with the lives and everyday practices of the research participants. In these lab studies, what is memorised by the students (and often even the associations to each mnemonic item) are already decided by the researchers, which narrows the scope of the human factors being studied. Here, participants are not given enough time to develop a relation to the virtual environment. Also, as emphasis is placed on having similar environments and loci for all participants for experimental control, participants cannot initiate a self-actualised project within it, and they are denied the possibility of making the task "their own". This stands in contrast to how the Method of Loci is traditionally performed, where the VMP is uniquely personal, and the participant feels ownership of their creation. It was our intention to address these limitations in our research, and for this reason, we conducted an open and explorative study of VMP use, where the participants dictated their own use of the VMP as part of their everyday study routine over eight weeks.

The principal contribution of this article is the insight it provides into the becoming of a VMP in a context of a self-initiated study regimen. This 'becoming', however, is complex and multistable. While we illustrate the experiences of participants who utilized the VMP constructively as part of a study process, many participant stories also give insight into the various challenges that arise when VMPs are employed in the ecology of tools in students' day-to-day study setting. Put simply, in analysing the interviews, we found that there was a large variety in our participants' experiences. In short, about half of the participants were able to develop a satisfactory relationship towards their VMP, whereas for the other half the experience of attempting this was

frustrating and without success. In order to make sense of the disparity of these re-
sults, the article discusses the participants' diverging experiences and relations to their
virtual environment in light of postphenomenological theory, drawing on the insights
from Article 1. The discussion culminates in the identification of *hermeneutical re-
lations* as a central topic for self-initiated construction of personal VMPs. Here, we
argue that the creation of hermeneutical relations must be seen in light of how the par-
ticipants experienced the affordances and constraints of the system experienced from
the standpoint of the embodied user. This embodied immersion is also of relevance to
their physical context: in VR immersion, the world and the general study context of
the student becomes inaccessible. The student has to achieve her goals *with* the tech-
nology and the limited options that it represents; in embodying the user role she has a
composite intentionality, and this composite intentionality was experienced differently
between the participants. For some, their composite intentionality as users in the VMP
was conceived of positively as *inviting* this particular kind of engagement, while others
experienced it as *inhibiting* the kind of engagement that they sought with the VMP.

What is brought to light here, beyond the insight into the use of VMPs over time in a
context of self-initiated studying, is the difference that our adaptation of the Method of
Loci makes. As participants do not just "read" associations/loci made by researchers—
they also construct these hermeneutical representations themselves—the relation to the
VMP is quite different. For this reason, we discuss *writing relations* as a critical issue
to be attentive to when designing new adaptations of the Method of Loci to VR.

In conclusion, the contribution of this article is the insight it provides into the be-
coming of a VMP in a context of a self-initiated study regimen, but also our discussion
of factors relating to an (un)successful constitution of a hermeneutical relationship to
VMPs.

4.4   Contributions of the Dissertation

The aforementioned findings and contributions present a preliminary and multi-angled
investigation into the potential for postphenomenological perspectives to elucidate the
user experience of Immersive VR as mediated in user-environment relations. The next
section reiterates the RQs and engages in a discussion of how these findings can help
illuminate the potential of postphenomenology for understanding and inquiring into the
user experience of Immersive VR.

4.4.1   Research Questions

In chapter 1, the research questions of this dissertation were framed as follows:

1. How can postphenomenology inform our understanding of the user experience and human-technology relations of Immersive VR?

2. How can we inquire into the user experience as constituted in user-environment relations?

In the following sections, the RQs will be discussed in their respective order based on the findings reported in this chapter.

4.4.2   RQ1: Understanding

As for the first research question of how postphenomenology can inform our understanding of the user experience and human-technology relations of Immersive VR, it is primarily our findings from Article 1 that are relevant. Here, we show how postphenomenology can bring nuance to the analysis of the ontological complexities that come with the use of Immersive VR technologies. In order to lay the foundation for such an understanding of Immersive VR mediation, the article analyzes the technology of Immersive VR in light of identified human-technology relations from postphenomenological literature. Here, it is shown how the human-technology-world relation of VR comprises both an embodiment relation *and* an alterity relation, i.e., in the embodiment of the VR technology, a user is constituted, standing in an intentional relation to the virtual environment, with the world in the background. Through the analysis provided, the framework demonstrates various *user-environment relations*, i.e., various ways of standing as situated users in relation to the virtual environment. The postphenomenological framework presented in Article 1 is also utilized in Article 3, where it is employed in empirically analyzing the human-technology relations of self-constructed Virtual Memory Palaces.

I argue that by allowing the conception of user experience as mediated in user-environment relations, postphenomenology can aid researchers in approaching a deeper understanding of the intricacies of Immersive VR mediation. The most illustrative example of the interplay between user-environment and human-world is perhaps the example in section 3.3 in Article 1, which describes the virtually recreated Milgram Obedience Scenarios. Here it is described how the study participants are doubly situ-

ated as both real and virtual participants. This entails that they, as both real and virtual participants, stand in relation to both real researchers and virtual researchers, an illustrative example of the nested subjectivity that the article argues for. By bringing to light the intricacies involved in terms of participants' virtual subjectivities as they enter into the user role, as well as the relation that is developed from their situatedness in both natural and virtual environments, I argue that postphenomenology can inform our understanding of the user experience of Immersive VR technology in a more holistic way that goes beyond what more isolated constructs can offer, and hence, prove to be a complementary focus.

So far, several researchers have already drawn on the insights from Article 1. In the first chapter of their anthology *Sonic Interactions in Virtual Environments*, editors Geronazzo and Serafin (2023) write how the "relationships between the listener, physical world, and virtual environment (VE) should be [...] discovered to make sense of the mediating action of VR technologies" (p. 3). The article posits a theoretical framework for the egocentric perspective of the auditory digital twin, where it is understood postphenomenologically, and situated in Entanglement HCI. In reference and likeness to Article 1, the authors present a re-adaptation of Hauser's illustration of technological mediation, where the auditory twin is seen as a mediator, not between user and environment as in Article 1, however, but between "listener" and "real/virtual environment." Here, the auditory digital twin acts as a mediator, and this mediation involves a "listener's ongoing reconfiguration through the human-world relationship occurring outside the VR experience" (p. 14). Here, we see the insights from Article 1, i.e., the understanding of VR technologies as mediators giving rise to user-environment relations, extended and more particularised for auditory perspectives through their introduction of a *listener-environment relation* (p. 17).

Another example of the framework being used to aid in the understanding of mediation is presented by Obreja (2022). His article analyses "kill cam" features of first-person shooters postphenomenologically by attending to their mediation effects. In reference to our work on user-environment relations generally, and subjectivity-objectivity inversions in particular, he writes how in the kill cams code, the "...need to observe a faithful representation of one's own death through the eyes of the killer confirms the postphenomenological feature of subjectivity-objectivity inversion, whereby the self (initially fully controllable) now becomes an exterior object, observed in the third person" (Obreja, 2022, p. 4). Through this inversion, the player stand in position to hermeneutically interpret their own death; the kill cams "provoke players to a bodily rethinking of death and failure" (Obreja, 2022, p. 1). We should note that Obreja is

not concerned with first-person shooters mediated through VR; however, there is structurally a subjectivity-objectivity inversion taking place, although the embodiment and the resulting sense of presence may be weaker in non-immersive games.

As I see it, a true demonstration of the potential of postphenomenology to aid in the understanding of virtually mediated experience is still dependent on its further utilisation in empirical user studies. In addition to my own work in Article 3, Montoya et al. draw on the ideas of subjectivity-objectivity synchronization from Article 1 in their paper depicting the design of playful water experiences through floatation. Here, the authors engaged in a soma design process, which "could be ideal for designing engaging interactions to encourage a feeling of being one with the system, in [their] case, being one with the water through the system" (Montoya et al., 2022, p. 121). Here, "VR designers match the perception of virtual water with real water" (Montoya et al., 2022, p. 123). It is particularly designing for increased breathing awareness which can be classified as a subjectivity-objectivity synchronization here, where "visuals related to water, such as ocean waves and water drops, could be synchronized with the user's breathing" (Montoya et al., 2022, p. 124), similarly to the many studies cited as subjectivity-objectivity synchronizations in Article 1. Here, we see not only how the postphenomenological framework can be used to *understand* VR mediation, it can also aid in the *ideation* of the intended user-environment relations that one wants to design for.

The article by Montoya et al. is only preliminary, however; to explore the user experiences proposed in the work, the authors will conduct a study where participants are introduced to floatation tank sessions with technological enrichment, whereupon their experiences will be qualitatively assessed.

4.4.3 RQ2: Inquiry

As for the second research question of how we can inquire into the user experience as constituted in user-environment relations, it is Article 2, which presents the VR Go-along interviewing method, that is the most relevant. Article 3, however, substantiates this contribution by illustrating the use of the VR Go-along method to gather empirical data for answering research questions that do not turn inward towards the VR Go-along method itself.

As we highlighted at the start of this chapter, the VR Go-along method allows the study and querying of a user situated in a virtual environment. A way to frame the benefits of the method is by drawing attention to how the method allows the user and the researcher to be more *precise* in their speech during the interview. For example, the ar-

ticle discusses the extent to which participants' utilized *deixis* in their communication, i.e., sentences with referring language such as "this", "that", and "there". Due to the extent of deixis, the written transcripts from the interviews would be rather meaningless without annotations as the participants heavily relied utilizing the virtual environment as a common ground to benefit the communication towards the researcher.

Beyond the 'interview' aspect of the data gathering method, the Go-along also focuses on observation. While, for explicit communication, the participants frequently utilized the freedom of being in the environment to gesture communicatively, point and refer to content as well as demonstrate interactions, more implicit communication such as where they redirected their gaze and how and where they positioned themselves in the environment, also benefited the communication. Further, while the participants might use the presence of the virtual environment as 'props', for the researcher, the virtual environment was more present as 'prompts.' Particularly in the empirical study presented in Article 3, entering into the participants' VMPs was an experience of entering into an odd conglomeration of objects, the connection of which was seen as unintelligible. In these cases, the researcher could simply ask what this meant for the participant, which kept the conversation rolling. By having visual cues to how the participant had conducted their task, it was easy to incorporate these topics into the interview itself as a means to understand what the virtual environment was for the participant in her relation to it.

These points, I argue, position the VR Go-along method as a promising method for inquiring into the user experience as constituted in user-environment relations. The relation itself—what the environment is *for* the participant—is what is of interest, and by conducting the interview in the environment with the participant in lead, the method approaches the environment through the relation that the participant has toward it. Due to the emphasis on the participant as the "tour guide" and expert of her own domain, the method can further aid in dissolving more traditional power dynamics between researcher and interviewee that may be inimical for the participant to freely share what the environment is *to them*.

Of course, in answering how we can inquire into the user experience as constituted in user-environment relations, a point could be made that any inquiring approach is likely to gather relevant data. It seems reasonable to expect, therefore, that the proposed method should be proven to be better in some respect than traditional approaches for us to have positively answered the RQ. Although we did not conduct an experimental study comparing VR Go-along interviews to regular, physical sit-down interviews, some differences in outcome can nevertheless be grasped without the need of a control

group. The way our participants utilized their presence in the environment to demonstrate interactions with the virtual environment in situ and point and refer to the virtual content around them would not be possible in a regular sit-down interview. In that setting, the participant would have to retrospectively provide verbal descriptions of the virtual environment and her interactions within it. Even with the use of 'prompts and props' in regular sit-down interviews, there is still a distinction between said approach and VR Go-along interviews. In VR Go-along interviews, the environment itself, which for the participants were contextually laden with meaningful associations, can be present in order to inform the interview, and in comparison with props as they are used in traditional sit-down interviews, in the context of a VR Go-along interview, these are not removed from the context to which they belong; they are situated in place.

To truly verify the potential of the VR Go-along method to allow the inquiry into the user experience as constituted in user-environment relations, however, more studies are needed. For our purposes in Article 2 and 3, the method was a particularly good fit as we studied the use of a virtual environment that only made sense to the participant as it was a personalised VMP. Here, the idea of a 'guided tour' led by the participant was particularly relevant. Since its publication, however, the VR Go-along method has been utilized for the performance of design reviews in the multiuser participatory design of the 2022 Nordic Pavilion Exhibition at the Venice Biennale (Reaver, 2022). Here, Reaver (2022) found that being in MR when conducting interviews enabled the participants to provide a guided tour and showcase "relevant design suggestions and view corridors within the space and the exterior environment" (p. 18). More generally, "testing in MR first allowed for several vantage points to be better understood by curators and artists and had a significant impact on the final design" (Reaver, 2022, p. 11). Architecture and design, therefore, also appear as promising points of exploration in which the method can serve a beneficial role.

In exploring the potential of the VR Go-along further, it would be particularly interesting to see accounts and perspectives from researchers studying emerging cultures in virtual social worlds. Here, the meaning of a space is more distributed and constituted intersubjectively. Studying virtual social worlds would be quite a different context than a researcher and interviewee going alone to a place that has been solitary for the participant and could reveal other advantages, as well as disadvantages, of the method.

4.5   The Epistemology of Postphenomenology in HCI

In presenting the knowledge claims of this dissertation, it is natural to clarify to which degree and in what sense I claim to contribute to the advancement of knowledge in the field of HCI. In answering this question, I will build on the phenomenological heritage of postphenomenology introduced in chapter 2.

In chapter 2, it was described how the interrelational ontology that Husserl aimed at became more concrete with Heidegger's Dasein as "being-in-the-world." What became increasingly clear with Heidegger was the anti-essential view of *nonrepresentationalism*. This view rejects "the grounds for any representationalist and *correspondence notion of truth*, by dissolving transcendental/empirical distinctions" (Ihde, 2016, p. 109, my emphasis). This view is posited even further in the pragmatic phenomenology that is postphenomenology. Ihde writes how "the pragmatist program succeeded in avoiding precisely the 'subjectivist' cast which Husserl's too-close use of subjectivity, philosophy of consciousness, and subject/object language could not avoid" (Ihde, 2008, p. 4).

For postphenomenology, its ties to pragmatism is also of relevance for its epistemology. While we have not introduced much of postphenomenology's pragmatic heritage, it should suffice for our purposes to describe pragmatism as a philosophical tradition that "understands knowing the world as inseparable from agency within it" (Legg and Hookway, 2021, p. 1). Rather than isolating objects from experience, postphenomenology "take it to be much more like the Deweyan concept of a contextual, interrelational process akin to an ecological organism-environment notion..." (Ihde, 2016, p. 111). It is nonsubjectivist in that it does not separate experience into the 'internal' and 'external' as a subject-object split: "Rather, something more like organism-environment with both 'private' and 'public' features operates instead" (Ihde, 2016, p. 113). In our case, this relational understanding can be identified in the holistic perspective that sees user experience as taking place in user-environment relations.

Given this introduction, we might ask on what epistemological basis postphenomenology grounds its claims about how humans relate to technologies. In answering this, we should note that postphenomenological inquiries do not "claim to discover something's true metaphysical nature or form" (Rosenberger, 2017, p. 472). Postphenomenological inquiries must be understood as situated and this also goes for the knowledge they generate: "all knowledge claims are understood to be inherently context laden, perspectival, and made in relation to human problems" (Rosenberger, 2017, p. 473). For instance, Rosenberger (2017) writes how Ihde's understanding of em-

bodiment and transparency "can be understood as Heidegger minus the radical critique of the entirety of Western metaphysics, and repackaged for the purpose of the providing practically-oriented descriptions of user experience" (p. 476). In this way, post-phenomenology "should ultimately be judged in terms of the practical contributions it makes to concrete issues in technology, design, usage, and policy" (ibid, p. 479). This is again pragmatic. In terms of knowledge, the "positive claims made by postphenomenological studies should always be understood as relative to an investigatory context" (Rosenberger, 2017, p. 481). In answering on what grounds the non-foundational postphenomenology has its basis in, Rosenberger (2017) writes that "postphenomenology should be understood to make claims about *particular stabilities* by virtue of the contrasts that can be drawn with *other particular stabilities* (p. 486). Even in the case of so-called "invariant" structures that postphenomenology may claim to identify, these are not invariant apart from a context of investigation. Rather, "postphenomenological claims should always be understood as posed from a particular subject position, and posed within a particular context" (ibid, p. 487). As an example, Rosenberger shows how Ihde's classic examples of multistability in the perception of Necker cubes rely on certain contextual rules. In short, it does not say anything about the object as separate from the context in which the stability was identified. Here we can return once again to the notion of an *onto-epistemology* where "any knowledge production is tied to this intra-action and the resulting phenomena, i.e., knowledge production is a material practice that produces facts that are reliably performed within given configurations" (Frauenberger, 2019, p. 15).

So while the inquiries indeed can be said to generate knowledge, this knowledge must be seen as situated within the practical involvement of the problem it tries to solve. It is in this way non-foundational and does not attempt at reaching objectivity in the foundational Husserlian sense. Vandermause and Fleming (2011) describes phenomenological research as follows: "Phenomenology grounded in the Heideggerian-Gadamerian tradition represents a shift from an epistemological emphasis on understanding essences and seeking universal truths to an ontological understanding of a person's being-in-the-world" (p. 369). The aim is to describe and understand the varying meaning of people's lifeworlds and how technology impacts their impression of, experience of, and engagement with, the world.

This does not mean, however, that postphenomenology posits a fundamentally relativistic philosophy. In an exceptionally clear passage in his book *What Things Do*, Verbeek (2005) distinguishes the "middle way" that postphenomenology posits:

"From the postphenomenological perspective, reality cannot be entirely re-

duced to interpretations, language games, or contexts. To do so would
amount to *affirming* the dichotomy between subject and object, with the
weight merely being shoved to the side of the subject. Reality arises in re-
lations, as do the human beings who encounter it. Only in this sense is
postphenomenology a relativistic philosophy—it finds its foundations in re-
lations" (p. 113, emphasis added).

Thus, postphenomenology is not a subjectivist philosophy. Nor is it a positivist phi-
losophy that asserts that any true objectivity can be reached. As phenomenology itself
asserts, "any description of reality cannot avoid being a rationale, explanation or con-
stitution" (Verbeek, 2005b, p. 107). While this might seem counter-intuitive to the idea
that the things "themselves" can be reached, Verbeek (2005) goes on to clarify how
the things themselves which phenomenology so often claim to approach and describe
is, in fact, always grounded in relations: "Merleau-Ponty does not, then, describe the
world, but rather the way in which human beings comport themselves to it. The 'things
themselves' that he addresses appear to be not the things of the world but rather the
relations between human beings and the world." (p. 108, emphasis in original). Post-
phenomenology attempts to more clearly elucidate this nuanced perspective of having
its foundations in relations, and so Verbeek (2005) defines the "world" that postphe-
nomenology speaks of as "reality as disclosed by human beings" (p. 108).

This view has implications for how we understand and relate to VR technologies.
If we subject virtual environments to Merleau-Ponty's phenomenological understand-
ing of place, we can not imagine virtual environments as something isolated, as an
"object" existing in a non-relation. 'Space' for Merleau-Ponty is an existential space
different from the geometrical space; it is a space of action and intentionality with a di-
rect meaning. We can also phrase this point with emphasis on the human; the human
is not a detached subject. For instance, for Merleau-Ponty, a human playing an organ
does not *receive* sense data for processing and then 'later' *outputs* an action. The or-
ganist *installs* himself in the organ, and establishes an existential, intentional *relation*
to the musical instrument.

As I have similarly argued in this dissertation, when humans embody situated
avatars in relation to the virtual environment, there is not a clear-cut line between sub-
jectivity and objectivity in the experience; they must be understood as they emerge in
their relations. This is relevant once again for epistemology, and we can return again to
the onto-epistemology of Barad (2007) in which knowledge production must be seen
as part of the intra-action of humans and technologies. In a research setting, this natu-
rally also involves a researcher; as researchers, we are also situated, and the knowledge

that we take part in generating must be seen in the context of our engagement with the challenges we try to solve.

4.6 Phenomenology

Having discussed the epistemology of postphenomenology, this section dedicated to a discussion of what a phenomenological perspective means in the context of Immersive VR. As it is the aim of this dissertation to investigate how postphenomenology can aid our understanding and inquiry into the user experience of Immersive VR, this section presents a discussion of how the employed research methods can be said to honour the postphenomenological commitment of relating to personal accounts of experience from a first-person point of view, as well as what this entails. This is performed through two sections. First, I situate my research in relation to phenomenological perspectives on place. Second, I present a discussion which contrasts my (post)phenomenological approach from more objective, quantified approaches to the study of user experience in Immersive VR.

4.6.1 Phenomenology of Place

In his *Phenomenology of Perception*, Merleau-Ponty (1945/2002) writes, how "it is possible to know how to type without being able to say where the letters which make the words are to be found on the banks of keys" (p. 166). Here, there is "knowledge in the hands, which is forthcoming only when bodily effort is made, and cannot be formulated in detachment of that effort" (p. 166). This quote is reminiscent of a point made in the introduction of this dissertation. As noted there, phenomenological accounts of place highlight the inseparability of place and human subjectivity. As an example, Trigg (2012), in his *Memory of Place*, discusses "the role the material environment plays in shaping, defining, and constituting our sense of self and world" (p. xvi). Consider, for instance, Trigg's memory of writing the book. In the memory, the act of writing is not recalled as separate from the place, but inextricably bound to it; "As though the two events have formed one image, it is impossible for me to isolate the act of writing from the draft and rot" (Trigg, 2012, p. xiv). His focus on place as something impossible to separate from experience overall, is classically phenomenological. Trigg understands 'lived spatiality' not as "a container that can be measured in objective terms, but an expression of our being-in-the-world" (p. 4). Discussing Merleau-Ponty, he writes how "Places are defined in their relationship with the particular subjects who experience them" (Trigg, 2012, p. 5), and so "... place emerges

as neither a realist nor an idealist concept, but rather somewhere in between" (Trigg, 2012, p. 6).

Trigg (2012) writes:

> "As our bodies reach out into the world, so a mimetic interplay arises, in which our sense of self becomes fundamentally entwined with the fabric of the world. Here, the very things that make up a given place lose their status as "objects" in the world and become an extenstion of the formal structure of personal identity. Being attached to a place means allowing memories to be held by that place" (p. 9).

Phenomenologically, then, due to the lived intimacy between our selves and our spatial environments, "one cannot assign specific phenomena to either person or world alone" (Donohoe, 2017, p. 76). It is by acknowledging this insight that we can conceive of the VR Go-along method, for instance, as a highly 'phenomenological' research method. The insight is that we exist in relations, and the rationale behind the method is that, when this relation is of relevance to the research questions, this relation as it comes forth in the interview is an object of study in itself. In a similar vein, (post)phenomenological perspectives highlight the importance of context in the becoming of technological artefacts. In the case of the VR Go-along, the whole rationale behind the study was to explore contextual interviewing in virtually mediated environments. Here, the VR Go-along method can be a valuable research tool as it can allow non-invasive and logistically simple contextual inquiries, where participants are 'doubly' situated; (1) virtually in the virtual environment and (2) physically in the use-context of the application.

4.6.2   Presence and Immersion: A Phenomenological Perspective

In the previous section, I argued how the research of this dissertation can be said to honor the postphenomenological commitment of relating to experiential accounts from a first-person point-of-view. In order to further clarify what a phenomenological perspective entails, this section presents a central phenomenon that VR gives rise to, *presence*, from a qualitative, phenomenological perspective, while contrasting this with a more quantitative and 'objective' perspective, such as is frequently seen utilized in, e.g., neuroscientific studies. This is done in order to clarify what the different perspectives can bring about in terms of understanding and focus, and will highlight the central role

of intentionality in the postphenomenological understanding of the lifeworld of human beings.

In VR research, the effectiveness of the VR technology in solving a great variety of problems is attributed to its capability of *immersing* the users in computer-synthesized worlds and further establishing a feeling of *presence* in relation to those worlds. What makes VR effective lies in its facilitation of first-person experiences of worlds created for specific purposes. The medium is flexible in this manner due to the distinct representational structure of the medium; the content is presented in mimesis of reality to allow us to interact with and perceive virtual worlds in the same way we interact with and perceive the real world. In short, Immersive VR mediates a world by making the content appear non-mediated; the medium itself withdraws to reveal its content. The immersiveness of the technologies is what allows us to feel present in the computer-synthesized worlds, or as Slater and Sanchez-Vives (2016) define it: "Immersion describes the technical capabilities of a system, it is the physics of the system. A subjective correlate of immersion is presence" (p. 5).

From a neuroscientific perspective, Immersive VR can be said to be immersive and likely to generate a feeling of presence, i.e., place illusion (PI), to the extent of the sensorimotor contingencies of the system. Slater (2009) defines *valid sensorimotor actions* as "those actions that consistently result in changes to images (in all sensory modalities) so that perception may be changed meaningfully" (p. 3550). Currently, Immersive VR supports natural head orientation in the virtual environment very well so that changes in the participant's visual field are altered upon turning one's head. Slater (2009), however, writes: "suppose the participant reaches out to touch a virtual object, but feels nothing because there are no haptics in this system. Here, the reaching out to touch something is not a valid sensorimotor action..." (p. 3550). In this way, for Slater (2009), the differentiation between immersion and presence can be drawn meaningfully by accounting for participant behaviour. Slater (2009) further explains how it is possible to conceive of two users in the same IVR system that experience different levels of PI based on their exploration and behaviour in interacting with the system: "PI occurs to the extent to which participants probe the boundaries of the system—the more they probe, the greater the change for PI-breaks" (p. 3552). We do not yet have ideal VR systems that can fully afford all our sensorimotor contingencies. Thus, place illusion is constrained by the extent to which the system can afford our carrying out of sensorimotor contingencies and dependent on the degree to which the participant actually carry out these.

Attending to the same problem and example from a phenomenological perspec-

tive is illustrative of the perspective that this research adopts. Here, I argue that, from a phenomenological perspective, place illusion, or the way in which one experiences presence, is affected by the degree to which one has developed a relationship with the virtual environment as such. From a phenomenological perspective, we could say that applications often signify *affordances* that they cannot deliver. When the virtual environment can no longer afford what it naturally signifies, a breakdown in presence occurs, the result of which is that the user sees the actual affordances of the virtual environment, i.e., the extent to which she can retain the embodied relationship she has to the real world also in VR. Thus, when users have yet to develop a relationship wherein she sees the virtual environment as such, the virtual environment is seen as something that it is not. Someone who does not 'test the bounds of the simulation' in the same way, or is in an ideal VR system (or application) wherein the world does not signify affordances that it can not deliver, would thus suffer fewer breakdowns. Here, what for Slater is described as PI-breaks, is for the phenomenologist understood as a breakdown of the embodiment, or, for the postphenomenologist, seen as a re-structuring of the user-environment relation, where the environment is no longer revealed through embodiment.

This notion of breakdown can be understood quite literally as the dissolution of the illusion, however, it is phenomenologically strongly related to Heidegger's notion of a breakdown in embodiment as posited in his tool analysis in *Being and Time*. When one embodies a tool such as a hammer, the hammer itself withdraws and is that *through which* one interacts, and one's attention is on the world, or, more specifically, the nail. When the hammer breaks down, however, *when it ceases to be a hammer*, the object is seen for what it is as an object. When it is no longer embodied, or, to paraphrase Merleau-Ponty, *when it is no longer incorporated into one's bodily schema*, we negatively perceive its background dependencies. In Immersive VR, the breakdown is similar in structure. The Immersive VR system is embodied; we act *through* it towards the content it represents. When, however, the medium can no longer support the users' intentional engagement with the virtual world, it breaks down. When this embodiment fails, through our exploration of the bounds of the mediated experience, what was previously embodied is now revealed as a thing, and that which was withdrawn to reveal its content now overshadows the worldhood of the content. It becomes clear what it is and to what degree it can support our actions, and we do not interact with it with the same good faith of believing that our hold over our physical environment is also relevant to what is virtual.

The relationship between interactive probing and the discovery of the quality of

one's relationship as an embodied user to the virtual environment can also be approached negatively. We could, for instance, argue that *no* probing of the VR system whatsoever would be inimical to developing a place illusion, as it is constituted by the (quite immediate) hold which the participant discovers she has over the virtual environment: "Phenomenologically, perception is not passive but active; holistically, it is bodily interactive with an environment" (Ihde, 2009, p. 15). The same principle would also be valid for our bodies and, therefore, our virtual embodiment: "...the perception of the body and of objects in contact with the body is vague when there is no movement" (Merleau-Ponty, 2002, p. 214).

To further clarify the emphasis phenomenological accounts put on intentionality, we can turn to yet another example from Slater (2009) that can be contrasted or compared to the phenomenological perspective. While Slater (2009) regards PI as binary, i.e., as an either-or situation, he holds that PI can differ in different modalities. He discusses the example of a person in a virtual world engaged in a conversation with someone around him in the real world, where he has an "unbroken PI in the visual sense, while simultaneously having a conversation with someone who is outside the virtual environment" (Slater, 2009, p. 3555). There is then no PI in the auditory domain, whereas there is PI in the visual sense. From the phenomenological perspective, this can be illuminated through the notion of intentionality: we direct ourselves toward the natural world through our ears, but we can continue our engagement with the virtual world, just as you can speak on the phone while doing the dishes. However, what does 'no PI in the auditory domain' say about the human experience? Do our senses live different lives, and where is the subjectivity in this? Is a binary, sensory-isolated approach helpful in describing what is occurring experientially here? If I hear my wife talking to me while I am in VR, I become aware of my physical surroundings in more than merely the auditory domain. I direct myself towards the world that the sounds speak of, and this is not just a sound but a world in which I can (through steps) engage in visual and tactile ways. Thus, the world it reveals is not just an auditory world, for this is not how it is generally revealed to me. I still have a hold over the physical world in my intentional relation to it; it still affords visual and tactile experiences within my reach. Merleau-Ponty (1945/2002) writes: "Though one may doubt whether the sense of hearing brings us genuine 'things', it is at least certain that it presents to us, beyond the sounds in space, *something* which 'murmurs', and in this way communicates with the other senses" (p. 267, emphasis added). The sound does not come from the virtual environment, which takes my attention elsewhere, to the physical environment and, indirectly, to my means of reaching its totality.

Similarly, if I am thirsty, I do not look for water in the virtual environment. My intentionality redirects itself towards my encompassing natural environment, which I know experientially is the only place that can satisfy my thirst, which I feel under my feet, and of which I can recall protuding into my bodily space just a few minutes ago as I bumped into the couch. I may continue to engage with the VR system less comfortably, but my thirst draws my attention and engagement away from the virtual environment and to the natural environment. Although it is not present visually around me, or even auditorily, I experience myself as situated *in* VR *in* a room in my apartment, and I know very well how quickly I can grab a glass of water and return. This is what is meant by having developed a relation to the VE as such, it has sedimented *as* something virtual, with clearly defined boundaries, and my own feeling of presence in it is dependent on my projectuality towards it. The situational impact can be further illuminated by another example. Being observed in VR in an experiment is a very different experience than when using VR alone. My concern about how I might look or be perceived is guiding my attention away from the virtual environment, or, if it is boring or proves to be a longer-than-anticipated VR experience, I might use my tactile senses to feel my way in real life towards a chair on which I can sit. The hold that I still retain over my physical surroundings is not present to me because I know "theoretically" that I am in real life despite all my sense impressions; instead, I have developed a hybrid sense of presence where the virtual horizons are understood to be virtual. Similarly, any anxiety, such as not having enough time to be immersed, will instantly draw my attention out of the virtual environment and lead to a reduced PI, not necessarily across all "sensory modalities"; or any one in particular, but through an altered intentionality; my intentionality is directed towards the real world, the only place that might solve my current problems. Whether or not there is a change of intentionality is, of course, also dependent on my relationship with the virtual world and the situation I find myself in. If a game is engaging, I might want to play more than I want to drink a glass of water. Geronazzo and Serafin argue similarly in relation to audio immersion, writing that "...the sense of presence will remain limited if the experience is irrelevant to the listener. If the listener-environment relation is weak, the mediating action of the immersive technology might result in a break in presence that can hardly be restored after a pause..." (p. 18).

One may argue that the place illusion here is demonstrated negatively. I know that in *this place*, where I feel present, I cannot get water, therefore, I need to move to another place. In finding my intentionality redirected towards the real world, however, there is a stiffening of the virtual environment, which happens when I cease being

engaged or involved in it and instead attend intentionally to any physical surroundings. I notice that "[w]hat is behind my back is not without some element of visual presence" (Merleau-Ponty, 2002, p. 6). For this reason, I argue that conceiving of presence in terms of sensory modalities and sensorimotor contingencies does not illuminate the experience of VR immersion in a holistic manner. As Merleau-Ponty explains: "If we turn back to the phenomena, they show us that the apprehension of a quality, just as that of size, is bound up with a whole perceptual context, and that the stimuli no longer furnish us with the indirect means we were seeking of isolating a layer of immediate impressions" (Merleau-Ponty, 2002, p. 9-10), and so "[t]he gaze gets more or less from things according to the way in which it questions them, ranges over or dwells on them" (Merleau-Ponty, 2002, p. 177).

The consequence of this, of seeing the VE as such, is that virtual objects take on a different appearance for me; objects that would be within reach for me if I was in a physical environment are not necessarily reachable in VR. The virtual environment changes for me after I bump into the TV after too many steps or if I lean down too far and obscure the head-mounted display from being tracked by the sensors. What is afforded by the object is uncertain, and I approach it hesitatingly. The continual discovery of my hold over the virtual environment is not the continual recollection of a memory; it is the virtual object itself that changes its appearance to me; my hold over it is uncertain: "Sense experience [...] invests the quality with vital value, grasping it first in its meaning for us..." (Merleau-Ponty, 2002, p. 61). "[T]he 'sensible quality' [...] are not *de facto* effects of the situation outside the organism, but represent the way in which it meets stimulation and is related to it" (Merleau-Ponty, 2002, p. 86, emphasis in original). To the extent that consciousness is a matter of "I can" (Merleau-Ponty, 2002, p. 159), the virtual body is an impoverished body: a limited body, again, to the extent that my hold over the virtual environment is limited.

In summary of this chapter, the research presented in this dissertation is concerned with the phenomenology of VR experience. Thus, the understanding of immersion and presence is grounded in the experience of standing in an intentional relation to a virtual world rather than in the more general conditions of immersion and presence seen as a technological answer to sensorimotor contingencies. This broader view involves understanding human involvement with VR as a part of their sensemaking and world construction, where the affordances of Immersive VR are understood in relation to each participant and what Immersive VR can mean for them, i.e., what role it can serve in co-constituting their lifeworld. From this phenomenological perspective, the technology of Immersive VR is understood as the technological mediation of sense stimuli that, to

various degrees, satisfies our bodily intention of creating a world.

4.7 Limitations

There are several limitations to the research carried out as part of this dissertation. Just as technologies have a mediating magnification/reduction structure, so do methodologies, and methods chosen for a particular purpose might entail that the research findings are limited in their ability to account for other perspectives and questions. A general limitation of this dissertation comes from the nature of exploratory research itself: by engaging in more open and flexible inquiries, the findings are not necessarily suitable to make clear-cut distinctions or answer more particular, narrow questions. An example from this can be drawn from our VR Go-along study. Here, we do not explicitly as part of the methodology do a controlled comparison between the VR Go-along method and a regular sit-down interviewing method, for instance. Rather, the study sought to understand Go-along interviewing in VR qualitatively on its own premises. This means that the study is limited in its ability to explicitly show how an interview mediated through VR is different from regular sit-down interviews, for example.

Another limitation that should be brought to light concerns Article 1, which analyses and discusses various VR interventions, which are usually studied in the lab. Brief in-lab encounters hinder participants to really develop a "relationship" with the technology. Moreover, in these studies, there are very few phenomenological accounts to go on, which is why the article frequently discusses the "intended" mediations, and can not comment on the actual phenomenological accounts of the participants. This means that the article must be seen as limited in its ability to account for the actual user experience of these interventions, and, indeed, the actually constituted user-environment relations. For this reason, the article itself writes that what is most desired in future work is empirical insight into actual user-environment relations, where the development of a relationship to a virtual environment is studied longitudinally and qualitatively.

A final limitation that should be mentioned concerns article 3, where several of the student participants studied disciplines which were not as likely as others to benefit from the MOL. Central to many of our participants' unsuccessful attempts at developing a productive practice in their VMPs was that they did not have to memorise information as part of their study regimen, either because they did not have to memorise information due to COVID-19 home exams, or that they were writing assignments or studying more practically oriented skills such as programming. Here, we regard any future studies with a more homogenous group that is known to be in need of mem-

orisation as complementary to our study. This would help us to shed light on how self-initiated use of VMPs can unfold when the objective is more clear for the student and the same across all participants.

4.8 Future Research

This dissertation serves as a preliminary inquiry into how postphenomenology can be fruitfully employed in HCI to understand and inquire into the user experience in Immersive VR and the relations to which it gives rise. How and where we immerse ourselves virtually stand to have a great impact on how we see our selves and the world around us. Immersive VR technologies hold great potential in mediating a broad set of activities. As Immersive VR technologies become more commonplace, household technologies, the question of how it finds its place in our everyday lives becomes more relevant. Here, a postphenomenological perspective can be utilised for a broad number of cases in order to explore the mediation that VR technologies bring about.

Within the myriad of possibilities for research, however, I want to highlight social interaction in VR as what I regard as the most interesting and important avenue for future research in this domain. In establishing an identity as an avatar in a digital culture, there is much to be explored in terms of 'who' you are in VR and 'who' you are in real life, and how the various subjectivities are interrelated. Another highly interesting avenue will arise when AI and VR technologies merge to a higher degree. Here, there will be a question of how we should design and relate to AI agents in Immersive VR. In an undergraduate course I ran at the University of Bergen in the spring semester of 2022, my students were tasked with reflecting over this question through prototyping towards various user-agent relations in VR. In designing a persona for their virtual agent, they reflected over what degree of personification, abilities, power balance, personality traits, tone, voice and appearance that the virtual agent should have, and how this would impact the desired relationship to the agent. Eventually, these decisions resulted in animated characters in VR that you could converse with using text-to-speech and voice-to-text technologies, mimicking traditional human-human relations in a more distinct way than mere text conversations. A few of the productions can be introduced here to clarify this idea. In the sublime world of Biotopia (Brandt and Høylandsskjær, 2022a), for instance, we meet the virtual agent Iris. Iris is a friendly, empathic, tree-human hybrid—a climate oracle—and welcomes parents with children who want to learn more about the climate. In another production, we meet Tails (Brandt and Høylandsskjær, 2022b), a somewhat cheeky, sarcastic, friendly, humoristic and knowledge-

able mentor. Tails is a fox, and guides you through the virtual environment called "Tales of the Now." Here, users can pick up glowing orbs and throw them in the ocean, and Tails will share his knowledge, enacting 3D visualizations of news stories.

With the incredible flexibility of the VR medium, almost every conceivable idea can be realized, and our experiences in Immersive VR can alter and shape us. Here, I argue that postphenomenology can be a useful framework for designing and researching such user-environment relations, and I look forward to and welcome a larger focus on the qualitative aspects of Immersive VR research in future work.

5. Conclusion

Motivated by the seeming suitability of postphenomenology to address the challenges that HCI face in regards to how Immersive VR technologies should be understood and approached, this doctoral dissertation has explored the potential of postphenomenology as a framework to understand and inquire into the complex entanglement of Immersive VR in human beings' lifeworlds. The dissertation presents theoretical, methodical and empirical contributions in relation to the goal of this inquiry. Theoretically, the human-technology relation that VR constitutes has been introduced as *user-environment relations*. By providing an analysis of the human-technology relation that VR constitutes, I have demonstrated how researchers can benefit from a postphenomenological understanding of VR, but also how VR prompts a reconsideration of traditional postphenomenological categories of human-technology relations. Methodically, the VR Go-along method has been proposed as an approach for qualitatively assessing the user experience as mediated in the constituted user-environment relations. Empirically, a qualitative and explorative in-the-wild study of Immersive VR use over two months was presented, where the VR Go-along was utilised to inquire into the participants' user experience as mediated in the constituted user-environment relations.

Based on these findings and contributions, I have argued the potential for postphenomenology to be constructively used to gain a qualitative understanding of user experience in Immersive VR. Here, I purport that researchers can gain a more holistic understanding of how VR mediates user experience by attending to how the user experience in Immersive VR is mediated in the constituted user-environment relations.

This dissertation serves as a reflexive account of an inquiry into the use of postphenomenology to provide an understanding of Immersive VR mediation. It demonstrates the mutually beneficial relationship between postphenomenology and Immersive VR, and illustrates how postphenomenological inquiries into Immersive VR mediation can be conducted. The contribution of this dissertation serves as a preliminary inquiry into how postphenomenology can be fruitfully employed in HCI to understand and inquire into the user experience in Immersive VR and the relations to which it gives rise.

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Part II

The papers

Paper I

A Postphenomenological Framework for Studying User Experience of Immersive Virtual Reality

Abstract

Virtual Reality (VR) is a remarkably flexible technology for interventions as it allows the construction of virtual worlds with ontologies radically different from the real world. By embodying users in avatars situated in these virtual environments, researchers can effectively intervene and instill positive change in the form of therapy or education, as well as affect a variety of cognitive changes. Due to the capabilities of VR to mediate both the environments in which we are immersed, as well as our embodied, situated relation toward those environments, VR has become a powerful technology for "changing the self." As the virtually mediated experience is what renders these interventions effective, frameworks are needed for describing and analyzing the mediations brought by various virtual world designs. As a step toward a broader understanding of how VR mediates experience, we propose a post-phenomenological framework for describing VR mediation. Postphenomenology is a philosophy of technology concerned with empirical data that understand technologies as mediators of human-world relationships. By addressing how mediations occur within VR as a user-environment relation and outside VR as a human-world relation, the framework addresses the various constituents of the virtually mediated experience. We demonstrate the framework's capability for describing VR mediations by presenting the results of an analysis of a selected variety of studies that use various user-environment relations to mediate various human-world relations.

1   Introduction

VR technologies are valuable and versatile tools because they allow for the instantiation of abstract ideas in encompassing virtual worlds. This capability of the medium enables us to simulate reality in a cost-effective manner, for instance by treating anxiety through exposure therapy in virtual environments (Lindner et al., 2019) or training surgery on virtual patients (Satava, 1993). Beyond mere simulation, however, VR also holds the power to realize goals in ways that would otherwise not be possible, such as reducing implicit racial bias by embodying white people in dark-skinned avatars (Banakou et al., 2016) or increasing self-compassion by changing perspectives through virtual embodiment Osimo et al. (2015). This latter approach—realizing goals in ways that would otherwise not be possible—involves the design of virtual worlds with ontologies different than the real world, tailored to elicit a particular effect on the immersed user. The power of VR to change ourselves in this manner is usually attributed to the capability of the medium to induce a feeling of presence in the computer-synthesized worlds (Slater and Sanchez-Vives, 2016). Immersed in VR, the user is situated; she feels present in the virtual environment, experiences it from a particular point of view, embodies avatars and tools, and involves herself in the scenario or narrative of the application. From this mediated situatedness, where some possibilities for experience are left open while others are restricted, a particular subjectivity of the user is constituted in relation to the objectivity of the virtual environment. Consider, for instance, how the embodiment of a child-sized avatar constitutes the virtual environment as large and perhaps overwhelming, or how the embodiment as a victim in a scenario may constitute the world as an unjust world in need of change. The user experience of VR is in this way dependent on how the subjectivity and objectivity of experience are constituted in relation to each other. What makes VR practical for interventions, of course, is that although the user's subjectivity is constituted in relation to a virtual environment, the effects are not restricted to the bounds of the simulation. The experience also plays a role in effectuating an altered human-world relation after exposure so that having experienced a virtual reality, reality itself is re-framed for the subject.

Because VR interventions owe their effectiveness to the experience of a virtually mediated subjectivity, we argue that insight into the phenomenology of these interventions can inform our understanding of them. In advocating for such a turn to experience, this paper presents a theoretical framework for understanding the user experience as mediated in relations constituted between user and environment. The mediation perspective that we advocate is distinguished from traditional approaches to understanding

user experience in that it does not presuppose the human subject and the technology as poles between which interaction occurs (Verbeek, 2015a). Rather, it sees the human subject and the experienced technology as a result of this interaction as they "mutually shape each other in the relations that come about between them." (Verbeek, 2015a, p. 28).

1.1 A Postphenomenology of Virtual Reality

The framework we present for understanding and describing the virtually mediated experience is grounded in postphenomenology. Postphenomenology is a philosophy of technology that understands technologies in light of how they mediate human-world relations by co-constituting the subjectivity and objectivity of experience (Rosenberger and Verbeek, 2015b). Postphenomenology is a highly relevant framework for understanding how VR technologies mediate experience, especially VR interventions, as these explicitly aim to change behavior, feelings, and attitudes, consequently, impacting the way that humans relate to their world. For instance, VR can be used to entice people to save for their retirement (Hershfield et al., 2011), enhance fear recognition in violent offenders (Seinfeld et al., 2018), or encourage prosocial behavior (Rosenberg et al., 2013). This is done by mediating a user-environment relation in VR within which the experience that effectuates the intervention takes place. Usually, this experience is approached in research through measuring several aspects of it such as presence, confirming the virtual embodiment, measuring simulator sickness, and generally accounting for a select number of psychometric variables. In this paper, we argue that approaching experience qualitatively from a broader post-phenomenological perspective can inform our understanding of the virtually mediated experience in a more holistic way than isolated constructs can offer. While a researcher studying user experience of VR from a post-phenomenological perspective would naturally also be concerned with whether a user feels present and embodied in the virtual environment, what she would have as her focus is how the embodiment and presence take part in constituting the user's subjectivity in relation to the objectivity of the environment. Approaching experience from a post-phenomenological perspective, therefore, does not involve replacing or rejecting established constructs used to measure experience; instead, it attends to this experience by describing it in terms of the subjectivity and objectivity arising from the mediation. For Immersive VR, this entails seeing the user experience as mediated in relations constituted between user and environment.

1.2   Ethics

Attending to the user experience of VR from a post-phenomenological perspective can also be useful for ethical assessment. The post-phenomenological approach to ethics is one of ontological disclosure; it asks what kind of worlds we disclose through new technologies, and in the same manner, who we become in relation to these worlds (Introna, 2017). Therefore, it is by providing an increased understanding of the ways that VR technologies can mediate our experience that the post-phenomenological perspective can aid researchers in discovering potential ethical issues resulting from their designs. Ethical concerns are particularly relevant for VR interventions as they explicitly aim to affect human behavior. We know that VR owes the effectiveness of its interventions to its mimesis of reality; the benefits observed in studies "rely on the extent to which the experience is perceived as real" (Slater et al., 2020, p. 1). In addition to the shared phenomenology of presence (Loomis, 2016), reality and virtuality also share what Metzinger (2018) refers to as *phenomenal transparency*, where the medium takes a transparent role so that the content it presents is not subjectively experienced as a representation. Consequently, it is because VR experiences can be similar to real life experiences (Slater, 2009) that VR is a powerful technology that is capable of producing beneficent as well as non-beneficent results. How complex the ethics of VR may become upon mass adoption is not known. Madary and Metzinger argue that VR will change deeply established notions of who we are and how we identify and so "transform the structure of our life-world" (p. 2). What is clear, however, is that the powerful capabilities of VR to "change the self" require researchers to exercise ethical attentiveness to the various ways in which a participant's subjectivity can change as the result of experiencing a virtually constituted subjectivity. Although the content of the experience is virtual, the experience is "*real as an experience*" (Slater et al., 2020, p. 5, emphasis in original), and the emotional and cognitive after-effects, although usually beneficial, can also be harmful (Slater et al., 2020). For instance, while VR interventions may reduce implicit racial bias (Banakou et al., 2016), they may also increase it in negative contexts (Groom et al., 2009; Banakou et al., 2020), suggesting potentially non-beneficent results when using VR as an "empathy machine." Similar warnings have been issued by Sri Kalyanaraman et al. (2010) who immersed participants in a simulation of the effects of schizophrenia. Although their simulation proved to be effective in increasing empathy and positive perceptions toward people who have schizophrenia in combination with non-VR perspective-taking exercises, they found that "mere exposure to a virtual simulation of schizophrenia by itself may not only be ineffective,

but actually prove to be inimical. . . " (ibid, p. 441). Other non-beneficent results were also reported recently by Neyret et al. from a virtual recreation of a Milgram Obedience Scenario, who highlights it as "vitally important" to be aware of possible adverse outcomes resulting from virtual embodiment in scenarios—even if the change of this occuring is deemed unlikely a priori.

Madary and Metzinger (2018) write how the embedding of VR in our world creates a "complex convolution, a nested form of information flow in which the biological mind and its technological niche influence each other in ways we are just beginning to understand" (p. 20). VR creates "not only novel psychological risks but also entirely new ethical and legal dimensions..." (ibid, p. 20). While no single approach or theoretical foundation can solve the ethical challenges of VR alone, we believe a qualitative turn to the user experience of VR—by inquiring into the experiential relationship established between user and environment—can be a complementary constructive angle from which researchers can uncover unintended effects resulting from their designs.

This paper is structured as follows. First, we provide a background to postphenomenology and account for its relevance as a framework for describing Immersive VR mediation. Having presented the paper's theoretical background, we detail our proposal of a post-phenomenological framework for understanding user experience in Immersive VR as mediated in user-environment relations. We demonstrate the applicability of the framework by analyzing a selected variety of studies on VR interventions that constitute particular user-environment relations in order to mediate particular human-world relations. After the analysis, we discuss the relationship between real and simulated subjectivity as well as the relationship between real and virtual worlds in more depth. Finally, we discuss the scope of the framework before outlining directions for future work to advance the applicability of the theoretical framework into the methodological.

2   Related work

2.1   Postphenomenology

The framework that we propose in this paper is informed by postphenomenology, a philosophy of technology that views technologies as mediators of human-world relations. With its phenomenological roots, postphenomenology understands humans and technologies as inseparable and views technologies as co-constituting human subjectivity and world objectivity (Rosenberger and Verbeek, 2015b). Consider, for instance, how the embodiment of a car enhances the human being by constituting the subject

as a driver and therefore also the world as more accessible or how, for a blind person, the white cane constitutes the world as such and extends the subject through the embodiment of the cane. Concerned with empirical data (Achterhuis, 2001), postphenomenology is pragmatic, and giving heed to its phenomenological origins, it draws its data from experience. Postphenomenology adopts from phenomenology the notion of intentionality as an invariant of experience: all consciousness is consciousness of something. Subjectivity and objectivity, experiencer and experienced—what Husserl referred to as the noesis and the noema—are two distinct ends of the polarity of experience. Postphenomenology stresses the role that technologies have in mediating this intentional relation by co-constituting both the human subject and their world. In doing a post-phenomenological investigation of a VR application, therefore, we would be interested in "who" the user becomes in relation to the virtual environment, and simultaneously, "what" the environment is for the user. In other words, we would be interested in what kind of user-environment relation is being mediated, but also beyond this, how the user-environment relation takes part in mediating the human-world relation outside of the virtually mediated experience.

Postphenomenology as a praxis-oriented phenomenology was established through the works of philosopher Don Ihde. An expanding group of scholars now contribute to the post-phenomenological approach of studying the ever-expanding role of technologies in our lives, most notably Peter-Paul Verbeek, who extends Ihde's post-phenomenological thought in his theory of technological mediation (Verbeek, 2005). In the sections below, we provide an account of Ihde's Human-Technology Relations before describing Verbeek's exposition of immersion as a human-technology relation.

2.2 Human-Technology Relations

Don Ihde identified four structures of human-technology-world relationships (Ihde, 1990). The first of these he calls embodiment relations, where the combination of human and technology together relate to the world. In embodiment relations, there is transparency, as when we look through our eyeglasses or talk through the phone. Second, he discusses hermeneutic relations, where humans "read off" an abstract representation by a computer, such as a weather forecast or an MRI scan. Third, in alterity relations, humans interact with technology directly within its own system, a common example being interaction with an ATM or a calculator, where the world withdraws into the background. Lastly, Ihde (1990) discusses discusses what he calls background relations, where the technology is an implicit condition affecting the environment, partly serving as the context in which we find ourselves (e.g., an air conditioner). Ihde (1990)

Table I.1: **Human-Technology Relations Diagram Ihde (1990)**

Embodiment relation	(human - technology) → world
Hermeneutic relation	human → (technology - world)
Alterity relation	human → technology (world)
Background relation	human → (technology/world)

illustrates his embodiment, hermeneutic, alterity, and background relations through diagrams indicating on which poles, subjective or objective, the technology primarily is "situated" with arrows indicating intentionality, as seen in Table I.1

2.3 Immersion as Human-Technology Relation

The human-technology-world relations identified by Ihde are not so exhaustive as to include all possible relations. Verbeek has further identified several human-technology relations enabled by newer technology developments, where the immersion relation is the most relevant for the user experience of VR. The immersion relation can be understood as a more active version of Ihde's background relation, where the environment and the technology become merged (Verbeek, 2015b; Aydin et al., 2019). It is more active in the sense that the environment is aware of human beings and actively interacts with them. The result is that human beings are directed toward technologies, and the technologies are in turn directed toward them, resulting in a "reflexive intentionality" (**?**) where humans can have new relations toward themselves through the technology. Although this relation is referred to as an "immersion" relation, we should note that Verbeek does not use the word "immersion" in order to relate it to VR technologies in particular. As examples of immersion relations, Verbeek describes smart toilets that analyze excrement and provide health reports, or beds that can detect whether somebody falls out. The immersion relation is nevertheless relevant for understanding VR because VR technologies open entirely new possibilities for reflexive intentionalities, which we return to in our analysis.

2.4 User-Environment Relations

Having described Ihde's and Verbeek's human-technology relations, we might ask what kind of relation VR constitutes. As we have discussed, the benefit of VR is its flexibility; it can be adapted to unique situations and be designed to elicit vastly different effects. In this regard, VR can be said to be an extreme meta-medium (Kay and Goldberg, 1977), as virtually all other media can be reproduced within it, including future, non-existing media. The result is that "...each form of VR is a medium unto itself."

(Lanier, 2017, p. 204). For this very reason, any attempt to give a total account of the various possibilities of VR mediation is impossible; all the various human-technology relations introduced above could conceivably be had within various VR applications. There is an invariant human-technology relation that lays the ground for other relations within the virtual, however, it takes a special form in VR. Comparing immersive VR to non-immersive simulators, Voordijk and Vahdatikhaki (2020) write that "when the technology 'disappears' in embodiment, the role of the VR simulator changes, in terms of Ihde, from an alterity relationship to an embodiment relationship." (p. 10). While the VR HMD becomes transparent in use and we act through it, the intentional relation is not mediated toward the world, rather, it is mediated toward the virtual environment. Consequently, when embodied, the user is in an alterity relation toward the virtual environment, interacting directly with the technology within its own system. Thus, in the embodiment of a VR HMD, we act both through it and upon it, which is why VR can simultaneously mediate both (i) the objectivity of the environment in which users are situated (alterity) as well as (ii) the users' subjective position and relation toward that virtual environment (embodiment). So, while we embody parts of the VR technology (hardware, avatars, tools) as part of our subjectivity in a transparent embodiment relation, the objectivity of our experience (environment, actors, social scenarios) is also mediated by the same VR technology, constituting an opaque alterity relation in which the world is in the background. This human-technology relation that VR constitutes, we describe in our framework as user-environment relations. This embodiment-alterity relation can be schematized in the manner of Ihde (see Table 1) as follows:

(Human - Technology) → Technology (-World)

This schema denotes a user-environment relation: a human in an embodiment relation with the technology (i.e., the user) in an alterity relation to the technology (i.e., the environment), while the world is in the background.

3   A Post-Phenomenological Framework for Immersive Virtual Reality

Immersive VR mediates user-environment relations in which the embodied user stands in an intentional relation to the environment while the world is in the background. This human-technology relation that VR constitutes lays the ground for our framework of VR mediation. In substantiating our framework, this section will present and discuss the constitutive elements of this mediation process in more depth. As illustrated in
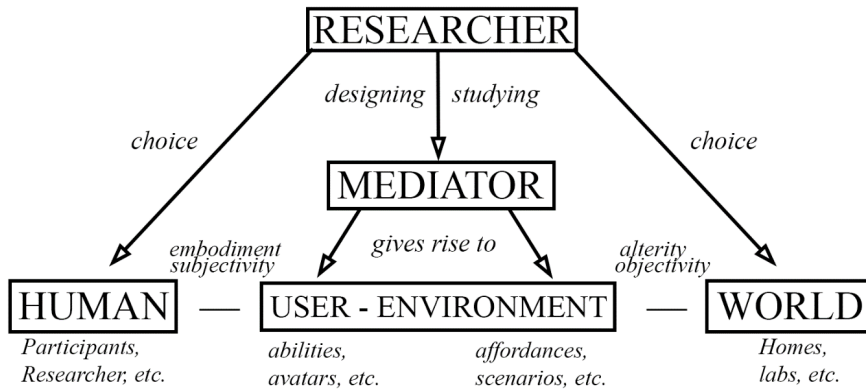
Figure I.1: Illustration of our Post-phenomenological Framework for Studying User Experience of Immersive VR as Mediations
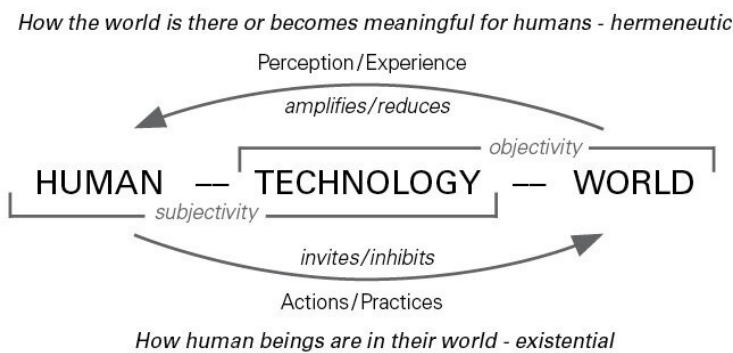
Figure I.2: Technological mediation Hauser et al. (2018)

Figure I.1 [which is an altered version of Figure I.3 by Hauser et al. (2018) depicting the roles of design researchers in RtD inquiries] this means recognizing the subjectivity-objectivity structure as constituted within VR (the user-environment relation), as well as the subjectivity-objectivity structure as constituted outside of VR (the human-world relation).

Our framework mirrors the overview of technological mediation provided by Hauser et al.; the humans of the study, the mediator, and their world are the basic constituents of any technological mediation process (see Figure I.3).

As the technology mediates the humans' subjective relation to their worlds, who these people are, where they are situated, and what the technology/mediator is are essential overarching variables in understanding technological mediation post-
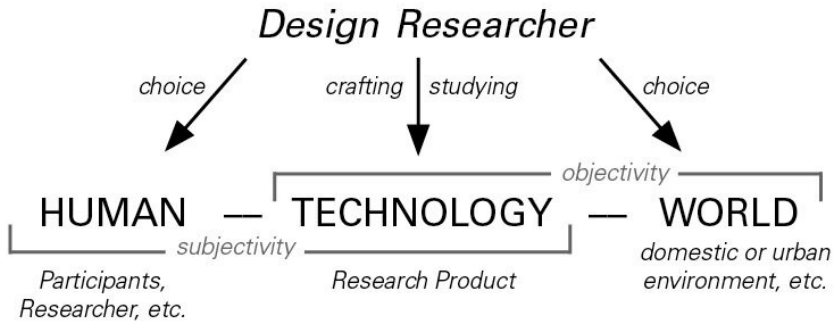
Figure I.3: Roles of design researchers in their RtD inquiries Hauser et al. (2018)

Table I.2: **Overview framework constituents**

1. Human. *The human being partaking in the study. Here, the particularities of the person might be mediated, as well as impact the mediation. Examples of human factors: personality, gender, socio-economic status, interests and motivations, involvements and previous technology experience. Human factors vary and impact relational and hermeneutic strategies towards the technologies.*

2. World. *The use context of the application: where the VR application is being used .This constitutes the background of the VR experience. Here, also, the particularities of the context might be mediated, or take part in mediating the VR experience. Examples: hospital, lab, work or domestic settings.*

3. VR Mediator. *The VR application that is being designed or evaluated for intervention purposes. Designed or studied for its ability to provide an experience or user-environment relation that can be a catalyst for change.*

4. User. *The human as user: in an embodiment relation to the alterity of the virtual environment. The user subjectivity is in a nested relation to the subjectivity the human individual has in relation to her actual world (Gualeni & Vella, 2020) but is further affected by avatars, tools, interaction possibilities, position, involvements and social scenarios.*

5. Environment. *The virtual environment as experienced by the user during the VR embodiment. The part of the VR application that is not embodied by the user, but is rather acted upon (alterity) or that which acts upon the user, including social actors, 3D objects, events, etc.*

phenomenologically (Hauser et al., 2018). In post-phenomenological inquiries in Human-Computer Interaction, the researchers stand in constructive roles regarding the studying, choosing, and designing of these constituents (see Figure I.3).

The next two elements in our framework more concretely address the user-environment relation: what occurs when a human participant engages with the VR application. The VR is here a mediator that gives rise to (4) a User, and (5) an Environment; the human as user has an altered subjectivity constituted in relation to the virtual environment.

In the next sections, we detail the various elements of our framework. An overview of the framework components is provided in Table I.2.

3.1 Human

The first element of the framework is concerned with the human who engages with the VR mediator. Postphenomenology sees technologies as multi-stable, the same technology can have several different stabilities in terms of how it is used and experienced. While multistability of technology can be actively designed for—our best example being the smartphone, the modern swiss army knife—multistability is also present in cases where the intention is for the artifact to embody a concrete function, such as a VR application intended to deliver a particular intervention effect. In short, technologies "simply can't be reduced to designed functions" (Ihde, 2002, p. 106). As a classical example, hammers are made for hammering nails, but can find other stabilities, such as being a paperweight or a weapon (Ihde, 2002). In the same way, an interactive VR application is not fixed in how it can be "used" or experienced, the user-environment relation that is mediated depend not only on the VR application, but on the individual human who engages with it in their context of use. The particularities of this group, such as their sedimented or unestablished relationship with VR technology, or their attitudes toward technology in general, will impact their virtually mediated experience. These are the humans who will experience the mediating effects of the technology on their self as well as on their world. Professional skills or diagnostic criteria fall under this point, but also differences in experience, culture, gender, etc., as this may be indicative of different relational strategies in approaching the technologies. Relational strategies can be defined as particular understandings and bodily approaches that "enables a user to relate to a technology in terms of a particular stability..." (Rosenberger and Verbeek, 2015a, p. 29). Similarly, different people may have different hermeneutic strategies, strategies which "enable a user to apprehend the meaning of a technology's readout in terms of a particular stability." (Rosenberger and Verbeek, 2015a, p. 29). This does not mean that VR applications can be so multi-stable that any user-environment relation can be experienced; as Ihde notes, "Multistability is not the same as neutrality." (p. 106). All technologies, however open they may be, have a certain directedness Verbeek (2008). Despite there being various trajectories for use, these are not unlimited, and some of these will prove more dominant and stable than others.

3.2 World

The second element of the framework is concerned with where in the human sphere the mediating technology is used. Phenomenological accounts of places and situational contexts highlight the inseparability of humans from their environments (Donohoe,

2017). Places—understood geographically, architecturally, or socio-culturally—take part in shaping behavior, identity, and moods; places, then, can also be regarded as mediators of our selves. The humans in the study, therefore, are only one aspect; equally relevant is the "world" in which these humans will use the technology. The world is the "use-context" of the application and will be present for the user as the background of experience, although she is immersed in a virtual world. Again, we return to the post-phenomenological concept of multi-stability; technologies will have different meanings for different people in different contexts. While it is possible to evaluate an application experimentally in-lab that is originally intended to be used elsewhere, this is not as likely to give an account of what the mediation effects of the technology will in fact be, simply because one of the constituents of the virtually mediated experience (the world) will be different than what is being evaluated. This is equally due to the situational context (being observed by researchers in-lab) as the geographical context of being in the lab. The use-context affects the experience of the virtual environment and the virtual environment may also further mediate how the participant sees the use-context.

3.3 Mediator

The third element in the framework is the technology, or mediator, which within VR interventions usually comprises a virtual environment that is experienced from the first-person point of view. The design of this technology can have various goals—such as therapy or training—which is meant to be attained by immersing the human into the virtual environment. This mediator gives rise to a user-environment relation: the human becomes an embodied user, immersed in, and standing in an intentional relation to, the virtual environment, while the world is in the background. In order to describe the mediator element more thoroughly, we detail the mediations that it gives rise to in the next sections: (4) User and (5) Environment.

User

The first sub-element of the mediator is concerned with the embodied user, situated and operating from a particular subjective position within the simulation. The "user" entity is not the same as the human participant, nor is it merely the subjective position into which the participant is immersed. Rather, it is the human participant as user, i.e., the human participant under active mediation of the VR technology, virtually embodied and in an intentional relation to the virtual environment. The subjectivity of the user, therefore, can be said to be "in a nested relation to the individual's subjectivity in the actual world" (Gualeni and Vella, 2020, p. xxi). Human subjectivity is

being mediated by the VR application, within the simulation in relation to the virtual world (User) as well as outside the simulation in relation to the real world (Human). This is an example of what De Mul refers to as *poly(ec)centric positionality*, denoting a mediated multiplication of one's center of experience. Phenomenologists such as Merleau-Ponty (2002) have famously distinguished between the body as lived and the body as object. This holds for VR also; while our avatar can be seen as one 3D object situated amongst others, it is also, to the degree that it is embodied, that through which we experience. Ihde refers to Merleau-Ponty's lived body as body one and understands the objectified body two as the acted-upon body of Foucalt; "...body one permeated with the cultural significances that are also experienced." (p. xviii). According to De Mul, it is this eccentricity—our being simultaneously inside (subjectivity) and outside (objectivity) of ourselves—which is the condition for telepresence and VR. With these technologies, we can objectify our thoughts of who we want to be, and, through embodiment, we can experience reality from the perspective of these bodies. In poly(ec)centric positionality, the virtual constitutes "a complete and additional, artificial experiential center" (Gualeni, 2015, p. 115) which lays the foundation for the simulation's capability to "elicit ontological effects" (ibid, p. 118).

The question of the user element in the framework is how this new, artificial experiential center is experienced during embodiment. It is concerned with what kind of subjectivity is mediated within the user-environment relation. For instance, what avatars and tools does the user embody? How is she positioned in relation to the virtual environment, and what are the possible points of action from this situatedness? Is she involved in a certain story, scenario, or task? Here, examples may range from leading a team of surgeons, to being positioned as a victim of physical abuse. What the user can do, and who she experiences herself to be, is defined in relation to the virtual environment and the affordances it presents.

Environment

In strong relation to the user, therefore, is the environment, the second sub-element of the mediator. The environment represents the part of the VR application that is not embodied, and therefore, that to which the embodied user relates to as alterity. In focus is the question: in what kind of environment or world is the user situated? What are the basic parameters for how this environment works and what it represents? For instance, the system may display some objects as interactable and some merely acting as decorative or situational elements, some in the proximity of the user and some at a distance. Such choices are a part of the intended mediation of the researcher, im-

pacts the subjectivity of the user, and provides the technology with a certain directed-
ness (Verbeek, 2008). It is here important to note that we understand the environment
(post)phenomenologically. We are interested in how the environment is understood
from the situated standpoint of the user, not from a detached God's eye view. Simi-
lar questions exist here as for the world constituent, but in relation to the environment.
For instance, as what is this virtual environment disclosed for the subject? What are
the most apparent features or affordances of this environment, and what does this com-
municate to the user? Does the environment invite certain trajectories of action, while
inhibiting others? In other words, we are interested in how the virtual environment is
experienced in its relation to the user, that is, how the human perceives the environ-
ment when immersed and embodied. How the environment is experienced is not just
dependent on the objective features of the environment. An illustrative example of such
numerous convoluting, mediating factors is the various virtually reconstructed Milgram
Obedience Scenarios (Slater et al., 2006; Gonzalez-Franco et al., 2018; Neyret et al.,
2020). In these virtual recreations of the famously controversial research described by
Milgram (1964), participants meet with real researchers in a lab who do an experiment,
but the experiment is to meet virtual researchers and partake in their experiment in a
virtual lab. In the event of partaking in such a study, participants are in a very real
sense both real and virtual participants, and likewise, stand in relation to both the real
researchers and the virtual researchers. VR technologies are not immersive to the ex-
tent of the participants forgetting their normal feeling of self or their worlds. The real
world is still present as a background relation, and the user subjectivity is in a nested
relation to the subjectivity of the human individual in the real experiment.

4   Analysis of User-Environment Relations

VR constitutes an embodiment-alterity relation that we describe as user-environment
relations, where the embodied participant is in an intentional relation toward the alter-
ity of the VR application. This describes VR mediation generally; how a particular
user-environment relation is mediated depends on what is embodied (subjectivity), and
what is related to as alterity (objectivity). In order to concretize our framework, this
section presents an analysis of various user-environment relations constituted in VR in-
terventions. What we intend with our analysis of user-environment relations in VR is
to account for some observed variance of how user-environment relations can be struc-
tured. The research papers in the analysis were selected in order to display the breadth
of ontological structuring that is possible within the overarching embodiment-alterity

Table I.3: **Overview of User-Environment Relations from Analysis**

Simulated Subjectivity: *Simulated Subjectivity refers to mediations where an altered subjectivity is experientially pronounced; a simulation of 'what it's like'. This may be done with the intent of having the application act as an empathy machine or for the application to facilitate for the experiencing of new first-hand perspectives on known information. Examples include what it is like to suffer from strokes, schizophrenia, blindness, as well as the effects of psychedelic drugs*
Simulated Objectivity: *Simulated Objectivity refers to mediations where the user is "transported" to a new place, where there is little to no explicit attempt to alter user subjectivity apart from being immersed in the environment. Examples include medical simulations, cultural heritage, VR exposure therapy, etc.*
Subjectivity-Objectivity Inversion: *Subjectivity-Objectivity inversion refers to a mediation process in which the subjectivity-objectivity poles are inversed, for instance framing the Self as Other, or the Other as Self to change either one's perspective on one's self or one's perspective on others. What "other" is being re-framed (opposite gender or different age/race/socio-economic status) varies depending on the Human-World Relation the researchers intend to achieve (for instance increased empathy or less racial bias).*
Subjectivity-Objectivity Synchronisation: *Subjectivity-Objectivity Synchronization refers to a mediation process in which the subjectivity and objectivity of experience approximate each other toward a state of equilibrium. This can be initiated by mediating properties of the subjectivity to affect the objectivity or the other way around. Which mirrors which can depend on what Human-World Relation the researchers intend to achieve or measure.*

relation. The analysis highlights in post-phenomenological terms how the interventions constitute various user-environment relations in order to mediate various human-world relations.

We categorize the identified user-environment relations as follows: (1) Simulated Subjectivity, (2) Simulated Objectivity, (3) Subjectivity-Objectivity Inversion, and (4) Subjectivity-Objectivity Synchronization. The first two categories focus on the two distinct poles of experience in VR: subjectivity (embodiment) and objectivity (alterity). These are discussed rather briefly, and by dealing with subjectivity and objectivity in isolation, these categories also act as an introduction for the two latter categories where subjectivity and objectivity are more entwined. Consequently, the analysis is mainly concerned with the two latter categories, "Subjectivity-Objectivity Inversion" and "Subjectivity-Objectivity Synchronization", as these describe the novel relations that can be constituted between user and environment in VR. A summary of the identified user-environment relations is provided in Table I.3

4.1   Simulated Subjectivity

In providing an experience, VR mediates sensory stimuli, some of which is embodied and becomes "part of" the user, and some of which is not embodied, and as such stands in an alterity relation toward the user as an environment. While this means that all VR applications will necessarily simulate both subjectivity and objectivity, what is

novel or unique in the VR experience may be more pronounced experientially for the user. Simulated subjectivity, therefore, refers to cases where the intended mediation is to convey what it is like to be another (subjectivity), with less focus on mediating a particular virtual environment (objectivity). It refers to cases where it is intended for the mediation of subjectivity to be more pronounced experientially than the objectivity. As an example, Suzuki et al. (2017) developed the Hallucination Machine by processing panoramic videos using Google's Deep Dream AI, in order to "[induce] visual phenomenology qualitatively similar to classical psychedelics." (p. 1). Other examples of simulated subjectivity include simulations of various visual impairments in VR (Ahn et al., 2013; Ates et al., 2015; Jones et al., 2020) as well as strokes (Maxhall et al., 2004) and schizophrenic episodes (Nyre and Vindenes, 2020). Simulating subjectivity is naturally linked to empathy as it could be said to be a virtual representation of "what it's like to walk a mile in someone else's shoes." However, most of the interventions promoting empathy in our analysis are discussed under section Subjectivity-Objectivity Inversion, as their strategy toward generating empathy is by mediating a more reflexive user-environment relation in which the alterity/objectivity is also of importance.

4.2   Simulated Objectivity

As the inverse of Simulated Subjectivity, Simulated Objectivity refers to mediations when the participant is immersed in an environment or scenario (objectivity) where there is no explicit intention of altering user subjectivity. Typical examples here include simulator training for various purposes such as surgery (Alaraj et al., 2011), but can also be exemplified through virtual field trips (Çaliskan, 2011), cultural heritage (Rua and Alvito, 2011), or VR Exposure Therapy (Flobak et al., 2019). In these cases, the success of the simulation is dependent on the degree to which the simulation represents reality. This is VR as it perhaps is traditionally understood, where the participant is "transported" to an environment but remains "herself." Thus, there is the intention of keeping the participant's subjectivity more or less non-mediated, apart, of course, from the mediating effects of the environment/situation itself.

Having briefly described Simulated Subjectivity and Simulated Objectivity as the two distinct poles that can be targeted in mediation, we move on to the reflexive user-environment relations, where the structured relationship between subjectivity and objectivity is of importance. Naturally, the two next user-environment relations also include the simulation of subjectivity and objectivity, but here it is the user-environment relations that are highlighted.

4.3   Subjectivity-Objectivity Inversion

In this section, we present a user-environment relation that we refer to as a subjectivity-objectivity inversion. We discuss this from two angles: mediating the Other as Self and mediating the Self as Other.

Other as Self

As humans, we identify in particular ways. We identify as individuals, but also with particular groups, such as socio-cultural, racial, and ethnic groups, as well as gender and age. To various extents, other groups are experienced as such, other, and so we experience ourselves and our own situation in a different perspectival manner than we do others and their situations. While this is a natural limitation of being a particular human being, VR can allow a user-environment relation that constitutes what has traditionally been related to as Other (objectivity) as Self (subjectivity). The studies which we cite below as examples of this usually comprise an active instantiation of perspective-taking (van Loon et al., 2018) where VR allows the point of perspective to be an actual experiential center as opposed to one imagined through cognitive activity.

An example of such a subjectivity-objectivity inversion, Other as Self, is present in the study by Banakou et al. (2016), who embodied 90 white females in black virtual bodies. They found an immediate decrease in implicit racial bias against black people. A similar experiment was performed by Hasler et al. who embodied 32 white females and 32 black females in avatars of various color so that, over two sessions, all participants had been embodied in both black and white avatars. They found that the embodiment enhanced mimicry of behavior between those of the same embodied racial group—independently of the actual race. Similar role changing by means of virtual embodiment has been conducted by Seinfeld et al. who embodied male domestic violence offenders in virtual female bodies where they experienced a virtual scene of abuse from a first-person victim perspective. After exposure, the male offenders had an improved ability to recognize fear in female faces, a trait which offenders as a group score significantly lower on compared to controls (Seinfeld et al., 2018). Other examples include embodying adults as children (Tajadura-Jiménez et al., 2017; Hamilton-Giachritsis et al., 2018), embodying younger people as elderly (Hershfield et al., 2011; Banakou et al., 2018), or even embodying animals (Ahn et al., 2016). What this "other" should be depends on the kind of intervention that is intended. Mothers may get an increased understanding of what it means to be a child, which in turn may alter how they view their role as mothers. Younger people may experience what it is like to inhabit

an aged body, perhaps altering how they view the impermanence of their youth and the role of their elders, and people embodied as animals may feel more connected to nature by being directed to reflect on the fact that animals are sentient too. By reframing what is mediated as the subjectivity and objectivity of experience, VR can through subjectivity-objectivity inversion help humans bypass sedimented relations and facilitate a perspective-taking that is more directly experienced.

Self as Other

Another example of subjectivity-objectivity inversion is the reframing of the Self as Other. Just as being a particular human being comes with a limited perspective of others, seeing ourselves from our own point of view can have its limitations as well. "From the perspective of the self, the other is so rounded out that it is a consummated, self-sufficient whole. In contrast, the self cannot see itself in that way. It is tied up in the incompleteness of its own story..." (McCarthy and Wright, 2004, p. 75). While we may be able to see others for who they are now, we see ourselves in terms of both our future and our past. Being caught up in worries for the future and regrets from the past may cloud our access to the present reality. Objectifying the self, therefore, may come with its own benefits of altered perspectives. The studies cited below usually comprise a more active instantiation of self-distancing theory (Leitner et al., 2017) of which methods are traditionally performed through the imagination. An example here is the study presented by Osimo et al., who had male participants embodied in avatars closely resembling themselves describe a personal problem to a virtual person in the likeness of Dr. Sigmund Freud. When the participant has described his problem, his body is swapped to that of Freud's, now seeing the avatar created in his likeness, which he previously identified with, sitting opposite him. Then his avatar begins to tell the story he had just told back again to the user embodied as Freud. Here, the participant as Freud again answers in terms of advice, before swapping back to the avatar again, and so on. In this way, the application reframes the self as other, as well as the other as self, and ideally allows the user to address his own problems as he addresses others' problems. Osimo et al. write how "...this form of embodied perspective-taking can lead to sufficient detachment from habitual ways of thinking about personal problems, so as to improve the outcome, and demonstrates the power of virtual body ownership to affect cognitive changes" (p. 1). A study similar in mechanism was conducted by Falconer et al. where female participants were trained in providing a compassionate response, which they delivered to a child in VR while embodied in a (non-lookalike) adult body. Later, the participants experienced their own compassionate statements in the embod-

iment of a child, which the researchers found increased self-compassion and feelings of being safe. Here, the perspective-taking which the body-swapping facilitated (i.e., the alteration of subjective roles) allowed the participants to be both on the giving and receiving end of compassion. Another example is brought forward by Bourdin et al. who created out-of-body experiences in VR by embodying participants in avatars, and changing the viewpoint so that they could view their virtual bodies from outside, reducing fear of death in the participants. Our final example of a subjectivity-objectivity inversion is the embodiment of participants as older versions of themselves in order to promote saving for their retirement (Hershfield et al., 2011). Here, the participants embody their future selves as part of their subjectivity and look in a virtual mirror. What is "other" in this intervention, however, and which the researchers intended the participants to identify more strongly with, is the aging of this future self. This can also be done where the "other" is not age deterioration, but increased/decreased physical fitness in order to increase motivation (Fox and Bailenson, 2009).

In the user-environment relation we call subjectivity-objectivity inversion—self as other and other as self—what the human participant embodied as user relates to as themselves is inversed. The result is that what was previously embodied (subjectivity) is now the alterity (objectivity), or that what was previously alterity is now embodied. This makes for an immersion relation between the user and the environment which constitutes a reflexive intentionality where the user can experience standing in new relations to themselves and others. We reiterate that reflexive intentionalities occur when the human is in an intentional relation to the technology-infused environment, where the technology-infused environment is also directed in intentionality toward the human. The human can experience how the environment perceives or interprets her from its perspective. In VR, however, the reflexive intentionality is realized somewhat differently. Firstly, the technology is fused with the environment in the sense that the technology is what instantiates the environment as such. Further, the environment does not abstract or convey a "representation" to the user of how it perceives her, which the user is meant to see from her situated perspective. Instead, aspects of the virtual environment that the user stands in an intentional relation to, such as a social actor, can itself be embodied so that the new relation that is opened toward one's self can be experienced more directly.

4.4   Subjectivity-Objectivity Synchronization

Having described Subjectivity-Objectivity Inversion, we turn to the case of Subjectivity-Objectivity Synchronization. A subjectivity-objectivity synchronization is an attempt

at producing harmony between the inner life of the user and the external world that is experienced. The attempt can either be to make the inner life of the user be represented through the external world, or to make the external world affect the inner life of the user, or both. In the way that subjectivity-objectivity inversion utilizes an active instantiation of perspective-taking and/or self-distancing techniques, applications facilitating subjectivity-objectivity synchronization actively instantiate meditative techniques such as Mindfulness. Many meditation or relaxation techniques have as their aim to redirect focus and attention on the breath or the body in order to promote a feeling of union both with oneself and the world. In VR, the attempt to promote unity between subjectivity and objectivity—self and other—is approached explicitly by blurring distinctions or creating new relationships between the two. For instance, Roo et al. (2017) created a mixed reality sandbox where the user can create a virtual environment by restructuring sand in a physical sandbox. The sandbox has an overhanging depth sensor measuring the peaks and valleys of the sandbox, and a projector that projects visual terrain upon it. Having created the environment, the user can immerse herself in a 3D render of this world through an HMD where the environment responds to physiological data of the user, such as breath and heart rate. Here, the aim is to facilitate mindfulness meditation through a focus on the body as it is mediated through the environment. The mediation amplifies the focus on bodily sensations such as breath and heart rate, and by having this represented in the external environment, the otherwise clear-cut boundary between self and other is diminished so that there is subjectivity in objectivity and vice versa. A similar example is brought by Amores et al. (2019) who designed "Deep Reality," a VR experience of underwater fluorescent beings that move based on biometric information such as electroencephalogram (EEG), heart rate (HR), and electrodermal activity (EDA). The aim was reflection and relaxation. Here, again, the recurring pattern is that of changing the external environment to affect inner states, and as with Roo et al. (2017), the external environment is in turn based on inner states or approximations of these, constituting a neurofeedback loop in which it is intended that the subjectivity and objectivity of experience should approximate each other toward a state of equilibrium. Another example is brought forth by Stepanova et al. who designed JeL, an immersive VR system designed "to bring awareness to our physiological rhythm, fostering a connection with our bodies, each other, and nature (p. 641). Here, two users aim to synchronize their breath in order to grow corals in a coral reef. Other examples include the projection of artistic visualizations in VR based on EEG in order to induce positive pre-sleep (Semertzidis et al., 2019), biofeedback through projection to support yoga-breathing practices (Moran et al., 2016), and virtual environments generated by

users' brain activities and respiratory rates in order to assist novice users in learning to reduce stress through mindfulness meditation (Prpa et al., 2016).

In these user-environment relations, the users also stand in an intentional relation toward the environment and so experience the environment, and likewise, the environment is in an intentional relation toward the user and "experiences" the user. In the study by Semertzidis et al., for instance, where the EEG is artistically visualized, the user perceives how the mediator interprets her state. This makes for an immersion relation between the user and the environment and opens up for a reflexive intentionality where the user not only experiences the environment, but a new perspective is opened toward one's self. Depending on the extent to which the user attempts to read or interpret the "message" of the application, these relations may lean toward hermeneutic as opposed to alterity.

This concludes our analysis of user-environment relations in VR interventions. We wish to stress that this list is far from exhaustive, and that the user-environment relations do not necessarily exclude each other. It is perfectly possible to imagine combinations of these as well as other possible subjectivity-objectivity configurations. We return to the idea of VR as an extreme meta-medium: each VR application constitutes its own form of medium. Beyond what we have described above, every user-environment relation will have its own subtly differently constituted subjectivity-objectivity structure, and we expect more nuances and complexity as researchers relate to actual phenomenological accounts. As Ihde (2012) writes regarding the methodology of phenomenological investigations, "[t]he analysis begins with what appears (noema) and then moves reflexively toward its how of appearing [noesis]" (p. 31). What kind of subjectivities will be revealed in virtual worlds cannot be grasped beforehand; this is rather discovered reflexively based on the mediated experience.

5   Discussion

Interaction with technology is traditionally understood as something that happens between the human being and the technological artifact (Verbeek, 2015a). In contrast, postphenomenology takes the perspective of understanding the human subject and the technological artifact phenomenologically as they arise from the interaction; it pays attention to how the human subject and technological artifact mutually shape each other in the relation that comes between them. The perspective sees the design of technological objects as also involving "the design of human subjects who interact with these objects." (Verbeek, 2015a, p. 28), making it particularly relevant for understanding the

user experience of VR interventions whose aim it is to "change the self." The theoretical framework in this paper is proposed as relevant for describing both intended and actual VR mediations. In order to clarify the contribution of the framework, we discuss more in depth the relationship between real and "virtual" subjectivity, as well as real and virtual worlds, before discussing the scope of the framework. We end the discussion by outlining directions for future work of advancing the applicability of our framework into the methodological.

5.1   The Relationship Between Human and User

Attempting to understand the nuances of the fleeting and mediated experience of VR can be complex. VR is a personal experience and will alter (and depend) on who the participant is, and in which world of meaning that they live. While the VR application is constant, the lived VR experience is a transaction between the technology and the human. So how exactly is this relationship constituted? To draw an example from post-phenomenological literature, Kaposy looked at how imulating ethical scenarios in medical education purports a view of the medical student more as an object than a subject. Utilizing Ihde's distinction of body one and body two—body one being the subjective, lived body, and body two, the objectified social and cultural body—the insight by Kaposy is that the students within the scenario are being evaluated after certain objective criteria, constituting an expected way of being that is abstracted as an object body. This is also the nature of interventions in Immersive VR. Within the design, the role that is more or less adopted upon embodiment and defined in relationship to social actors and the virtual environment is an abstract object body, a "body two." We draw on information from our environment and our bodies' appearance in determining who we are, and this impacts our behavior. This is, of course, not just a phenomenological discovery. This nested subjectivity is also described within other disciplines. For instance, both The Proteus Effect Fox et al. (2013), and the idea of Body Semantics (Slater and Sanchez-Vives, 2014) claim, and demonstrate, that body type can influence attitudes and behaviors. The Proteus Effect describes the mechanism utilized in many VR interventions from a social psychological perspective based on self-perception theory, where participants conform to the behavior they imagine that a third party would expect (Slater and Sanchez-Vives, 2014). Body semantics approaches this from a neuroscientific perspective and sees this as an intrinsic property of brain functioning, where the brain generates attitudes and behaviors "concomitant with that type of body, independently of any other factors such as social expectation." (Slater and Sanchez-Vives, 2014, p. 28). Returning to the example brought forth by Kaposy (2017), however,

the point is that although we may embody an objectified "body two", it does not fully become who we are. Kaposy underscores the need to recognize the "anthropological constant" of bodily lived experience (body one) in the simulated clinical encounter. Although body one will never 'become' body two after long enough exposure, there is here a synthesis: "body one is situated within and permeated with body two, the cultural significations which we all experience." (Ihde, 2003, p. 13). Consequently, in VR, our "virtual selves" and virtual worlds—and how they are ontologically structured—do not become our new selves and our new worlds. They do, however, affect the way the "real world" and our "real selves" are constituted. Take for instance the study by Banakou et al. (2016), in which white participants were embodied in black avatars. The participants did not start to identify as black after the experiment and so radically change their sense of self. Yet, having experienced the world in which this was the structured ontology, their implicit racial bias, and so their subjectivity, was changed by means of the intervention. As Gualeni and Vella (2020) write: "in virtual worlds, human beings can reflect on their values and beliefs, take on new subjectivities, explore previously unexperienced ways of being, and take reflective stances toward their existence and their subjectivity in the actual world." (p. xix).

5.2   The Relationship Between Environment and World

In addition to considering the relationship between Human and User in the framework, it can be fruitful to clarify the relationship between the Environment and the World. In the phenomenological tradition, a given world is not understood as equivalent with reality. Rather, a world is understood as how reality is disclosed by human beings (Verbeek, 2005). Worlds are—in their intentional relationship to human beings—intelligible, persistent, and "understood together" (Gualeni, 2015). The virtual environment with its "world characteristics" is seen as a part of the regular world in which it is accessible; however, engagement with it leaves the "real world" in the background in the alterity relation that is constituted. Ihde (2002) describes alterity as a "quasi-other or quasi-world with which the human actor relates" (p. 81). The virtual environment can be quite "other": it does not need to behave according to traditional ontologies and can instead, as we have seen, inverse them. In short, virtual environments are "fictive world[s] that [are] constructed, not copied" (Ihde, 2002, p. 81) and they come with their own "integrated ontology" (Metzinger, 2018, p. 4). The point is, however, that although the real and virtual worlds have distinct self-contained ontologies of their own, they are nevertheless highly interrelated. Again, we return to the concept of mediation. Postphenomenology stresses the role that technologies have in

mediating humans' intentional relation toward their world, and in the case of Immersive VR, it is the experience of a virtually structured ontology that might reframe how humans disclose their worlds, and vice versa. Thus, postphenomenologically, we understand the ontologies of VR and RL as interrelated, so that experiencing a differently structured ontology in VR might affect the ontology of one's real world, or as Gualeni formulates it; "people's capability for structuring thought and rationalizing experience in relation to the actual world." (p. 19).

5.3   The Scope of the Framework

This paper has presented a theoretical framework for understanding the user-environment relations that Immersive VR gives rise to. One may ask, however, whether the framework extends to other VR technologies such as desktop VR (e.g., computer games), Mixed Reality (MR) technologies, and Augmented Reality (AR) technologies. The identified user-environment relations we presented rests on the particular human-technology relation that VR constitutes: the possibility of embodying, as well as relating to as alterity, parts of the same technological mediator. Other immersive technologies, such as AR and MR, do not constitute the same human-technology relation as VR. They are mainly distinguished in that they are not so immersive, and therefore engagement with the world persists actively instead of existing as a background relation. MR, for instance, seem to constitute an immersion relation in the sense that the virtual is merged with the world, and so it is distinguished from Immersive VR in which there is not this "merging" of the physical and the virtual. AR technologies are also distinguished in the human-technology relation they constitute and are well described by Verbeek's augmentation relation. In the augmentation relation of a device such as the Google Glass, we embody the glasses, and we are in a hermeneutical relation to the technology, while our involvement with the world persists (Verbeek, 2015b).

The less immersive Desktop VR medium actually constitutes a similar relation to Immersive VR; the human interacts through an avatar toward the alterity of the virtual environment, where the world is in the background. Nevertheless, the experience is very different as Desktop VR is less immersive, and you can clearly see the bounds of the medium. The content is framed, and "[e]verything is in front of the participant" (Ihde, 2002, p. 10). This framing restricts the medium's capability to encapsulate the user, and so the Desktop VR cannot achieve the same kind of mimesis with reality that Immersive VR can, where user interfaces can be natural and transparent, and the mediated information appears as if non-mediated. The degree of isomorphism between reality and virtuality that a simulating medium can achieve is important because it

dictates how objects with their horizons and affordances are available to the user. For instance, Immersive VR can enable user interfaces to utilize natural bodily engagement with the virtual world (e.g., physically jumping vs. pressing space, or rotating head vs. moving mouse). This is not to say that desktop VR interfaces cannot also be embodied, or that all Immersive VR applications utilize natural interaction exclusively. In terms of general medium characteristics, however, desktop VR is not as inherently intuitive as immersive VR and may require more time to embody properly, just as we need to learn to drive a car before it truly becomes an extension of our bodies and we can pay attention to the road rather than how to maneuver the car.

To conclude, AR and MR constitute different human-technology relations than Immersive VR, and so our framework of user-environment relations is not directly relevant for understanding user experience in environments using these technologies. The encapsulating capabilities of the Immersive VR medium distinguishes it from other computer simulation technologies like Desktop VR, which do not leave the world in the background to the same extent as Immersive VR technologies. The capability of Immersive VR to provide reality-based interaction also contribute to the differences in how we experience worlds mediated through Immersive VR as opposed to Desktop VR.

6   Future Work

The perspective of postphenomenology sees the technological research product as a mediator that gives rise to a particular user-environment relation. It purports the view that the design of technological objects should also be understood as the design of human subjects. As Willis (2006) posits in her idea of ontological design, having this understanding—that what we design also designs us—"inevitably means undertaking any kind of designing activity with a very different kind of disposition." (p. 82). Developing systematic approaches of incorporating this understanding in evaluation and anticipation, however, is outside the scope of this paper. Future work addressing the applicability of post-phenomenological theory to concrete, practical cases would therefore complement our research. Here, we wish to highlight two avenues for research as particularly promising. Firstly, the development of systematic approaches to the empirical study of user experience in VR, and secondly, the development of guidelines for anticipating mediations as part of design processes and ethical assessment. For empirically studying user experience in VR, we see contextual inquiries where users are interviewed/queried in the virtual environment (Schwind et al., 2017, 2019; Alexan-

drovsky et al., 2021) as promising venture points for understanding user-environment relations as such. In terms of anticipation, the post-phenomenological approach to "variational analysis" is highly relevant, which could be described as "brainstorming stabilities of a multi-stable technology" (ibid, p. 27). Rosenberger and Verbeek discuss how this approach is inspired by Husserl's eidetic reduction, but radically altered to find variations within particular contexts instead of the aim being to locate general "essences." Work looking into how postphenomenology's variational analyses can be performed more concretely for VR is here desirable.

Beyond the advancement of theoretical insights into methodology, however, what is most desired in future work is empirical insight into actual user-environment relations. In our analysis, we were not able to perform an analysis of the research participants' mediated experience, as in most of the cases, the participants' experiences were not outlined in-depth enough for it to be possible. Although assuming the participants' experienced the mediations as they were intended may be somewhat justified as the interventions were successful, we wish to stress that reaching experience through induction is not relating to actual, phenomenological accounts. In fact, the role of postphenomenology as we see it is precisely to move away from the researchers' assumptions of what experience is being mediated toward the actual mediated experience.

7   Conclusion

Immersive VR is a remarkably flexible medium for interventions as it allows the construction of virtual worlds with ontologies radically different from the real world. Moving toward an understanding of the experiences underlying these effective interventions, we have proposed a theoretical framework that sees the user experience in Immersive VR as mediated in relations constituted between user and environment. The perspective that we advocate is distinguished from traditional approaches to understanding user experience in that it does not presuppose the human subject and the technology as poles between which interaction occurs. Rather, it sees the human subject and the experienced technology as a result of this interaction and the user experience as mediated in relations constituted between user and environment. We purport this perspective is a more relevant way of understanding the user experience underlying VR's capability to "change the self," as it specifically attends to how the human subject is mediated in the user-environment relation that is constituted. The applicability of the framework has been demonstrated through an analysis of a variety of VR interventions that constitute particular user-environment relations that vary greatly in terms of their on-

tological structuring. Finally, we have discussed the interrelations of various aspects of our framework, addressed the framework's scope, and provided directions for future work in advancing the theoretical framework into the methodological.

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Paper II

Show, don't tell: Using Go-along Interviews in Immersive Virtual Reality

Abstract

Go-along interviewing is an emerging qualitative research method where researcher and interviewee go together to a location relevant for the research. Usually employed in ethnographic studies,the method is used to provide a contextualized understanding of a participant's experience. This paper explores performing Go-along interviews in Immersive Virtual Reality (VR). Through an analysis of ten interviews conducted inside our participants' Virtual Mind Palaces we show how the interlocutors' shared presence in the virtual environment established a common ground beneficial for communication. Being in VR enabled our participants to demonstrate interactions spontaneously, and, by providing a guided tour,show us relevant objects and locations in their Virtual Mind Palace.Benefits and challenges of adapting this method to VR are discussed and recommendations for researchers who want to conduct VR Go-along interviews are provided. Finally, we argue the method as an effective tool for eliciting contextual, phenomenological accounts of virtual environments.

1 Introduction

Go-along interviewing is an emerging qualitative research method in which both researcher and interviewee are immersed in a context relevant to the interview. In ethno-

graphical studies, this method has been used to gain an understanding of participants in their context, such as neighbourhoods (Carpiano, 2009; Kusenbach, 2003), campuses (Lechner et al., 2013), and places of leisure (Burns et al., 2020). Combining observation with interviewing, researchers utilizing this method can inquire into their participants' contexts while experiencing these contexts themselves (Carpiano, 2009), providing an added layer of insight for the researcher. The Go-along method "brings to the foreground some of the transcendent and reflexive aspects of lived experience as grounded in place" (Kusenbach, 2003, p. 456). Instead of removing the participant from the environment being discussed in the interview, Go-along interviews can access the participants' experiences when they are present in and interacting with their environment Kusenbach (2003). Thus, the method can allow researchers greater mobility for constructing knowledge by being present in environments that for the participants are "spatially charged" (Jørgensen, 2016, p. 37). Go-along interviewing is also preferred because of its participatory qualities. The method can help to alter the power dynamics between researcher and interviewee as the participant often takes the lead and provides a guided tour of their familiar environmental context. Beyond this, being present in an environment can help elicit information that otherwise might not have come forth in a traditional sit-down interview where participants are removed from the environment of interest. Performing Go-along interviews is, therefore, a more explorative method that is open to spontaneous reactions from both researcher and interviewee, where the environment in which they are present can shape the course of the interview. In this way, the Go-along interview method can facilitate for the emergence of a natural conversation that is informed by the participants' sedimented relationship to the environment, as well as both parties' observations and reactions during the interview itself (Burns et al., 2020).

Although Go-along interviewing is usually performed by attending to physical environments the method also holds promise for use in environments mediated through Immersive VR. As VR applications are not just tools, but environments in which we exist (Houliez and Gamble, 2013), performing Go-along interviews in VR can provide possibilities for being attentive to a broader range of the virtually mediated experience. Being co-present in the virtual environment can also provide communicative benefits similar to those reported in physical Go-along interviews. Whereas in a traditional sit-down interview the participant would have to provide verbal descriptions of the virtual environment and her interactions within it retrospectively, being in VR can allow the participant to demonstrate interactions with the virtual environment in situ. Being present with the participant in the virtual environment can also aid the researcher, who

can draw on observations to ask more informed questions. In addition to this, performing Go-along interviews in a virtual environment of relevance to the research can evoke participants' memories of past experiences within the environment as well as provide access to the participants' current flow of experience as it unfolds within the particular context. As current assessment of VR applications often takes quantitative and objective approaches through the use of biosignals and questionnaires (Slater et al., 2010; Alexandrovsky et al., 2021), Go-along interviewing can further be a suitable addition to the researchers' toolbox for the study of user experience in VR. The method can also enable researchers to conduct qualitative, contextual research while socially distancing, thus contributing to some of the challenges HCI researchers face during the ongoing COVID-19 outbreak.

In this paper, we describe a study where we gave ten participants an Oculus Quest they could use to access a virtual environment when at home over one week. The participants interacted with the virtual environment by inserting images, 3D objects, GIFs and videos to create a virtual "Mind Palace"; i.e., a visuospatial structuring of information comparable to a three-dimensional mind map (Yates, 1966). To gain an understanding of our participants' experiences of creating and spending time in their Virtual Mind Palaces, we conducted Go-along interviews inside the virtual environments they had created. We recorded video footage of the interlocutors' avatars inside the virtual environment and conducted a thematic analysis of the interviews, focusing on verbal and non-verbal communication as well as system interactions. Overall, we found the shared presence that the researcher and participant had towards the virtual environment beneficial for evoking contextual accounts of our participants' experiences. Through the analysis, we show how the shared ground of the virtual environment benefited communication between interviewer and interviewee. By being in VR, participants were able to spontaneously demonstrate preferred and not-preferred interactions with the virtual environment. They were also able to show meaningful objects and locations within the virtual environment by providing a "guided tour" of the virtual environment for the researcher, where the environment offered cues for conversation. Furthermore, as the Virtual Mind Palaces were highly personal and associative, having the participant guide the researcher through the furnished environment made it easier for the researcher to gain an understanding of what the environment meant for the participant. Moreover, expressive tools within the application, such as drawing, allowed participants to spontaneously suggest desirable interaction features based on their own experience.

This preliminary and explorative study suggests the Go-along method as promising

for studying user experience in, and of, interactive virtual environments. The paper discusses advantages and disadvantages of this adaptation as well as the feasibility of employing Go-along methods across other media. The primary contribution of this paper is the rationale, recommendations and guidelines we present for HCI researchers to conduct Go-along interviews in VR.

2   Background and related work

In providing a background for our exposition of the VR Go-along method, we first account for the role of contextual and ethnographic research methods in HCI before reviewing contextual inquiries of VR experiences in particular.

2.1   Context and situatedness in HCI

The importance of context and situatedness for understanding user experience has become more recognized as technologies have entered our lives across various contexts and use scenarios (Dourish, 2004). Going beyond the focus on usability and clear, pre-defined goals, "3rd Wave" HCI (Harrison et al., 2007) has seen an increased focus on understanding experiences qualitatively in their particular context with a focus on lived and felt experiences (McCarthy and Wright, 2004; Bødker, 2015). HCI researchers have, therefore, increasingly turned to qualitative methods that are sensitive to the role that context plays in the way we experience and use our technologies. As part of this shift, researchers have found ethnographical methods useful for researching various environmental contexts. Through detailed observation of workplaces and other everyday settings, the rationale of ethnography within HCI is that a thorough understanding of participants in context can be useful in research—whether in critiquing systems design or generating insights for use in design processes.

As an example, Pink et al. presents their approach of "sensory ethnography" as enabling an understanding of practical activity as "emplaced within complex and shifting ecologies of things" (Pink et al., 2013, p. 1). As with Go-along interviewing, their approach involved touring of homes with participants, "using the materiality, sensoriality and affective meanings of the home itself as prompts and props" (Pink et al., 2013, p. 8). They write how sensory ethnography can allow "designers to begin understanding this 'constantly evolving ecology of place,' which is a subjective sensorial, intangible concept that cannot be described, but can be re-enacted as a sensory experience" (Pink et al., 2013, p. 12-13). Here, their approach allowed the identifying, situating and interrogating of practices in context in order to gain insights for a design intervention.

Whereas which role ethnographies should play in design have been subject to discussion (Dourish, 2006; Crabtree et al., 2009), ethnographic *methods* are not just used to produce ethnographies of existing, naturally occurring practices in order to define system requirements. Qualitative, context-sensitive methods can also be used to study new technologies "in-the-wild" (Rogers, 2011) as interventions rather than studying naturally-occurring use (Chamberlain et al., 2012). Both approaches share the in-depth, qualitative focus on situatedness, while in-the-wild studies focus "on creating and evaluating new technologies in situ, rather than observing existing practices and then suggesting general design implications or system requirements" (Rogers, 2011, p. 58). In this study, we utilize the Go-along method to inquire into the use of a VR application in-the-wild, where participants used the application as part of their everyday. Our contextual inquiry focuses primarily on the virtual environments as the context of experience where the physical environment is in the background.

Media as context

The in-depth, qualitative focus of ethnography goes beyond physical locations; media technologies are also being understood as "environments" in their own right. Møller and Robards write how "netnography" (Kozinets, 2010), "virtual ethnography" (Pink et al., 2016), and "digital ethnography" (Hine, 2000) all "[filter] understandings of media through the lenses of *space, place and mobility*" (Møller and Robards, 2019, p. 95, emphasis in original). Here, cultures are studied as they emerge in digital and social spaces—or how participants are in their virtual contexts. One method of inquiring into such digital spaces is the "Media Go-along" (Jørgensen, 2016), where researcher and interviewee discuss media use while navigating, for instance, a smartphone app. The Media Go-along "involves research participants giving a verbal and kinetic 'guided tour' of an app, with the researcher intervening in different ways..." (Møller and Robards, 2019, p. 96). The method combines interviewing with observation of participants' media use in situ. The Media Go-along shares similarities with other contextual inquiries in HCI such as the think-aloud (TA) (Wright and Monk, 1991; Tan et al., 2014) in that researchers can observe participants as they interact with their media and hear verbalized accounts of their experience.

The think-aloud is a widely employed method for usability testing, and is often used without any explicit theoretical grounding or referring to any particular protocol (Boren and Ramey, 2000; Nørgaard and Hornbæk, 2006). What unites the more detailed TA protocols, however, stands in contrast to Go-along interviews with their dialogical qualities. The traditional TA protocol emerged within cognitive psychol-

ogy (Ericsson and Simon, 1984), and Boren and Ramey has since provided a protocol grounded in speech communication theory to more adequately tailor the method to usability research (Boren and Ramey, 2000). While the traditional TA protocol understands the think-aloud as a participant monologue, Boren and Ramey admit that achieving a monologue while researchers are present is not entirely possible (Boren and Ramey, 2000). For this reason, their protocol rather focuses on communication roles that the researcher and participant should assume in the ongoing dialogue, aiming to establish "a highly asymmetrical speaker/listener relationship, one which maximizes the speakership of the participant and minimizes the speakership of the usability practitioner" (Boren and Ramey, 2000, p. 267). The goals of these two TA protocols are similar; "eliciting a verbal report that is as undirected, undisturbed, and constant as possible" (Boren and Ramey, 2000, p. 268). In addition to these rather strict TA protocols, Olmsted-Hawala et al. discuss a "coaching protocol" that utilizes "more verbal feedback and probes where test administrator asks direct questions..." (Olmsted-Hawala et al., 2010, p. 2384). This latter TA protocol is the most similar to the Media Go-along as it allows a somewhat more synchronous speaker/listener relationship than the traditional and speech-communication protocols.

That being said, beyond being less dialogical, TA protocols are distinguished from the Media Go-along in that they are often used to measure the usability of a system that the user has never seen before. In contrast, the Media Go-along looks at media that the participants have an established relationship towards, which is why the participants can provide a "guided tour". They are also distinguished in what kind of data they are likely to generate. In following the strict TA protocol presented by Ericsson and Simon, for instance, the kind of data Go-along methods often gather and are primarily interested in, would have to be disregarded entirely as it falls within the classification of "Level 3 data" (Ericsson and Simon, 1984). Here, if the participant draws from long-term memory or answers comments, prompts or questions from the researcher, any subsequent verbalization would have to be disregarded "...because the normal flow of information in [short term memory] during the task has been altered" (Boren and Ramey, 2000, p. 262). Stream of consciousness, value judgements and feelings can not be considered data either within this model (Boren and Ramey, 2000). The Go-along method, which is grounded in ethnography and phenomenology on the other hand, is actively seeking precisely this kind of data: "...body and environment are treated as *a priori* portals through which narratives of meaning arise" (Jørgensen, 2016, p. 38, emphasis in original).

Another method which the Go-along method shares similarities with is the elici-

tation interviewing method, a central method in psychophenomenology that has also been applied in HCI (Light and Wakeman, 2001; Hogan et al., 2016). Here, a trained researcher attempts to guide the interviewee in introspection (Vermersch, 2009) in order to access pre-cognitive, non-verbalized experience by a "'reliving' of the subjective lived experience of a past, specific and singular situation" (Mouchet et al., 2019, p. 970). This interviewing method places careful consideration on language, both in asking of questions as well as in evaluating interviewee responses. The goal is for the interviewee to engage in *embodied speech*—a reflective exploration in a sensory mode—as opposed to established ideas about their previous experience (Mouchet et al., 2019). Whereas in psychophenomenological approaches researchers guide the interviewee in accessing a past experience, the Go-along interview uses the environment which the interviewee has access to as a means to bring previous experiences in proximity, in addition to the here-and-now experience as it is currently unfolding.

This means of elicitation is not exclusive to Go-along interviews. Using props like diaries, photographs or other objects for purposes of elicitation in interviewing (Jones et al., 2004; Price and Jewitt, 2013) allows the participant and researcher to access what is being discussed during the interview and provide a certain sense of context. Possible limitations following the use of props is that these are removed from their context of use. Moreover, in photo elicitation methods or use of props, the researcher is usually controlling the presentations or selection to a larger extent, which "communicates the researcher's point of view to the participant..." (Jørgensen, 2016, p. 37) and the "guided tour" element is lost. Any mobilities that may occur in such settings are discursively traversed across "narratively [constructed] environments" (Jørgensen, 2016, p. 38). This is contrasted with the Go-along's "active exploration of materialities - whether they are built or media environments" (Jørgensen, 2016, p. 38).

Møller and Robards purport that the Go-along method can be useful in the study of any interactive media technology that is part of everyday life, also in the field of HCI (Møller and Robards, 2019). Benefits of contextual inquiries such as the Media Go-along are that the researcher can tell stories of how "people are *with* their media," (Møller and Robards, 2019, p. 104, emphasis in original) and so understand the participant in relation to a digital context. Such mobility can also be along temporal dimensions. For instance, the "scroll back" method looks at digital traces in virtual spaces, such as scrolling back on a Facebook timeline (Møller and Robards, 2019). Both methods draw on contextualized observation and interviewing of participants.

Although Go-along methods surfaced in ethnographic studies, the tenets of the method are conceptually more tied to environments and mobility than the often so-

cial and cultural interests of ethnography. Moreover, the method used in isolation "is not inherently ethnography in that it does not involve a prolonged, focused entry into a specified culture or context" (Burns et al., 2020, p. 53). As a synergistic combination of the qualitative methods of observation and interviewing, the Go-along method is highly flexible and can be adjusted to fit particular research projects (Carpiano, 2009). While social and cultural structuring are powerful dimensions of places that the Go-along method is effective in unveiling, spatial dimensions need not necessarily be socially or culturally structured for the Go-along method to be effective in eliciting contextual accounts of experience. With spatial computing becoming more prevalent and accessible, places and environments that are social *and* individual will be places of situated action, and so be imbued with memories, meaning and practices of interests for researchers.

The Go-along method is performed by immersing both researcher and interviewee in a navigable context relevant for the interview. Whether this is a physical environment, an app interface, or a virtual environment, matters less as long as the context offers mobility for the researcher and participant to "go along" within it to observe and conduct the interview. With the new possibilities of conducting VR research in-the-wild enabled by the commercial availability of VR technologies, the Go-along method can moreover be a useful research tool as it can allow HCI researchers to perform studies on usability and user experience in the contexts in which they occur, where participants are situated virtually in the virtual environment and physically in the use-context of the application (homes, offices, etc.).

2.2   Contextual inquiries of Virtual Reality

There is thus a sense in which media can provide their own context, and this becomes especially clear in the case of VR because of its capability to immerse the participant in virtual environments. The VR medium can provide a context of its own where participants' experiences are tied to the virtual environment to which they feel present. This is being recognized in methods that seek to approach VR experience in the context of the virtual environment. For instance, researchers had participants fill out presence questionnaires while still inside the VE (Schwind et al., 2019, 2017; Putze et al., 2020; Alexandrovsky et al., 2020; Feick et al., 2020). The approach of having participants answer questionnaires while in VR reflects the same rationale as the Go-along method and other contextual inquiries. Schwind et al. writes how the disadvantage of post-test questionnaires "is that they rely on subjects' memories which reflect an inconsistent and incomplete picture of the VR-Experience" (Schwind et al., 2017, p. 1578). By giving the participant access to the virtual environment and, therefore, also access to their

own experience as it unfolds within the context of relevance, the hypothesis is that their answers will be more reflective of said experience. Performing questionnaires while in VR has been shown to be less invasive than post-questionnaires, leading to a reduced break in presence, and so also provide more reliable self-reports (Putze et al., 2020).

While there exists research on Go-along interviewing in VR (Kostakos et al., 2019) it has so far not been conducted to gain an understanding of participants' relationship to *virtual* environments as such. In a pilot study, Kostakos et al. immersed participants in Google Street View to explore university community members' contextualized perceptions of urban habitat fragmentation (Kostakos et al., 2019). The study aimed to reduce limitations of the traditional Go-along method, such as the inability to include people with physical or mental disabilities in the interviews. During the participants' navigation through Google Street View, the participants were interviewed by a non-immersed researcher who watched the participants' view on a screen. They found that mediating physical locations through VR evoked emotional reactions that participants expressed both verbally and non-verbally. Whether this can be strictly considered a true "Go-along" is disputable as researcher and interviewee were not immersed together, and the researchers mention that having participant and researcher immersed together could improve their approach. That being said, the relevance of virtually mediated Go-along interviews of all kinds are increasing now that researchers must find new ways to conduct research during the ongoing COVID-19 outbreak.

2.3   Non-verbal Communication & Interaction

Performing Go-along interviews in VR involves going from a non-mediated to a mediated way of communication. The communication between the researcher and interviewee is mediated through avatars, and researchers can not view the participants in their physical context, only as they appear in the virtual environment. There is thus a question of whether the VR system mediates communication in a way that is transparent enough for meaning not to get lost, and further, in terms of observation, whether viewing the participant's avatar gives a good impression of their embodied interaction. Non-verbal communication has been shown to be vital in regulating how verbal communication is perceived (Knapp et al., 2013; Mehrabian and Wiener, 1967). Although we return to this issue in more detail in the Discussion, we generally argue that Immersive VR satisfactorily supports both verbal and non-verbal cues of communication and interaction (Otto et al., 2006; Maloney et al., 2020b). This is primarily because of its natural user interface—and following from that, its natural semantics—where the bodily comportment of the user is being tracked and displayed in the virtual environ-

ment. In terms of communication, spatial behaviour in VR such as avatar positioning and orientation designates the viewpoint of the embodied user in the same way as in real life, which contribute to avatars having information on what the other person is seeing so that a common ground can be established between the interlocutors (Smith and Neff, 2018). Bodily correspondence to the avatars also open up for a great variety of gestures that can be used communicatively and spontaneously through natural interaction. In Social VR, non-verbal communication is heavily relied upon (Maloney et al., 2020a; Yassien et al., 2020). For instance, Maloney et al. conducted an observation study in Altspace VR where they observed communicative non-verbal behaviour such as nodding, applause, pointing, waving, dancing and kissing as well as pushing, poking, bumping and flailing of arms Maloney et al. (2020b). They write how these gestures were shown to "mainly indicate paying attention (e.g., nodding, moving body to indicate social connection)" (Maloney et al., 2020b, p. 175:19). The same paper describes a text interview study with VR world users who found non-verbal communication to be positive in their social VR experience as it was similar to offline F2F interaction and made it more natural to initiate communication with strangers in the virtual world (Maloney et al., 2020b).

The non-verbal interaction affordances of VR applications is also relevant for what the VR Go-along interview can be used to inquire into. VR applications are often designed to utilize this possibility for natural interaction through bodily engagement with the virtual environment (Dehesa et al., 2020; Kosmalla et al., 2020; Zindulka et al., 2020), and here observations in VR can help to illuminate researchers' understanding of the usability and user experience of such embodied interaction; observing the user while they are interacting with the system. Luff et al. has argued that conceptions of embodied interaction that only considers the bodily interaction is insufficient as the interaction takes place in relation to the environment, which thereby is of equal importance (Luff et al., 2013). As a result, gestures between interlocutors become "fractured." Thus, "...the production and intelligibility of action is entailed and dependent upon occasioned features of the immediate environment in which it occurs" (Luff et al., 2013, p. 6:2). Researchers might, therefore, benefit from perceiving these embodied interactions as embedded in the virtual environment, as this can provide a more complete picture of what is going on. As Immersive VR is transparent in mediating the bodily comportment of users as they interact with the system, it stands out as a promising candidate for studying embodied interaction as embedded in the virtual environment.

3   Research design

This section details the research design of our study. First, we give a brief introduction to our work on Virtual Mind Palaces to provide the context in which we used the Go-along method. Further, we detail the Go-along as the method employed in our study to gain a situated and contextualized understanding of our participants' experience in creating, as well as being in, their Virtual Mind Palaces.

3.1   Study Context: Virtual Mind Palaces

We used the Go-along method to inquire into our participants' experience of creating a Virtual Mind Palace. A Virtual Mind Palace can be defined as a visuospatial structuring of information comparable to a three-dimensional mind map. The method is related to the mnemonic "Method of Loci"—also called the Memory Palace technique—which involves visualizing objects at particular loci or places (Yates, 1966). The method is promising in terms of VR adoption as it utilizes visual and spatial cues to aid the memorization (Vindenes et al., 2018), features that immersive VR is particularly fit to produce. In recent years, several works of research have investigated such adaptions in various ways (Mann et al., 2017; Legge et al., 2012; Jund et al., 2016; Krokos et al., 2019; Vindenes et al., 2018). In our work, we relate to the concept of the Method of Loci in an expanded way as a "Mind Palace" rather than a "Memory Palace," the difference being that the place is not necessarily limited to mnemonic purposes. What we mean by this in practice is that the participants can define the role of the virtual environment more or less as they wish, within the broader focus of approaching the creation of meaningful, personal virtual worlds of information. For this particular study, where our participants used the VR application for one week, however, we were most interested in understanding our participants' experience in using the VR tools we offered for creating their own Virtual Mind Palace. We were interested in how users experienced interacting with the interface and their experience of being in, and furnishing, the virtual environment we had designed. The study was explorative in that we were open to receiving otherwise valuable input from the participants that could inform our further work on Virtual Mind Palaces in more longitudinal studies. Beyond this—which is the topic for this paper—we were also interested in exploring conducting VR Go-along interviews in order to determine whether this could be a useful method in our continued research, and in that case, which role Go-along interviews could serve within a broader research context.

3.2   Application

We used the open-source project "Mozilla Hubs" to host the virtual environments that functioned as the locus for our participants' Virtual Mind Palaces. Hubs allows the upload of virtual environments as GLTF-files and thus virtual environments can be developed for Hubs through a variety of 3D software such as Blender, 3DS Max or Maya. In our case, we used the web editor "Spoke" which features integrated upload possibilities to Hubs directly as well as offering performance checks that can be valuable when designing for mobile VR systems such as the Quest. The environment we created comprised a house with three rooms divided over two floors, set upon a lake with enclosing mountains (see Figure II.1.) The virtual environments published to Hubs are available on the Web through WebVR browsers, in our participants' case the Oculus Browser on the Oculus Quest. By hosting one's own instance of Hubs through Hubs Cloud, it is possible to connect to content integration APIs such Google Poly, Sketchfab, Bing Images, Bing Videos and Tenor GIFs, which provide a broad set of possibilities for creating a Virtual Mind Palace filled with information, while still being immersed in the virtual environment. By connecting to these content integration services users can search for images, videos, GIFs, and 3D objects to insert into their environment. Beyond this, Hubs affords 3D drawing that provides possibilities for writing, modelling and other creative expressions within the environment. As Hubs originally is intended as a social VR application, it also has the benefit of allowing the researcher to be co-present with the participant in the Virtual Mind Palace for the interview without any additional development needed to achieve this.

Interaction possibilities for Hubs on Oculus Quest

The Oculus Quest is a stand-alone wireless VR Head-Mounted Display with tracked controllers. It offers interaction in six-degrees-of-freedom so that users can not only orient themselves in 360 degrees but also otherwise move freely about in three dimensions. Being able to interact in three dimensions makes it possible for participants to walk within their tracked space physically, and otherwise use the hand-tracked controllers within the same tracked area. Hubs utilizes the tracked controllers for interaction, allowing users to grab objects and move them about in the environment. The user can access the interface for content integration by tilting their head upwards. Upon doing this, a GUI akin to a more traditional website pops up, and the users can choose whether they want to insert content from the various integrated services. Here, they can search for specific content using a virtual keyboard, or browse common categories.
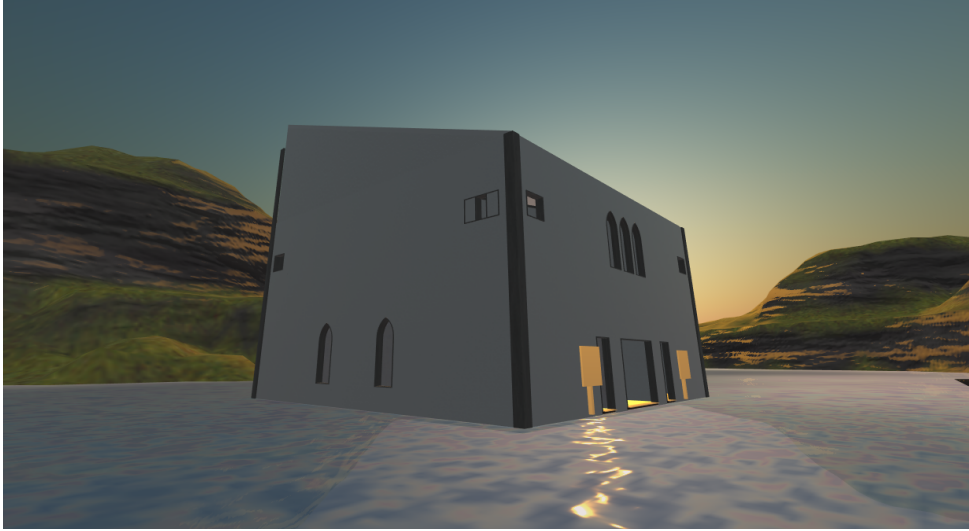
Figure II.1: The building positioned in its wider environment

When the user chooses to insert a piece of content, it appears approximately one meter in front of them and can be moved to the desired location by grabbing it with the hand controller. If an object is too far away, or if the user is writing on the virtual keyboard when searching for an object, a pointer extends out of the controller, allowing writing as well as manipulation of objects from a distance. Users can navigate through their environments in Hubs by either physically walking, teleporting, or virtually "slide" in the direction they push the thumbsticks on the Oculus Quest's Touch controller. In addition to this, there are several buttons on the Touch controller, which enables various changes to the objects in the environment, such as giving an object gravity or pinning it to a location. These controls were explained to the participants through a YouTube video where the researcher recorded a session from a first-person point of view, explaining the various steps of interaction possible.

3.3 Experiment Design

The study was conducted over one week. Participants who did not already own an Oculus Quest borrowed one from our lab. We instructed the participants to use their Oculus Quest to create a Mind Palace with a theme in which they were more or less interested, for instance, outlining one's favourite books. The participants were not trained in the Method of Loci but were handed a general text introduction to how the method worked. The study ran over one week; however, the participants were not

Table II.1: **Overview of participants**

Participant	VR Experience	Virtual Mind Palace Theme
Barry	Yes	Childhood interests
Anna	Yes	Memories from 2019
Josh	Yes	University assignment
Isaac	Yes	Software technologies
Lucy	Yes	Games
James	Little	Covid-19 infection numbers
Emma	None	Solar system and nature
Daniel	Little	Shopping list for surf trip
Mia	None	Pregnancy memories
Evan	None	Lost his environment

required to use the Quest every day. Instead, we kindly asked that the participants visited and interacted with the environment at minimum three separate occasions during the week. The researcher was not present in the virtual environment during this week, only in the interview that followed. The participants could use the Quest at any given physical location they wished although we assumed most would do so in their homes. The participants were provided with a unique URL to their own respective Virtual Mind Palace that they could access using the browser on the Quest.

3.4   Participants

In total, ten participants partook in the study. Participants were recruited on campus by the use of flyers as well as through posts on social media. Two of the participants (F:27;M:39;) were recruited from a Facebook group chat for VR workouts, whereas six undergraduate students (F:20;F:30,M:33;F:23;M:39;M:21) and two graduate students (M:35;M:31) were recruited by their discovery of the study from one of the flyers. We wanted to make sure that there was a spread in our participants' previous experience with VR and therefore recruited five regular VR users and five without much experience. Five of the participants had enough VR experience that they could be said to be "used to it," meaning that they either owned a VR headset or had access to one at a regular basis, such as through studies or work. The other five had either never tried it before or just a few times at exhibitions. We detail this in Table II.1, where we gather an overview of particular participant details relevant for the analysis. The names we have given the participants in this paper are fictitious.

3.5   Data collection and analysis

To inquire into our participants' experiences, we conducted VR Go-along interviews; interviews in which both researcher and participant were immersed in the virtual environment of relevance to the study. For the interview, the researcher and the participant met only virtually, i.e., the participant and the researcher met virtually in the Virtual Mind Palace of the participant while they were physically distant. For the first five interviews, the researcher was physically located at the university, whereas the five remaining interviews were conducted from home due to the local COVID-19 shutdown. The participants were physically located in their homes where they had used the application. The participants used their Oculus Quest and communicated through its built-in microphone, whereas the researcher used either the stand-alone Oculus Quest or an HTC Vive Pro connected to a PC. We recorded video footage of the interview either using the native functionality of the Quest or through the Xbox Game Bar available through Windows 10. Due to sound issues when recording using the Quest, we used an external microphone to record audio from the interview.

We conducted a thematic analysis (Braun and Clarke, 2006) on the gathered interview data to search for common themes in how our participants communicated about their experiences in and through VR. The analysis was performed using inductive coding in a bottom-up approach: we did not have any pre-conceived theory or categories after which we evaluated or sorted the data in the analysis. Concretely, the following question focused our analysis: "How do the participants choose to communicate about their experiences?" Thus, the analysis was concerned with modes of communication; we did not create codes or themes for usability or user experience issues, although such issues naturally are an integral part of *what* was communicated. The interviews were approximately 20 minutes each and were transcribed first textually, before gestures and events within the virtual environment were added to the text as annotations after careful review of the video material. Particularly, participants' use of deixis (i.e., referential language that cannot be understood without the visual context) and various gestures, demonstrations and references were annotated to the objects or actions within the VE with which they were concerned. After reviewing the transcribed material, the various events within the VE were coded descriptively before the codes were organized into suitable themes. Finally, each code was again checked by the first author, however, in this third iteration the entire video material was not reviewed, the researcher only went back to the video material to review the presence and precision of the codes already identified. It should also be noted that the researcher conducting the interviews wrote

general notes of impressions regarding communication in the interviews immediately after the interview was finished. These, however, did not emerge from the analysis although they naturally guided attentiveness to the re-discovery of these events during the analysis itself. An overview of the codes and their relation to the three themes that emerged from our analysis is given in Table II.2. The interviews, transcribing, and thematic analysis was performed by the first author.

3.6   Go-along interviewing in Virtual Reality

In line with traditional Go-along interviews (Carpiano, 2009) we chose to keep the interview semi-structured in order to be open towards how our shared presence within the VE could stimulate and engage topics of discussion. As the study was explorative in this regard, we were equally interested in how the structure of the interview would develop as we were in participants' answers to our questions. Although explorative, and open to the possible elicitation role of being in the virtual environment itself, we had prepared a few questions. At the start of the interview, we thanked the participants for their participation before we explained the reasoning behind the study; that we wanted to hear about their experiences in conducting their task, and that we wanted to explore interviewing in VR. To start the conversation, we asked them how they had conducted their task of "furnishing" their Virtual Mind Palace, that is, what theme they had chosen for their Virtual Mind Palace and how they had actualized its creation. After this, the remainder of the conversation was, in large, further stimulated by the particular Virtual Mind Palaces they had set up. In all the interviews, either initiated by the researcher or the participant, we also discussed how interacting with the virtual environment and its interface was experienced. When the conversation approached its end, we finally asked the participants to reflect on how it was to partake in a virtually mediated interview.

4   Findings

The focus guiding our analysis was how our participants chose to communicate about their experiences. What emerged from our analysis was the significant extent to which our participants communicated in other ways than the spoken language during the interview. Participants gestured communicatively, pointed and referred to content, and demonstrated interactions with the VE during the interview. Moreover, how they directed their gaze and the way they positioned themselves within the VE contributed to communication in various ways. In this section, we discuss these results under three overarching themes that emerged from our analysis: (1) demonstrating interactions, (2)

Table II.2: **Overview of themes & codes in thematic analysis**

Theme	Codes	Theme description	Example
Demonstrating interactions	* Demonstrating bug * Demonstrating unavailability of GUI from a comfortable embodied viewpoint * Demonstrating desirable interaction feature * Demonstrating undesirable interaction feature * Suggesting by demonstration a desirable interaction feature not yet implemented	Spontaneous demonstrating of interactions during the interview	Josh suggesting an application feature allowing the grouping of several objects to appear as connected by utilising the drawing tool
Referencing virtual content	* Pointing to sites of action or experience * Casual gesture towards objects in VMP * Showing the way by means of gestures to guide the researcher * Navigating to objects as part of "guided tour" * Pinpointing concrete objects to be specific in their speech	Referencing to the virtual content to make a point during the interview	Anna referring to an image of "Beat Saber" representing memories of 2019, when the researcher asked her how she became interested in VR
Non-verbal communication	* Eye contact * Nodding * Communicative hand gestures * Looking at environment	Non-verbal ways of communication. Naturally overlapping with other themes, but designating the more subtle non-verbal communication	Lucy holding eye contact, nodding, using communicative hand gestures, and looking at the environment during conversation

referencing virtual content, and (3) non-verbal communication. Under these sections, we bring illustrative examples from some of the interviews that show these particular ways of communication. We do not provide concrete examples from all the participants, nor of all the events representative of a theme. Instead, we describe a selection of events that were particularly illustrative of the different themes. Within the sections describing each theme, we mention whether the particular theme was present in all of the interviews or just in a few of them. We did not isolate deixis and gestures as themes in our analysis, but these are present in our exposition of all the three themes in the next sections and were also present in all of the ten interviews we conducted. For clarity and ease, we present the instances of deixis in our examples in italics, whereas we describe the gestures which are often crucial to our examples in our describing of the various themes. After we have presented the three themes of our thematic analysis, we discuss our participants' answers to how they experienced being interviewed in VR and how the Go-along allowed us to understand how our participants' experienced their Virtual Mind Palaces as meaningful.

4.1   Demonstrating interactions

In several interviews, the participants took to demonstration in order to communicate their points. One of the participants, Barry, had experienced some difficulties in pinning the objects to the environment he had furnished, and so he and the researcher met in an empty environment instead. As there were no cues for conversation, the researcher asked whether the participant recalled what he had placed and where. In answering, the participant started to reintroduce the elements into the VE as the conversation ensued. "Yes, *over here*—can you see where I am pointing by the way?—I put a small skyscraper and scaled it a hundred times its size, so it was more of a real-life size. And I put a jeep *over there* somewhere and a cockpit chair *here* somewhere. . . "

Having reintroduced some of the objects into the environment, Barry mentioned various interaction possibilities that he found hard to use, such as resizing objects. "It would be more natural if you could just grab the object and just *whoosh* make it bigger," he said, gesturing the desired interaction by quickly increasing the distance between his connected palms, dragging the hypothetical object to a larger size. "Also, for the object manipulation. . . " he continued: "For instance, it was very unnatural doing *like this*," he said, rotating the object back and forth from afar with the pointer beaming out of the controller on his right hand. "And *this menu*, I have to bow down to reach it," he said, illustrating the unnatural bodily posture he had to perform in order to reach the menu attached to the object. Continuing, "And if the objects are large, the menu is very far up, like on the skyscraper. . . Moving [the object] around, however, is fine, *as right now*. There is this natural grab, but if I let it go, *this thing happens*. You see? You sort of have to let it go in a nice way, keeping your hand quiet." Barry showed how the object was floating further away from him and the researcher, as if in outer space.

Here we see the immediate access that Barry has to the VR interface aiding him in being able to demonstrate his points to the researcher spontaneously. He is able to demonstrate the actual process he is talking about instead of having to represent it entirely in terms of language. That Barry had this possibility for interaction during the interview itself made it easy for the researcher to understand the issues that he were facing, as he could see a live demonstration of the particular issues that he had experienced the last week. In a similar manner, another participant, Anna, demonstrated an interaction she did not enjoy when the researcher asked her how it was to interact with the VE. In answer, she turned her face towards the ceiling and described how it was a little painful having to tilt her face like that in order to access the content integration menu.

Another participant, Josh, demonstrated an undiscovered bug of the virtual environment through similar means: "If you see *here*," he said, while quickly virtually walking to the stairs and abruptly, involuntarily stopping, "the fact that I cannot walk down the stairs is quite immersion breaking." Having illustrated the bug in real-time, Josh went on to explain how he had utilized the space for the task. Josh had placed three objects in a corner that represented an essay he was writing in an Information Science course. In describing these objects, Josh noted how he wished there was a way to 'group' the three models into 'one,' as they all contributed to representing the paper he was writing. To illustrate what he meant, he took a virtual pencil and drew a red frame around the elements, illustrating a crude version of the functionality that he wanted his Virtual Mind Palace to have. As Josh described what the objects meant to him, the objects
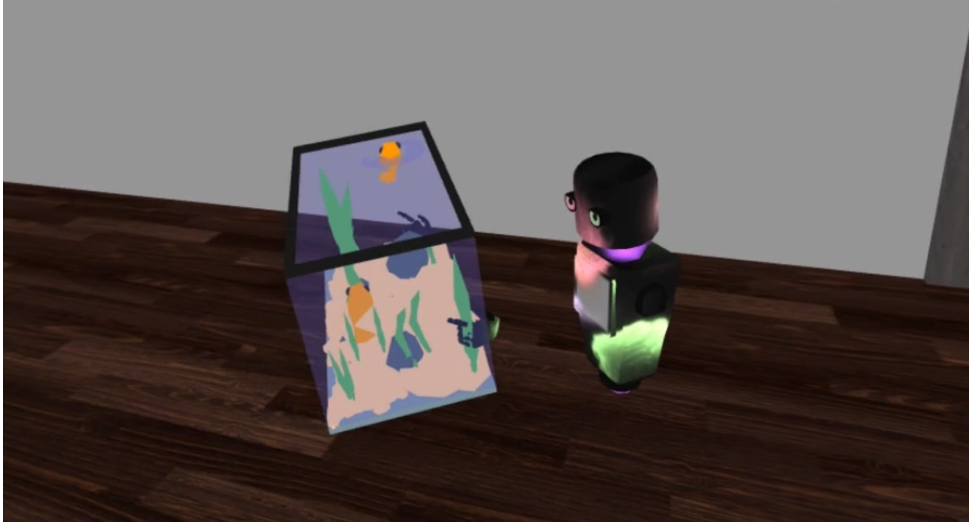
Figure II.2: James sponaneously demonstrating the re-sizing of objects with a fish tank from Google Poly during the interview

in the virtual environment acted as a visual reference to the topic at hand for both the participant and the researcher. The proximity of the objects and the interaction possibilities of the virtual environment further allowed Josh to not only reflect on what this representation meant for him but also to actively interact with it in the virtual environment to show what he meant. During this explanation, Josh alternated his attention between the objects and the researcher as he told the story of how the representation came to be—relating to the common ground between him and the researcher—a way of non-verbal communication that was present in all of the interviews we performed.

Another participant, James, also took to demonstration in order to communicate his points. When asked how he found the process of interacting with the VE, James spontaneously instantiated an object—a fish tank from Google Poly—in order to demonstrate what he found to be troublesome (see Figure II.2). He showed how resizing worked fine but said that he found tilting the objects challenging: «Of course, now when I am showing it works out fine, but if you look at the pictures at the wall, you see how they are leaning forward.»

4.2   Referencing virtual content

The perhaps most common finding was the extent to which the participants pointed to, navigated to, and directed themselves towards the virtual content they were discussing. This occurred during all of our ten interviews. For example, when asked of her previous

Figure II.3: Anna after she navigated to the corner of the room, orienting herself and gesturing towards a picture on the wall as part of her answer to the researcher's question.

experience with VR and for what purposes she had purchased an Oculus Quest, Anna moved towards one of the corners of the house. "If we go *over here*... you can see that it is Beat Saber that made me buy the Quest," she said laughing, gesturing towards one of the photos on the wall depicting the popular VR game (see Figure II.3).

Actions that fell under this theme were typical. In all of the interviews, the participants provided a more or less "guided tour" of the VE, queued by the first question of how they had conducted their task. During this tour, referring to the virtual content itself was done extensively, both by the researcher in questioning and the participants in answering—or just as part of the guided tour that the participants provided. In guiding the researcher through his Virtual Mind Palace, Josh moved on from one representation to the next: "And *over here*, what I did *over here*," Josh said while navigating to the other side of the room, "was to represent modern technologies, like holograms and AI." Josh gestured towards a chessboard hovering in the air playing against itself and a hologram from the Iron Man movies. Such simple gestures referencing virtual content was very common. Answering the initial question of how she had executed the task, for instance, Anna gestured with her hands towards the collection of photos in the room and explained how she had gathered her best memories from the last year. Referencing virtual content was not just beneficial for the participants to aid in their explanations; it was also useful for the researcher in the interview process. Having these visual cues

to the activities the participants had conducted enabled them to be addressed and questioned. For instance, after Anna had said how the images on the walls of her Virtual Mind Palace were representing memories from the last year, the researcher pointed towards one of the photos depicting a woman getting up from the sea and asked whether she had been ice swimming, which then started the next part of the conversation. These examples illustrate how the virtual environment was perceived and utilized as a shared ground between the researcher and the participant.

There were, however, also some limits to the common ground. Although the environment was shared, and each avatar could view each other, the users' content integration interface from which they inserted content into the virtual environment was not shared. The lack of shared information in this regard came up several times during the interviews when the participants attempted to illustrate how an object manipulation menu was ill-placed. In these cases, the participant could not "show" or demonstrate their points, and instead had to explain them verbally. In these cases, what the participants wanted to communicate was not as clear as when they could directly visually demonstrate it before the researcher, inversely demonstrating the benefits of the common ground.

4.3   Non-verbal communication

In addition to the two themes described in detail above, non-verbal communication was used extensively in all of the interviews. By non-verbal communication, we refer to the direction of gaze ("eye contact"), nodding, pointing, and hand gestures while communicating, such as the opening of palms. As a concrete example illustrating this theme, when Lucy discussed the billiard table in her "Game room," she held eye contact, was nodding, using communicative hand gestures, and alternated looking at the environment and the researcher during the conversation. The only case where this was not as present as in the other interviews was an interview where the participant was sitting and thus situated lower than the researcher. As participants reach the Hubs menu by looking upwards, the participant hesitated to make "eye contact" as this would bring the menu down and so cloud the participants' view of the researcher and the environment. The hesitation on the participants part to see avatar-to-avatar appeared to affect the degree of non-verbal communication and, therefore, also the feeling of being co-present with the participant.

This concludes our thematic analysis on how our participants chose to communicate about their experiences in VR. In the next sections we describe (1) how the participants found the experience of partaking in a VR Go-along interview, and (2) how the VR Go-

along allowed us to understand what the Virtual Mind Palace meant for the participants.

4.4 On Being Interviewed Virtually

At the end of each interview we asked the participants about how they experienced the VR Go-along interview. This section describes their answers. All of the participants were relatively positive regarding the experience but highlighted different nuances in their descriptions. Anna said she thought it worked out "OK" though it was a bit unusual. Josh described it as "exceeding all expectations" and noted how it felt "natural." Josh also said that he could evaluate the level of interest from the researcher by his voice, but also his body language. He pointed to the researcher, who then was nodding during his explanation, exemplifying the researcher's nodding as a way in which he experienced "confirmation" or "understanding" during his explanations. Mia said it was fun, although she had thought that the avatars would be a bit more realistic than what they were. Isaac said he enjoyed the spatial audio, that he could see the animated heads of the other person's avatar while speaking and being able to make hand gestures. When asked how it was to communicate in VR during the interview, Daniel answered: «I wouldn't say it is much different from face-to-face, the only thing is you don't see the facial expressions. But just seeing what you do with your hands and head is enough for me to get what you're trying to say, or, the way that you say it.» Evan noted the spatial audio and movements of the avatar and compared it to other ways of communication: «I do kind of feel as if you are here when compared to it being on the Web.» James came to the interview straight from a video meeting and chose to compare the two: "The advantage is that I can go around pointing to stuff, so it is more dynamic in that way, but because of the avatars it is not as personal.» James also noted how he found the medium to be more committing than video meetings: "Here, I am bound to being in the environment. What I've noticed at video meetings is that people work with other stuff and get a bit distanced. But since VR is very immersive, it is kind of committing. Either you use it 100%, or you don't use it.»

4.5 Meaningful associations in Virtual Mind Palaces

Although we are in the beginning of our project and this paper is concerned with exploring Go-along interviewing, we here briefly note some preliminary findings regarding participants' relationships to the Virtual Mind Palaces that the method helped us in uncovering. As the Method of Loci works by using visual imagery as associations, participants used associations that were very personal and not intelligible for the researcher without them being explained by the participant. An example here can be given from

the interview with Mia, who had used the environment to store memories from her pregnancy. What appeared to us as an arbitrary assortment of objects, were for her inherently meaningful as each acted as a reference to a memorable story that she told as we walked around the environment. Another example can be given from the interview with Josh, who had used three objects to symbolize the Pomodoro technique, a study technique he used in the writing of an essay. One of these objects was a board with pizza slices to indicate the Pomodoro technique's compartmentalizing of time. Having the participant explain these associations to us as we walked through the environment allowed our first impression of their Virtual Mind Palaces to be dictated by how the users themselves understood them. As the Method of Loci is usually performed by the imagination, which hinders researchers in directly accessing the visuo-spatial creation, mediating the method through VR can in this way grant researchers better access to the Virtual Mind Palaces. By further exploring these through the Go-along, there was also the added benefit of having the associations explained by the users for whom the associations were meaningful.

5 Recommendations for conducting VR Go-along interviews

The Go-along interviewing method is used to inquire into participants' experiences in context. Combining observation and interviewing, it is by its nature an explorative method, where the environment of relevance can inform the topic of the conversation. Our analysis of Go-along interviews in Immersive VR suggest that benefits reported in "traditional" Go-along interviews can also be achieved in Immersive VR. As demonstrated through the analysis, we found the VR Go-along to be a valuable approach in gaining an understanding of our participants' experiences in their virtual contexts. By being in the virtual environment, it was convenient for both researcher and participant to address the topic of the conversation as it existed as a common ground between them. To demonstrate their points, the participants could interact with the system in order to show ways of interactions that they liked or disliked, and, through the use of expressive tools, the participants could demonstrate interaction features that they imagined would be useful. Moreover, the method proved beneficial for the researcher to gain an understanding of what the environment meant for the participant, which was particularly relevant in our case as it comprised a space that for the participants were imbued with meaning and personal associations. The support of bodily transparency and natural interaction was further appreciated by the participants, who highlighted nodding, pointing, hand gestures and spatial audio as beneficial for communication.

Having provided an analysis of our conducted VR Go-along interviews, we now turn to a discussion of what comprises the VR Go-along and provide recommendations for researchers who wish to utilise the method. The recommendations are based on our limited experiences and reflections so far. They are an addition to the more apparent tenets of the method which are as follows:

1. The researcher should be immersed together with the participant in an environment of relevance.

2. The researcher should move around together with the participant in the virtual environment during the interview and be open to the possibility of the environment informing and shaping the interview.

3. The researcher's role should be that of a visiting guest, and the focus should be on what the environment means for the participant.

The next sections outline our recommendations for researching wanting to conduct VR Go-along interviews.

5.1   Keep a loose structure

Go-along interviews are open and explorative in their essence. They can be used with a variety of interviewing formats, from being entirely open-ended to more semi-structured (Carpiano, 2009). Although some research objectives may require strict approaches, we advise against having a too rigid structure in the Go-along interview. Having an inflexible approach can lock the researcher's and participant's focus on a given trajectory and increase focus on the verbal, thus working against what the Go-along method is trying to achieve. Being flexible and having room, even for silence, can allow the participant as well as the environment agency in steering the interview. Go-along interviews are usually meant to be conducted in environments or with interfaces to which the participants are familiar. Allowing the focus to sometimes go from being interviewed to also observing can help the participant recall experiences from the virtual environment. Similarly, the researcher should take time to observe both the participant and the environment during the interview. Here, we also regard informal and tangential talk as appropriate in order to make the interviewing process seem less formal, which can encourage free association instead of strictly adhering to question-answer protocol, making it more like a conversation where the researcher and participant are having a shared experience of being in the virtual environment. This can also be explicitly encouraged as with TA protocols by telling the participant that one

is interested in whatever comes to mind during the interview when being in the virtual environment. Similarly, researchers can use what Boren and Ramey calls "acknowledgement tokens" such as "OK, yeah, or mm hm" (Boren and Ramey, 2000, p. 269) as a way to be encouraging with regards to their suggestions and promote participant speakership.

5.2   Have a checklist as a backup

Although it is important to be flexible enough to benefit from the presence towards the environment, having a checklist of points that one would like to touch upon in the interview is nevertheless important to guarantee a particular focus in the interview. We advise researchers to memorise this checklist, however, as removing the VR Head-Mounted Display to read paper notes may break both the researcher's sense of presence in the environment and the social connection with the participant. In our case, we knew we wanted to navigate across the virtual environments along with the participants; we wanted to ask about their interactions, and we wanted to ask how they experienced the VR interview. In most of the cases, however, we did not have to ask the participants to provide a guided tour; this happened as a natural result of engaging a conversation about the environment. That the participants took agency and control over the interview situation was very welcome from our perspective, and illustrated that this felt natural for them. If this does not happen naturally, however, it can and ought to be initiated. In the few interviews where this did not occur initially, we kindly asked the participants whether they could show us to another one of the rooms as well. Although in this case the researcher took the lead in engaging the activity, the focus was still on the participant leading the way as the researcher was the visiting guest. We recommend allowing the participant to take the lead as much as possible as this can stimulate the participant to provide their own narrative of their experience on their terms, not within the terms of concrete questions posed by the researcher.

We usually did not have to ask explicitly about how our participants experienced interacting with the virtual environment either; in most of the cases, the participants either mentioned or demonstrated this of their own accord, knowing this was one of our interests. Having this come up organically during the conversation and by the terms of the participant was a result of the interview that we appreciated. Our participants took to actual, live demonstrations of not-preferred interactions, preferred interactions, and even desired, imaginary interactions for future implementations. This was something that we did not expect to occur as a result of the Go-along method, but which we nevertheless found to be one of the most useful aspects of being in the virtual en-

vironment during the interview. This participatory quality is one of the most beneficial aspects of Go-along interviewing, which allows the participant to draw the attention of the researcher to what they find to be the most critical aspects of their experience. This does not mean that the researcher should be hesitant in asking questions; however; the Go-along method is, after all, an interviewing method. In our case, in addition to the questions we had prepared, we found asking ad hoc follow-up questions to issues the participants themselves brought up fruitful in gaining an understanding of what they enjoyed and did not enjoy in their process of creating their Virtual Mind Palace.

5.3 Utilize the mobility, whether through the environment or the interface

The mobility of the interview can be along various dimensions. The most common dimension is the spatial in which the participants and researcher can virtually move through the environment. Mobility may also be in interactional terms through the various trajectories of the VR interfaces. Utilizing mobility along dimensions relevant for the research project is an essential part of Go-along interviewing. If the research project is more or less only concerned with the VR interface, and there is not necessarily a navigable environment for the interlocutors to be mobile in, we suggest the mobility of the researcher and the participant to be across the interface of the application as in the Media Go-along method (Jørgensen, 2016). In this case, and in all cases where the interaction is in focus, it will also be useful to design the application so that each user's interface is also visible for the other user. In this manner, each of the interlocutors can see what the other can see, adding to the common ground in between them.

5.4 Be aware of your own non-verbal behavior

In order to promote use of the environment and its interactional features during the interview, researchers can here lead with a good example. While we experienced that most users intuitively made use of non-verbal communication, we usually started the interviews with a wave and greeting towards the participants and visibly orienting ourselves in 360 degrees to take a peek at the virtual environment encompassing us, commenting tings like "So this is where you've been the last week", or "Ah, would you look at this." Although this was not necessarily a conscious intention on our behalf—it was a natural way to start the interview by greeting the participant and addressing the fact that we are meeting in a virtual environment—it can be a good way to promote use of non-verbal communication as well as demonstrating some of the benefits of being in the virtual environment itself.

In regards to researchers' own attentiveness to the way they are communicating in the interview, personal space is also something to consider as this varies between cultures. Hall termed the social significance of space as "proxemics," where cultures vary greatly in terms of preferred social distance to other persons (Hall, 1966). Current research indicate that proxemics in VR is similar to F2F interactions (Bailenson et al., 2001, 2003; Guye-Vuillème et al., 1999; Wilcox et al., 2006). For instance, in a desktop VR study, Hasler and Friedman found that Asian dyads interacted at larger distances than European dyads, "consistent with the cross-cultural differences typically observed in face-to-face interactions." (Hasler and Friedman, 2012, p. 238). Similar results have also been shown in Immersive VR through Head-Mounted Displays (Bailenson et al., 2003). In light of this, researchers should be attentive to how participants are positioning themselves from the researcher, and pay attention to the distance that the participant wants to uphold and not move closer than this in order to avoid invading the personal space of the participant. We ended up adding more distant spawn spots in the virtual environment as in a few of the interviews the conversation opened rather awkwardly where researcher and interviewee were located at almost the identical position in the virtual environment. Being attentive to personal distance may be particularly relevant for certain research projects as VR allows recruiting an especially culturally diverse range of participants (Saffo et al., 2020). Here, depending on which application is used or being designed, possibilities also exist for having "personal bubble boundaries" (McVeigh-Schultz et al., 2018, p. 292) which makes it possible to regulate personal space also in the case of accidental navigation.

6   Discussion

Having presented the analysis of our conducted Go-along interviews as well as some recommendations for other researchers, we now turn to issues that could be enlightened by a discussion. Here, we discuss which avenues of research that are likely to benefit from the VR Go-along; discuss epistemological concerns relevant to the adoption of this method to VR, as well as discussing Limitations and Future Work.

6.1   When to use the VR Go-along

For researchers considering the relevance of the VR Go-along for their research, this section provides a discussion of research topics that stand to benefit from the method. The Go-along method is particularly relevant for studies in which the digital context the participants are immersed in are of importance for situating their experiences. Ex-

amples here include remote work collaboration (Li et al., 2020; Smith and Neff, 2018; Roberts et al., 2003), VR learning environments (Lui et al., 2020; Mikropoulos and Natsis, 2011), cultural heritage (Rua and Alvito, 2011; Slater and Sanchez-Vives, 2016), virtual tourism (Loureiro et al., 2020), as well as emerging social VR worlds such as VRChat and Altspace VR (Maloney et al., 2020a,b). For in-the-wild studies of VR use in the everyday, VR Go-along interviews also provide an easy way to conduct interviews in longitudinal studies at given intervals across the study duration.

The method can also be particularly useful in close studies of embodied interaction in VR. Here, observing embodied interaction in VR can provide similar insights as those reported from studies using interactive physical props in regular interview settings. For instance, Price and Jewitt compared various interviews approaches in the study of embodied interaction with LightTable, a physically interactive artefact "designed to illustrate how objects reflect, refract and absorb light" (Price and Jewitt, 2013, p. 2908). While they found that straight interviews provided rich verbal descriptions with gestures, this interview approach was "inherently disembodied and dislocated from their experience: providing no external resources to support a link back to their activity." (Price and Jewitt, 2013, p. 2909). For the interviews with the artefact affording embodied interaction present, "[d]irect access to the resources enabled them to demonstrate what happens with each object, and multiple objects; and presence at the interactive site enabled them to explicitly show how important their body positioning was in seeing what each other was seeing" (Price and Jewitt, 2013, p. 2909). It should also be mentioned that they found that the participants in the "embodied interview" were less reflexive and provided subjective rather than objective narratives of their activity. How they physically interacted with the objects, however, was more apparent through their demonstrations. For this reason, they found this kind of interview "particularly good for examining the role of action and manipulation in verbal articulation, and better provides a narrative of the physical forms of engagement that took place in the study, acting as a kind of repeat of activity coupled with a narrative" (Price and Jewitt, 2013, p. 2910). In the same way, we found that when performing Go-along interviews in the Virtual Mind Palaces—where various interactional activities were distributed across the virtual environment—our participants would interact with the system as they told us how they experienced interacting with the system, actively utilizing the presence of the virtual environment in their explanations. While they were doing this, we were able to clearly view their bodily engagement with the VR system. In this way, researchers studying embodied interaction in VR, and particularly those studying virtual environments where various activities are distributed across the virtual

environment, are likely to benefit by employing the VR Go-along interviewing method in their studies.

Depending on the application in question, however, not all research projects stand to benefit from the mobility aspect of the Go-along. They may, however, benefit from being in the VR context in which the embodied interaction takes place and see these embodied interactions as embedded in the environment. We were for instance able to gain a highly detailed understanding of usability issues where sometimes participants would have to enter into physically uncomfortable positions in order to interact with the system. There is here a possibility of conducting TA sessions in VR where the participant can be observed and think aloud while the researcher is present in the environment. Further research should look into this possibility beyond what has been shown in this paper.

6.2   Epistemological concerns of conducting research in VR

Uncritical adaptation of research methods to HCI has warranted criticism in the past (Crabtree et al., 2009), and one may ask if any particular considerations must be made for "traditional" research methods to also work in VR (Houliez and Gamble, 2013). Although we argue for its compatibility, adapting the Go-along method to VR is not without complications as it involves going from a non-mediated to a mediated way of communication. Communication through VR constitutes a magnification/reduction structure of the information that is conveyed, as do all other forms of mediating technologies (Ihde, 1978). VR affords natural interaction in a shared environment to which the interlocutors feel presence, and transmits non-verbal cues through body language; however, the avatars are simple and do not show facial expressions or an otherwise realistic visual representation of the interlocutors. This may have implications for the role of the method in a research design, where different research objectives may require a different combination of methods. From an epistemological standpoint, one may ask, therefore, whether the information retrieved from a participant represented by an avatar in a virtual world is comparable to the information retrieved from a real participant sitting in a chair opposite the researcher in the real world. In answering this, we purport that many of the potential issues with doing this kind of work are related to (1) the degree to which the participants are "themselves" in these virtual worlds; (2) whether one's research questions concern the real or the virtual world; and (3) whether the communicative medium has enough transparency for the interlocutors to understand each other thoroughly. For instance, Guo and Barnes studied factors influencing purchase behaviour in virtual worlds and conducted the focus groups inside the desktop VR ap-

plication Second Life Guo and Barnes (2011). In this case, to treat the virtual world as the "world" of the study and the "virtual participant" as the participant is very natural. The results may even be more ecologically valid as the research is conducted in the environments with which the study is concerned, where participants are representing their identity as it exists in relation to the virtual world. Performing the research in a virtual world on purchase history in real life, however, is different, because the participant's behaviour and assumed identity might be connected to the virtual world. The identity to which the participant adheres to is especially hard to control for when real identities are not known, and the participants are regular inhabitants in that virtual world, which has been the case in several Second Life studies. In our case, we wanted to observe the participants as they behaved and expressed themselves in their virtual context. As Immersive VR moreover supports non-verbal communication, which serves an important role in solving incongruencies in communication (Mehrabian and Ferris, 1967), we saw no serious epistemological issues in adapting the Go-along method to Immersive VR for our purposes. We should mention, however, that when using less immersive VR systems such as either Desktop VR or VR offering movement in three degrees-of-freedom with no tracked hand controllers, participants find it harder to interpret conversation protocol or interpreting social cues as supplementing interactions with gestures is not possible (Moustafa and Steed, 2018). This should be taken into consideration if considering the use of Go-along interviews in Desktop VR systems.

Immersive VR, however, appears to be a promising medium for performing qualitative, contextual interviews. Immersive VR with head- and hand tracking seem to solve the issues of gaze direction, clumsy orientation and navigation by relying on reality-based interaction (Jacob et al., 2008). Although avatars may be crude and facial expressions are not supported, the medium manages to immerse its users in a more wholesome way into a shared virtual context that can aid in establishing social presence and a common ground (Smith and Neff, 2018). The natural interaction that Immersive VR affords can facilitate more spontaneous, non-verbal communication as well as the use of deixis; using the common ground of the visual space as the way of 'least collaborative effort' in order to make meaning in the communication (Clark and Brennan, 2004). Thus, Immersive VR appears to be a promising medium for Go-along interviews due to its fidelity of information transfer. VR does not involve just audio or image transfer, but also information on bodily posture, gaze, spatial interaction, navigation, and orientation. Through the transfer of these cues, non-verbal communication is supported, and often also encouraged by the natural interaction and natural semantics of the VR applications. These are important characteristics as non-verbal communica-

tion is used to complement, accent, contradict, substitute, and thus in general regulate, verbal communication (Knapp et al., 2013; Mehrabian and Wiener, 1967). At the foundation of all of these features lies the capability of VR to immerse the researcher and participant in a virtual world and the subsequent effect of presence that results from this embodiment. By further incorporating avatar representations of its users, the medium of VR facilitates for social presence as well; feeling present with not just the environment but with another, sentient being (Oh et al., 2018). Thus, the strength of VR to mediate Go-along interviews lies in its approximation to our natural, non-mediated way of communicating.

In closing, we want to briefly address what information researchers conducting Go-along interviews should include in their publications so that replication and comparison across studies are possible. The idea of the Go-along is rather intuitive and is likely to be a method that researchers already use informally as part of their research. With this there may follow a risk, however, as has been seen in studies utilizing TA protocols where sufficient levels of details regarding how the method was employed is not documented (Boren and Ramey, 2000; Nørgaard and Hornbæk, 2006). Generally speaking, therefore, we recommend being explicit on how the particular study employed the VR Go-along interview. It is for instance important to separate between what data resulted from questions being asked directly to the participant, and which data resulted from being in the environment. Such information can situate their answers within the context in which they were delivered. Other information that is relevant for the Go-along interview is how much experience the interviewee's have had with VR in general and the application that is being studied in particular. Similarly, researchers should state the degree of common ground available (do the researcher and participant see what the other is seeing?); the interaction possibilities available; what VR medium is being used, as well as the type and variety of avatars that are available, as these are factors that have an impact on how the communication is experienced.

6.3   Limitations and Future Work

This study has sought to understand Go-along interviewing in VR qualitatively on its own premises as well as in comparison with benefits reported from traditional Go-along interviews (Carpiano, 2009; Kusenbach, 2003; Lechner et al., 2013; Burns et al., 2020). Thus, we are not showing how an interview mediated through VR is different from regular interviews; necessarily. We should also note that we did not intend to evaluate whether VR Go-along interviews could replace traditional Go-along interviews; instead, we wanted to explore using the Go-along method in VR to uncover

contextual accounts of our participants' experiences in VR. In our case, it would not be possible to conduct Go-along interviews in real-life as we aimed to evaluate a VR application without a real-life equivalent. Future studies comparing different interviewing approaches to the VR Go-along in experimental conditions, however, would complement our study. In our case, we utilized the Go-along interview after our participants had interacted with it over the course of a week. Approaches exploring being co-present with participants during their first exposure to the system would likely generate different results, as participants can be observed and interviewed while they are interacting with the system for the first time. Here, in addition to evaluating overall effectiveness in measuring user experience and usability, studies evaluating beneficial degrees of intervention on behalf of the researcher would be interesting. Work looking into data analysis methods appropriate for analyzing Go-along interviews would also complement our research. Here, conversation analysis (Goodwin and Heritage, 1990) is a promising candidate. Luff et al. writes how studies drawing on conversation analysis and ethnomethodology are distinctive because they "emphasize the collaborative nature of embodied action but also because they reveal how embodied interaction is accomplished through an interweaving of talk, visual conduct, and features of the material environment." (Luff et al., 2013, p. 6:4).

Other viable areas for future work include the mediation of Go-along interviews across other media than Immersive VR. The COVID-19 pandemic has vastly increased the amount of video conferencing calls done worldwide. Here, there are numerous possibilities for inquiry. Video conferencing tools, for instance, may provide far more visual fidelity in terms of facial expressions and general appearance than what VR can provide; yet, they lack in other respects. For instance, webcams do not show the whole person nor their entire physical context (Smith and Neff, 2018). That they also are stationary limits mobility and movement in task performance as well as gesture cues. Through video conferencing tools, eye contact is also not supported, as the offset between screens and cameras makes it so that the eyes never meet (Smith and Neff, 2018). Nevertheless, the video conferencing tool itself is in many ways a shared medium, and advantages and disadvantages of the medium in providing a common ground, for instance through screen sharing, can be explored. Here, also, the rationale for exploration is that the participant can experience the mediating effects of the video conferencing tools on social communication while the interview is actually occurring.

7 Conclusion

Go-along interviewing is an emerging qualitative research method where researcher and interviewee go together to a location relevant for the research. This paper has presented a study in which the Go-along method was used to inquire into participants' experiences of Immersive VR in their virtual context. Through an analysis of ten interviews with participants in their respective Virtual Mind Palaces, we found that benefits reported in traditional Go-along interviewing were also attainable when the method was mediated through Immersive VR. We found that the interlocutors' shared presence in the virtual environment allowed for a common ground beneficial for communication. Being in VR enabled our participants to demonstrate interactions spontaneously, and, by providing a guided tour, show us relevant objects and locations in their Virtual Mind Palace. Benefits and challenges of adapting this method to VR have been discussed, and recommendations for researchers who want to conduct VR Go-along interviews have been provided. Throughout the paper, we have argued the VR Go-along method as a useful tool for eliciting contextual, phenomenological accounts of virtual environments.

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