THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Connected Practice:

The Dynamics of Social Interaction in Shared Virtual Environments

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ABSTRACT

This thesis investigates the phenomenon of social interaction in shared virtual environments (SVEs), supported by virtual reality (VR) systems over time. SVEs are computer generated 3D graphical spaces where geographically distributed people can meet and interact with each other in a graphical space. Although there have been a number of studies about social interaction in SVEs, there has been a lack of research looking into changes over time, which this thesis does.

In order to gain more knowledge about social interaction over the longer term, this thesis compares and contrasts four different types of VR systems that supported various SVEs. Two of the systems were internet based SVEs on desktop computers where many users could interact at the same time. One of the SVEs had voice based communication. The other SVE had text based communication. The other two were based in laboratory settings. One setting was networked immersive projection technologies (IPT) in which two participants performed a variety of tasks together. The other was one IPT connected to a desktop VR and participants changed systems half way through the trial in which they collaboratively solved a task together. In both settings voice based communication were used. Observations and other methods of analysis were carried out, focusing on differences and similarities in peoples behaviors in the process of social interaction over time in SVEs.

The six papers contained in this thesis explore social interaction over time in shared virtual environments. This thesis argues that technology becomes not only a tool for social interaction; it also becomes a key aspect in social interaction. While the technology filters out some of the social cues we are familiar with from face to face situations, it also 'filters in' new cues that become important for how people can connect to each other in the shared virtual environment. Over time, these social cues, that people creates among themselves while using the technology, become essential for people learn about; otherwise they find it difficult to relate to each other and do things together in the shared virtual environments.

The more difficulties people have in figuring out how to use the technology while interacting with others, the less they will accept the technology as an appropriate tool for connecting people and doing things together. The reason for this is that social and technical issues can only be separated analytically in shared virtual environments; in practice, as this thesis shows, they are highly intertwined.

This thesis puts forward a dynamic model identifying the importance of looking more explicitly at individuals, technology, task and time while studying social interaction in SVEs. In this way, the thesis combines a number of insights both from previous social science theories of social interaction and practices - together with observations from the studies this thesis builds on. The thesis puts forward a concept that includes these insights - *connected practice*, defined as the dynamics of social interaction in technical systems. This concept can guide future studies to incorporate both technical and social aspects over time since it was shown to be the key to understanding the phenomenon of this thesis. It is finally suggested in the thesis that the concept *connected practice* can be utilized in other technical systems apart from SVEs in future research of social interaction in technical systems.

Key words: Shared virtual environments, virtual reality technology, social interaction, practice, dynamics, time, connected practice.

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Göteborg, March, 2009
Maria Spante

APPENDED PAPERS

This thesis is based on the following papers, referred to in the text by their Roman numerals:

I) Heldal, I., Steed, A., Spante, M., Schroeder, R., Bengtsson, S. and Partanaan, M. (2005) Successes and Failures in Copresent Situations. *Presence Teleoperators and Virtual Environments*, 14 (5), pp.563-579.

II) Spante, M., Heldal, I., Steed, A., Axelsson, A-S. and Schroeder, R. (2003) Strangers and Friends in Networked Immersive Environments: Virtual Spaces for Future Living. *HOIT 2003,* Irvine, CA.

III) Spante, M. (2004) Elaborating Distraction-Conflict Theory: Towards and Analytical Model for Evaluating Collaboration in Shared Virtual Environment. In *Proceeding of Virtual Reality Design and Evaluation Workshop,* Nottingham, UK.

IV) Spante, M., Axelsson, A-S. and Schroeder, R. (2006) The Good Inequality: Supporting Group-Work in Shared Virtual Environments. In R.Schroeder and A-S. Axelsson (eds.) *Avatars at Work and Play. Activities in Shared Virtual Environments*, Springer, London, pp.151-166. ISBN/ISSN: 1402038836.

V) Spante, M. (2004) Learning to be Social: Establishing and Maintaining Relationships in Shared Virtual Environments. Elaborated version of paper published in proceeding of *Realitat Virtual a l'arquitectura i la Construcció,* Barcelona, Spain, pp.96-106. ISBN/ISSN: 84-608-0394-5.

VI) Spante, M. (2006) Talking Heads on the Internet: Social Interaction in a Multi-User Voice-Based 3D Graphical Environment (unpublished manuscript).

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List of abbreviations

Virtual reality (VR)
Shared virtual environments (SVE)
Immersive projection technology (IPT)

1. Introduction

Dealing with other people is not always easy. When dealing with other people via technical systems the situation can be even trickier. Or it can be simplified. It is not evident what will happen. However, it is certain that humans in all times have tried to stretch the possibilities to interact with each other even in situations when not meeting face to face. Clever solutions such as lighting fires on mountaintops are early precursors to modern solutions such as phones, e-mail and mobile interaction. These various solutions have generated questions regarding humans' capabilities of handling new ways of dealing with each other throughout history. Likewise, interest has been drawn to the technological approach of wanting to invent and develop technologies that make social interaction over geographical distances possible. When it concerns so-called new technologies, the history of technology has been full of societal hopes and fears regarding consequences of new technology for humans in everyday life. Ideas about the path of human progress have hovered between enthusiasm and gloom linked to new distance-bridging technologies (Marvin 1990). Thus, new technologies supporting social interaction have always attracted research interest. This thesis is no exception, and the new technology it focuses upon is known as shared virtual environments supported by virtual reality (VR) systems. More specifically, social interaction in shared virtual environments over time is studied.

I would like to present the original point of departure of this thesis and how it changed during the research process. The starting point for the thesis concerned questions such as whether and how users need to adapt to VR systems, or whether VR systems need to be adapted to users over time. The thesis began with an either/or perspective: either users should adapt to the technology, or the technology should be adapted to users. During the research process I found this point of departure too narrow. Observations from each individual study, presented in a number of papers, rather suggested that the functions of the technology and humans' way of using the technology influenced each other. The issue was not either/or, but both/and. The design of the technology became influential as well as people's will and abilities in dealing with each other. Consequently, we need to address these factors in greater depth and analyze them factors simultaneously, considering how they are connected and not limiting our investigations by looking at them separately. It is in the meeting between 'the technical' and 'the social' over time that this thesis has its focus. Even though the original either/or

perspective was abandoned during the research process in favor of the both/and view, the over time aspect was present from the very beginning. Time as a dimension has been addressed differently in the different studies, which will be described further in the cover paper.

During the years this thesis work has been conducted, VR technology has gone from being something of a futuristic hype product to a technology we increasingly see in our workplaces, such as interactive visualization models or simulators, and in our homes we use diverse VR technologies in various kinds of 3D games. In the beginning of the thesis work the strive was oriented towards technical improvements and finding out about suitable situations to apply VR technology. Today, with increased use of VR, new questions have been raised from us that are more interested in social aspects of technology, focusing less on the VR system as a tool and more on its importance in and for social interaction. Hence, my contribution concerns how different VR systems both hinder and support social interaction in shared virtual environments over time. In other words, I present a way to address the phenomenon of social interaction in shared virtual environments.

1.1 Aim

The aim is to analyze social interaction in shared virtual environments over time with special reference to how technical and social aspects are related.

1.2 Structure and content of the thesis

The thesis is a compilation thesis containing six papers. In the cover paper, these six papers are compared and contrasted with each other. Observations presented in the papers have also been analyzed in relation to a theoretical framework that has emerged during the thesis work. Rather than describing this iterative process in detail, it will be presented in relation to different parts of the thesis work as well as explaining how these parts are related.

To begin with, a short description of common terms will be given in section 1.3, *Terminology*. Next, to justify the research focus and the need for studying social interaction in shared virtual environments over time, I refer to research on human interaction in and with technical systems in broader terms. How this is done is presented in section 1.4, *Specifying the research*

focus. To provide an early grasp of the content of each paper included in this thesis, an overview is given in section 1.5, *Appended papers*.

Thereafter a more detailed presentation of methods is made in Chapter 2. The six appended papers come from four different studies, and in Chapter 2 these studies are presented regarding how they were conducted in different types of VR system, also clarifying which paper has emerged from which study. The overarching methods in the thesis as a whole, here briefly described in terms of the growth process of empirical material and the appropriate analytical tools, are described in the chapter. The necessity of the 'over time' dimension when social interaction in shared virtual environments is studied, something also commented upon in section 1.4, *Specifying the research focus*, is explicitly emphasized in the method chapter.

In Chapter 3, *Analytical framework*, the motivation for and content of the analytical framework that has emerged during the thesis work are presented. A common aspect of the chosen theoretical tools is that they contain in one way or another an 'over time' view, hereafter referred to as a process view, which permeates this thesis.

Chapter 4, *Analysis*, explains how I have interpreted the empirical observations from the appended papers while comparing and contrasting them with each other in relation to a created analytical model. The model has its point of departure in Turner's model of social interaction, and is further expanded by the interpretations of the observations. This iterative way of working is informed by the overarching method of 'systematic combining' described in section 2.4 of the methods chapter.

As a result of the iterative work that has characterized the research process, the theoretical contribution of this thesis is captured with the concept *connected practice*, defined as the dynamics of social interaction in technical systems, in Chapter 5, *Conclusion.* In this chapter I present the key inference that technical and social aspects can only be separated analytically since in practice they are intertwined, something that becomes manifest over time. In order to describe this phenomenon, the theoretical concept of *connected practice* is introduced, and it can also be used as a guide for future studies to incorporate both technical and social aspects over time. Then follows a methodological discussion stressing the need for process-oriented methods in studies about social interaction in technical systems. Finally it is suggested that the term *connected practice* can be utilized in other technical systems apart from the SVEs studied here, for future research on social interaction in technical systems such as those in working life, education and everyday life.

1.3 Terminology

In this section a short presentation is given of different terms that will be used on several occasions in the cover paper.

A key concept in this thesis is that of shared virtual environments (SVEs). The definition used has been discussed elsewhere (Spante 2004:3-5), and therefore I limit this outline to stating the chosen definition:

Shared virtual environments are computer-based, distributed, 3D graphical spaces or sets of places. In such places two or more distributed users can experience themselves and others as being present in an environment in which people can navigate, interact with each other and manipulate virtual objects in real time.

In line with the definition, it is thus important that at least two distributed persons can be present in a 3D graphical environment at the same time that they are graphically represented in the environment, that they can manipulate virtual objects in the environment and that they somehow can communicate with each other. When two or more persons can be present in a 3D graphical computer-generated environment at the same time, then it is a shared virtual environment (SVEs). When only one person can be present in such an environment, it is called simply a virtual environment.

Another commonly used term in the thesis is the virtual reality (VR) system. Schroeder (1996) describes VR systems as including three parts: (1) an input device that transfers information about the user's presence in the virtual environment, (2) an output device that shows the user how the virtual environment looks, and (3) the hardware and software that are necessary in order to process input information and generate output information. When talking about VR systems, it is this description I refer to in the thesis. The different VR systems in which the studies are conducted are presented in Chapter 2, *Method.*

Immersive VR is yet another common term. In this thesis the word 'immersive' is used to describe how output information is presented. When I speak of immersive VR, the users are surrounded by the graphics, in contrast to desktop VR where the graphics are presented on a flat screen.

The avatar is also a concept connected to 3D graphical environments. An avatar is a graphical figure that represents each unique user of the shared virtual environment (Damer 1998). Avatars look different in different shared virtual environments.

1.4 Specifying the research focus

In this section a review of studies oriented towards interaction in technical systems is presented. In order to motivate the research focus, and emphasize the importance of studying social interaction in shared virtual environments as well as studying this topic as a process, I argue that it becomes critical to relate to research on interaction in technical systems in broad terms. The purpose of this section is to highlight how the research focus was developed in relation to previous and related research on interaction in technical systems.

Previous research on interaction in virtual environments has focused upon a range of issues, studied by a variety of researchers. One type of research common from a computer science point of view has dealt with the technology and its relation to users' experience of presence in the virtual environment. Usually, such research concerns an individual interacting with a virtual environment. This type of research has suggested that the more immersive the technology is, the higher sense of presence its users experience (Schroeder 2002). Others have put their focus inside the virtual environment, investigating how users' sense of presence varies in different places in the virtual environment, and linking this difference to the design of the virtual environment (Garau et al. 2004). Further, investigating the importance of visual realism in virtual environments connected with users' sense of presence has attracted attention, showing that simple representations of users transmitting high motion fidelity enhance the sense of presence compared to a visual representation that is almost photorealistic (Bente and Krämer 2002).

Yet another group of researchers has looked more deeply into how haptic force feedback in a virtual environment affects the sense of presence, suggesting that haptics increases the sense of presence in virtual environments (Biocca 2001; Sallnäs 2002; Deml and Fäber 2002). Others also interested in the sense of presence are researchers approaching the study of presence from a psychological point of view in order to increase understanding of the sense of presence *per se*. In such initiatives the aim has been to learn more about 3D applications in therapy, such as possibilities of curing phobias (Raya et al. 2002). This type of presence-

oriented research has mainly been experimental, and exposure times in the experiments have been relatively short, normally in the range of 5-20 minutes.

Social psychologists have shown interest in using virtual environments for the investigation of social-psychological mechanisms such as people's reactions to gender, ethnicity and social influence, where the other person present in the virtual environment has been a virtual agent – i.e. the graphical representation is run by a computer, and not linked to a human user as avatars are (Bailenson et al. 2005). In medical research, 3D graphical application for rehabilitation of stroke patients has been investigated, showing promising results in experimental research (Goude, Björk, Rydmark 2007; Broeren et al. 2006). To sum up, we can see that the design of the technology and users' experience of presence have attracted a multiplicity of research interests.

A limitation of such research is that it focuses on single users. This thesis adds another dimension by introducing *social* interaction in shared virtual environments. With such a focus, apart from individuals' interaction with the technology, users' interaction with each other in the technical system becomes important to take into consideration. Of course, social interaction in technical systems has been studied before. Social interaction in multi-user technical systems has been studied in text-based environments (e.g. Pargman 2000; Svenningsson 2001; Cherny 1999; Baym 2000; Turkle 1995) and video conference systems (e.g. Sonnenwald 2006). Experimental studies with special reference to technological impact on collaboration in shared virtual environments have investigated how desktop-supported SVEs influence collaboration, identifying problems in the way technology hinders collaboration (e.g. Hindmarsh et al. 1998, 2000), but also in immersive systems where both technological advantages and continuing problems have been discussed in regard to collaboration (Robert et al. 2006; Heldal et al. 2005).

Departing from experimental research and looking at studies conducted in naturalistic settings – i.e. in situations that have emerged without interference of researchers, such as online games, social chat rooms and the like – we can see for example that online gaming has attracted a lot of research, focusing particularly on games as social arenas (see e.g. Taylor 2006; Jacobsson 2006; Yee 2006; Axelsson and Reagan 2006; Linderoth 2004). A focus on the sense of presence attracting experimental research has in naturalistic settings been directed towards sociological issues such as democracy and equality. Likewise, economic issues have been studied, such as the emergence of virtual economy in games, observing that virtual

objects are sold for real money (Dibbel 2006; Castronova 2005). Even legislative issues have gained interest, where an important discussion is concerned with rights of possession of virtual objects (Duranske 2008).

The diversity in studies about interaction in/with technical systems is huge and needs to be structured. When confronting this wide range of research it is helpful to have a sorting tool. The sorting tool I suggest takes its point of departure in what I regard as underlying ideas concerning the relationship between what I categorize as 'the technical' and 'the social'. Some studies represent underlying ideas that the shape of technology leads to a human response, and others that humans and their condition impact on how the technology is used. When designating these underlying ideas, a theoretical terminology is borrowed from the field of science and technology studies (STS), where concepts such as technological determinism and social shaping of technology are discussed and visually presented as causal relationships.

T ⟶ S (technological determinism, i.e. the notion that technological development leads to social change and economic growth): In this thesis a technological-deterministic view is seen in VR technology (as well as other types of interaction technologies such as text messages and video conference systems) and its impact on humans' way of interacting.

S ⟶ T (social shaping, i.e. the notion that how humans are organized hinders or makes possible how technology is incorporated and developed in society): In the thesis this view is taken to maintain that humans' attitudes and conditions have an impact on VR use.

In cases when there is a focus on the relationships rather than causalities one can say that there is a double arrow between T and S.

My suggestion for a sorting tool is based on these dichotomous perspectives of technological determinism and social shaping of technology. Further, I sort the literature in accordance with a focal view in the study concerned, i.e. whether there is a focus on technology or on social aspects where an individual focus is included. Below, a visual representation is provided.

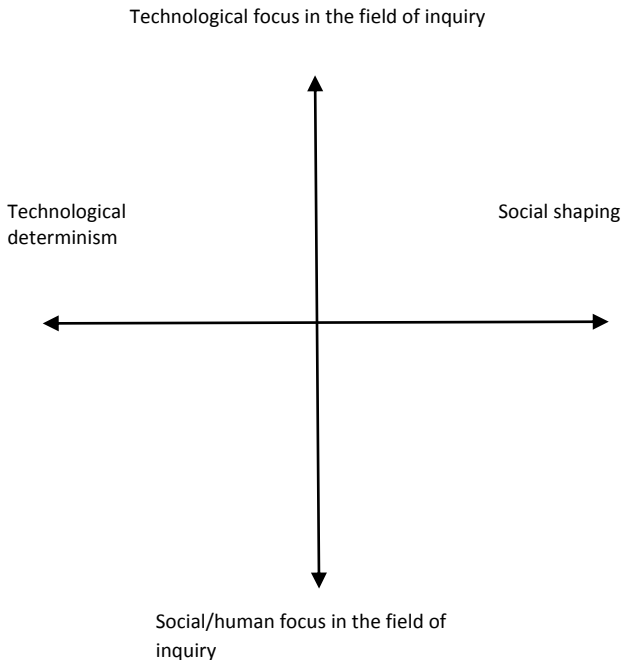

Fig.1. Sorting tool of literature

While it is impossible to find an exact point for each individual study to be plotted into the sorting tool, this model provides a mental basis for reasoning about the literature. In such a way previous research can be systematized with a range of different circumstances where the technology has varied in relation to different technical systems (e.g. video conference systems, desktop computers and immersive VR) as well as different types of multi-user environments (such as text chats, online games, 3D graphical chat rooms and limited experimental rooms), and to social aspects (e.g. gender, ethnicity, leadership, social phobias, virtual economy, possession rights) as well as emotional reactions (e.g. the sense of presence or fear). Below I will exemplify a selection of literature that has been associated to the different fields in the sorting tool.

The field between technological determinism and technological focus in the inquiry

Studies belonging to this field in relation to my interpretation are studies that aim to improve the technology as such (Frécon 2004). I view such studies as driven by an idea that improved technology impacts the use of technology in a positive direction.

The field between technological determinism and social/human focus

In early research on social interaction in mediated situations, Short, Williams and Christie (1976) argued that each medium's special characteristics have an impact on the relations that users establish between themselves. They argued that the fewer social signals a medium could transmit, in comparison with face-to-face interaction, the colder the relationship would be. This view was later addressed as the cues-filtered-out perspective (Culnan and Marcus 1987). Yet another theory sharing similar conclusions about media impact is the media richness theory of Daft and Lengel (1986). According to their theory, people's relationships are influenced by the number of channels a medium contains – i.e. the more social cues a medium transmits, the warmer the interpersonal relationships will be. Since the argument is that the characteristics of the technology impact on social relationships, I sort this type of research in the field between technological determinism and social/human focus.

In several experimental studies of individual reactions, interacting in a VR system is seen as having a technological deterministic trait. The more forceful the technology, the higher the sense of presence that has been reported (Schroeder 2002; Slater 2003; IJsselsteijn 2004). It seems that we can manipulate the sense of presence in humans with VR technology. The question raised is then how long such a feeling will be there. We have only evidence from short experimental studies in virtual environments, so what happens over time? Such studies would be sorted into the field between technological determinism and a social/human focus in the study. Experimental studies explicitly examining how the technology transforms social interaction are also plotted into this field (Yee and Bailenson 2007). In studies about individuals or groups in different types of online environments, the underlying ideas are seen as mixed and not as evident. When arguments are raised that the [computer] technology gives us new identities (Turkle 1995), I maintain that such arguments incline towards a technological-deterministic approach, while suggestions explicitly stating that 'the fact that technology shapes social interaction' (Axelsson 2002:201) clearly are associated with this field.

The field between social shaping and social/human focus

Studies stressing that virtual environments are a perfect platform in studies of social-psychological processes are associated with this field (Blascovich et al. 2001) since the use of

theories when analyzing behavior are the same as in face to face situations without theoretical adjustments. I have also related to this field a study replicating a classical social-psychological experiment, Stanley Milgram's obedience experiment, in a virtual environment and shown similarities in humans' responses between the real and the virtual environments (Slater et al. 2006).

The field between social shaping and technological focus

As a response to Short, Williams and Christie's (1976) technological-deterministic research, a range of studies has rejected the hypothesis that media characteristics could predict relational qualities among humans. Studies show that warm social ties can emerge even in text-based communication (Culnan and Markus 1987; Rice and Love 1987; Lea and Spears 1995; Farnham 2002). Since these studies established that humans create warm relationships even when they interact via media that filter out most of the social cues we are familiar with from face-to-face situations, I interpret them as having an idea of social shaping in their arguments and at the same time a focus on the technology. Studies arguing that old social conditions are reflected in the virtual world (Wajcman 2004) or that social circumstances outside the technical systems circumscribe social occurrences within the technical system (Dutton, Cheong and Park 2004) are associated with the field between social shaping and technological focus in the field of inquiry. This also applies to studies emphasizing that neither the range nor type of technologies used in interpersonal relationships can predict relational qualities among humans (Baym et al. 2007).

A field in the middle

In between, studies with a both/and view can be seen, i.e. where interest is oriented toward the nature of social processes as well as toward how the technology supports or hinders them (Pargman 2000; Pargman and Jacobsson 2007; Svenningsson 2001; Svenningsson 2007; Cherny 1999; Baym 2000; Sonnenwald 2006; Axelsson 2004; Heldal 2004; Walther 2002). In such studies the focus varies regarding the social and technical aspects. In these studies it has not been clear whether they tend to favor a technological-deterministic or a social-shaping perspective. However, I argue that the concern with social issues in technical systems

acknowledges both aspects as equally important. In the sorting tool there should be an intermediate category capturing this comprehensive both/and view.

The importance of time

Looking more closely at the literature it becomes also relevant to incorporate a time dimension in the studies. A simplified way of structuring the literature is to consider whether studies have been conducted over a short term – such as some experimental studies with exposure times between 5-20 minutes, which has been common – or over a longer term, for example in ethnographic studies when online social interaction has been going on for years in different environments. With the help of a time dimension we can decide whether the research may provide information about longer-term or short-term consequences. Additionally, we can see if a phenomenon has been studied as a process, i.e. events over time, or as a single event. Previous research about social interaction via diverse types of information and communication technologies has asked for studies incorporating an 'over time' perspective in order to support conclusions more on over time observations rather than snapshots (Scott 1999; Horton, Davenport, Wood Harper 2004).

Surveying studies in text-based environments, Walther concluded that 'When time is plentiful, people adapt to their systems and each other' (Walther 2002:251). Walther demonstrated that if people are only given enough time, they adapt to the technology as well as each other. Kleij, Paashuis and Schraagen (2005) showed the same in their experimental studies of group work using video conferencing systems as compared to face-to-face groups. Thus, time becomes important for allowing humans to develop successful ways of dealing with each other in computer-mediated situations.

By disentangling previous research with the help of the sorting tool, a niche emerges where it becomes important to put the research focus. It seems important to contribute knowledge where both technical and social aspects are incorporated into the studies, i.e. the *meeting* between 'the technical' and 'the social' which I discuss in the beginning of this cover paper. In addition, it becomes important to address a time dimension that is better described as longer-term than as short-term, in order to capture the meeting as a process rather than as something that immediately happens (see Jacobsson (2006) for stressing this need from a designers' point of view). Such a focus is still lacking in studies about social interaction in

shared virtual environments, given the definition of shared virtual environments used in this thesis.

In the previously presented sorting tool I also implement a time dimension that cuts through the model in depth. With the help of the time axis, the field where this thesis sets its focus can be visualized. The marked area in the sorting tool symbolizes the research focus in the thesis.

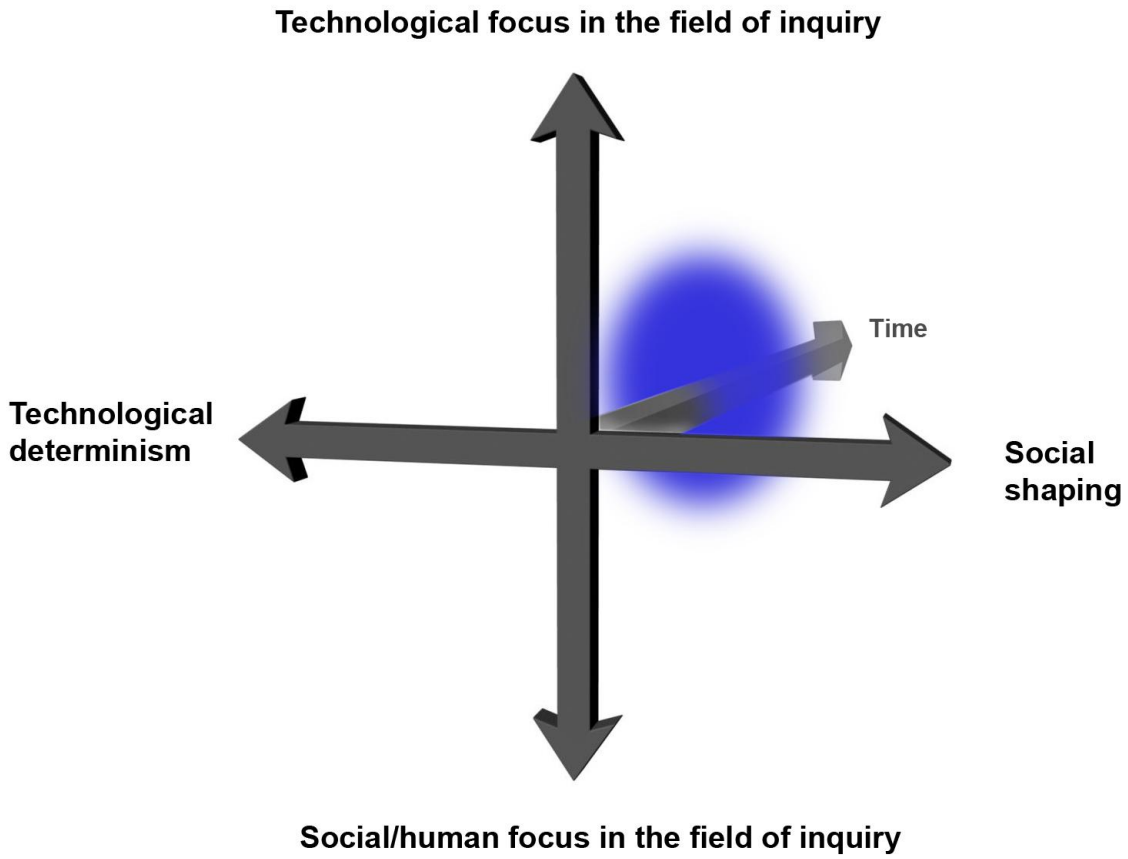

Fig.2. Identifying the research focus in the sorting tool

1.5 Overview of appended papers

In this section the appended papers underlying the thesis are presented in a general manner. This is done in order to provide an early insight into each individual paper regarding what it addresses and what conclusions are drawn in it. These six papers come from four different studies which address social interaction in different types of VR systems. A more detailed description of the four studies is presented in the method chapter's section 2.1. The appended

papers are presented in relation to which study they build on. Papers I, II, and III come from the same study. Paper IV comes from an individual study, as do papers V and VI. In section 2.3.1 a chart is shown to give an overview of how the studies and papers are related.

I) Heldal, I., Steed, A., Spante, M., Schroeder, R., Bengtsson, S. and Partanaan, M. (2005) Successes and Failures in Copresent Situations. *Presence Teleoperators and Virtual Environments*, 14(5), pp.563-579.

This paper examines how immersive technologies support interaction in comparison with desktop systems. Close observations of the micro interaction of how pairs worked together in a networked IPT situation showed that the immersive technology did support seamless collaboration to a large extent. Users did pay little attention towards the technology as such while they were engaged in various tasks. Their interaction was oriented toward the problem and little time was devoted to compensate for hindrance caused by the technology. This differed for desktop VR since in such situation it has been shown that users must put a lot of effort in finding out ways to compensate for technical hindrance. Socially, the IPT system provided advantages for social interaction in these problem solving tasks to a much higher extent that in desktop VR. The paper concludes that the immersive technology supports social interaction in a very efficient manner because of the larger field of view supported by the system together with the active embodiment due to the tracking system, i.e. when the users moved that movement was transmitted directly without keyboard command that is the case with desktop VR.

II) Spante, M., Heldal, I., Steed, A., Axelsson, A-S. and Schroeder, R. (2003) Strangers and Friends in Networked Immersive Environments: Virtual Spaces for Future Living. *HOIT 2003*, Irvine, CA.

The aim of this paper was to put the possible future usage of networked immersive technologies in the home into focus. Previous research about networked technologies in the home has shown increasing diffusion patterns. Still, there has been a lack of studies of long-term usage of immersive networked technologies. The paper builds upon a trial that

investigated whether people who never had met before – strangers – and people who already had an established relationship – friends – differed in how they collaborated together and experience being in a distributed situation using immersive technologies for an extended period of time. Previous research has taken neither different types of relationships nor longer-term usage of networked immersive technologies into account – which this study does. The discussion, based on this networked immersive long-term trial, reports how users experienced the trial and observations about how they worked together during the trial. The findings reported in this paper, based mainly on observations, could yield a fine-grained analysis of the various patterns of collaboration. From the observations we could show that the pairs of friends differed in how focused on the task they were, and the pairs of strangers in how focused on each other they were. Still, regardless of the way they worked together they could spend a considerable amount of time in networked IPT systems. This paper showed that even if people can spend a considerable amount of time together, for future development of this technology we need to actively take social issues into consideration. This is important since future usage will depend not only on cheaper and more powerful displays, but also on how inhabitable these environments are experienced to be.

III) Spante, M. (2004) Elaborating Distraction-Conflict Theory: Towards an Analytical Model for Evaluating Collaboration in Shared Virtual Environment. In *Proceeding of Virtual Reality Design and Evaluation Workshop,* Nottingham, UK.

The aim of this paper was to develop an analytical model for gaining a tool that focused explicitly on analysis of collaboration in shared virtual environments. Since 'focus of attention' has been identified as important for the study of social interaction in shared virtual environments, this paper argues that there is still a need to explicitly enhance what the focus of attention is guided *towards*. Distraction conflict theory developed in face-to-face situations was chosen as a suitable foundation to build upon. It was elaborated by using findings from the networked IPT systems trial presented above for better suitability in the context of shared virtual environments. The elaborated model explicitly acknowledges the role of technology and introduces a process dimension in the new model in contrast to the previous model.

IV) Spante, M., Axelsson, A-S. and Schroeder, R. (2006) The Good Inequality: Supporting Group-Work in Shared Virtual Environments. In R.Schroeder and A-S. Axelsson (eds.) *Avatars at Work and Play. Activities in Shared Virtual Environments*, Springer, London, pp.151-166. ISBN/ISSN: 1402038836.

This chapter reports on a trial where 18 individuals worked together in pairs on a collaborative problem-solving task in a SVE using very different VR technologies: a desktop VR system on one side and a high end immersive VR system on the other. Half way through the task (after approximately 10 minutes) they were asked to switch system with their partner. The hypothesis was that a change of perspective would lead to better possibility of dealing with issues that are related to distributed group-work and thereby improving the group-work process. It was found that there are several advantages with experiencing different and unequal systems when dealing with a collaborative task of this kind. Partners learn not only about the strengths and limitations of the different systems, but also about collaborating with others and about the implications of using different technologies. If people know about the differences, they can make use of them in their collaboration. In other words, knowing about the different capabilities of the technology and develop a common strategy how to deal with these differences can enhance collaboration, thus creating 'the good inequality'.

V) Spante, M. (2004) Learning to be Social: Establishing and Maintaining Relationships in Shared Virtual Environments. Elaborated version of paper published in proceeding of *Realitat Virtual a l'arquitectura i la Construcció,* Barcelona, Spain, pp.96-106. ISBN/ISSN: 84-608-0394-5.

The aim of this paper was to investigate the evolving practice that users need to learn about and adapt to in order to become a social person in the virtual environment. The paper explored a 8 year old text-based 3D graphical environment available online, Active Worlds. Previous research that has investigated social interaction in mediated interaction has not investigated how use of the longer term can be investigated as processes of socialization. This is important so as to better understand social interaction in shared virtual environments and how people adapt to the specific functions of the technological as well as established social conventions that have evolved over time in Active Worlds creating both possibilities and constraints for social interaction in this environment supported by the text-based 3D graphical environment.

The paper shows that is becomes important to learn about how to use the functions that supported movements in the graphical space in accordance to social expectations. It became equally important to learn about communication conventions on a very detailed level such as using so called smileys in a social significant way, being witty in the conversations, and knowing what virtual place in Active Worlds was suitable for what type of conversational content. The most important issue for users was to combine the movements in the graphical space and textual communication conventions to a coherent whole to become a social actor in this text based 3D graphical environment. The paper concludes that when people establish relationships in Active Worlds, technical and social aspects are intertwined.

VI) Spante, M. (2006) Talking Heads on the Internet: Social Interaction in a Multi-User Voice-Based 3D Graphical Environment (unpublished manuscript).

This paper reports on the findings from a qualitative study which investigated how long-term users of *Traveler*, a 10 year old voice-based 3D online graphical environment, experience their social relations in relation to this specific cue-rich communication technology. The paper describes the subjective perceptions of the technology-mediated social experience such as the experience of social atmosphere in the community, of online friendship, of the meaning of the online social interaction in the users' offline lives. The paper also discusses the importance of these subjective experiences for motivation to regularly use *Traveler*. Conclusions drawn from the study suggest that it is crucial for users to have the ability to handle the technical functions of the program in order to function socially in the environment such as using the functions of the graphical program and using the voice channel in a social significant way. As a result, in order to have positive and meaningful social experiences in online environments it is critical for users to adapt to technical as well as to social factors. This process of adaptation is very important since the way functions are used was interpreted as social signals by users suggesting that technical and social aspects are intertwined in social practice. The paper describes this process of adaptation and the positive social effects of a successful adaptation.

2. Method

The method chapter begins with a description of the various VR systems in which the different studies have been done. This is in order to clarify similarities and differences between the systems, since both technical similarities and differences were found to be important when social interaction occurs in shared virtual environments over time, something that will be discussed later in the analysis chapter. Thereafter, the necessity of a 'over time' perspective in the studies is emphasized since previous research on social interaction in shared virtual environments has been lacking such a perspective (as previously shown in section 1.4, *Specifying the research focus*). Then follows a section where I argue for the possibility to combine experimental and naturalistic studies. Next, an overview of the appended papers is presented and each paper is discussed with regard to its methodological advantages and disadvantages. Section 2.4 emphasizes the strength of the variations in the papers in which I also argue that the variation has been an asset to obtain the aim of this thesis. Finally, the overarching methodological strategy is presented in which the appended papers, in relation to the aim of the thesis, have been compared and contrasted with each other and connected with the theoretical framework used in this thesis.

2.1 Description of studies in VR systems

The thesis builds on four studies of social interaction in shared virtual environments over time in four different VR systems. These four studies, denoted as study 1, study 2, study 3 and study 4 in the cover paper, have generated the six papers which the thesis builds upon. The following section provides a description of these VR systems. Each presentation of respective systems begins with a picture of how it looks. Then the main use of the various shared virtual environments is presented, followed by a description of how the shared virtual environment looks when users have entered the environment and in what way the environment is presented to them. Further, how to navigate around in the SVE and how to manipulate virtual objects are presented, as well as what kind of communication channels the users have at their disposal when communicating with each other. The studies are presented in the order that I have chosen to present the appended papers in. First I present the study that has generated three papers, followed by the studies that have generated one paper each.

Study 1: Networked IPT

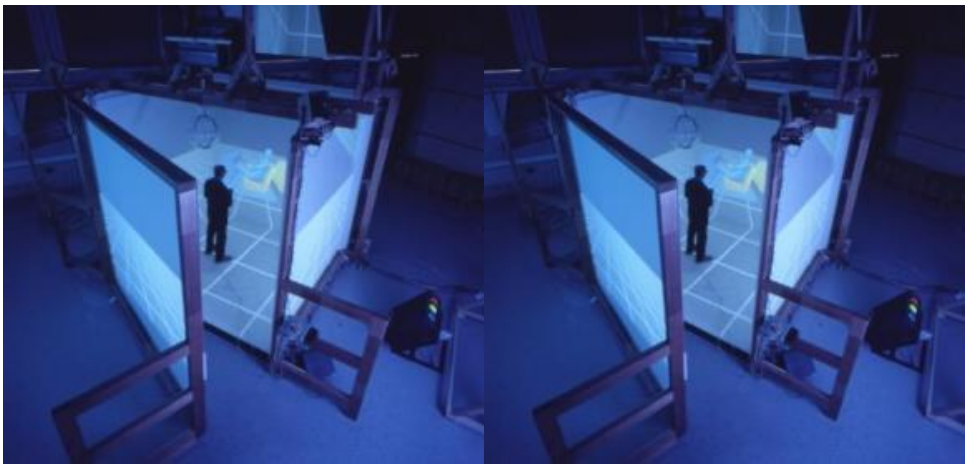

Fig 3. Networked immerive projection technology (IPT)

This type of VR system is called immersive projection technology (IPT). The purpose of these types of systems is to create systems that involve and immerse users to a higher extent than desktop VR. IPT systems that have been connected here are used for research purposes and were available at Chalmers in Gothenburg (Sweden) and at University College London (Great Britain).

The users in this system enter a room-like construction of projection walls, measuring approximately 3x3x3 meters at each location. The shared virtual environment is projected on the walls and floors of each room, and thus users become immersed by it – each of the users in their respective rooms, at the same time as they are virtually presented to each other as avatars with the size of adults in the shared virtual environment.

In order to experience the 3-dimensional effect of the shared virtual environment, each user wears 3D goggles. With the help of the goggles, users acquire depth perception in the shared virtual environment and can experience virtual objects as close or distant. Users' positions in the shared virtual environment are tracked with the help of the goggles. In effect this means that users' body movements, such as bending down to the floor, become projected virtually to each other. Since their avatars will follow this body movement, the users can see each other move in the shared virtual environment, thanks to this tracking system. They can also see if they face each other or are facing in different directions, as well as whether they stand near or far from each other in the shared virtual environment as avatars. Users can also bend down

and look under virtual objects in the shared virtual environment, go round virtual objects and pass through virtual objects. Users can also go through each others' avatars in this particular set-up using these particular shared virtual environments.

With a joystick, users navigate in the shared virtual environments. The joystick is also used for manipulating virtual objects. Our subjects communicated with each other via a voice-based system during the trials. In the networked IPT study, 12 subjects divided into 6 pairs spent between 210 and 230 minutes together in five different shared virtual environments, solving different tasks together. Papers II and III build on the whole experiment. Paper I builds on parts of the experiment.

Study 2: Networked desktop and IPT

Fig.4. Networked desktop and immersive projection technology

In this study we connected desktop and IPT. The presentation of the shared virtual environment for users will then be different depending on whether they are facing a desktop screen or standing in the IPT. In this study all subjects were in Gothenburg at Chalmers. The connection of the two systems was for research purposes.

The user with a desktop views the shared virtual environment (SVE) on a computer screen. The 3D experience is due to depth perception in the SVE and possibilities to navigate sideways, up and down, as well as in a close and distant way. The user with the desktop can navigate and manipulate virtual objects with the help of keyboard commands. The user in the IPT is presented to the desktop user as a graphical representation, i.e. an avatar on the desktop

screen. In the picture above, the avatar of the user of the IPT can be seen on the desktop screen as a humanoid figure behind the cubes. The user in the IPT has the screens around him/her as well as the shared virtual environment, and is using a joystick for navigation and manipulation as described earlier. The 18 subjects divided into 9 pairs communicated via a voice-based system during the trial. Halfway through the trial, subjects changed system and then continued to solve the task at hand.

Study 3: Active Worlds

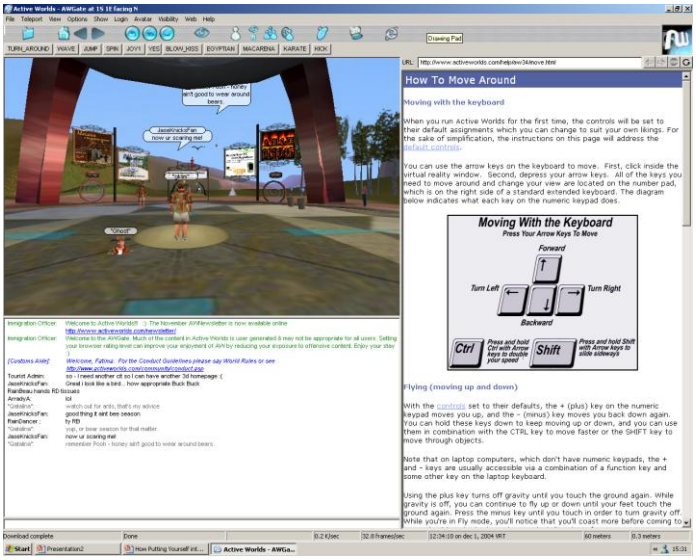

Fig.5. Active Worlds

In this study I investigated a shared virtual environment accessible online, defined as a naturalistic study in this thesis. Active Worlds was launched in 1996 and is still running. Active Worlds is a multiuser system where users can socialize and create their own shared virtual environments.

Active Worlds is a shared virtual environment accessible for those with a computer linked to the Internet. The shared virtual environments are presented on the individual users' computer screens and each user is represented as an avatar. The users can choose from a range of different avatars how they would like to be presented – whether they would like a male appearance, a female appearance, or a fantasy appearance such as a dinosaur or bird, for example.

The 3D experience is due to depth perception in the shared virtual environment and the possibility of navigating the avatar in all directions such as sideways, up and down and in a close and distant manner with the help of keyboard commands. Users view the shared virtual environment in line with the face position of their avatar, i.e. you look in the direction of the nose of the avatar. As a user you also have a first-person view, and therefore you do not see your own avatar as others see it. Apart from navigating the avatar, users can manipulate virtual objects in the shared virtual environment by making specific keyboard commands. In this shared virtual environment, avatars can pass through each other.

In this shared virtual environment it also becomes relevant to consider the different places to which users can go via different links. The places are created from different themes. One place may be a national park. Another may look like an exhibition hall. A third may look like the planet Mars – just to give some examples. Thus, users in this shared virtual environment can choose from a range of places to go to, and they can also create their own places if they like. In order to see what place users are present in, user data from each place are presented on the screen.

The main communication channel in this program is text-based. The text that users exchange is presented under the visual presentation of the shared virtual environment. The text rolls as more text is produced by users, and every user who is present can see this text. If users prefer to communicate more privately, there is a function in the program allowing users to send private text messages to each other. This study was the basis for paper V.

Study 4: Traveler_OzGate

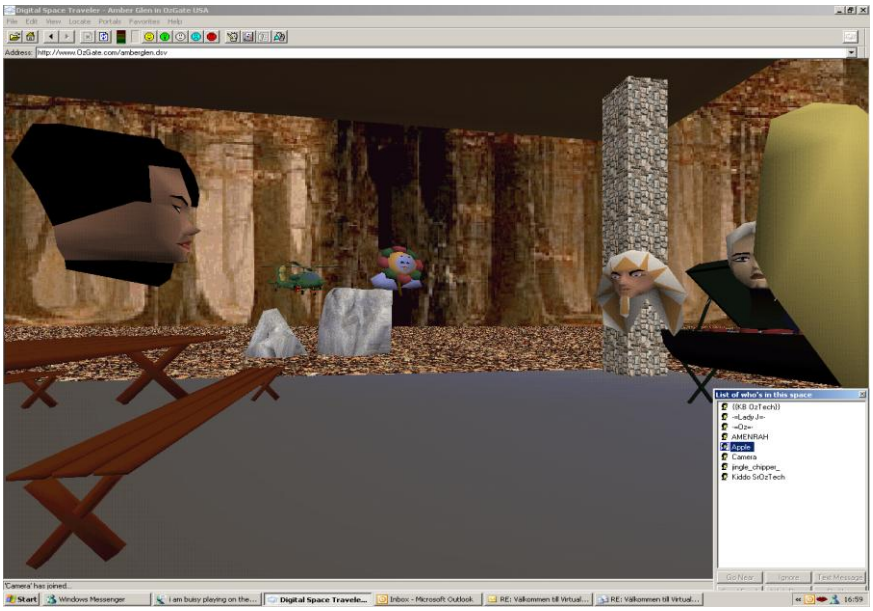

Fig. 6. Traveler Oz_Gate

This shared virtual environment is also accessible online and defined as a naturalistic study in the thesis. Traveler, the name of this SVE, started also in 1996 and is still running. Traveler is a multiuser system created for allowing people to socialize, using voice-based communication in a 3D environment. Some construction possibilities are also available.

The shared virtual environment is presented for each of the individual users on their own computers. We have to imagine how single users in various situations are sitting in front of their computers spread in different geographical locations, and at the same time meeting inside the shared virtual environment as avatars, as in Active Worlds. In Traveler, avatars are flying heads. In the picture above, we see a selection of different avatars that users have chosen for themselves – such as a helicopter, a flower, a pharaoh, and females with different hair colors. The 3D experience is due to depth perception in the shared virtual environment and the possibility of navigating the avatar in all directions such as sideways, up and down, near and far, with the help of keyboard commands. With keyboard commands, too, users can rotate their avatar both horizontally and vertically.

Users see the shared virtual environment in the direction of their avatar. In this shared virtual environment, users cannot go through each other's avatars. When running into another avatar,

a tinkle can be heard and the speed of the avatar is stopped, at the same time as the avatar it runs into is put out of its position.

In Traveler, just as in Active Worlds, there is a range of different places to go to, reached by portals and built around different themes. One place may look like a party, another like a bar, and a third might be an illustration of a fantasy world. In contrast to Active Worlds where users communicate via text, users in Traveler communicate via a voice-based system. The users can talk to each other with overlapping comments, just as in a phone conversation or a face-to-face discussion, and there is also a depth in the sound so that an avatar close to your own avatar would be heard more loudly than a distant avatar. Paper VI builds on this study.

2.2 Combining experimental and naturalistic studies

In the description of the studies that make up the foundation of this thesis, it becomes clear that they build on very different circumstances, where controlled experimental situations are combined with so-called naturalistic studies. In spite of these differences, most of the empirical material has been collected and analyzed by using qualitative methods. Occasionally I have employed answers from questionnaires used in the experimental studies (studies 1 and 2), but most of the analysis of the empirical material from the four different studies has built upon various qualitative approaches. Using various approaches is seen as strengthening the analysis (Kvale 1997:207-227). When talking about various approaches, the term 'method triangulation' is increasingly used for both combinations of qualitative and quantitative methods as well as combinations of various qualitative methods (Flick 2009). In this thesis, the empirical material has been collected and analyzed by different *qualitative* methods, whose individual strengths and weaknesses have been combined in order to handle shortcomings of each method, which will be described in detail in section 2.4.2.

In this thesis I have benefited from both possibilities and constraints presented by the different study situations. For example, in the experimental situation one is dealing with planned procedures, whose strength is that one controls the situation without distractions from everyday life. However, this lack of everyday distraction is also the drawback of the controlled situation since the situation lacks real life realism. Results coming from such situations are not unproblematic to generalize to situations where the same control does not exist, e.g. into everyday life and its richness in realism (Kerlinger 1986:347-375).

Consequently, studies of social interaction in shared virtual environments over time in naturalistic settings have both advantages and disadvantages. Studying social interaction in shared virtual environments as it has emerged without interference from a researcher, as in the experimental situations where everything is set up by the research team, allows study of a natural process at the same time as having to deal with all sorts of influences permeating the natural situation.

When this thesis work started, IPT systems were a new technology that for the main part could be found at universities and other types of research labs and was under development (and still is). Combining this high-end technology with technologies that were already out in everyday life was seen as a strength for arguing how 'the technical' and 'the social' relate when social interaction occurs in shared virtual environments over time. If I had based my arguments only on experimental studies, I would have needed to limit my conclusions to incorporating experimentally organized collaboration in networked IPT systems, or IPT to desktop, and that was not the aim of the thesis work. Thus, by combining experimental studies of social interaction in shared virtual environments supported by high-end VR systems with naturalistic studies of social interaction in shared virtual environments that users had incorporated into their everyday practice without interference from a research team, commonalities would be discoverable about social interaction in shared virtual environments over time as a phenomenon with focus on how 'the technical' and 'the social' relate over time.

Experimental and naturalistic studies in SVEs also involve research ethics. Early on in the internet research field, ethical issues specifically addressed problems related to the new ways of data collection that the new technology enabled, such as surveilling users without them knowing about it (Cherny 1999). These issues are still highly topical and are relevant for research in SVEs since ''in SVEs the whole graphical and auditory environment, including the user's body, can be recorded'' (Schroeder 2006:7). These technical possibilities highlight the notion that what is possible to do is not always desirable, and therefore research in this field involves ethical considerations.

2.3 The necessity of a time dimension

In section 1.4 specifying the research focus, the lack of a 'over time' view in studies of social interaction in information and communications systems was pointed out, particularly in the

case of experimental research concerning shared virtual environments. This enhances the importance of this thesis work. An important exception, even though the studied environment was not a shared virtual environment by the definition used in this thesis, is Walther (2002) showing the importance of following social interaction over time in text-based experimental research. Walther clarifies in his studies that, by following social interaction over time, the need for adaptation to both technical and social circumstances becomes evident in computer-mediated communication via text.

This thesis addresses the over time perspective differently in each study, still focusing on social interaction as a process that should be followed over time. Different methods have been used in order to capture this process. 'Over time' in this thesis has been defined in the experimental studies in relation to exposure time in previous research. In the naturalistic studies 'over time' is related to how users' time inside the shared virtual environment is linked to users' common activities and experiences. A more detailed description of how the 'over time' dimension was tackled in each study will be presented in the following section.

2.4 Overview of methods used in the appended papers

Since this thesis is a compilation of papers, it is relevant to go through each paper individually and clarify how social interaction in the shared virtual environment was addressed over time. The section begins with an overview of the appended papers. Then follows an individual presentation of each paper focusing on methodological advantages and disadvantages of the method used in relation to the aim of each paper.

2.4.1 General overview

My aim has been to contribute knowledge whose focus is in the meeting between 'the technical' and 'the social' when social interaction occurs in shared virtual environments supported by different VR systems. In order to generate such knowledge I suggest, in accordance with Schroeder (2002:3), that a multi-method approach has the potential to yield complementary results when we study social interaction in shared virtual environments. In this thesis I mainly combine different qualitative methods of collecting and analyzing

empirical material, regardless of whether the study is experimental or naturalistic as described in section 2.2.

Below follows an overview of the different VR systems, how the studies were organized, the aim of each paper, how the time dimension was addressed, and the title of the paper.

Table 1. Overview of studies

	VR system	**Method**	**Aim/objective/purpose**	**'over time' dimension**	**Title**
Paper I	Study 1: IPT to IPT Immersive VR Voice communication	Experimental Between subject design. 12 subjects. Video and audio tape analysis	Examine how immersive technologies support interaction and compare this to the experience with desktop systems	210-230 minutes of social interaction for each couple	Successes and Failures in Copresent Situations
Paper II	Study 1: IPT to IPT Immersive VR Voice communication	Experimental Between subject design. 12 subjects. Video and audio tape analysis	Examine how two people collaborate for an extended period of time in highly immersive systems, comparing pairs of strangers and friends	210-230 minutes of social interaction for each couple	Strangers and Friends in Networked Immersive Environments: Virtual Spaces for Future Living
Paper III	Study 1: IPT to IPT Immersive VR Voice communication	Relating established theory to observations	Put forward an analytical model based on distraction-conflict theory that focuses on particular issues when studying collaboration in shared virtual environments	210-230 minutes of social interaction for each couple	Elaborating Distraction-Conflict Theory: Towards an Analytical Model for Evaluating Collaboration in Shared Virtual Environment
Paper IV	Study 2: IPT to desktop VR. Voice communication	Experimental Within subject design. 18 subjects. Post trial individual interviews	Exploring advantages with experiencing different and unequal systems when dealing with a collaborative task	20 minutes of social interaction. Change system after 10 minutes and then continue for additional 10 minutes	The Good Inequality: Supporting Group Work in Shared Virtual Environments
Paper V	Study 3: Active Worlds Desktop VR Text communication	Naturalistic Long term observations	Study what practices people need to learn about, become involved with and adapt to in order to become social actors in Active Worlds	150 hours of observation	Learning to be Social: Establishing and Maintaining Relationships in Shared Virtual Environments
Paper VI	Study 4: Traveler. Desktop VR Voice communication	Naturalistic Long-term observations, focus group interview with 5 subjects	Explore how long-term users use the technology and how they experience social interaction in order to understand the role of technology in social interaction in this system	Focus group interview with committed users having 2-10 years of regular use	Talking Heads on the Internet: Social Interaction in a Multi-User Voice-Based 3D Graphical Environment

2.4.2 Review of methodological advantages and disadvantages in appended papers

In this section the chosen methods in each paper will be discussed more in depth, since the methods have varied. Each review clarifies the advantages and disadvantages of the method in relation to the aim of the paper.

Paper I: Successes and Failures in Co-Present Situations

In this paper, built on study 1, we used qualitative analysis of the video recordings from subjects' social interaction in the collaborative tasks during a networked IPT trial. The trial was designed to give the subjects five different tasks to solve in five different shared virtual environments. Each pair spent between 210 and 230 minutes together in the networked IPT set-up. This time span was related to previous research where networked IPT still was very rare and, when conducted, exposure time for subjects was usually between 5-20 minutes. Thus this set-up was seen as unique. After each task, the subjects left their 'room' and filled in questionnaires. After the full trial day we audio-taped the debriefing interviews held with each subject. During the trials we video- and audio-taped the subject on both sides (in London as well as Göteborg), obtaining rich empirical material to analyze. Thanks to the video recordings we could go back and replay them over and over again to analyze how subjects interacted with each other, how they handled the technology and how they approached the tasks given to them during the trial day. In this paper we had already established categories to work in line with, created by another research team since we wanted to compare our results from networked IPT with their networked desktop trials. Hence their categories were leading our analytical work in this paper.

Thanks to our video recording we could identify changes as well as remaining issues for the subjects in relation to the established categories. By being four different interpreters of the video and audio recordings, we could compare our individual interpretations with each other and find examples that we jointly considered to be the best illustrations of situations where the technology supported social interaction, but also situations enhancing difficulties regarding how subjects could deal with each other, as well as how they commonly handled the technology throughout the trial. In this paper, two tasks (1 and 5) were analyzed since they involved object manipulation in the shared virtual environment.

The benefit with this design was that we had already established categories to use as a guide for the analytical work on the rich empirical material that video and audio recordings provided. We could run the tapes repeatedly to identify what was happening during the trial. The drawback with the established categories was that they might have obscured our attention to important issues that were not covered by the categories. However, in relation to the aim of the paper, comparing our findings with another published study, the advantages outweighed the disadvantages.

Paper II: Strangers and Friends in Networked Immersive Environments: Virtual Spaces for Future Living

This paper builds also on study 1. In this paper we wanted to investigate whether users' way of collaboration and how they related to each other differed depending on whether they had known each other before as friends, or met for the first time in the shared virtual environments. In this paper the focus was oriented towards users' previous relationships and how these influenced their interaction with each other in the shared virtual environments, given the tasks they should solve during the trials. Previous research on social interaction in shared virtual environments had not addressed differences and similarities among subjects' previous relationships among each other. Thanks to the audio and video recordings, analysis of their social interaction in the shared virtual environments could be done repeatedly. This ability to "re-run" the experiments on several occasions made it possible to observe closely how subjects treated each other, the technology and the task at hand as a process rather than instantaneously. It was found that their previous relationships had an impact on their small talk, but very little importance for how they handled the whole experiment apart from one couple of friends, whose participation in the experiment had to be terminated due to severe nausea for both participants.

Documenting the full process made it possible to analyze subjects' social interaction as a process. Had we only collected answers in questionnaires, which we also used, we would have missed small but important details such as *how* the members of couples talked to each other and what they said during the trial day. Additionally, we would have missed what kind of technical difficulties they had during the trial as well as how they came to solve such difficulties together, since this influenced their social interaction during the whole trial. Further, if we had used only the debriefing interviews, held with each participant after the trial

and asking about the overall experience of the trial day, we would also have missed the small but important details, since we did not explicitly ask for those in the interviews and subjects did not mention them either. However, combining all the different ways of collecting empirical material from the experiment provided rich material for the analytical work.

The advantage of the video and audio analysis conducted in this paper was its openness, not governed by pre-established categories. Important issues emerged during the analytical work when going through the recordings repeatedly. As for disadvantages, the openness was sometimes overwhelming. Therefore the debriefing interview provided support to the observations. The subjects' own words describing their experiences of the trials could be linked to their behavior and to spontaneous comments that they shared during the trials in the shared virtual environments working together. Additional support for the observations came from subjects' questionnaire answers. Still, the small sample reduced the relevance of statistical analysis, and the open questions in the questionnaires provided more revealing information in order to analyze the social interactions.

Paper III: Elaborating Distraction-Conflict Theory: Towards an Analytical Model for Evaluating Collaboration in Shared Virtual Environments

Paper III builds also on study 1. Here I sought explanations for differences among subjects regarding how they handled the technology and each other while solving the tasks together in pairs. In addition, I wanted to explain why such differences sometimes led to difficulties in how pairs could collaborate, and why pairs sometimes could handle the differences and continue to solve the tasks together. Supported by the rich empirical material I analyzed behavior, comments and questionnaire answers with special reference to an established social-psychological theory, Distraction-Conflict Theory (Baron 1986). Two pairs were particularly interesting: a pair of strangers who neither liked each other nor worked well together but still continued to participate in the full trial, and a pair of friends whose participation we needed to discontinue due to severe nausea.

Looking more closely at the latter pair of friends, I could see how their behavior over time related to how they handled each other, the technology and the tasks at hand. It became clear that the experimental situation as such influenced their social interaction over time, as well as their continuation with the trial in spite of their nausea. They did not inform the researchers or

each other about their state when their nausea started, and unfortunately we did not see signs of nausea, such as pale faces, since their goggles covered half of their faces and the IPT in Göteborg immersed the subjects with four surrounding walls. Future research in long-term studies of immersive systems should learn from this to actively ask subjects during the trial about how they feel. Our disclaimer with questions regarding former diseases, such as epilepsy, that each subject received before the start of the experiments, in combination with our information that they were free to stop their participation at any time, was not enough to encourage these participants to be explicit about their physical state. After the experience from this couple we asked the other participants on several occasions during the trial about how they felt. Even if this happens rarely, it is important to incorporate in further research when subjects will spend a longer time in immersive systems, since it was such an unpleasant experience for these subjects.

By actively connecting observations with the distraction-conflict theory, the analysis became deeper and I considered this to be a strength, since a lot of experimental research is mainly concerned with empirical presentations of results. The disadvantage of a close connection with an established theory is the risk of forcing empirical observations into a fixed model. Even in this paper, the small sample required precautions. In spite of these problems I think that the rich empirical material, which followed each pair's social interaction over time from start to beginning of the trials, allowed for observing how subjects' focus of attention was guided towards different things during the trial and how these individual differences in focus could positively as well as negatively influence how they handled each other, the tasks, the technology and the experimental situation.

Paper IV: The Good Inequality: Supporting Group Work in Shared Virtual Environments

This paper builds on study 2 where we connected a desktop VR to an IPT system. The unique design in this experiment, compared to previous research, was that subjects changed places halfway through the trial, allowing each subject to experience both systems. The experiment was documented in a range of ways and this paper builds on the individual audio-taped interviews held directly after the trial. Each interview was fully transcribed. Capturing each individual experience directly after the trial, we were able to get information about how these experiences were related to both technical and social aspects. A big problem with this paper,

connected with the thesis emphasis on an ‘over time’ dimension, was the short time span of the trial, only 20 minutes. However, and this is important, each subject experienced repeated exposure to the use of different VR systems, since they exchanged systems halfway through. The *process* that was followed here was short in relation to time but involved an important change of technology.

The reason for incorporating this paper in the thesis, in spite of the far too short time span in this particular experiment, is that it addressed an important process where the change of technical systems became a part of the social interaction among the individuals in each pair, which in turn became important for their collaboration. When the two persons in each pair exchanged systems and then continued with solving the task at hand together, an ‘aha’ experience became evident that influenced their strategy on how to collaborate when solving the task. Experience from *both* systems influenced their collaboration positively. This result was important since previous research had emphasized that system equalities support collaboration and system inequalities hinder collaboration. We were able to show that this problem could be bridged by experience of both systems in a collaborative task.

Paper V: Learning to be Social: Establishing and Maintaining Relationships in Shared Virtual Environments

The work presented as study 3 was my first encounter with a shared virtual environment, and it was in Active Worlds. The method I worked in line with was participant observation. The main idea was to get a sense of how users exploited the environment and related to each other. What resulted was a mixture of observations and personal participation. My observations were open, without guidance by any particular theory, with a focus on social interaction processes in the shared virtual environments. The advantage of this openness was that I could focus on *what* users did and *how* they did it in a distant manner. The disadvantage was that I did not gain a deeper insight in why they acted as they did. Neither did I acquire insight into individuals’ experiences about their use of Active Worlds over time. The dilemma of the beginner in these environments became evident, i.e. it can be hard to learn about how to use the technology and how to act in line with social norms in the specific shared virtual environment at the same time as one is studying such processes. I never got the feeling of handling the system or being a part of Active Worlds.

According to my view ethnography inevitably raises ethical considerations, particularly when observations are the main method of gathering data about the phenomena under investigation. The concerns about participants' privacy call for well-grounded arguments in relation to how the study is conducted. In this study, I collected observations by covert participation. The main argument for covert participant observation was that the study did not focus on individuals as such. Rather, the phenomena under investigation were the users' behaviours inside the 3D graphical environment. Therefore no individuals would be exposed in the presentation of observations made, nor could they be traced after the study was done. The focus was strictly on practices and observed patterns of interaction over the course of time. However, it is important to note that even if the outside observer initially defines the shared virtual environment as a public place, it is not necessarily the case that users share that view (see Cherny 1999:297-315; Svenningsson 2001). To protect users from being exposed, quotations that are presented in the paper have been anonymized.

Paper VI: Talking Heads on the Internet: Social Interaction in a Multi-User Voice-Based 3D Graphical Environment

In study 4, in order to avoid the difficulties of being an observer at the same time as a beginner, as in the case of the Active Worlds study, I spent substantial time in Traveler before beginning my actual study. I was also open about who I was and what I did, to inform users clearly that I was there for research purposes since I wanted to rely on their subjective experiences and conduct interviews with users. In order to be able to focus on social interaction in this particular shared virtual environment, I learned to handle the technology and got used to the voice-based communication system, so as to become comfortable with using the system. During this learning period I talked to several users, participated in various social events in the shared virtual environment, and also personally met the owner of the servers where Traveler is placed.

To capture users' experience, this paper built on a focus group interview. I wanted a group of committed long-term users to provide their stories about their time in Traveler. I wanted to take advantage of the fact that they were familiar with each other as users and let the warm and family-like atmosphere in Traveler, which I had experienced, permeate the focus group interview and stimulate the participants to speak more readily about their presence and convivial time together and how it had evolved over time. For this purpose, the focus group

method was suitable. The advantage was that I got close to the individual experiences so that they also shared with each other during the interview, and they all generously shared their stories about their time in Traveler. The interview contained rich information that could illustrate the huge importance of Traveler in these users' lives, both as a technology and as a social place where intimate friends regularly meet. The disadvantage of the method was that the stories from these committed users were unchallenged. It captures the stories from long-term enthusiasts, and I am still unaware of stories from non-committed users in this shared virtual environment. In relation to the aim of the paper, finding out about drivers behind long-term use of a particular shared virtual environment, I would argue that the methodological advantages outweigh the disadvantages.

2.4.3 The strength of methodological variation

I believe that the diverse study situations and method used in each paper presented above have strengthened the work in order to achieve the aim of the thesis. This is important since experimental and naturalistic studies normally are not combined – which is a pity as they not only provide important information on their own, but can provide even richer information when combined. I suggest that there are situations when this combination has the potential to generate more interesting analysis and conclusions than would have been possible if the focus were on either experimental or naturalistic studies.

Even though the study situations have differed and the methods in the appended papers have varied, the main focus in the empirical material has been on how the technology was used and how users treated each other in the shared virtual environment, as well as on their own experiences of their social interaction in shared virtual environments over time. The main methodological approach has been qualitative. I argue that the observations and subjective experiences presented in the different papers complement each other and reinforce the conclusions presented later in this thesis. Thanks to comparing and contrasting the different studies and papers, a more general learning process was possible. In the following section I present the overarching methodological strategy used in the thesis work.

2.5 Overarching methodological strategy

In this cover paper, the analytical work has been inspired and guided by established theory. I could have worked differently, for example in accordance with grounded theory (Strauss and Corbin 1990) with the ambition of generating theory from the empirical material. I have chosen to place observations and subjective experiences in relation to established theory and models when I compared and contrasted the different studies and papers in this cover paper. The theories and models which were eventually selected as analytical tools were not evident in the beginning of the thesis work, but became relevant during the work process, as will be described more in depth in Chapter 3, *Analytical framework.*

The overarching methodological strategy is best described as an iterative process. The different studies individually provided information and answers to questions asked in each paper. However, the unique contributions providing most insight emerged by combining them with each other and further relating them to theoretical perspectives. This iterative research process shares similarities in what the literature refers to as abduction (see for example Danermark 1997) or systematic combining (Dubois and Gadde 2002). Systematic combining concerns the process of finding discrepancies in the material and leading these towards theory elaboration, or finding new analytical tools in order to obtain a better understanding of the empirical material. The process can also be reversed, i.e. expanding the empirical material supported by the theoretical framework. But, as expressed by the authors, "matching requires more, and has the potential to yield more, than inductive fit" (Dubois and Gadde 2002:556). The systematic matching between theory and empirical material is seen as the essence of systematic combining, which means to move or expand both theoretical and empirical boundaries during the learning process that research is all about.

In the thesis, this iterative work process generated both theoretical elaborations, discussed in the following chapter, and expansion of the empirical material by investigating different VR systems in different situations, as described previously in the present chapter. Since new questions emerged during the studies, they became drivers motivating additional studies or new angles on the same study in different papers (see the overview on page 27). The overarching methodological strategy also enabled me to formulate a conceptual proposal that will be described and explained in the concluding chapter.

3. Analytical framework

In this chapter the theoretical models and perspectives that became the main analytical tools in this cover paper are presented. These perspectives and models were not evident in the beginning of the thesis work, but have arisen and expanded during the research process in line with the systematic combining approach previously described in section 2.5. In order to analyze social interaction in shared virtual environments over time, I argue that models and perspectives enhancing social interaction as a process, and explicitly focusing on the necessity of time in such processes, are suitable tools for the overarching analytical work of the rich and diverse empirical material collected in each study and presented in the appended papers. In addition, a process view is important since I showed in section 1.4, *Specifying the research focus*, that such a view is lacking in studies of social interaction in shared virtual environments as the latter are defined in this thesis.

Much of our knowledge concerning social interaction in general we owe to the discipline of sociology. Since I study social interaction, I turned to sociology in my quest for suitable tools to analyze social interaction in shared virtual environments. Previous theories of media were regarded as having either too strong a technological-deterministic perspective or too strong a social-shaping perspective on the matter, as discussed in section 1.4, and I observed neither of these so exclusively in my empirical material, so the scope was broadened to embrace theories outside the media theory field.

One model I found particularly interesting in relation to my material was Jonathan Turner's model of social interaction. It is based on insights from sociology and social psychology, but before describing his model I would like to emphasize the fundamental importance of social interaction in human life. Social interaction consists not only of theoretical concepts that can be defined in different respects, followed by explaining the connections between these. Social interaction is the foundation of our lives. As humans, we grow and develop in interplay with each other. It is in the presence or absence of other humans that we are both healed and injured as individuals (Asplund 1987). When new interactions are made possible in society, in laboratories or in everyday life, it becomes a concern to closely investigate how they work and what is happening when new forms of social interaction emerge. The new form studied here is social interaction in shared virtual environments. Since the phenomenon of social interaction is far from new, I think it is relevant to rely on previously established models of social interaction in face-to-face situations. However, it is important to have in mind that the

phenomenon has entered a new situation, the shared virtual environment, and to pay particular attention to differences and similarities that appear when using theories developed in face-to-face situations as analytical tools for social interaction in shared virtual environments over time.

Turner argues that in spite of humans' basic need for social interaction, it is not unproblematic for us. He writes that, ''although humans are social to a degree, they have never been emotional junkies who seek deep, personal contact with all others in all social relations. Closely synchronized face-to-face interaction is not as natural as we often think; rather it is a process that requires considerable effort in most instances. Why should this be so if humans are naturally so social?'' (Turner 2002:3).

Even if we, as a social-biological species, experience a lot of social interaction, it is also one of our main challenges to handle each other in our everyday life. In order to pin down what is happening in social interaction, Turner has developed a model that describes fundamental processes inherent in all types of social interaction. According to Turner, ''the nature of human interaction reveals fundamental properties and processes. These are invariant in the sense that they always exist when humans interact'' (Turner 2002:3).

Turner's claim of generality is vast. He also suggests that these processes are independent of where social interaction occurs, and mentions specifically social interaction in information and communication technologies as if the technology did not matter for social interaction (Turner 2002:1). In spite of disagreeing with his view regarding the role of technology in social interaction, I still regard the model as useful in relation to analyzing the empirical observations, and as offering a possibility to present the analysis in a structured way in order to handle its complexity.

The model I have benefited from is a visualization and description presented in Turner's earlier work (Turner 1988). It divides social interaction into three processes that depend on each other as well as being each other's prerequisites.

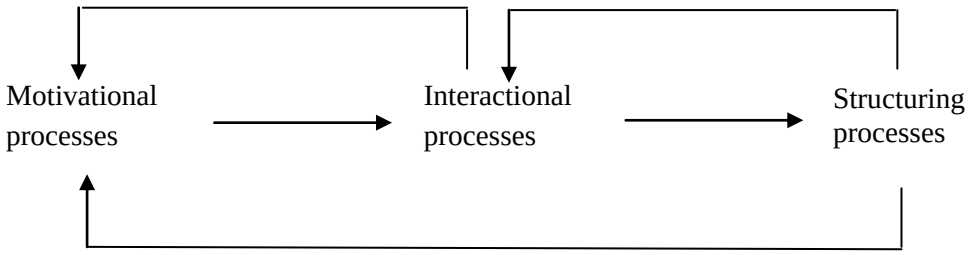

Fig. 7. Parts in social interaction (Source: Turner 1988:15)

The first part of the social interaction process concerns (i) motivation. According to Turner, motivation is essential for social interaction. By this he means that people for various reasons are "mobilized, energized, compelled and driven to behave in various ways" (Turner 1988: 15). However, from a sociological point of view, motivation *per se* is of less importance than how it influences the process of social interaction. In other words, although 'motivation' is often regarded as falling within the domain of the discipline of psychology, for Turner motivation is more about social processes. Motivation from this viewpoint is seen as an essential part of social interaction rather than a psychological state of mind.

(ii) Interactional processes are regarded as "the mechanics" of interaction. Here, one can claim, is the analytical core of the situation, where people meet and engage somehow with each other. The duality of the situation is that it takes into consideration both what the individuals are doing and how they interpret these actions performed by themselves and the ones they are engaging with, i.e. how they are signaling and interpreting both their own behavior and that of others.

(iii) Structuring processes are about how people's engagement with each other over time and space creates abstract structures in which their behavior is both enabled and hindered. Here Turner talks about how social interaction tends to be repeated across time and space. This repetition "creates" structures in which interaction takes place. These different types of processes in social interaction, following Turner, are mutually intertwined and should only be separated when analyzing social interaction. As expressed by Turner:

"Motivational, interactional, and structuring processes are interrelated... Just how people signal and interpret is related to their motivational energies; in turn, motivation is circumscribed by prevailing structural arrangements as well as by the course of signaling and

interpreting; and the structure of the interaction is very much determined by the motivational profiles of individuals as these affect their signaling and interpreting activities" (Turner 1988:15-16).

The parts with which Turner builds his model take their point of departure in a range of theories. He argues that there are shortcomings in each theory and that ''we should not be intellectual slaves, viewing their works as sacred texts and seeing rejections of bad ideas as blasphemy. Instead, we should view their work as a starting point for further theorizing'' (Turner 2002:4). I take that as an encouragement to avoid the 'crossword puzzle trap', i.e. to be enticed to interpret our observations in accordance to established theories, which are helpful for increasing our knowledge of the world but at the same time are framing our possibilities to look outside these theoretical boundaries (Craib 1992:11). In order to avoid that trap I take support from Turner's model in the analytical work in the cover paper, but contrary to Turner I explicitly address the role and place of the technology in social interactions studied in this thesis. Turner focuses on the micro-interaction happening in face-to-face situations, whereas in this thesis VR technology becomes an added part of Turner's reasoning. Thus, I actively incorporate the technology into the analysis and pay close attention to how the technology is used when humans are dealing with each other in shared virtual environments over time, and present how this is done in Chapter 4, *Analysis*.

Even though Turner does not explicitly discuss the importance of time in social interaction, I interpret his model as containing an 'over time' dimension since the model addresses processes and not static conditions. To additionally clarify the theoretical importance of time, I take inspiration from yet another sociologist, Pierre Bourdieu, and especially his discussion about the role of time for human practice. Practice in his sense means the conscious and unconscious ways we behave. These behaviours we incorporate via contexts we spend our time in. Our everyday practice embodies our social lives and, according to Bourdieu, "practice unfolds in time" (Bourdieu 1990:81). When observing who is doing what and when, time is put forward as a crucial element in the analysis of observations of human behaviour. Bourdieu claims that "because it [practice] is entirely immersed in the current of time, practice is inseparable from temporality, not only because it is played out in time, but also because it plays strategically with time and especially with tempo" (ibid. 81). This perspective on the importance of time for our practice has led me to explicitly incorporate the time dimension in the analytical work as well as providing a theoretical argument for the over time

approach in this thesis work, a lack of empirical 'over time' studies having been indicated in section 1.4, *Specifying the research focus*.

From Turner and Bourdieu I have borrowed terms that I consider helpful to describe social interaction in shared virtual environments over time, as well as tools to work with when analyzing observations presented in each appended paper. From Turner, I take the clear model of social interaction that he presents. From Bourdieu, I derive the emphasis on the role of time incorporating practice[1].

Important to note here is that the analytical framework has grown during the process of the thesis work, just as the tools have been adjusted in interplay with the studied phenomenon – i.e. social interaction in shared virtual environments over time. It is not self-evident that theories developed in one specific context can be implemented in a completely different context, but I argue that we certainly can find insights with theories developed in non-mediated situations as analytical tools and sources of inspiration even in situations when humans interact in mediated situations. As mentioned repeatedly in this cover paper, it is important to have in mind that social interactions are played out in different contexts, in this case in shared virtual environments; yet despite this difference, in this case I argue that it is both possible and reasonable to draw support from previously established theories on social interaction, even if they are developed in face-to-face situations, in the analysis of social interaction in shared virtual environments, since the theoretical focus is on social interaction

[1] This is a rather unconventional choice since Bourdieu is not directly connected with the concept of practice even though many of his publications specifically concern practice (Bourdieu 1977, 1990, 1998). The most famous conceptual apparatus are habitus, social field and symbolic capital. But when reading Bourdieu I find practice to be an important part of that conceptual apparatus. Therefore I argue that it is possible to incorporate Bourdieu in the analytical framework in this cover paper but with a focus on practice rather than the social conditions for and consequences of practice that the conceptual apparatus mainly addresses. One point of departure is that humans strive for social distinction (Bourdieu 1984). A straightforward description of his theoretical reasoning is that through our manners, habits and way of talking we signal to a wider audience what social group we belong to as well as what social group we want to distance ourselves from. Our way of being and our way of behaving arises both consciously and unconsciously. These patterns of behavior have evolved over time through the individual's dependence on the cultural contexts in which his/her time is spent. Yet another perspective that focuses on practice is that of 'communities of practice'. This approach studies and describes contexts in which social groups have developed a common way of behavior patterns that has acquired social acceptance among group members (Wenger 1998). Since the concept of 'communities' is involved, it focuses on established contexts including numerous participants and excludes situations such as when two people are connected during a given period of time. While I find the communities of practice approach interesting, it falls outside the scope of this thesis since I have observations from situations where two people are connected in a VR system. However, I still regard Turner's reasoning about social interaction as a useful analytical tool as well as Bourdieu's discussion about the importance of time for human ways of behaving and developing practice.

processes (Turner) emphasizing the necessity of time in order to develop practice (Bourdieu). This is particularly relevant in the thesis since I have considered previously established media theories focusing on social interaction, such as social presence theory (Short, William and Christie 1976) and media richness theory (Daft and Lengel 1986) to be unsuitable as analytical tools, because I argue for a both/and view in contrast to either/or views – with special reference to how 'the social' and 'the technical' are related when studying social interaction in shared virtual environments over time.

4. Analysis

In the previous chapter the sources of theory for the coming analysis were presented. As stated before, the analysis has evolved during the process of the thesis work by comparing and contrasting the appended papers with each other, relating the observations to different theories and finding tools that lifted the empirical observations to an overarching interpretation of what kind of phenomenon they enhanced and how the phenomenon could be described and explained. The process view is crucial in this thesis and the time dimension permeates the interpretations of the observations in the analytical work.

This chapter begins with a general description of what I observed in the appended papers when they were compared and contrasted to each other. Thereafter follows a presentation of the systematic categorization of observations from appended papers in relation to Turner's process model of social interaction. The created analytical model based on Turner is further expanded to incorporate technical aspects. With selected examples from the appended papers, the claim made in this thesis, that 'the social' and 'the technical' are intertwined, is supported in terms of the created analytical model. The chapter ends with an analysis of the importance of the time dimension for social interaction in shared virtual environments.

4.1 Categorization of observations in appended papers in relation to Turner's model of social interaction

In the method chapter I described how the overall methodological strategy was inspired by the systematic combining approach, in which the research process is regarded as an active and iterative process (Dubois and Gadde 2002). This chapter will now combine observations from the appended papers with Turner's model of social interaction. The observations were systematized into the three processes of the original model at the same time as I implemented the VR systems and the shared virtual environments as aspects. Introducing technology into the model deviates from the original model, since Turner based that model on face-to-face interaction situations.

To explicitly incorporate technology in the model is crucial, since I claim that the studies this thesis builds upon enhance the importance of users being able to deal with the technology and with each other in a good enough manner at the same time. If users do not learn to handle the technology, it is likely that the technology will be an obstacle to durable social interaction in

the shared virtual environment. At best, social interaction under such circumstances will be bearable, but I have observed situations when it was hardly that (paper II). Moreover, we can observe in the different papers how people have been creative in circumventing possible problems with the technology, asking their more competent partner for help, and thereafter continuing with their tasks in the shared virtual environment (papers I, II). Likewise, examples have been presented that knowledge about different VR systems' possibilities and constraints has been fruitful for collaboration when users gained insight into such differences (paper IV). I have also seen that people who became fond of the VR system also became fond of each other, developing warm social ties (paper VI).

I would like to point out in this thesis that the technology does not become invisible when social interaction occurs in shared virtual environments, nor does it become placed into the back ground in relation to the ongoing social interaction among users. I argue that the technology is perpetually present since it intertwines with our way of interacting and becomes a part of our interaction with each other. The word *intertwines* is pertinent since it indicates an ongoing process and the fact that different threads are used in the process. In this case the threads are 'technical' and 'social'. It is shown in this thesis that the functions of the technology do not disappear any more than do people's will and ability to deal with each other over time. Rather, I show that these different aspects are mutually important in social interaction in shared virtual environments over time. In spite of the complexity that needs to be handled, it is necessary to make an effort to pin down how these aspects are related and not only focus on the one or the other. Turner's model provides support in the process of pinning down the complexity presented in the different studies.

Turner's model of social interaction was built up by distinguishing three processes: motivational, interactional, and structural. In the thesis, these processes are identified in the appended papers. They can be described briefly as follows:

i) Motivational process: this concerns individuals' will and ability to be a part of the social interaction that goes on.

ii) Interactional process: this is regarded as the mechanics in social interaction. It concerns people's signaling and interpreting of their own and each other's behavior when social interaction occurs.

iii) Structuring process: this concerns the structural arrangements in social interaction that are repeated and organized across time and space.

In order to structure the observations from the appended papers, I have created an analytical model based on Turner's model. To begin with, I categorized the studies on which the appended papers build on in three main parts. These parts concern technical conditions, naturalistic conditions and experimental conditions. Then I related each part to the three processes presented in Turner's original model. In this thesis the technical aspect is added to the original model. As mentioned earlier, Turner developed his model in face-to-face situations. However, I will show that his model is also useful as an analytical tool when social interaction occurs in shared virtual environments over time. Important to note is that this categorization was not a pre set work procedure during the thesis work. The analytical model was created as a result from the analytical work of the appended papers. In order to clarify that process, I structured the analytical work in relation to as well as by expanding Tuners model of social interaction.

Table 2. Categorizations of studies in relation to Turner's process model of social interaction

	Motivational processes	**Interactional processes**	**Structuring processes**
Technical conditions	The will and ability of the individual to handle the technology over time	'The mechanics' of the functions in the VR system when individuals use them over time	Structural arrangements regarding type of VR systems used over time
Naturalistic conditions	The will and ability of the individual to deal with others over time	'The mechanics' when individuals socialize over time	Structural arrangements regarding everyday situations that are established over time
Experimental conditions	The will and ability of the individual to solve tasks over time	'The mechanics' when individuals mutually solve tasks over time	Structural arrangements regarding an experimental situation that goes on over time

Motivational processes:

- One motivational process I defined as ‘the will and ability of the individual to handle the technology over time’. Common to the different studies in this thesis is that they have been conducted in various types of VR systems in shared virtual environments. For users of each system, it has been necessary to handle technical possibilities and constraints that the system and shared virtual environment provide for social interaction over time. These technical aspects are present regardless of whether the study is experimental or naturalistic.

- Another motivational process I defined as ‘the will and ability of the individual to deal with others’. The individuals’ will and ability to deal with each other impact on their drive to continuously be with and interact with each other. I have observed this process in both the experimental and naturalistic studies in the thesis.

- Since the experimental studies were organized in relation to given tasks that subjects were asked to solve together, I created the category ‘the will and ability of the individual to solve tasks’.

Interactional processes

- One interactional process I defined as ‘the mechanics’ of the functions in the VR system when individuals use them over time. This refers to users’ way of exploiting different functions in different VR systems, seen as signaling and interpreting each other’s use of functions over time.

- Yet another interactional process I defined in relation to the studies as ‘the mechanics’ when individuals are socializing with each other over time, which was observed in the naturalistic studies in Active Worlds and Traveler.

- A third interactional process I defined as ‘the mechanics’ that are involved when individuals mutually solve given tasks, as in the experimental studies.

Structuring processes

- Three structuring processes were also identified in the studies. The first structuring process in the model is connected with technology and termed ‘structural arrangements regarding type of VR systems used over time’. Here the VR systems are considered as a structure that both enables and hinders social interaction in shared virtual environments over time.

- The second structuring process is connected with the social situation in which interactions occur. This specific structuring process is related to an everyday situation for users, since they spend time in environments accessible online independently of research efforts as in the networked IPT system. The online shared virtual environments, Active Worlds and Traveler, are used for socializing purposes in users’ everyday life. This is why the structuring process in question is termed ‘structural arrangements regarding everyday situations that are established over time’.

- In the third structuring process, defined as ‘structural arrangements regarding an experimental situation that goes on over time’, the experimental situations are considered in which subjects spend their time during the timeframe of the experiment. Since the experimental situations are prearranged in both content and time duration, I suggest that there is a clear difference between the experimental arrangements in this thesis and the arrangements structuring the naturalistic studies in the online shared virtual environments in Active Worlds and Traveler.

To summarize, above I have presented the categorization of the studies this thesis builds upon in relation to Turner’s process model of social interaction, showing the basic arguments for the categorizations. The technical dimension has actively been incorporated into the model in contrast to the original one, since the analysis of the studies showed how ‘the technical’ and ‘the social’ intertwine over time.

4.2 Analysis of observations in relation to Turner’s process model

By relating the observations to the model, an analytical tool was created in order to pin down courses of events when studying social interaction in shared virtual environments over time.

With the help of examples from the studies presented in the appended papers, I will show how I reached insights regarding how 'the technical' and' the social' became intertwined in the interaction processes, with support from, as well as elaboration of, Turner's process model of social interaction. The examples are presented in relation to each respective process previously presented. Despite these distinctions, it is important to keep in mind that the model is an analytical tool, and that the three processes mutually influence each other as well as being each other's prerequisites. The analysis begins with presenting motivational processes, followed by interactional processes and then structural processes. Finally the chapter ends with an analysis of the importance of time.

When comparing and contrasting the appended papers I observed that, independently of which VR system was used or whether the study was experimental or naturalistic, the way in which the technology was used became regarded as a social signal among users. The different functions in the various programs studied in this thesis were not exclusively connected with objective functions that put virtual objects in motion in the shared virtual environments. The way these functions were used was also connected with users' attention to and interpretations of this usage. I observed, and users also told me, that they used available functions in different ways. This was especially obvious in the observations presented in paper II where the observed couples, strangers as well as friends, worked differently during the trial days. Five of the six couples could spend the full trial day in the networked IPT system. The trial was stopped for one couple of friends due to severe nausea (paper III). One of the five remaining couples participated the full trial day in spite of their discontent with working together, one of them saying about his partner: 'I took an instant dislike to him since the very beginning' and the other saying 'he was just a point of reference'. This couple also had difficulties in finding a flow in their social interaction during the trial day. Additionally, they handled the technology differently – the person in Gothenburg had major obstacles in using the functions, whereas the person in London hardly had any difficulties at all (paper III). This difference caused irritation for the London person, but, interestingly enough, in the last task when both used the technology in similar ways they both made positive comments about their collaboration (paper II).

In the study when subjects exchanged places (paper IV) the difference in handling the technology was enabled as well as hindered by the VR system with an IPT connected to a desktop. Before subjects exchanged places, the person with the desktop was surprised about their partner being so skillful in using the system. After they had tried out both systems, such

assumptions regarding their partner's superior skills were not found in the interview material. The subjects said that by exchanging places and thus systems, their understanding of the possibilities and constraints of each system increased and they could use this new insight in a way that was positive for their collaboration. In order to reflect upon these and other observations I have benefited from Turner's model of social interaction.

4.2.1 Motivational processes

In this section I present observations interpreted as motivational processes, i.e. individuals' will and ability to drive the interaction further. In this case, three different aspects are considered, such as individuals' will and ability to handle the technology, deal with each other and solve given tasks. In spite of the presentation of focusing on one process at a time (motivational, interactional and structuring processes) I would like to emphasize that these processes are intertwined as well as being each other's prerequisites. Thus, observations interpreted as motivational processes include also interactional and structuring processes, even though motivational processes are highlighted in this section.

Regarding motivational processes, it was observed that the technology could be experienced as both supporting and constraining. In the naturalistic studies conducted in Traveler and Active Worlds, it became evident that the motivation to continuously use the VR system originated from users' appreciation of the technology as such, in addition to the created social atmosphere in the shared virtual environment. In relation to Turner's model, the long-term users of Traveler were seen as continuously motivated to spend time there and interact with each other, thus contributing to creating and recreating the social structure emerging in Traveler over the years. Similar processes were observed in Active Worlds. It is when people act and react in these worlds, interpret and reinterpret their actions, that motivation to continue or to stop the activities is fed – and when the motivation to continue is fed long enough, social structures are created that in turn influence both motivation and interaction. Since the VR system creates the foundation for social interaction in shared virtual environments (SVE) and users actively use available functions in the SVE, the technology as such becomes something that motivates people to continuously interact in the environment.

At the same moment as I say 'motivation', the structure that enables interaction in the first place, i.e. the VR system, becomes part of the motivational processes, just as the motivation

to use the technology over time creates social structures maintained by users' practice in the SVE. Additionally, the functions of the program become the mechanics in the social interaction for two reasons: one is the technical mechanics that are necessary to enable social interaction in the system at all, and the other is the social practice that has emerged by using the functions in a socially accepted way.

The forms of interaction studied in this thesis have addressed collaboration and socializing. In order to be successful in these forms of interaction it was observed that users needed to act in particular ways. In the experimental situations, one path for successful collaboration was to find a mutual way to interact. The couple that was unsuccessful in doing this serves as an illustration of the importance of mutuality in interactional processes (or symmetry: see Heldal et al. 2005). Interestingly enough, users did not need to use equal systems in order to create such mutuality (paper IV), indicating that technical differences do not necessarily imply inequalities in users' collaboration, for example. Additionally, as mentioned before, technical similarities do not necessarily imply equalities in collaborative situations. The couple that did not work well together enhances yet another interesting observation: the structure of the experimental situation can motivate continuing to participate in the experiment in spite of having problems in the other processes, as in this case: the will and ability to deal with one another were low, the competence in using the technology varied within the pair, and there was a lack of ability to mutually find strategies to overarch these competence differences (paper III).

4.2.2. Interactional processes

In this section I present observations interpreted as interactional processes, i.e. 'the mechanics' in social interaction in relation to how people signal and interpret their own behavior as well as the behavior of others. Three different aspects are considered: 'the mechanics' of the functions in the VR system when individuals use them over time, when individuals socialize over time, and when individuals mutually solve tasks over time. Even if observations are interpreted as interactional processes, they also contain motivational and structuring processes since these processes are intertwined.

When people interact face-to-face, they interpret each other's behavior as well as their own. In this specific situation, when social interaction occurs in shared virtual environment, yet another aspect is added, i.e. the technology. Since I have observed that the way the technology

was used became a signal for others to pay attention to and interpret, I suggest that the technology becomes integrated into the interaction process. The way the technology is used becomes a signal available for interpretation. The way the technology is used becomes socially important when users interact with each other. In shared virtual environments, there are no other signals available for interpretation than the visual representation of users, how virtual objects are handled, and the specific communication channel in the program – be it text or voice. Although we can see similar interaction processes in a shared virtual environment as in a face-to-face situation, this thesis shows that we need to pay specific attention to how the technology becomes integrated into the social interaction process.

Turner talks about a duality in the interactional processes when people interact with each other. He argues that it becomes equally important to study how individuals signal and interpret their own behavior as well as the behavior of others. Users of the different VR systems in this thesis show that they do interpret the behavior of others as well as their own. For example, when users saw that their partner did something in the shared virtual environment which they considered hard to do, they believed that the partner had superior skills compared to their own, rather than thinking that the difference might depend upon their having used different systems (they were not aware of this in the first part of the trial before they exchanged places). Users seemed prone to believe that their partner used the same system as themselves, as expressed by one of the subjects: 'I thought it was superman that I met, who could do exactly as he pleased with his keyboard', when his partner in fact used the IPT system with a joystick as a manipulation device (paper III; see also Schroeder et al. 2001). Another example comes from the long-term users in Traveler. They described how they used the program's collision detection differently depending on whether they 'bumped into' an avatar belonging to a user they already knew or not. This possibility of 'bumping into' another avatar was not possible in the other shared virtual environments studied in this thesis, since they lacked collision detection and thus allowed users to go through each other's avatars. In Traveler, for the experienced users this way of using collision detection was associated with play and humor, given that they knew each other since previously. Acting in the same way with newcomers in Traveler was considered as rude and unwanted behavior. The difference was explained accordingly: 'you would not throw a snowball at a complete stranger and you don't want them to throw one at you, but it is okay to throw one at your best friend' (paper VI).

My interpretation of this is that each VR system's specific design is important for what people can and will use as a basis for their interpretations of what is happening in the interaction process. Again we can see how the different processes that Turner emphasizes, here used as analytical tools, lift the observations from an empirical level to a broader understanding of these observations.

4.2.3 Structuring processes

In this section, observations interpreted as structuring processes are presented. Structuring processes were defined as structural arrangements repeated and organized over time. Structuring processes considered here are related to the studied technology, everyday situations and experimental situations. While this section focuses on structuring processes, it is important to keep in mind that the three different processes, motivational, interactional and structuring, are intertwined and can only be separated analytically.

Spending many hours in Active Worlds, my first encounter with shared virtual environments, I observed differences in users' way to move around in the environment (paper V). Beginners seemed to move around mainly by using the preprogrammed functions to set their avatar in motion – for example by dancing, waving and kicking – whereas more experienced users tended to move around less. Likewise, it was observed that users needed to learn how to express themselves in the text in order to become involved in the ongoing social interaction. Consequently, even if the functions to set avatars in motion were the same for all, different users used them differently. Even if the communication channel was the same for all, users needed to learn how to express themselves in relation to the expected style. And by doing this, they seemed to signal to a wider audience what kind of user they were, beginner or experienced. This interpretation can be disputed since it is hardly based on the method, in this case participant observation. But in combination with what the experienced users in Traveler said in the focus group interview, namely that beginners and experienced users used the technology differently, and that they, as experienced users, put a lot of effort into teaching beginners how to use the technology to blend into the social milieu, I consider the interpretation valid.

Observations from the naturalistic studies (papers V and VI) showed that repeated use of functions in similar ways created the foundations for social conventions followed by users (see Becker and Mark 2002 for similar observations). To use the functions in a repeated

manner shows a similar type of behavior Turner describes as structuring processes in this model. In his reasoning he speaks about social structures people create when they are motivated to participate in interactional processes in face-to-face situations, as well as being motivated by an established structure to continuously support that structure. In this thesis, the incorporation of technology into these processes becomes crucial. In Active Worlds as well as in Traveler, repeated behavior is seen as an ongoing structuring process at the same time as there are established structures with which users act in accordance.

When the long-term users in Traveler shared their story about how they became regular users over time, ranging from two to ten years, it became evident in the focus group interview that the technology played an important role for their positive experience of social interaction in the voice-based shared virtual environment. Conclusions drawn from the study suggest that it is of paramount importance for users to have the ability to use the functions in the program in order to function socially in the environment. Since it was observed in the naturalistic studies that shared practices have evolved, such observations have commonalities with what Wenger refers to as a community of practice (Wenger 1998). In Active Worlds as well as in Traveler, both of which have been available on Internet for ten years and still are, social interaction occurs that has similarities with the framework of communities of practice, i.e. a place where people act in a common way and experience meaning in the way they act (Wenger 1998).
These observations are in contrast to the experimental studies where subjects did not have a pre-established social structure in the shared virtual environment to become familiar with when the experiment started. In the experimental situations, the subjects had no prior experience or expectations about how to act in the shared virtual environment, and they had only each other as trial partners to interact with. One observation interpreted as an initial social practice was that pairs who got along well in the trials said both ‘hi’ and ‘goodbye’ when they went in and out of the IPT during the trial day. The pair that did not get along did not do this (paper II). However, the subjects in the trials had no other people around them either to ask or to observe how they were doing in order to mimic their behavior. The subjects in the experiment were in a situation in which they had to create the social interaction without support from pre-established social practice, as in the naturalistic studies.

Above I have provided examples that show how people learn to use the technology and respond to each other’s actions and their avatars inside the various shared virtual environments, creating common ways of using technical constraints as possibilities over time.

The reasoning above concerning the different processes enhances the importance of a multifacetted analysis. To become a skillful user of the technology, having the will and ability to interact with another person, the fact that the functions have special designs, and that the situation has a structure experienced as meaningful, are important aspects but none of them is the sole consideration. Taking them all into consideration, I suggest that the analysis supports the view that neither the person, the situation nor the technology can independently explain social interaction in VR systems. However, they are important when combined if our aim is to increase the understanding of social interaction in shared virtual environments over time.

4.3 The importance of time in social interaction in shared virtual environments

Based on the studies underlying this thesis, the time aspect is central in relation to what can be called the gradual acquisition of social and technical competence in shared virtual environments. Using the VR system in a socially accepted way is not something you immediately know how to do. It is not a competence users learn at the same time as they enter the shared virtual environment. For example, in the networked IPT study, subjects seemed not always aware of what kind of signals they sent out to their partner when they collaborated. Both during the trial and in the debriefing interviews, they commented more on their partners' behavior than on their own. In contrast to this experiment, the long-term users in Traveler (paper VI) expressed that they were highly aware of what kind of signals they wanted to send out to other users, as well as being aware of how to do this. For example, they all had the word 'tech' in their avatar name, which signaled that they had a special role in the program (to be a tech means that one is knowledgeable about the program and willing to help others to learn how to use it). They also had the same avatar each time they spent time in Traveler, so as to clearly signal to others about their presence, and by using the same avatar they facilitated for others to identify them.

A conclusion from this is that *the way* in which functions are used, such as manipulation and navigation possibilities or choosing how to represent oneself visually, contains symbolic value that becomes socially important. People's interpretations of how other people are using functions become something to address and handle even socially and not only technically.

A possible inference regarding why the technology becomes intertwined with the social interaction process is accordingly as follows. Since the arena for social interaction in shared virtual environments is graphical, this feature – both how it looks and how it is put into motion in combination with the used communication channel, whether text or voice – becomes the only source of signals available for interpretation. Even if the technology transmits reduced social cues compared to face-to-face interaction, it is inside the shared virtual environment that social interaction occurs, and people are confronted with these signals and no others. And, as Turner says, it is the interaction process – what people *do* – that are the mechanics of social interaction.

The development of social practice, in this case using the technology in a socially accepted way, has proven to be central for social interaction in shared virtual environments. Bourdieu's claim in relation to practice in everyday life that ''practice unfolds in time'' indicates that it is not an instant process. The process needs to be supported and carried further. I suggest that in shared virtual environments it is when users use the technology that these mechanics are set in motion. Thus, when users successfully cope with distractions coming from other users, the task at hand and handling the technology, then there is a chance that the interaction process eventually creates supporting structures for social practice. When people act in a socially accepted way they act in accordance with social practice. In shared virtual environments, social practice is connected with the functions in the program. Using the functions in a socially accepted way becomes eventually natural (if users are motivated to continuously use the technology), as expressed by one of the participants in the focus group in Traveler: "the controls here become second nature – we don't think about it, we already know what we are doing''.

These quotations (from paper VI) illustrate how the use of functions in the program, activated by specific key commands, have become incorporated activities and actions in their behavioral repertoire. When the usage is experienced as 'second nature' the technology as such, in relation to how functions should be used, is in line with others' expectations and no longer a distraction (paper III). For the long-term users in Traveler (paper V), the use of the technology is seen as a fundamental driving force to be engaged in, throughout the ongoing social interaction during all these years. In experimental situations, as shown in paper I, when users interact in immersive systems with a tracking system they are less distracted by the technology in comparison with desktop VR, and their social interaction becomes more fluent,

depending on how the immersive system is constructed and how it works. But it is not so simple that immersive systems automatically lead to more fluent interaction, since it was shown in paper IV that experiencing both desktop and IPT made the users aware of possibilities and constraints in each system, and they could actively make use of these differences when they collaborated in order to solve a given task together, while the long-term users in Traveler also emphasize that the ordinary desktop VR certainly supports fluent social interaction as well.

When social interaction occurs in various types of VR system, users need to deal with possibilities and constraints posed by the VR system at hand, as well as possibilities and constraints among the people involved. The phenomenon of social interaction in a shared virtual environment contains a range of different challenges that users need to handle in order to reach each other in a successful way over time. It is obviously not enough to provide technical possibilities for social interaction via VR systems in shared virtual environments. The dynamics of social interaction between people become equally important. In particular, it becomes important to address the time dimension when social interaction in shared virtual environments is described and analyzed. Even though I have separated the different parts in Turner's model, this is only possible for analytical purposes. In practice they are intertwined. But in spite of the difficulty to separate motivational, interactional, and structuring processes, if we think about this across the time dimension, it becomes clear that motivations lead to interactions which are structured by a particular setting as well as social practice which, in turn, structures the motivations, and so on in an ongoing spiral incorporating the technology in all three processes. The role of time is that this process takes place continuously and can be shown to occur within time scales in both experimental and naturalistic settings, as has been described in this chapter.

5. Conclusions

In this chapter the thesis' main conclusion is presented: that technical and social aspects can only be separated analytically since in practice they are highly intertwined, in a process manner that emerges over time. In order to describe this phenomenon I suggest the theoretical concept of *connected practice*, defined as the dynamics of social interaction in technical systems. I also argue for the importance of studying the phenomenon as a process rather than as a snapshot. These are regarded as the theoretical and methodological contributions, respectively, of the thesis. Finally, as a guide to further research, I discuss the general applicability of the suggested theoretical concept when studying social interaction in other technical systems apart from shared virtual environments.

5.1 Connected practice

In this section the theoretical contribution of the thesis is presented. As an introduction I present my view on why it is possible to use theories about social interaction developed in face-to-face situations in studies of social interaction in technical systems. Then follows a presentation of the concept of *connected practice*.

My argument is that we can use insights from theories developed in non-mediated situations as analytical tools or sources of inspiration even in situations when people interact in mediated situations, but, as mentioned several times before throughout this cover paper, it is important to keep in mind that the social interaction situation occurs in a technical system and to implement a technical dimension into the theoretical tool. The basic logic is that if social interaction in technical systems were exactly the same as social interaction in face-to-face situations, then it would possible to use theoretical tools for face-to-face situations without any theoretical adjustment to the technical situation. Conversely, if social interaction in technical systems were totally different from face-to-face interaction, then it would be impossible to use social interaction theories developed in face-to-face situations.

My contribution to a 'both/and' view of social interaction in shared virtual environments has been nurtured by a range of sources. Inspired by Bourdieu's view of practice (1977, 1990, 1998) in combination with a focus on the technology as such, and Walther's view on the role of time for people to adapt to the technical situation in mediated situations when they interact with each other (Walther 2002), the following conclusion is drawn. In order for shared virtual

environments as a technology to be appreciated and used over time, it is important that numerous aspects are matched with each other. In this thesis it has been shown that the technology needs to match users' preferences with respect to how the graphics look and what users need to do in order to set the graphics in motion, what kind of communication channels are available (text or voice), what people talk about when they interact with each other, and the experience of the created and recreated social milieu in the shared virtual environment. This dynamic shares similarities with Turner's model of social interaction (1988, 2002). But in contrast with Turner, this thesis explicitly addresses the technology. Here it has been shown that the way the technology is used becomes a crucial part of the development of practice, i.e. the way people are dealing with each other over time, independently of whether the main aim is to socialize with each other (as in Active Worlds and Traveler) or to collaborate towards a given goal as in the experimental studies.

The users in the different studies were connected via a technical system. In addition, they were connected with each other in a human relationship created over time through the different practice developed in the social interaction among the users. In order to capture this both/and connection, i.e. being connected via a technical system as well as being connected to each other in a human relation when developing practice over time in dealing with each other, I suggest the concept of *connected practice*, defined as the dynamics of social interaction in technical systems.

The word 'connected' is used in order to direct attention towards the fact that people are connected both via a technical system and in a relationship with each other. The concept of practice is borrowed from Bourdieu in the sense that it addresses people's way of acting consciously as well as unconsciously. To add an unconscious way of acting is important in relation to Turner, who speaks of conscious processes when people are signaling and interpreting others' behavior as well as their own, as previously described in the analytical framework chapter. To incorporate unconscious behavior is necessary since I have examples from the studies in which users have been unaware of what kind of signals they sent out to other users of the VR system.

In the concept of practice there is a time dimension involved. Bourdieu emphasized that 'practice unfolds in time', which is important in this context. When people interact with each other it concerns actions over time. Social interaction captured as snapshots misses the dynamic that goes on in the interactional processes, something that also Horton, Davenport,

and Wood Harper (2004) previously have pointed out as a problem. In order to avoid that problem of presenting snapshots of processes, I would like to direct the analytical eye towards a process view with the help of the concept of practice.

By combining the word 'connected' with the word 'practice', two important aspects are enhanced regarding social interaction in shared virtual environments. With the word 'connected' it is stressed that humans are connected via technology as well as in a relationship with each other. The word 'practice' makes clear that the way people are dealing with each other is something that has evolved over time. When Bourdieu refers to practice he speaks about how individuals are acting in cultural face-to-face contexts and how these ways of acting become incorporated into individuals over time. In such circumstances the analytical eye is oriented towards the individual. When I talk about *connected practice* I refer to the dynamics of social interaction in technical systems. The concept directs the analytical eye towards *relations* among people when they are dealing with each other in technical systems over time.

Connected practice is also distinct from the adjacent concept of communities of practice. Communities of practice focus on how people in larger constellations create common ways to act (Wenger 1998). In this thesis there are also examples from situations where only two people have been connected with each other over a long period of time in order to collaboratively solve given tasks in experimental situations. In some of these cases the individuals in the pairs had not met before, so they needed to develop ways to act during the time they spent together that worked socially for them. In such cases when established common ways to act are lacking, it is not relevant to talk about a community of practice, whereas it becomes relevant to talk about *connected practice*. The concept is applicable also in situations when a 'community' is hard to define but people still are interacting with each other in a technical system, such as the pairs participating in the experimental studies in this thesis. Hence, the advantage with the concept of *connected practice* in comparison with the community of practice approach is that it is more generally useful since it can be utilized even in situations when established social practice are not yet created. I will later come back to the discussion regarding a more general applicability of the suggested concept in section 5.3, *Further directions*.

The observations in this thesis lead to the conclusion that the use of the technology becomes a gradually incorporated practice. It was observed that social interaction as a process in a shared

virtual environment is fully intertwined with the technology used. The technology is not put into the background in the ongoing social interaction or made 'invisible'. On the contrary, it becomes an important and evident part of social interaction in shared virtual environments. Even if the technology filters out social signals that we are used to in face-to-face situations (Culnan and Marcus 1987), I suggest that this thesis shows that new social signals are 'filtered in' through the way the technology is used by people. Over time, such signals become important to learn, for example turning the avatar upside down when one is away from the keyboard as well as only 'bumping into' avatars belonging to people with whom one has an established relationship (paper VI), or that people point with their tracked hand instead of the non-tracked hand, or inform their partner that they are pointing with the wrong hand in order to inform the partner of what is happening at their side of the VR system (paper I). If people do not adapt to this way of using the technology, and conversely if people do not develop common ways to use the technology in their social interaction, then it will be almost impossible to deal with each other in the technical system. It goes both ways! If we have already decided beforehand that 'the technical' affects 'the social' or the other way around, we run the risk of not being able to see the fine-grained mechanisms in how social and technical aspects influence each other over time, and what social consequences this specific pattern might lead to.

The key message of the intertwined perspective is that we need to look at the social situation for which the technology was meant as well as the specific technology and how it is used. It is not only the technology that is responsible for fluent or fragmented interaction. Nor can the social situation alone explain what happens. The way forward to increased understanding is to direct the research focus where the social and the technical meet over time. I suggest that we can see a simultaneous process of adaptation to both social and technical aspects as the mechanics that drive social interaction further. Over time, people adapt to the possibilities and constraints of the technology at the same time as they create ways to take advantages of these possibilities and constraints for ongoing social interaction. We can see the concept of *connected practice* as the word in the middle of the sorting tool I asked for earlier when adding a time dimension.

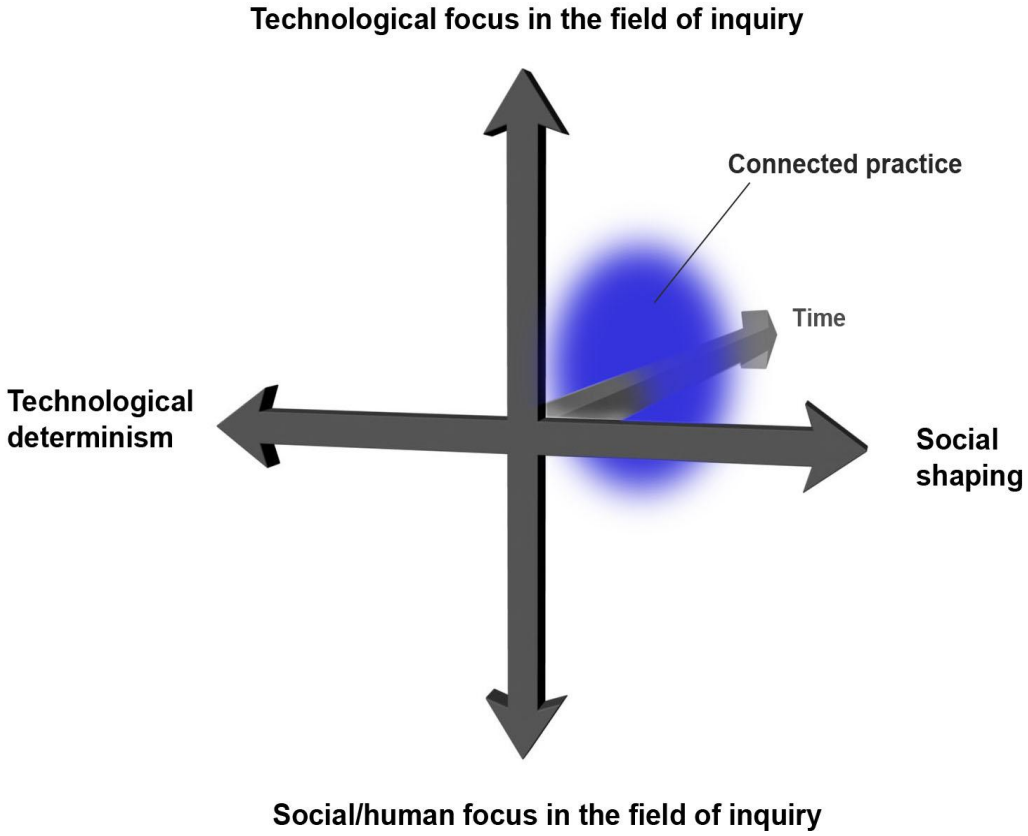

Fig.8. Connected practice in the sorting tool

With the help of the concept of *connected practice* our thoughts and analytical eye are directed towards situations when two or more people are dealing with each other in technical systems. The thesis has given examples of technology that is highly visible and highly evident for the users, which is a point in itself. It is thus not always desirable for users that the technology should 'disappear' or be in the background. There are situations when the technology and how it clearly looks and functions become crucial for people who interact with each other with the help of a VR system. For example, in the study when people exchanged VR systems with each other halfway through the trial, we could see how the technical differences were used to solve the problem in a more efficient manner (paper IV). In another study the long-term users of Traveler talked about how important the design of the program was for them (paper VI). In spite of the fact that in 2005, when the study was conducted, there were numerous sites online with considerably more sophisticated graphics, more stable functionalities and substantially more users, they were still faithful to Traveler. Some of them even expressed that they sometimes went to other environments online, but

always returned since they really appreciated the technology and the social milieu they had created over the years. This little faithful group of users stands as an illustration that – in spite of what I call flock behavior online, in which many users are drawn to places where many users are – there are individuals acting differently, driven by the wish to find their preferred technology and social equals. In this thesis it is pointed out that the technology needs to match the preferences of the users concerning how the graphics look, what they need to do to set the graphics in motion, what kind of communication channels are used (text or voice in this case), what users talk about when interacting, and the experience of the created and recreated social milieu in the shared virtual environment in order for users to regard the VR system as relevant to use over time.

The thesis thereby deviates from technological-deterministic media theories stressing the impact of technology on social relationships, such as the social presence theory of Short, William and Christie (1976), and the media richness theory of Daft and Lengel (1986). The thesis also deviates from perspectives holding that social conditions shape the technology. In this thesis, the main argument is driven by a both/and view and is to be positioned closer to studies in which conclusions concerning social interaction in technical systems are characterized by such a view more or less explicitly (for example Pargman 2000; Pargman and Jacobsson 2007; Svenningsson 2001; Svenningsson-Elm 2007; Cherny 1999; Baym 2000; Sonnenwald 2006; Axelsson 2004; Heldal 2004; Walther 2002). *Connected practice*, here investigated in shared virtual environments, is important to learn more about. We see increasing use of VR systems in our everyday life in mediated situations. It is important to learn more about this phenomenon since ever more people spend ever more time in such environments and seem to prefer to do so together with others in order to fulfill different needs, especially social ones.

Croon Fors (2006) suggests in her thesis that life *with* technology becomes a part of our lifeworld, in which the technology is not seen as an object but rather as a relation to our everyday life. She investigates in what way information technology becomes important in how we live our lives, arguing that the technology as such influences our relationship to technology but also the relation to our everyday life. Croon Fors regards the technology as containing a potential for change that can spill over from being a product with functions to become a way for people to relate to their lives (Croon Fors 2006). Apart from looking at life *with* technology, it can be added that life *in* technology also becomes a part of our lifeworld, in which the technology becomes not only a relation to our everyday life but additionally

becomes a part of our relations to each other. In spite of the high level of complexity (see Janlert and Stolterman 2008 regarding interaction complexity), I would again like to emphasize that it is important to analyze how 'the technical' and 'the social' are related, and not settle for an either/or approach. Additionally, it is important to accompany the process over time in order to reach a better understanding of the phenomenon of social interaction in shared virtual environments. This means paying attention to the intertwined relationship between social and technical aspects over time, since the thesis has shown that VR technology is not only a tool for social interaction – it is a key feature *in* social interaction over time.

5.2 Capturing processes

Conducting studies with an 'over time' perspective is the methodological contribution of this thesis. To study social interaction in shared virtual environments over time is still unusual (not surprisingly, since it is hard to do). Here I have made an effort to let the organization of the four studies based on the view of social interaction as a process be matched with different methods that can be used when the ambition is to follow and describe courses of events over time, as described in detail in the method chapter. The temporal dimension has been defined in the experimental studies in relation to previous research exposure times, while in the naturalistic studies it referred to users' time in the environments related to activities as well as their experiences as processes.

The thesis problematizes results from short exposure times in experimental research, as well as static views on social interaction in technical systems. The main criticism is that short exposure times, as well as single measurements in an experiment, capture moments that run the risk of supporting a false hypothesis or rejecting a true explanation. One might be unlucky and capture a snapshot of a process that does not reflect the dynamics going on over time, thus leading to wrong conclusions simply because of the short-term design of the experiment. Thus, it is stressed in this thesis that future research should adopt a process view. In experimental research this means, if not longer exposure times for subjects, then repeated measurements within the experiment in order to capture eventual tendencies for change that only become clear over time. Still, it is not necessarily the case that the first measurements are wrong, but neither that they are right. This needs to be investigated. Therefore, making repeated measurements can also be seen as a method of validating the original observations (Kerlinger 1986).

In naturalistic studies I argue that we should make the effort to follow processes when people interact with each other over time, in order to present more process-oriented descriptions rather than snapshot views of these processes. If not, there is a risk that social interaction in technical system is considered as a static phenomenon, in which either the technology does not matter at all – regarding social interaction as the same wherever it happens – or else the technology fundamentally revolutionizes interaction patterns among people. To capture processes rather than collecting snapshot pictures enhances the both/and view where the technology is seen as 'filtering out' social cues we are familiar with in face-to-face situations, and at the same time as 'filtering in' new social cues that we incorporate when dealing with each other. In that regard, 'the technical' and 'the social' intertwine over time.

5.3 Further directions

In this section the concept of *connected practice* is discussed in relation to possibilities to use it when social interaction occurs in other technical systems than shared virtual environments, which were studied in this thesis.

The intertwined relationship between the social and the technical was captured in this thesis by the concept of *connected practice*, defined as the dynamics of social interaction in technical systems. Further research investigating social interaction in shared virtual environments should actively incorporate technical and social aspects to support increased understanding of the phenomenon. Perspectives that do not actively use the both/and view run the risk of presenting the phenomenon as if the technology is merely a tool for social interaction that does not influence the situations – as if the technology does not contain an important social aspect, which was shown in this thesis. On the other hand it is also important not to be misled into believing that, by adding more technical functions and more sophisticated technology, the technology as such creates smooth social interaction. The relationship is not as simple as that, according to this thesis. A meeting between 'the technical' and 'the social' takes time and involves matching processes between social and technical aspects. In practice it means giving people a chance to develop common practice to be able to realize the aim of the technology, i.e. connecting people over geographical distances and at the same time experiencing interpersonal contacts in order to accomplish something together – be it to socialize or to collaborate to reach a defined goal.

Although this thesis has focused upon shared virtual environments, I suggest that the concept of *connected practice* can be utilized in other types of technical systems. It should be possible to study the dynamics that emerge, for example, in collaborative and mediated situations independently of whether the technology is place-bound, such as video conferencing, different types of text-based programs, or teleconferences. I can also see possibilities in mobile situations when social interaction over time occurs in wireless systems. However, the social interaction that goes on does not need to be connected with collaboration (as in papers I,II, III and IV). It may also be connected with relations among friends using different systems to keep in touch with each other, or it might concern new relations that emerge within different systems, and not only in the shared virtual environments studied in this thesis (as in papers V and VI).

What delimits the use of the concept of *connected practice* is that the study should focus on social interaction in technical systems of any kind with special reference to the dynamics happening when people are dealing with each other in such systems. Future studies guided by a *connected practice* approach need to deal with how 'the technical' and 'the social' are related, in what way the dynamics emerge and sustain them as well as the consequences of such dynamics. In cases where interest is directed towards following and describing processes in order to explain what goes on between people and what they accomplish together in technical systems, I suggest that the concept of *connected practice* is both useful and enriching for such process-oriented analysis.

At the same time as I promote the process-oriented perspective both in relation to study designs and in the analysis of collected observations, I do not pretend that it is an easy task. In this thesis various methods have been used such as participant observation, repeated exposures in experimental situations in combination with rather long exposure times compared to previous research, and a focus group interview with long-term users of a shared virtual environment. One possible method not used in this thesis is to use technical possibilities to document users' virtual activities via the system. Future research should thus on the one hand have an 'over time' perspective in order to present process-based analysis of social interaction rather than framed snapshots. On the other hand, it should develop new methods that can capture such processes and combine them with a clarification of social issues related to technical possibilities.

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APPENDIX

The following is a complete list of work which I have been to varying degrees, involved in.

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Learning to be social: Establishing and maintaining relationships in shared virtual environments

Maria Spante

Abstract

The increasing use of chat rooms available through the Internet has attracted many studies about how social and technical aspects are related to each other in these forums. This paper examines what people needed to learn and adapt to in order to establish and maintain virtual relationships inside Active Worlds, a 3D graphical virtual environment on the Internet. Ethnographic observation showed that people created "togetherness" in their interaction with each other through processes of adaptation to both technical and social conditions. In comparison with text-based social interaction, people in this 3D graphical environment needed to learn *how* to use text-based language as well as *how* to use the functions in the software that supported movements and emotions expressed by their graphical representation inside Active Worlds. The paper concludes that this process of adaptation was essential for becoming a social person in Active Worlds. Thus when people are establishing and maintaining relationships in the 3D graphical virtual environment, Active Worlds, technical and social aspects are intertwined.

1. Introduction

Today the Internet is increasingly used in order to connect with others. While previous research has demonstrated that people use e-mail mainly for connecting with people they already know (Haythornthwaite and Wellman 2002), it is becoming more common for people to use chat rooms for connecting with those whom they do not know (Haythornthwaite 2001), in particular to find friends and obtain social support (Ridings and Gefen 2004). Whereas the telephone did not markedly change the social network for people using it (Fischer 1992), the Internet is also used for interconnecting strangers who initiate social relationships *inside* the virtual world. Granted, it is not a novelty to have distant relationships. People have corresponded, and even today have pen pals, without necessarily meeting each other face-to-face. However, by contrast to this asynchronous communication, people connect in real-time interaction in chat rooms.

In early research in the area of social interaction in mediated situations, Short, Williams and Christie (1976) argued that the characteristics of the medium itself had an impact on the content of the messages that people exchanged. The fewer social cues a medium could transmit, the "colder" the relationships would be. This viewpoint was termed the "cues-filtered-out" perspective (Culnan and Markus 1987). Predicting the types of relationships based on media characteristics was not consistent, however, since some studies showed that warm social ties and social emotional content were possible in text-based computer-mediated communication (Culnan and Markus 1987; Rice and Love 1987; Lea and Spears 1995; Walther 1996; Farnham 2002). This was particularly true when people were studied over longer periods of interaction with each other, having had time to create relationships in computer-mediated communication (Walther 1996). In later work Walther concludes that 'When time is plentiful, people adapt to their systems and each other' (Walther 2002:251). Walther's work thus shows the importance of adaptation, both to the technology that is used and to social processes such as becoming a member of a group. His work also clearly shows that adaptation is a process that requires substantial time. Competence acquisition related to technical as well as social aspects is crucial for well-functioning social interaction in computer-mediated communication. However, most research focusing on computer-mediated communication has focused on the gradual acquisition of such competences in text-based interaction, and therefore been oriented towards linguistic analysis and language practices (Jankowski 2002; Baym 2000). But today people can also communicate and interact in 3D graphical environments. Since 3D graphical environments have features different from text-based communication, we need to address how social interaction occurs in them. The most obvious media difference between text and graphics is between words and pictures.

Looking more closely at the characteristics of text-based computer-mediated communication, 'everything' happens *in* the conversation (Farnham 2002). Despite the well-documented practice among users of overcoming the filtering-out of socio-emotional cues, by transferring socio-emotional content through the words that users type and the use of emoticons such as smilies, there are no cues to be seen if a person does not type anything. Put differently, there is nothing to interpret if no text is produced. By contrast, in a 3D graphical world, the very presence of the user in the environment is 'pictorial'. As soon as users log into the world, their graphical representations – or avatars as they are called (Damer 1998) – represent them visually. The mere appearance of an avatar gives cues that can be used as a basis for interpreting the person's representation of him/herself (Taylor 2002). Even if others cannot see the person in front of the computer, they will see the name and the symbolic representation of the user as an avatar and make instant judgments based on that information.

Previous research about text-based interaction has shown that patterns of activity, such as the rate of postings and the duration and frequency of one's presence in a newsgroup, have an impact on the establishment of friendships as well as the evolution of the community (Parks and Floyd 1996; Baym 2000). If posting decreased and people spent ever less time in the community, it eventually died out due to lack of interaction (Svenningsson 2001). Thus it has been shown that people need to be actively involved in the conversation to be able to form relationships; i.e. the practices that people are involved with, to create social relations, are connected with ongoing social interaction via text. Still, due to the features of text-based computer-mediated communication, the practices are tied to the production and interpretation of text. But what type of practices do people have to be involved with in order to become social beings in 3D graphical environments? In what way are the 3D graphical features used to establish and maintain relationships?

The purpose of this paper is to study what practices people need to learn about, become involved with, and adapt to over time in order to become social persons inside Active Worlds, a 3D graphical environment that first started in 1996 and is available online http://www.activeworlds.com/help/aw36/move.html. Ethnographic observations were made in Active Worlds, focusing on how people used the technology when they interacted with each other.

1.2 Theoretical point of departure

Becoming a member of a social formation includes a learning process that is both supported and constrained by the context in which the social formation can be found (see for example Turner 1988). Important to note here is that the learning process does not exclusively include cognition. That is to say, becoming a member of a social formation does not only include an understanding about what to do. It also involves acting in line with the expectations that the other members have in common. Becker and Mark (2002), while comparing and contrasting three different online communities, two of them being 3D graphical environments and the third a text-based community, showed that 'social conventions play an important role in the development of a specific code of behaviour and language which creates social coherence within these environments. People who are coming to these virtual spaces for the first time have to become aware of these conventions and also to follow them to be accepted by the others' (Becker and Mark 2002:36) Here they highlight the importance of recognizing the general necessity of becoming a member of a social formation and how that is linked to an understanding of how to act in accordance with other users' expectations. However, in their study they emphasize the need to learn about these expectations without showing the learning process involved.

These expectations have evolved over time in the process of interaction among users, thus creating an activity system to which users need to adapt. The way people express themselves, and how well they contribute to the shared experience of being a group with a common interest via the text they produce and the feedback they provide to other members of the community, are part of the practices involved in the establishment and maintenance of social relations online (Baym 2000). Practice theories stress the role of action, i.e. what people do, what activities they are involved in, and what they do when they interact with each other in face-to-face situations to learn about how practices influence social formations, as well as becoming influenced by cultural systems (Wenger 1998, Bourdieu 1990). People in naturalistic groups that often endure over long periods of time, even years, develop practices for both entries and exits of individuals regarding how members become socialized into the group (Levine and Morland 1994). Since 3D graphical environments provide not only an empirical ground for investigating language practice but also embodied interaction (Taylor 2002), practice theories are a well-suited theoretical perspective to enhance our understanding of the role of 3D graphical environments in the establishment and maintenance of social relations online.

2. Method

In a 3D graphical environment it is possible to observe how people use the functions of the software for movements, and to follow public conversations in the text-based communication. The approach in this paper was participant observation. This choice was based on the assumption that, in investigating social interaction within a limited domain, the observer can perceive the actions involved with as much realism as possible (Sillars 1991). One limitation of participant observation is that it does not give access to the subject's feelings and thoughts, but only to their visible outcome in behaviour. However, since the research questions address what people do when they establish relationships, and not why, observation was a useful tool.

2.1 The observed environment

The shared virtual environment Active Worlds was chosen since it has been available on the Internet and used steadily for more than eight years. During that time, this virtual environment has provided a virtual *social* environment for many users. Active Worlds falls into the definition of a virtual environment as "a computer-generated display that allows or compels the user (or users) to have a feeling of being present in an environment rather than the one they are actually in and to interact with that environment" (Schroeder 1996). A more in-depth description of Active Worlds will be presented in later sections, since the structure of the environment and how it was used are tightly coupled to what people needed to learn and what they adapted to when becoming social beings, as will be demonstrated subsequently.

2.2 Observations in Active Worlds

Field knowledge about Active Worlds was obtained by spending time with the technology, learning how to use it and interacting with other users inside Active Worlds. Starting with no previous knowledge about Active Worlds, the author spent around 150 hours, mostly around 6 am and 7 am GMT from April until September 2001, on random days doing participant observation. The time of observation was chosen since many users would be logged in during that period and it was possible for the author to be present in Active Worlds by that time of the day. The longest session was 6 hours and the shortest 20minutes, but the typical session was 1 hour. The observations were open, focusing on how people interacted with each other and the environment. The author was engaged in conversations with people as well as moving around in different places in Active Worlds. The observations were written down in a diary during and after visits in Active Worlds. The focus of the observations was on how people talked and when they used the various functions in the software, how they presented themselves, how they moved around in the environment with their graphical representation, and how they expressed their feelings. In addition, using one technical function in Active Worlds called chat-log made it possible to log

chats, and a few of these logs will later serve as examples of observed issues. Observations were also made in May and June 2003 during random days and times, mostly around 6 am and 7 am GMT, to be consistent with the timeslots of the observations that were conducted. These later observations were typically 30 minutes long, adding another 10 hours to the total observation time. The reason for returning to Active Worlds was to see whether the main observations were still valid after some time had passed, and try to make a critical evaluation of the previous observations to enhance validity.

2.3 Ethical considerations

Ethnography inevitably raises ethical considerations, particularly when observations are the main method of gathering data about the phenomena under investigation. The concerns about participants' privacy call for well-grounded arguments in relation to how the study is conducted. The main argument for covert participant observation was that the study did not focus on individuals as such. Rather, the phenomena under investigation were the users' behaviours inside the 3D graphical environment. Therefore no individuals would be exposed in the presentation of observations made, nor could they be traced after the study was done. The focus was strictly on practices and observed patterns of interaction over the course of time. However, it is important to note that even if the outside observer initially defines the shared virtual environment as a public place, it is not necessarily the case that users share that view (see Cherny 297-315: Svenningsson 2001). To protect users from being exposed, quotations that are presented in the paper have been anonymized.

3. Results

The structure of this section is as follows. First a description of Active Worlds will be presented, followed by a presentation of how people move in the environment and how they use pre-programmed body language. Secondly, observations regarding how people use text-based language will be presented, followed by a presentation of different relations that could be observed. Finally, comments will be made regarding how people use different channels when communicating with each other as well as what kinds of strategies people use to cut off others they do not want to interact with.

3.1 Entering Active Worlds

Active Worlds (AW) is available online and delivers real-time interactive 3D content over the web. In this environment people can chat with others, explore different places, build their own objects, pursue education, shop and become members of groups with varied interests. The environment became public in 1996, is owned by Active World Inc. and was still running in 2003, which means that it has been

available online for eight years and used by thousands of users from different parts of the world. Although the number of users that are logged into Active Worlds varies during a 24-hour period (Szczepanska 1999), in general one could find between 300 and 750 users logged on at the same time during ‘peak’ periods, and 30-100 during low periods Monday to Friday. Judging from the observable cues based on the gender look of the avatars, there was a mix of males and females in Active Worlds and the range of the users’ ages seemed to be from approximately 12 to 50 years old. Geographical origin was mixed, depending on the time at which observations were made. Users who explicitly told others where they were from came mainly from the USA, but also from Australia, Spain, France, Norway, Sweden, Finland and Russia. However, age and gender distribution as well as geographical origin are hard to provide exact data about, since the collection of data came from observations in Active Worlds. Still, this rough description provides some flavour concerning the user variation that could be found in Active Worlds.

Inside AW, social events take place and have done so over the years – such as festivals, specific exhibitions of created objects, and playing games such as bingo or role-playing games. There are also social gatherings offline: reunions are held, usually in the USA, where the company is located. Reunions are organized face-to-face get-together events where users in AW arrange seminars, dinners and parties for those who attend.

When entering AW, people could log in as tourists or become citizens. Being a tourist meant having free access to the software, but restricted possibilities for engaging in activities. A citizenship, with its broader opportunities of what to do, where to go and how to look, could be bought for a yearly fee of 19.95 USD in 2001 and 6.95 USD per month in 2003.

Picture 1. Entering the Gate (taken August 2003)

The picture above is a snapshot of the Gate, the first world that users enter when logging into Active Worlds. What appears in the picture are humanoid figures, called avatars. The speech bubbles above some of the avatars indicate that they are talking. This conversation can also be seen in the text field below the graphics. Some of the avatars have hats and red shirts with cameras on their stomachs. They are tourists. Others have changed the way they look and these are citizens, since changing avatars is a privilege for citizens. Users can choose avatars among a range of options. Each avatar has its particular look and most of them are depicted as males or females. There are also fantasy figures to choose from, such as a bird or a dinosaur. Once an avatar is chosen, the user must also come up with a name for the chosen avatar that will be exposed in Active Worlds.

Looking at picture 1 again, some avatars are at the ground level and some are flying in the air. Navigation in Active Worlds can be done both at ground level and in the air. To be able to navigate in Active Worlds, users need to press buttons on their computer keyboards to activate the function of navigation, in order to move back and forth as well as up and down.

Apart from the different privileges between tourists and citizens, other social roles are those with particular privileges, such as gatekeepers. They can be considered hosts at the Gate. Their main tasks are to assist people regarding what to do in the virtual environment and to support the social rules that exist at the Gate. There, certain kinds of talk, such as swearing, are strongly advised against since all users, children as well as adults, enter at the Gate.

In the left text field, names of different worlds are presented as well as how many users there are in each world at the moment, and whether it is possible for anyone or only certain users to enter. Above that field, different functions available for citizens are located, such as contacts. Using the contacts function gives an opportunity to set up one's own contact list of people to communicate with. There is also the function of telegrams, with which one can send shorter text messages to individual contacts of one's choice. Further functions are teleports, where one can add coordinates to places one would like to return to easily – instead of walking the distances with the avatar by using different keyboard buttons navigating through the graphical space, which can be rather time-consuming.

Above the graphical field are other functions with a number of choices available for both citizens and tourists. For example, one can press different buttons to change the perspective, ranging from a first-

person field of view, which is the default mode, to a bird's-eye perspective. One also has the possibility to look up and down inside the virtual environment with the avatar. Other pre-programmed functions are connected with more expressive body movements such as waving, kicking, or blowing a kiss.

When entering Active Worlds for the first time, the unskilled user – or newbie, as one is called initially – may feel fairly confused. A newbie is anyone who enters the environment for the first time, and s/he will be considered as a newbie for a while before becoming a regular user that others recognize. This confusion is due not only to how the virtual environment looks on the computer screen, but also to how the interaction goes on and what people do there, as will be demonstrated later.

In the virtual environment there are many different worlds to go to. Each world has its particular look or theme such as a beach, a gallery, a planet, or under the sea surface. There are also worlds built up according to specific themes, such as types of role-playing games called Gor-worlds.

When spending time in the virtual world and visiting different places, one observation was that each world tended to have its particular conversational style and content. At the Gate – the world that the author spent most time in, since there one could find the most people with varied experience at any time during the observation – the atmosphere was relatively relaxed. At the Gate users greeted each other and asked questions such as "where do you come from?" or "how long have you been here in Active Worlds?".

In the themed worlds, as a rule, the conversations were about theme-specific matters such as following the intentions of a game, or talking about the paintings or poetry that could be seen or read in a gallery. There were also different types of discussion taking place inside these worlds, but the general pattern was that different worlds had different conversational manners and topics.

However, it was not always the case that the look of the world made a theme-specific impact on the discussion. In one environment that resembled a national park, public talk among users tended to have a rather sexual undertone. Here, people also explicitly talked about sexual experiences, as when one user told others openly "I got laaaaaaaaaaid" and received cheerful remarks back from those participating in the discussion at that particular time.

3.2 Learning to walk the walk

In Active Worlds, a large part of the virtual experience is linked to the possibility to navigate around in the virtual environment. Therefore it is necessary to learn how to use the functions that support movements. For a newbie it was not easy to place or move the avatar inside the virtual environment. Text information on the computer screen that gave guidelines on how to move and what buttons to press helped the users to learn what to do. More skilled users provided help as well, giving verbal instructions to newcomers about how to use the program to be able to move around in the virtual environment. In addition, gatekeepers often approached newbies with the explicit offer to teach them how to move inside Active Worlds.

While exploring how to move, happy remarks from newbies who had found out how to fly, for example, occurred quite often. Such happy remarks were met by cheerful comments provided by other users. Often the gatekeepers were supportive when newbies explored the possibilities to move around. Pre-programmed functions that could get the avatar to wave, dance or kick, for instance, also seemed to amuse newbies. Another observation over the course of time was that newbies ran around a lot within Active Worlds, moving their avatar back and forth, up and down, seemingly just for the sake of moving *per se* to explore the possibilities the program afforded, whereas more experienced users tended to select a particular place to be found at on a rather regular basis. In a game world it was also observed that newbies moved differently than experienced users. In this world gamers moved a lot, since gaining credits involved finding and killing monsters as well as going on quests. It was observed that experienced users moved around more systematically and focused than newbies in this game world that could be found in Active Worlds.

To move the avatar, keys were pressed. For the newbie, it sometimes seemed quite hard both to move and to talk. In practice, this meant using arrow and letter keys. In addition, based on the experience of the author, it became even harder if a laptop was used, since that involved more button-pressing to number-lock (numlk), for example, on some computers. The resultant time spent in changing back and forth with numlk slowed down the communication.

The author's general observation, though, in spite of the newbies' initial enjoyment of exploring the possibilities to use the pre-programmed functions that could get the avatar to wave, dance or kick, was that few people used the functions of the program for pre-programmed body language while engaged in social interaction with other users. These pre-programmed body movements seemed to serve as a shared activity to become involved in at the beginning of the learning process of becoming a social

being in Active Worlds. Still, perhaps somewhat surprisingly, these functions play a significant role in establishing relationships online, as will be argued later in the discussion.

3.3 Learning to talk the talk

One key factor to adapt to concerned language. The language presented to the newbie, who has little or no experience of the environment, consists of text-based sentences that s/he has never seen before. Short sentences with incomprehensible abbreviations multiplied at incredible speed on the screen. Even figures created by buttons on the computer keyboard, in order to reinforce expressions and show emotions, were used. However, the use of figures seemed to be highly situation-dependent. It was quite common at the Gate where users entered, and it was used especially between gatekeepers and known users coming or leaving, who gave each other hugs and greetings.

To signal emotions in general, and hugs in particular, certain signs were used. Putting * at the start and end of a word meant that it was an action taken by the users, such as *hugs* or *handshake for Usual*, two examples from the dialogue below. Another way of signaling hugs was to put brackets around the name of the avatar/person that the hug was meant for, as in the example (((Lionel))).

Example 1. Hugs to and from familiar comers and goers at the Gate. (Avatar names are changed due to privacy issues.)

Angel: ((((((((((Lionel))))))))))))))))))))))

"kitty": :o)

Mork: hi

Usual: good night everyone

Novist: nite Usual :)

Mork: nite Usual

"covah": nite Usual

Usual: {{{{{{{{{ hugs }}}}}}}}} and such to all

Novist: *hugs* for Usual

Lionel GK: ((((((((((((Angel)))))))))))) my lovely angel

"covah": ty for thee help

Solid as a Rock: *handshake for Usual* lol

mark0612: oo

Usual: ty {{{{{{{Novist}}}}}}}

Lionel GK: Novist nice to see you again after soooooo long

Usual: laterz SR

Usual: {{{{{{{{{Angel}}}}}}}}}

Novist: {{{{{{{{{hug}}}}}}}}}

"markis": hey, alll

Angel: *hehehe Lionel, my halo falls off too much to really be a legitamate angel *LOL*

In the example from the Gate we can see how the users are engaged in a greeting situation where users are saying hello and goodbye to each other. They indicate that they recognize each other by this cheerful way of giving each other virtual hugs using brackets around the avatar names. This example is also typical of the friendly and easygoing atmosphere at the Gate. Further, it shows the difference in patterns of interaction among tourists and citizens. User names that begin with a capital letter denote citizens, i.e. users who pay a monthly fee to be able to use more of the functions in the program than a tourist can use. User names that begin with a small letter and are inside quotation marks denote tourists. Already in the way users' names are presented, cues are available to interpret what kind of users are present. They may be newbies, or they may be users who do not want to pay the monthly fee to get extended possibilities to use functions in the program. This example is interesting since it illustrates quite clearly that there is a difference between citizens and tourists in how they say hello as well as goodbye. The citizens here express emotions to a larger extent, as well as addressing attention to specific users by typing their names. Brackets around user names are used only by citizens, illustrating that the use of brackets in the interaction is not a common practice from the very start for every user. Rather, it is a behaviour that can be learnt. A part of the local language was to learn about the significance of expressing emotions with specific signs in greetings as well as goodbyes. The gradual acquisition of when to use which signals to transfer socio-emotional content was interpreted as a process of adaptation – learning to express oneself in line with the common practice that has evolved during the years of users' interaction in Active Worlds.

In contrast to this cheerful moment of entering or leaving the social milieu, it was rather rare to see such figures in discussions about particular topics. Normally, users' involvement in ongoing conversations was rather mundane and just like any everyday talk about various issues. Still, to illustrate, it was not always the case that users' interaction was friendly or ended in flaming wars. A discussion could also build up gradually, increasing irritation among participants taking different standpoints in a discussion. One clear and still atypical discussion, to exemplify the gradual build-up of irritation, is from a discussion

on 13 September 2001 concerning the terrorist attack of 11 September in New York, where two airplanes crashed into the World Trade Center. It was a vibrant and engaged discussion between those who participated, and they used very few figures in the text-based communication to enhance emotions or opinions. The discussion took place at a world inside Active Worlds called AlphaWorld. In this discussion, emotions were not signalled in written figures but shown in the text-based conversation. For instance, a user became more and more upset over another's argumentation about whether attacking the terrorists is the best way to act in this situation:

Example 2: Irritation towards another with a different opinion

Calvin: hello?! we're threatening to destory a country because a man that was BORN there had an act of terrorism..

Calvin: the guy didn't even live there..

StiffD: The recent attacks show that it is possible to inflict great damage on the strongest nation in the world

NightW o: I wouldn't say that we are the strongest in the world'

Calvin: they lived in the u.s.

Fiona: but that doesn't mean we CAN destroy it....or that we WILL destroy it

StiffD: We haven't threatened to destroy anyone yet

Calvin: NightW o-not any mroe.. but the size of our alliance can easily take the heads off of any of those third world countries that think about defying us..

Dexter: the war is against terrorism worldwide

Calvin: Fiona-i wouldn't put it past us..

Fiona: but i wouldn't count on it either

Calvin: if i was the leader of a third world country, i'de ally with the u.s.

NightW o: China keeps private about what all military forces they may have

CalvinL: i'de feed off of our every word..

NightW o: no one knows for sure what all they have

Fiona: i wouldn't

Calvin: i don't want to defy a country that could destroy mine hundreds of times over..

Calvin: and above all else.. they're giving us money and jobs.. just for allying..

Fiona: don't get me wrong...i believe in our country...

Calvin: and protection from other countries..

Fiona: i just think the u.s has gotten pretty good at buffaloing everyone

StiffD: Well obviously that wasn't the thinking of the terrorists, they don't seem the least bit concerned about what retaliation we might mount

Calvin: because the terrorists died in the attack..

Calvin: why should it matter to them.. they're alread dead...

StiffD: In fact Osama Bin Laden has said that if you kill him the attacks will continue even after he is gone

Dexter: Pakistan is not concerned...they already threw their hats in with Afghanistan

Fiona: no...the 'players' died...not the terrorists

Actuallity: <the martyrs died in the attack>

StiffieD: Thank You Fiona

NightW o: true, but if one of them did it, they have to know we are going to bite back, you have to know that they are going to have their defenses ready for us when we do bite back

Dexter: whoa where did you hear that one StiffD?

Actuallity: <the terrorists are still here for the next round>

Calvin: *THE PEOPLE WHO COMMITED THE ACTS OF TERRORISM ARE DEAD!*

The same discussion also exemplifies how people used different channels to interact. People could interact in public domains where everyone in the space could both see and participate in the interaction if they pleased, but a separate channel for interaction, called the “whisper” function, was available for sending private messages so that others could not take part in the dialogue. Sometimes people “spoke” both in public and in private. It is of course difficult to show the content of what users talked about while whispering. The only way to illustrate such content is to show examples where the researcher and a user were involved in a mutual conversation. Above, we could see how different opinions were expressed and reacted upon. In the same discussion it became evident that some individuals had probably suffered a heavy loss. The example below shows such a conversation, and the reason why the conversation went from public to private was that the researcher became emotional towards the harsh treatment that the user with the pseudonym Moki Ro received from some other users in the discussion. The pseudonym Me in the quotation is the researcher.

Example 3: Using whisper function to talk about issues in private

Moki Ro : thx.. I will do better if the planes were flying so i could get out of DC

Moki Ro: i live in Minnesota..

Me: (to Moki Ro) it must feel awful to not be able to move to the place where you want to be even though its understandable that filghts are cancelld

Moki Ro: yea...it is..

Moki Ro: my mother lives in NYC.. and goes to wrk everyday at the wtc

Me: (to Moki Ro) oh

Me: (to Moki Ro) have you heard from her?

Moki Ro: no not at all...nothing..

Me: (to Moki Ro) dearest Moki Ro

Moki Ro: gawd i cant stop crying... i came in here fro support.. i know icame across angry i started it.. im sorry

(September 13th 2001)

In this example we can see how a person seeks comfort inside the virtual world at a stressful moment in life, being uncertain about the mother's fate in the attack. In public as well as in private, using the functions of the program for both sending messages in the public space and using the whisper channel, Moki Ro seeks and gets comfort but also questions such as "why do you go in here if you worry so much about someone, why don't you go there?" – a comment to which Moki Ro reacts strongly, as shown in the example when saying: "gawd i cant stop crying... i came in here fro support.. i know icame across angry i started it.. im sorry". Even though this example is very special, it is an illustration of how the virtual environment is used to get in touch with other people without face-to-face contact. It has become a social arena where social interaction of various kinds is considered appropriate.

A very different situation of meeting people in the virtual environment occurs when a user becomes aware that the person with whom s/he is engaged in a conversation might be someone s/he has met before in another world. Such re-encounters were occasionally observed, and seemed sometimes pleasant, sometimes not. Below an example of such a situation is presented. The example shows a part of a dialogue where one user recognized another person that she was still angry with, and expressed this in the public space.

Example 4: A re-encounter in the virtual environment

"julii": aud r u the person that use to be in yellowstone all the time?

Audio: yep

"julii": i thought so

"julii": mutes U

Audio: were you a cit then, julii?

"julii": u were very rude ....the end!

Audio: I was?

"julii": u dont remember ?

Audio: no

"julii": well u were

Audio: how so?

"julii": i have never treated ppl like u ppl treated us in yellow

Audio: I normally treat ppl with respect if they warrant it

"julii": i do NOY like rude ppl and u were one of the rudest!

"julii": NOT even

(june 2003)

These two different situations exemplify a generally observed pattern: no matter whether people have met before or not, contacts can be made and togetherness can be established and maintained. But not every encounter with another person will be pleasant or lead to a relationship. Logging into Active Worlds and meeting other people in a virtual environment represented as avatars gives an *opportunity* to establish relationships. However, the need for interpersonal accord, a symmetry in communication skills between the interacting individuals, in order to develop an encounter into a relationship, seems to be the same in Active Worlds as offline (Burlesson and Samter 1994). Even when visual offline social cues are filtered out through the interface of the shared virtual environment, it is still important that there is a *quality* in the interaction between two people that motivates and facilitates the building and maintenance of a relationship.

During the study it was observed that some people seemed to have rather close relationships. Below, two examples of long-term users who presented themselves at the Active World Homepage in June 2003 indicate that meeting others and making friends are one key reason to spend time in Active Worlds. Both users seem keen on sharing their experiences with others and have done so for quite some time.

Example 5. Presentation of a long-term user

I have been using AW ever since 1996, after I had read about it in a computer magazine. ----------. For the first year I just wandered around AW because it looked so magnificent, like a lucid dream. Then I learned to build and found out that it was much easier than I had imagined, doh. Later I built with other people as well and made some really good friends. And now I have worlds of my own...

I have been a Gatekeeper ever since the program started in December 1997, because I wanted to answer people's questions and welcome them to the best virtual place I know. I'm still not much of a hugger I'm afraid, but I think we are all needed at the Gate :)

Exampel 6. Presentation of a long-term user

I came into AlphaWorld in April 1996 and have been building ever since! My biggest never-ending project is NorthWest Builders Supply (an object yard at AW 1096n 988w) which I began in November 1996 simply for myself, because I wanted to see all the objects in one place. Had I known about [name of user] great object yard back then, my supply yard never would have happened. :)

Besides actually building, I enjoy spending some time as a volunteer teacher in AWSchool world, helping newcomers learn to build. There are many 3D chat programs, but Active Worlds' building feature is the most attractive to me. Remembering how long it took me to figure out how to get my first starter object to "stick" makes me sympathize with newcomers who download the program and want to start building right away. AWSchool world (conceived by [name of user]) does a great deal to make those first building steps easier for newcomers. It's fun to hear the "wow!" when a newbie, assisted by a friendly teacher, sees his/her first wall appear.

As one can see, these two examples show the need for finding individual interest in the virtual environment, such as building or guiding newcomers, to find a role there which is rewarding – as well as the importance of interacting with others and establishing relationships there.

3.3.1 Multi-dialoguing

During the time spent in Active Worlds, it could be observed that there were multiple dialogues going on at the same time, using different channels such as public speech, whispering channel and sending telegrams as exemplified earlier. Many different discussions took place simultaneously among individual users. Users seemed to have developed a skill to keep several discussions going on simultaneously – a daunting task in real life where we seldom, but increasingly, are engaged in different dialogues at the

same time, using for example the phone, e-mail and face-to-face interaction. That is to say, the program offers a possibility to talk to a lot of people simultaneously by using different channels. The technology offers something new, not necessarily better, but a new way of communicating.

The “multi-dialoguing” seemed to be a well-accepted mode of behaviour. To use the different channels was apparently an established social convention. Especially the skilled users seemed to have adapted to this means of communication. However, it is not only the users who have adapted to the technology. The technology has been changed by the owner of the program to meet users’ wishes. The clearest example of this was the introduction of the function called “whisper” in the program, which did not exist in the beginning of Active Worlds (Szczepanska 1999). With the whisper function, people were able to have a private conversation even if they wanted to stay in a public domain.

When people used different channels in the communication process it caused a halt in the interaction. Using different channels as well as being engaged with other activities, such as building in the virtual environment, made time delays common in the social interaction. Having a lot going on at the same time meant that people could not always follow a straight conversational path, but did things here and there which led to delays. There was not only a need to adapt to the communication style in the virtual environment; there was also a need to adapt to the delay between remarks shared by senders and receivers.

3.3.2 Witty conversational style

Another aspect that was rather clearly reflected in the conversation during the observations was related to the conversational style in the virtual environment. A general skill, apart from having a lot going on at the same time, that seemed important to adopt as well as adapt to gradually was the particular style of communication that can be labelled as humorous, playful or witty (see also Danet et al.1998, Wellman 1999, and Baym 1995 for related findings).

To be witty was also a skill that could be improved over the course of time. The function of wittiness was not only interpreted by the author as emotional glue between users. It was also very important for the social interaction in the virtual environment over time. To be able to have a sustainable conversation, there is a need for a mechanism that can drive the interaction, and in this particular environment one such mechanism was humour. The role of humour as critical for creating social meaning in computer-mediated communication has been argued elsewhere by Baym (1995).

The humour in Active Worlds as a shared virtual environment was mainly word-oriented. If people showed a skill in playing with words and finding associations that were regarded as funny, it was praised with smiles and cheering remarks. People created a sustainable conversation driven by creative wordplay.

Example 7: Playing with words and each other

ShannonsShadow: hey Lord of the Pies.....can I have a pie? I'm hungry. lol :o)

Lord of the Pies: what kind shannon?

ShannonsShadow: cherry and apple pies?

Lord of the Pies: <------ throws a cherry and apple pie @ shannon

ShannonsShadow: *pie splatters all over me, and I eat some* thanks, Lord of the Pies ;o)

"Double X": *wants pie*

"Double X": Gimme pie or I steal pie.

Lord of the Pies: so u can, i guess that makes me a filthy lier then lol

ShannonsShadow: lol

"Double X": Yuppers.

Lord of the Pies: *hides an explosive pie for XX to steal*

"Double X": *finds explosive pie*

Lord of the Pies: lol

ShannonsShadow: Give me candy, give me pie, cuz if you don't I'll spit in your eye, LOL

"Double X": *eats the thing whole*

"Double X": Well done Shannon./

"Double X": *muffled explosion*

"Double X": Did you hear something?

Lord of the Pies: lol shannon

"Double X": *smoke starts coming out nose, ears and mouth*

In this example we can see that the people who participate are driving the conversation together, with input that relates to the start of it all – i.e. a person finding a way to use another avatar name as an inspiration for a playful topic. That person drives the conversation by posing a question which relates to the first comment regarding pie. Instead of giving pie, the person throws pie, and this leads to a reaction from the other, whereupon a third person becomes involved, also wanting pie. They are using wordplay and invented action that the three of them find amusing and worth participating in. The example is rather

typical of both the witty style and how people become creative in keeping a conversation going in the virtual environment to establish as well as maintain relationships.

When people got more used to interacting within the virtual environment, they learned more and more about the witty style of interaction. But that learning process was hindered by some factors. One was linked to language. The native English-speaking people, or people very good at English, seemed to be more able than others to speak in a humorous way. They were quick in their responses and could also introduce play on words.

3.5 Using strategies to cut off people

When people establish and maintain relationships, various practices are involved. Burlesson and Samter (1994) could show that symmetrical styles of communication among involved individuals were more crucial to the establishment as well as the maintenance of social relationships than the communication competence of each individual. But learning to be social also means learning to relate to others and using strategies that are accepted in the social formation of the community. Baym (2000) argued that the management of disagreements is highly important in online communities since 'it is in the point of disagreement that friendliness is most challenged' (Baym 2000:123). Focusing on how users learned to become social in Active Worlds, with special emphasis on the establishment and maintenance of relationships, it was important to observe how users dealt with the situations when they did not want to relate to another user, and what kinds of strategy became conventional over time in this regard.

According to my observations, these strategies were based on social mechanisms as well as technological possibilities. When someone was considered to be unwanted in a conversation or behaved in an unaccepted way, people usually told the person publicly to stop addressing the request directly to the user concerned – a social mechanism imported from verbal face-to-face interaction. Usually such a request came from a gradually built-up irritation towards the user, coming from a disagreement in a discussion that reached a point where one of the participants did not want to continue the discussion any longer.

Example 8: Telling a person to stop in the public space

SimpLy Ho: Taz shut your cockholster up and leave me alone

Telling someone explicitly to stop unwanted behaviour was also encouraged by other people giving instructions to users that it was an appropriate way to act inside the virtual environment.

Example 9: Telling someone to stop

"Covah": just tell that person you found what they said was offensive to you

If telling a person to stop was not effective, people tried to ignore the person. If this did not work, people with knowledge of the functionalities of the program used the function “mute” so that the disturbing individual could not be “heard”. Below is an illustration of how instructions were provided for using a function in the program to get rid of annoying comments, i.e. to enable a break in the conversation.

Example 10: Muting someone with the functions in the program

icco: if you would like to mute someone, right click on their avatar or their name in the chat window. .... select the mute option. you will no longer "hear" what they are "saying".

Finally, users having a special role in the shared virtual environment, with access to special rights supported by the program, could kick the person out from the particular place where the interaction occurred – also a technical means of cutting off a person from an ongoing interaction that was not considered appropriate.

These examples show that social conventions have been developed regarding, among other things, how to end unwanted conversations. These social conventions are linked to both social and technical aspects. Social behaviour such as telling someone explicitly to stop, or ignoring people, is a convention that we also use in face-to-face situations. In Active Worlds there are also technical functions to use to end a conversation. The program makes it possible to “mute” a person. In such cases people can still be present in the environment together with, yet without hearing, the person they do not want to be engaged in a conversation with. To mute someone, or to ‘kick’ someone out of the program, was regarded as accepted behaviour in Active Worlds.

4. Discussion and Conclusion

I have presented observations regarding how people become social persons inside Active Worlds. They learn to use the program's functions when entering it and adapt their use to the established conventions when they move and navigate in the environment. The learning process involves reading written instructions inside Active Worlds and/or getting verbal instructions from other users. They also learn to communicate in accordance with the way people use the written language. They learn to interpret the figures in the text-based conversation, and adapt their own writing to this way of conveying emotions through the interface. They learn to use different channels for talking to people in public and in private, using the functions of the program for public speech and whispering. They also adapt to delays in the conversation and do not pay any specific attention to these delays. In addition, they adapt to the witty conversational style and become creative in keeping playful conversations going. People also learn how to interrupt unwanted conversations, using social conventions such as explicitly ending the conversation or ignoring the conversant. They also learn that they can use functions in the program to get rid of unwanted people and that this is regarded as an appropriate way to act.

Linking the observations back to the general research question, i.e. what practices people needed to learn about, become involved with and adapt to over time in order to become social persons inside Active Worlds, one can see some general patterns within the range of different behaviours performed by the users in the shared virtual environment.

First, people met at the Gate since everyone entered there when logging into Active Worlds. Quite often, conversations started between people who were totally new and those with more experience. Particularly the gatekeepers were important for being introduced into Active Worlds and learning how to behave in there in accordance with established social conventions. This was considered a general pattern of introduction for newcomers by old-timers, i.e. people who had spent a lot of time in Active Worlds. This observation can be compared with how people gradually become socialized into offline situations following Levine and Moreland (1994), and with the importance of adapting to practice when people are engaged in social formations (Wenger 1998; Bourdieu 1990). Even if the social process inside the virtual environment shares similarities with face-to-face encounters, it is noticeable that the *way* in which the technology is used plays a significant role. It has been demonstrated that people use symbols in the text-based communication to convey emotions as well as pre-programmed body language. Still, based on the observations and time spent in the virtual environment, it seemed important not only to learn *how* to use these functions as well as symbols, but also to learn *when* it was

appropriate to use them. Therefore it became crucial for the establishment of relationships inside Active Worlds to learn about social conventions, as well as how to use the technological functions since the use of these functions was part of the conventions. This observation recalls the role of language practice which Baym (2000) identified as crucial to experienced meaning for users in a text-based online community. In a graphical environment we can see that not only language practice, but also the use of functions within the program that supported navigation and movements in the graphical space, became important in the shared practices of user interaction in general. In the graphical world Active Worlds, social practice was linked to the combination of language use and the movements of the avatar.

In addition to the learning process linked to language and movements, it was observed that people gradually got used to meeting each other on repeated occasions and, after a few occurrences, started to greet each other with cheerful remarks or by making figures indicating hugs, as illustrated in one of the examples above. Users seemed also to prefer different types of worlds in Active Worlds. These particular worlds, each with a particular social milieu, attract people with a shared interest. Driven by mutual interests to create togetherness, meeting each other again and again, people established and maintained relationships with each other. It also seemed important to seek and find a user who corresponded to a particular type of communication pattern in order to facilitate the process of creating and sustaining a relationship, as argued by Burlesson and Samter (1994) in face-to-face situations and by Biocca and Harms (2002) in mediated situations. If accord was not possible, i.e. if mind-to-mind could not be interconnected, the “social ground” was too infertile for nurturing a relationship. Since the *ways* in which users applied the technology became cues for interpreting each other’s interests, it became important to learn and adapt to world-specific conventions to convey shared interests.

In general, following the social conventions that have been established over time in Active Worlds was informative, as also shown by Becker and Mark (2002). Linked to the issue of social conventions is how people behave so as to let others be involved in the community. In Active Worlds, the dynamic of newcomers being introduced and old-timers staying put creates a certain type of culture. It was observed that old-timers taught newcomers how to act in Active Worlds both in relation to how to use the technology and in line with existing social conventions. If we think broadly about this observation, one interpretation is that old-timers in Active Worlds do not keep their social position by exclusively relating to each other. Rather, they include newcomers and teach those who are interested to become more and more involved in the community, finding personal roles. Even if individual users come and go, this particular culture of an open social system continues and is seen as one explanation for why the community still exists after eight years online. The continuation of an ongoing social interaction among

users has been proven crucial for the longevity of virtual communities (Svenningsson 2001). Thus we can see how the structure and function of Active Worlds provide support for the learning process of becoming social beings in a new environment.

The overall conclusion that can be drawn from this study is that social practices in Active Worlds are intertwined with the use of the available technical functions within the program. The *way* in which functions are used is the result of an ongoing interaction process among users where they develop conventions as to how to create a social formation that persists over time. Users have developed practices that have become a requirement to learn about and adapt to – as Walther (2002) has also shown. These practices can be seen as a cultural system, and this cultural system in turn influences the patterns of interaction that become repeated over time (Wenger 1998, Bourdieu 1990). The process of adaptation is linked to patterns of micro-interaction, for example how users move their avatar, whether and when they choose to fly as well as what types of utterance they make while flying – *and* how other users respond to these activities. Over time they learn that certain behaviour is associated with typical newbie action and other behaviours are associated with experienced users. To become a social person in Active Worlds, users must learn how to act in line with these behavioural codes. How users act in line with these behavioural codes, i.e. the observable performance of user actions, becomes a signal to other users about how well one has adapted to the cultural system. Thus users are able to infuse these common practices with meaning. It is only at the analytical level that we can distinguish between technical functions and social interaction – in Active Worlds the two aspects are intertwined in social practices. Learning to be social is linked to the gradual acquisition of skilful use of the technology as part of the social cues and norms that bind people together who build up patterns of interaction that support the sense of togetherness. One possible topic for further investigation in 3D graphical environments would be to address gender issues since there are still uncertainties concerning how gender specific patterns of interaction are influenced by this specific media.

To summarize, this 3D graphical technology enables strangers to get together at a common place, something we can also do at a pub, for example. However, in the shared virtual space, even though we are connected with technology and can relate to people socially, there is a disconnection between people since the richness of cues that are exchanged when people meet in person is reduced through the interface. Still, these reduced social cues are handled by the creativeness of the users, who not only "import" offline social conventions in how to establish and maintain relationships, but also develop new ways to connect with others and new behaviours through the process of socialization that becomes essential for building relationships in a 3D graphical environment. The new technology employed in the

context of socializing can be seen as a useful tool for distributed people to connect with others. Nevertheless, to be able to connect in the virtual environment one must learn how to use the technology in accordance with the expectations of other users. These expectations are linked to social conduct in general and to the way the technology is used. Otherwise it is hard to form and preserve virtual relationships and it will be almost impossible to become a social person in the virtual world.

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Talking Heads on the Internet: Social Interaction in a Multi-User Voice-Based 3D Graphical Environment

1. Introduction

Some users do really trigger curiosity! One particular group of users impressed me greatly over the years I spent time online looking into various shared virtual environments. The users of the particular multi-user voice-based 3D graphical environment called Traveler, established in 1996, spent a lot of time in it even though the consistency of the program fluctuated, the graphics were not great, the pictorial representation crude, the amount of users tiny and they used voice communication as the main channel. Since the small amount of previous research that I found when studying voice communication in graphical environments emphasized that committed users rejected voice in favour of text-based communication (Wadley and Gibbs 2005), these users were rare, and I was puzzled. Why was that? What drew them there? What continued to draw them in? Why did they spend so much time in there? Why were they so faithful to the program and each other? Why didn't they use other programs that looked better and functioned more stably? Why?

In relation to the general pattern of development which moves towards multiple-channel applications with an increased focus on interaction (Wiberg 2005, Dourish 2004), matching the growing demand for distributed social interaction (Hinds and Kiesler 2002, Wellman and Haythorntwite 2002), this group of users becomes highly interesting to study more in depth. Even if technology trends are toward multiple channels and interaction, the vast bulk of users in shared virtual environments still prefer text-based communication. However, a small group of users acted differently and they have preferred to interact with multiple channels for a long time.

Guided by curiosity I wanted to really plunge into their experience, taking their point of view to get the feel for what at first glance was a strange and incomprehensible commitment to this shared virtual environment. I believe that it is not only the thousands and thousands users of the same program that can increase our understanding of social interaction in shared virtual environments. I believe that we can also learn from groups of users that act off the beaten track.

This exploratory study will describe how long-term users of an online voice-based graphical environment *use* the technology and how they *experience* social interaction. The aim is to understand the role that this particular environment has for social interaction in this system, and to learn about drivers behind long-term and committed use of this small-scale program. But before listening to some of the Travelers and then trying to make sense of their experience, let me start by describing Traveler as a shared virtual environment.

1.1. Traveler: the studied 3D graphical environment

Traveler (http://www.digitalspace.com/traveler/startpage.html)
is a voice-based free-of-charge multi-user 3D graphical environment delivered on the Internet and built to be a social venue (see DiPaola and Collins (2002) for design intentions). It first started in 1996, and is still running.

In this particular virtual environment users are represented as graphical depictions of various types of figures such as a Pharaoh, an apple, a worm, a woman with stylish hair-do, a man with glasses etc. These graphical representations of users are called avatars. In Traveler the avatars are faces. The faces have eyes, nose and mouth. The eyes blink and there is lip sync corresponding to the users' sounds, so one can see who is talking in Traveler. The avatars can be moved around in the graphical space by key-pressing commands on the keyboard. The avatars can be moved backward or forward and rotate horizontally or vertically around their own axes.

The delivery of the voice was built to support the use of voice in conversation similar to face-to-face conversation. Comments that were made could be overlapping and anyone present could make their voice heard in the virtual environment. The technology was built so that an adjacent avatar would be heard louder than an avatar at a distance in the same virtual room. In the environment it was the position of the avatars that was linked to this sound proximity, just as in the physical world.

In Traveler, there are various places to go to. Each place has its own link and can also be reached through portals within the virtual environment. Each place is designed differently in regard to form and content. Some places are rather vast and may be forest-like areas with trees, rivers and caves. Others are small bar-like places with stools, benches, a jukebox and the like.

2. Method

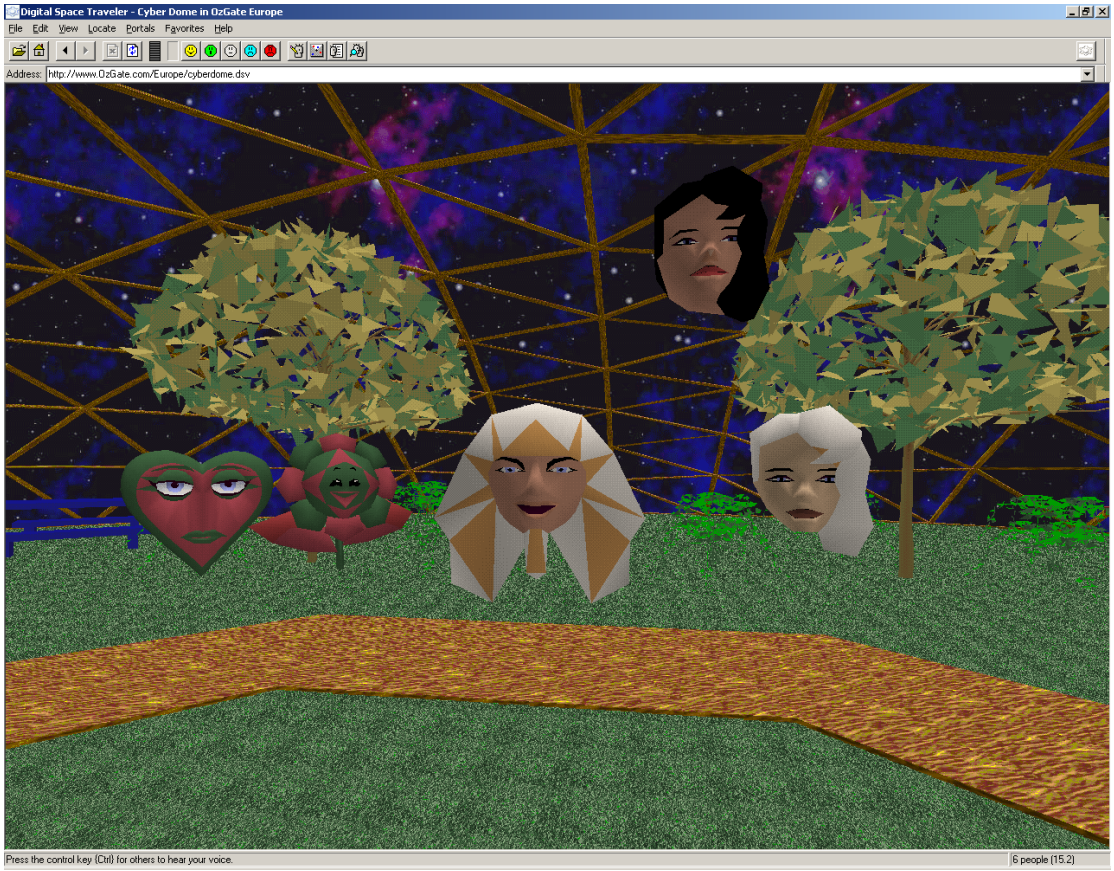
2.1 Focus group interview

To get a better understanding of users' experience and technology use, a focus group interview was held with users who had spent two years or more in Traveler on a regular basis with a strong commitment to the community. Strong commitment was defined as having an explicit role in Traveler as a so-called tech, spending a lot of time interacting with others in Traveler. To learn about the experience of social interaction in Traveler as a 3D graphical voice-based virtual environment, it is crucial to talk to people with long experience and high degree of involvement. The focus group method builds on the theory of group dynamics happening in human interaction in familiar constellations, and how humans in such circumstances more readily talk about their experiences and provide deeper insights by interacting with each other than a person-to-person interview probably would have led to (Stewart and Shamdasani 1990).

The focus group interview took place in Traveler. There were five committed regular users present and they sat in front of their computers in their individual homes, logged into Traveler. Their visual presences were indicated by their avatars. All had their speakers and microphones on, to be able to hear and talk to each other. The author had a digital recorder near the speakers in her office and recorded the interview. The total time of the focus group interview was 2 hours and 10 minutes. The recorded interview was fully transcribed. After several re-readings of the transcriptions, a common procedure in qualitative media analysis (Altheide 1996), two overarching themes emerged. They were labelled 'reason to get in' and 'reason to stay put'. Each theme was built up by quotes from the participants in the focus group interview. Some quotes will be presented in the result section, exemplifying users' experience and technology use.

2.2. Participant presentation

The selection process regarding participants in the focus group interview was the following. The guardian of the server, Oz, posted a message in the OzGate website that there was a scheduled group interview for research purposes, and regular users were welcome to participate voluntarily. Two regulars showed up in the beginning of the scheduled interview and three more joined during the interview, so eventually five regulars participated in the focus group interview.



The presentation of participants is in the order of their appearance in the focus group interview that took place on 2005-12-06.

KBOzTech (the full flower in the picture): A man living in California in his forties who has been using Traveler since 2001. He was introduced to the program by another long-term user in Traveler that he had met in a music file-sharing program. His online friend needed to persuade him for more than three months before he finally decided to download the Traveler program and started to use it. The first time his friend showed him around and introduced him to the program and to other users. He normally uses Traveler on weekends since he works swing-shifts during the weeks, but now and then he uses Traveler in the mornings as well. These are his own words describing how he became a regular committed user:

> KBOzTech: [the reason why he finally entered Traveler] It was the persistence of [xxx]. Each time I would see him on one of my chat programs, like ICQ or something, he'd always remind me to try it out, and so finally I decided: okay, I give it a try. He showed me around when I first came in so it was not very intimidating to

me when you got some people that really like the program and know quite a bit about the program and they are there to help you out. And I really appreciate it. And on top of that I liked it so much that I myself have learned everything that is to learn about Traveler and how to use it and all that. I spend some of my time helping other people that came in and I think Oz and those, and [xxx] knew that I really liked the program because I was really helping quite a few people out. And Oz finally decided and asked me if I wanted to be a tech, and I said sure! Actually the way it works here at Oz gate, they ask you if you want to be at Oz gate first, the guy that does basic things to help people, and if you done that for a while you work your way up to the tech status.

LadyBlueOzTech (the heart in the picture): She has been using Traveler since 2003. She is a tech on the program and says she is one of the newer techs in Traveler. She works during the day and normally she is in Traveler every night after 6 PM Central time until about nine o'clock, and all weekends. It has been her regular routine for the past two years. However, she does not stay on the program the entire day. She does other things such as housework but leaves her avatar in the program and keeps the program running while she is occupied doing other things in her home.

LadyBlueOzTech: I was actually in a chat room on Yahoo and somebody came in and said that 'if you're tired of all the baloney in Yahoo try this website', and they posted it in the room and I downloaded it and came in and actually the first person that I met was KickBack [KBOzTech], and I've been here ever since.

Kiddo (the dark-haired female head in the picture): She has been using Traveler for six years, and she is a tech. She has grown children and grandchildren and teaches the piano.

KiddoOzTech: I was also actually in another chat program. I was in what is called Inplayer, it's another voice chat, it's not a 3D virtual reality thing as Traveler, it's just a voice chat, and someone there told me about the program, and I liked the idea and I came over and it was just like I found my virtual home. I came in here, and I actually went back into Inplayer to stay in touch with some of these people, but I came in over here and I kind of moved in and I been here ever since.

LadyJ (the light-haired female in the picture): She has been using Traveler for seven years. However, she has known about the program since the beginning since it is her husband, Oz, that runs the server. Before using Traveler she was not using any other chat programs. She went straight to Traveler, and has been there ever since.

LadyJ: Oz was using Traveler and talked to his friends. I stood in the back and after three years I got my own computer. Now we are sitting in the same room with a computer each and we meet in Traveler.

Oz (the Pharaoh in the picture): Oz has been using Traveler since it first started 10 years ago. He runs the community OzGate [insert link]. He has established the only community rule, 'No

abuse', and cannot imagine living without Traveler, where he has many of his best friends that he has known for years but never met in person.

> Oz: Yeah sure [using other programs but Traveller] Yahoo or whatever, we have them, but, and that's ok if I would like to send you an URL or something like that or if I need to send you a quickie like: hey don't forget to pick up some cookies on the way home or something like that, whatever, but why would I like to hold an entire conversation in Yahoo or in ICQ or something when we can just come here? And talking as such, even if I was great at typing say 90 or 100 word a minute I can talk slowly and careful with 150 so clearly this is a superior form of communication.

3. Result and analysis

In this section I present what I suggest as key themes regarding reasons why users spent so much time and devotion to Traveler and each other. These themes are related to both social aspects as well as technical aspects.

3.1. Reasons for getting in

Each of the committed users had a personal story about how s/he became a Traveler. These stories will be presented below in relation to reasons found (i) outside the technical setting, (ii) inside the technical setting but outside of Traveler and (iii) inside Traveler.

3.1.1. Reasons found outside the technical setting

Lady J became interested in being a Traveler by experiencing her husband interacting with his friends in Traveler for some years. While he was interacting in Traveler, she stood beside, still experiencing it. When LadyJ got a computer of her own both she and Oz could be active participants inside Traveler at the same time if they wished, sitting next to each other in the same room in their house. LadyJ said that she went straight to Traveler, indicating that she did not have much prior experience in computer-mediated communication for the purpose of chat. Her reason to become a Traveler was found outside Internet, namely in her own house experiencing the online social interaction of her husband.

3.1.2. Reasons found inside the technical setting but outside Traveler

The rest of the regulars participating in the focus group interview had previous experience of online interaction from various places.

Kiddo and LadyBlueOzTech shared the experience of using chat rooms as well as the dissatisfaction in the virtual environment they were visiting before finding Traveler. Kiddo had experience from a voice chat, but as she said:

> Kiddo: Well, the problem with [name of the voice chat] was that whoever opened a room there was a moderator for that room, and there were a lot of people coming in to cause trouble and we don't have that in Traveler. Well, we do occasionally, but it was not as regulated – and just a lot of troublemakers, although there was some nice

> people. I met some great people, people that I still stay in touch with. Well, I came over here and I met the people at OzGate. It was just such a friendly environment, and everybody was so helpful and it was just such a peaceful environment.

The reason to start using Traveler for Kiddo and LadyBlueOzTech can be found in dissatisfaction with previous chat experiences online. They both thought that chatting online in the social milieu they were participating in was not as rewarding as they wanted it to be. They both express the wish for a friendlier place.

3.1.3. Reasons found inside Traveler

One participant in the study was at first reluctant to get into Traveler. KBOzTech said that it was his online friend, whom he had met in a music file-sharing program, that persistently tried to persuade him to go to Traveler. Since KBOzTech disliked chat rooms, he was not easy to persuade. It took him more than three months to start to use Traveler. But after being introduced by his friend in the program he stayed. The main reason from the beginning was connected with his love for music:

> KBOzTech: When he told me he said you can also play music in here and you can listen to it and I said oh, really – [xxx] and I both liked music and had the same taste of music and when he mentioned the fact that you can go into a room and you could play music to everybody and listening to it, I think that was the final draw. After I heard that I finally got the courage to come in.

This exemplifies the importance of shared interest, i.e. music in combination with technical possibility. KBOzTech had spent time in the music file-sharing program. Not liking chat programs, he was actually content with using that program. However, since his friend liked to be a Traveler and believed that KBOzTech would like it too, as music could be shared in Traveler, a driver towards use in this case was linked to what types of activities can be performed in the virtual environment.

3.2 Reason to stay put

After looking at reasons to get in we need to look for further reasons in order to understand the long-lasting appreciation of the Traveler community that these regular committed users clearly express. Once inside, the users shared the experience of difficulty in explaining what Traveler is like for people who do not use it. Everybody had a story about how they tried to tell people at work what it is like, as well as friends and family members. They all found that it was hard to explain why Traveler is such a good place. Kiddo summarized how they all have tried but somewhat failed to tell others about Traveler and the meaning that Traveler as a community provides for them:

> Kiddo: I was just going to say that it has been my experience that you can't explain this environment for somebody without them seeing it. I've told people about it and you cannot get the full effect, you cannot get the full idea of what you are talking about until you actually visit the place. You know I shown my children but of course my children are grown. I've shown friends and introduced them to the program and they all like wow that's cool but you can't really explain to them. You can tell them

> that it is a 3D environment but most people don't know what a 3D environment is until they actually see it. You know and the avatar thing then they kind of lose their minds cause here you're looking at another representation of a person. The mouth moves when they speak, the eyes blink involuntarily they have somewhat you know lifelike movements so I think it is really hard to explain what this place is like without showing them.

Still, they all had told their friends about Traveler, indicating that it is a significant experience to be a Traveler, and they do want to share that experience with their social surroundings outside Traveler and within their individual social contexts in everyday life. As one of the regulars said:

> LadyBlueOzTech: I have a friend who comes over sometimes and she takes the computer downstairs and we log into Traveler and meet there. It's pretty cool.

3.2.1 Visual recognition

The users are represented by avatars. As already mentioned, user interaction in Traveler was via avatars speaking to each other. The special look of the avatar in this graphical environment was head-only. In Traveler there are a number of different avatars to choose from. The program also enables users to change colors and change the default facial expression from normal to happy, angry or surprised, for example. The functions of the program were designed to make users actively choose the way they look and also invent a name for their chosen avatar. The group photo in the section *Participant presentation* shows us how these regulars present themselves. In spite of the possibilities to change their user presentation, they use the same avatars:

> LadyB: Well, we may have, we may put different names behind them, like I have a Christmas name but I'm still a heart. I do have a couple of different avatars, but nobody knows me as those avatars, so it is not comfortable for them to look at it, say a clown, and it's been me behind it, so I pretty much stick with the heart and everybody in here pretty much sticks with their basic avatar also. Oz is always a Pharaoh, LadyJ is always, I think that is Brady avatar, and KickBack is always a flower.

> Kiddo: And as a matter of fact when you have another avatar just to play around or, you know, for a special occasion or so, and even though I can't see myself different in here, I don't feel right when I don't have this avatar, and I find when other people change their avatar it's hard for me to look at, it would be hard for me to look at LadyB over there and the apple avatar because that's just not her. She has been a heart ever since she got here and I would feel like I was talking to somebody else even though I was talking to her. It is just, it is funny because you get used to see what everybody looks like – even though there is a limited number of avatars, everybody paints them differently so, you know, there might be a half a dozen people in Traveler that use a heart but they're painting them differently so you know who you are talking to.

> LadyJ: Yes, that is how we distinguish people.

> LadyB: It's kind of like dressing up to go to a Halloween party – you dress in different clothes, you look different, but when you go home, you put on your sweats and you are comfortable and normal, and that's what it's like if we change avatars for any reasons, it is always nice to go back to our comfortable sweats.

We can see how they prefer consistency in relation to the visual presentation of their presence in Traveler, and that this preference has a social facilitation factor in it. If they look the same, users know the user behind the look of the avatar. When they enter a room in Traveler they can take a glance in the room to see who is there without explicitly asking. This indicates that it is in the interaction process that coherence becomes important, and that a user tends to adapt to the situation since identification is facilitated by this coherence. People learn about who is using what avatar, and learn to recognize users by voice as well as by the look of the avatar.

3.2.2. Voice appreciation

The users in Traveller really like the voice-based communication for two main reasons: because they sense that they come closer to each other, and because it is fast.

> LadyB: When you're in voice you hear the emphasis on people's words, you share their emotions, you don't hear that in text. I mean they can put the exclamation point and smiley faces and everything, but you don't actually hear the emotion that makes it so personable.
>
> LadyJ: Yeah, we can tell if they are not feeling well or if they are upset or if they are happy.
>
> Researcher: So would you say that voice-based communication brings people more close to one another?
>
> Everybody: Yes absolutely, certainly [at the same time].
>
> Oz: We do not translate our words into type and then read them again and then send them in that slow, arcane process of communication where we can just press a button and speak.

In comparison with text-based communication, these users prefer voice communication. They think that the text restriction in the program is a good thing, fostering the use of voice-based communication. They experience voice as a means to connect more closely with one another than they would have done in text. They emphasize the nuances in the voice that can be directly heard during a conversation. It is not only that users need to be trained to use the voice channel in relation to merely transmitting voice. They also need to learn that the voice channel *should* be used rather than text messaging. In addition, as shown in the example above where everybody answers at the same time – meaning in practice that they all pressed the control key at the same time and answered my questions – the technology supports group conversation where people can have overlapping comments.

Clearly they have developed skills to use the technology for both moving around and using the voice channel, but what do they talk about? Kiddo says:

> Kiddo: I would say that the main two topics are food and software and computers… in that order.
>
> [Laughter from all.]

3.2.3. Functional and fun functions

Still, just voice communication is not enough for these users. They also appreciate the visual feature of the 3D graphical program and its other functions. The long-time users of Traveler express that there are typical way of using functions in the program that they highlight as important, common and sometimes fun. For example, forming a group for a group discussion is one typical feature of user patterns in Traveler. When they form a group they place their avatars in a circle in the virtual environment. Since it is a voice-based environment where the voice is connected to the avatar and there is sound proximity in relation to the avatar, the circle facilitates the view of the present users as well as supporting good sound from all.

One example that showed how the use of the technology in various situations was connected with the relationship that could be found among users was an activity called 'bonking'. The technology has collision detection, i.e. it is programmed so that avatars cannot go through each other. When they collide there is a resistance, and they can push each other's avatar around in the virtual space. This has developed in two directions. To 'bonk' into another user is considered abusive behaviour, and if the regulars see this happen among users, they intervene. However, that does not happen every time. 'Bonking' has also become a playful activity among regulars. They do what they call 'portal jamming':

> LB: You know, you were talking about feeling like you're really here, like you're really in the presence. When you are looking at somebody's eyes you can go up to them and tell them a secret, [whispering] guess what, and they say what? It's just like real life. To me, and we do it all the time, we go and kiss somebody on the cheek or KB goes up to Oz and says something teasing and they chase each other around in the room.
>
> Kiddo: And we do portal jamming too and ban people down on the floor and all kinds of things and funny stuff.
> [Laughs.]
>
> LB: No, it's just Kiddo who does that stuff.
> [Laughs.]
>
> Kiddo: Yeah, that is a kind of friendly fun kind of gesture that we do to people we know, we don't do that to newbies or that kind of things, we do that to people we know or just playing with them.
>
> LadyJ: When we know they won't mind.
>
> Kiddo: Right. I have left my computer and when I came back I was in a totally different space MANY times, or left my avatar in a room where there is water and come back found out that I'm drowning because I've been shut down into the water.

> LadyJ: Yep, Oz loving doing that. He is the master.
>
> KB: He is the master, he IS the master.

So there is a complexity in using the function collision detection. If users do not know each other or if they are newbies, 'bonking' is considered inappropriate. But if people know each other, then the same way of using collision detection is a playful act. Oz and LB clarify this difference in the following way:

> Oz: Again, it makes all the difference in the world if you know somebody. With people here in this room, and I known them for years and years, so, yeah, it would be inappropriate if newbies started to bonking each other and stuff like that, that's abuse, but let's say, among friends like us, we get together and let's say Kiddo go to the bathroom, and just for fun I would bonk her avatar in a portal, she wakes up in another room, it's pretty funny actually.
>
> LB: You know it just like, you would not throw a snowball on a complete stranger and you don't want them to throw one at you, but it's okay to throw one at your best friend.

This example indicates that the use of the technology has a social complex dimension. Not only do you need to learn that there is collision detection and that to collide is often regarded as inappropriate, something to avoid. You also need to learn that there is an exception to that rule, which is connected with the type of human relations involved. Thus, users need to learn about both the technical function and the appropriate situations for using it, and the various responses that will come in these different situations. Learning to use the technology in an appropriate manner in an appropriate situation with the appropriate people is crucial, and cannot instantly be taught to users.

Learning all these issues in Traveler in order to become a devoted member of the community takes a while, but not long according to the users:

> KB: Well, actually it is not hard to learn at all. It's like learning to ride a bicycle, some people learn quicker than others. When I first started, it took me a little while because there was so many things to know at first – being just overwhelmed by how the program looked, how the avatar looked and all that, just kind of blew me away, you know.
>
> KB: I would say a typical user if they come in and they have enough time on that day that they come in, they could probably learn how to move around and learn most of the program in one day, if that.
>
> LB: I would say as a person came in here a couple of hours for two, at the most three days, they'd be moving around just like we are today.

Another important cue to learn, which is supported by the use of the technology, is turning one's avatar upside down when a user leaves the keyboard and is not available for interaction in Traveler, but still intends to come back.

> Kiddo: Right, and another piece of netiquette that we do is if we are away from our keyboard, we flip our avatars upside down. So anybody who are upside down, they are not there.

All these practices take time to learn, and are also essential in order to become a member of the community. Again we learn about the crucial role of looking at the *usage* of the technology in social situations, so as to understand patterns of human-to-human interaction in such circumstances. We can see the use of functions as social interaction patterns that users learn. The two aspects i.e. the use of function and social interaction, become intertwined, sometimes so tightly that even for analytical purposes they are hard to separate. As Kiddo expresses it:

> Kiddo: It's like walking and chewing gum, scratching your head at the same time – you don't think about 'okay, I need to put one foot in front of the other. I need to take my right hand and scratch my nose and chewing my gum.' You just do all these things at the same time. That's kind of the same as it is in Traveler. Once you hit the buttons down and where they are and what they do is just kind of automatic. It's just kind of a second nature.

3.3 Social atmosphere

Even though none of these individuals have met face to face (apart from Oz and LadyJ being married and living together) they have strong relationships to one another and they greatly appreciate the community spirit in Traveler. The all say that they experience Traveler as a very warm, friendly and family-like place, exemplified with comments such as:

> LB: People here are so close. We exchange Christmas presents. We send birthday presents. I mean it's just a family, that's just what it is.
>
> KB. Yeah, we like it a lot.
>
> Kiddo: I've never met any of these people but they are my friends. They may be avatars, they might look like a heart and KB a full flower, but I know that there are actual people behind these avatars and some of them I'm speak with on the phone, and you know we talk about real life experiences. It's not just the virtual stuff we talk about. You know it's real friendship, it's real family environment.
>
> LadyJ: We have wonderful friends in Traveler that we have never ever met personally but we know them and we know about their lives and we love them.
>
> Oz: You know, this made it possible to make friends for years and years and years and I can't imagine my life without it now. I can't imagine my life without these people now.

It is so significant for them to stay in touch via Traveler that they combine everyday activities with the use of Traveler. One example of such combination is having dinner together:

> Kiddo: And a lot of us bring our dinners to our desks and have dinner with a friend in here.

Another example is just to sense the presence of friends by running Traveler and doing other things at home:

> Oz: If you have friends coming over they can just grab some chips, sit down and watch TV. I don't need to entertain them. They are just hanging around and then they leave after two hours. It was just good to see them. We didn't need to talk so much. It's the same in Traveler. I just have it on, if I want to talk I do. If not, I just feel their presence.
>
> LadyBlueOzTech: Well, I work during the day so I'm normally here every night after 6 pm central time until about nine o'clock, and I'm here all week-end.
>
> Researcher: So is that typical now or has that been your regular routine for these last two years?
>
> LB: It's pretty much a regular routine. I don't stay on the program the entire day. But I may leave my avatar in here, go do some housework and stuff but pretty much, yeah, it's pretty much my routine.

Again we can see that the use of Traveler is interwoven in their everyday life. These five committed users tell a story which highlights that the use of Traveler should be seen as an intertwined activity in everyday life rather than an 'escape' from the offline world. They do not use Traveler as a 'virtual play land' in the Sherry Turkle terminology, where they become different for an hour or two. They do not express that they separate to a large extent Traveler time from everyday life time – rather, they express how their virtual practice and experiences fit well together with their life in general.

4. Discussion and conclusion

Investigating how long-term users of an online voice-based 3D graphical environment *used* the technology and how they *experienced* social interaction in Traveler, the five committed long-term users in Traveler clearly put forward their message: using Traveler is important in their everyday life. Looking more closely at their use of Traveler, they all use it extensively during the weeks, and have done so over the years. They are all skilful in the way they handle all the functions in the program, such as colouring the avatar and moving their avatar around in the virtual environment. They share an understanding of conventional use of the technology, such as placing their avatars in a circle while engaged in a group discussion, turning their avatar upside down whey they are away from keyboard (se also Becker and Mark (2002) for similar observation), and always use the same avatar coloured in the same way except when 'dressing up' for parties that occasionally take place in Traveler. They all enjoy the voice-based communication channel and feel that the voice channel brings them closer to one another.

The long-term users express a proud sensation of being a Traveler and they experience a warm and family-like connection to each other that they cherish deeply. Spending time together with their friends in Traveler is highly regarded and rewarding. These warm and

meaningful experiences are seen as a driving force to enter into Traveler again and again. In spite of the fact that their social surroundings outside Traveler seem not to comprehend the meaningfulness of interacting in Traveler, they continue to tell about their usage to other people in their everyday life to share their experience even outside Traveler. Now and then they even try to convince others to join them to share friendship, knowledge, and everyday life experiences in Traveler. Traveler is seen as being their 'third good place' with its warm and family-like atmosphere experienced like a 'home away from home' (Oldenburg 1999:38-41). In contrast to 'third good places' such as coffee shops, bars and bookstores studied by Oldenburg (1999) where people leave their homes to get to their third place, users in Traveler reach their 'home away from home' *in* their homes using their domestic computer with Internet access to log into Traveler spending hours together with their Traveler friends.

Looking more closely at the way use and experience are linked, this study argues that there is a close coupling between the use of the technical functions and the social experience for these regulars. Previously presented examples such as 'bonking' indicate that the active use of the functions, and how the use becomes appropriated in different situations among close friends, have a strong bonding feature. The use of voice is yet another bonding feature, highly significant for these users since they all prefer to interact via voice rather than typing messages[1]. This observation highlights that the graphical features and the voice function are unique in comparison with text-based environments. Here there are functions connected to graphics and voice that become essential to learn about in order to interact socially. In text-based environments, users deal with various ways of using only text for social interaction. Still, in similarity with Traveler, users need to learn appropriate ways to use the *text* to take part in and appreciate the online social interaction (Cherny 1999, Baym 2000, Pargman 2000).

Yet another observation that supports the inference of close coupling between the use of the technical functions and the social experience is that these long-term users spend a lot of time introducing new users to the program, with a specific focus on how to use the functions. They argue that if users learn about the program, they will have more freedom to act on their own merit in the community and decide to eventually become members of the community. The focus on learning through participation shares similarities with what Lave and Wenger (1991) framed as a 'community of practice'. Lave and Wenger (1991) suggests that participants gradually acquire accepted ways of acting within the community, hence becoming more and more involved. In Traveler such behaviour is closely coupled with how to use the functions. In addition, all the long-term users agreed that using the program becomes second nature. They do not reflect on how they use it any longer. They just act with a social goal in mind, without paying attention to which key does what.

The studied long-term users view the technology as a provider of possibilities rather than a media with limitations. However, they acknowledge that learning to use the technology with respect to the voice function, how to choose and adjust the avatar as well as moving it around, requires some time. Just as in cue-lean media, as in the case of text-based interaction (Walther 2002), users in this cue-rich medium need to adapt to how to use the technology. Important to note is that *the way* that technology is used becomes a social cue in itself. It is clearly not

[1] The role of voice is also highlighted by Sallnäs (2004) in experimental research where she claims that "The strongest conclusion in this thesis regarding the effects of communication medium on social presence is that people experience that voice and video/voice communication significantly increase the sensation of social presence [the sense of being together] compared to communicating with text-chat in a shared virtual environment" (p.85). Still, there are also studies that enhance user rejection of voice in online games in favour of text-based communication (Wadley and Gibbs, 2005)

enough to learn only how to use the functions as such. Users must also learn the appropriate way to use them as well as the appropriate time to blend into the community. The process of adaptation that happens over time is therefore oriented towards the *integration* of used functions into social processes. This observation is also seen as a restriction regarding accessibility to social interaction in this virtual environment. To be able to blend in, users needs to accept this way of interacting and act in line with it. Hence, even if Traveler is technically available to everybody with computers with speakers, microphones, and Internet access, it is socially constrained, regardless of how positively the users experience their virtual social milieu.

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