SOCIABLE CSCL ENVIRONMENTS

Social Affordances, Sociability, and Social Presence

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Karel Kreijns

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Voorwoord

> "*What attracts people most, in sum, is other people. If I labor the point, it is because many urban spaces are being designed as though the opposite were true*"
> (Whyte, 1988, p. 10).

Het citaat is afkomstig van William H. Whyte, een stadsplanoloog die geïnteresseerd is geraakt in de vraag welke de essentiële elementen zijn die plekken als pleinen, straten, en parken aantrekkelijk maken zodat mensen zich daar gaan verzamelen, groepjes gaan vormen, en met elkaar in gesprek raken. Het antwoord dat hij vond was bedriegelijk eenvoudig, namelijk zitplaatsen, voldoende schaduw, zon, goed eten, allerhande activiteiten, goede verbindingen, het hebben van overzicht (om naar mensen te kunnen kijken), warmte en water (fonteinen). Desondanks lukt het menig ontwerper van dergelijke plekken juist het tegenovergestelde te bereiken. Doodsaaie onaantrekkelijke plekken waar mensen haastig doorheen lopen zijn eerder regel dan uitzondering.

Eenzelfde situatie wordt ook aangetroffen bij elektronische leeromgevingen, doorgaans aangeduid als computerondersteunde omgevingen voor samenwerkend leren (Engels: computer-supported collaborative learning environments, hier afgekort als CSCL-omgevingen). CSCL-omgevingen hebben vaak de neiging enkel en alleen de nadruk te leggen op de facilitatie van de cognitieve aspecten van het leren: het zijn daarom *functionele* CSCL-omgevingen. Wanneer men echter bedenkt dat CSCL-omgevingen bedoeld zijn om te worden gebruikt door geografisch verspreide studenten die in groepjes gaan samenwerken aan een leertaak, dan is het duidelijk dat CSCL-omgevingen ook aandacht moeten besteden aan de sociale aspecten van het in groepsverband leren en werken. Juist geografisch verspreide studenten hebben behoefte om met elkaar te socialiseren (met als doel elkaar te leren kennen en te vertrouwen), omdat zij elkaar van te voren niet kennen en het onwaarschijnlijk zal zijn dat zij elkaar ooit face-to-face zullen zien. De vraag die hier naar boven komt is dezelfde als de vraag van Whyte: welke zijn de essentiële elementen die de CSCL-omgeving naar een aantrekkelijke *sociabele* CSCL-omgeving transformeren zodat het socialiseren gefaciliteerd wordt. Het vinden van een antwoord op die vraag is de focus van het promotieonderzoek waar deze dissertatie het verslag van is.

Contents

CHAPTER 1

General Introduction

Abstract

The emergence of new information and communication technologies (ICT) has provided new opportunities for designing and implementing innovative computer-supported collaborative learning (CSCL) environments enabling group members to learn and work independently of time and space. Although very promising, especially in distance education, this new kind of learning has also introduced a number of questions about the effectiveness of collaborative learning through CSCL environments. This chapter is an introduction to this dissertation reporting on the research undertaken to answer those questions. The chapter starts with a short overview of the pitfalls and barriers that accounts for phenomena –the impediment of social interaction and difficulties with achieving group formation and group dynamics– that complicate effective learning in CSCL environments. This is followed by a delineation of the activities of the research including the formulation of a theoretical framework upon which a design of sociable CSCL environments can be based and the presentation of the hypotheses within the research context. The chapter concludes with an outline of the structure of the dissertation and a short overview of the contents of the different chapters.

This chapter is based on parts of:

Kreijns, K., Kirschner, P. A., Van Buuren, H., & Jochems, W. (2004). Determining sociability, social space and social presence in (a)synchronous collaborative groups. *Cyberpsychology & Behavior*, *7*(2), 155–172.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Journal of Education Technology & Society*, *5*(1), 8–22. Retrieved April 1, 2004, from http://ifets.ieee.org/periodical/vol_1_2002/v_1_2002.html.

1.1 Introduction

The emergence of advanced information and communication technologies (ICT) and worldwide networks, notably the internet, has given rise to a number of services including e-mail, news groups, real-time chat, desktop video conferencing, and the World Wide Web. New services are continuously being added on the internet such as net game playing, online shopping, instant messaging, and exchange services for music, video, DVD movies, and documents (i.e., Kazaa[1]). Although well-known and intensively used by a significant group of consumers, companies, enterprises, students and the like, it is only in the last few years that educators, educational technologists/designers and educational researchers have begun to think about its use, and to study the pedagogical potential that these electronic network infrastructures may have on their field, in particular for group learning and distance education. E-learning environments for group learning are commonly designated as computer-supported collaborative learning (CSCL) environments (Koschmann, 1996). By default, these CSCL environments have been equipped with a computer-mediated communication (CMC) system that connects the CSCL environment with the internet.

The current CMC system allows a group member to send an e-mail message, read or post a message on the message board, have a conversation with someone else using a duplex audio connection, or discuss a topic with other group members in a chat room. However, in order to completely fulfill the needs of a distributed learning group the CMC system needs to be augmented with tools that permit and support group collaboration and group coordination (Ellis, Gibbs, & Rein, 1991). Group collaboration requires the use of shared spaces, such as a white board, shared editor, or knowledge base. Every group member has simultaneous access to the shared spaces and is permitted to modify the contents of it. Group coordination manages the interdependencies between group members so that every group member knows exactly which activities other members are carrying out, or will carry out, in order to effectively determine what one's own activities at the moment and in the future should entail (for a general discussion about coordination theory see Malone & Crowston, 1990). Group coordination has to happen at both the group level (e.g., allocating resources and defining workflow, see Ellis, Gibbs, & Rein, 1991) and the task level (e.g., a shared editor use requires group members to know exactly where others are typing, see Dourish & Bellotti, 1992; Gutwin, 1997). We have called such augmented CMC system a CM3C system, the '3C' in CM3C stands for collaboration, coordination, and communication. Yet, most CSCL environments in use are very simple; in most cases, they are either an e-mail system or a computer conferencing system (i.e., a discussion forum). The more advanced ones integrate a basic CMC system consisting of e-mail, forum groups, and real-time chat.

CSCL environments that integrate CM3C systems and can be deployed for group use, offer two distinct advantages above those based upon simple CMC. Firstly, these CSCL environments permit group members to be geographically dispersed, thus, relaxing the need to be co-located for meetings and discussions. In addition, group members can engage in their working and learning tasks at any time, hence dismissing the need to be co-present. This characteristic, the 'anyplace-anytime' characteristic,

[1] The Kazaa home site is http://www.kazaa.com/us/index.htm.

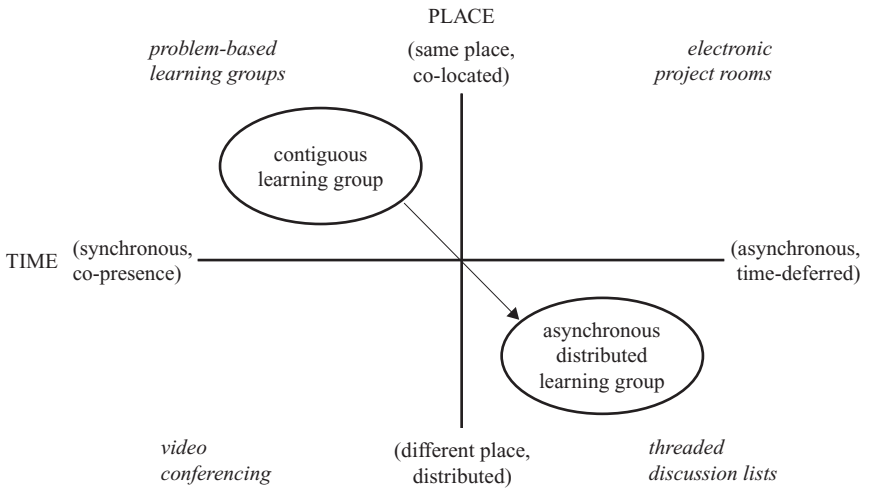

Figure 1.1 The Shift from Contiguous Learning Groups to Asynchronous Distributed Learning Groups

enables the shift from real-time contiguous learning groups to asynchronous distributed learning groups (DLGs). This shift is depicted in Figure 1.1. Secondly, embedding CM3C systems in CSCL environments increases their potential to support current insights in teaching and learning that rely heavily on the social interaction amongst group members. These insights include interactive group learning, deep learning, sustained critical discourse, social construction of knowledge, and competency-based learning, which we define as learning, based on the acquisition of knowledge, skills, and attitudes and on the application of these in an ill-structured environment (Kirschner, van Vilsteren, Hummel, & Wigman, 1997).

1.2 Problem Description and Analysis: Pitfalls and Barriers

The anywhere-anytime characteristic and the potential to support collaborative learning have convinced many educators that CSCL environments are the promising next generation of tools for distance education. However, despite their potential, research and field observations on their use report inconclusive findings. Along with the positive findings (e.g., Cronjé, 1997; Gunawardena, 1995), mixed and negative findings have also been reported regarding the learning process itself (Gregor & Cuskelly 1994; Hallet & Cummings, 1997; Heath, 1998; Mason, 1991), and regarding group forming and group dynamics (Hiltz, 1998; Hobaugh, 1997; Hughes & Hewson 1998; Taha & Caldwell, 1993). These disappointing results can be traced to the impediment of social interaction and group dynamics in asynchronous DLGs. Although this is a serious problem, many educators appear not to pay attention to these phenomena. These educators appear to fall prey to two pitfalls. The first pitfall is taking social interaction in groups for granted. Many educators think that because social interaction is 'easy' to achieve if not already present in contiguous learning groups, the same will be true in DLGs because the CSCL environments allow for it.

The second pitfall is that the stimulation of social interaction in DLGs is usually restricted to only the cognitive aspects of learning. Most educators are either unaware

of or ignore the fact that social interaction is also important for the socio-emotional processes underlying group forming and group dynamics and as a result think that group forming and group dynamics are processes which –similar to social interaction– happen automatically.

Be that as it may, two questions remain, namely:

- Why is social interaction impeded in CSCL environments?
- Why are group forming and group dynamics difficult to achieve in CSCL environments?

The answer to these questions can be found in the barriers raised by the use of CSCL environments sec and the use of CMC systems embedded in those environments. These barriers –when not recognized–impede social interaction for both cognitive and socio-emotional processes. The barriers are organized into three 'rings' (see Figure 1.2), namely:

- Ring 1: CSCL pedagogy. The barrier raised by this ring is that there is not yet a suitable pedagogy specific to the CSCL context (i.e., the use of asynchronous DLGs and CSCL environments). Brandon and Hollingshead (1999) point out that CSCL "seeks to provide classroom-based collaborative learning theory with theory and research on CMC in order to provide a foundation for understanding how CMC-based group projects can enhance learning" (p. 110).
- Ring 2: CSCL communication media. This refers to the barriers raised by the CMC system embedded in the CSCL environment, which are connected to the limitations of the communication media for the transfer of different types of information. Typically, CMC media are text-based, excluding the non-verbal (visual and audio) and back-channelling cues. Literature reports that the absence of these cues may hamper social interaction, impression formation, group formation, and group dynamics (Short, Williams, & Christie, 1976; Wallace, 1999; Walther, 1992), coordination of conversations and task accomplishment (Whittaker, & O'Connail, 1997), and grounding (Clark & Brennan, 1991).
- Ring 3: CSCL environment. This ring is concerned with barriers raised by the CSCL environment itself as software product and can be divided into two categories. The first is concerned with utility; the kinds of functionalities that CSCL environments offer to learners. Almost all contemporary CSCL

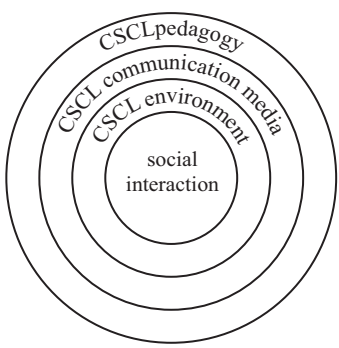

Figure 1.2 Rings of Barriers to Social Interaction

environments are designed and implemented with purely educational constraints in mind and, consequently, contain only educational functionalities. These *functional* CSCL environments limit the socio-emotional processes, which add to the difficulty in achieving group forming and group dynamics. The second is concerned with interaction design (Alben, 1997) and usability (Shneiderman, 1998). CSCL environments that do not meet the criteria of interaction design and usability are difficult to use and learn from.

If not all of the rings of barriers are overcome, the effectiveness of group learning may be rather limited.

1.3 Focus of the Research

The present research, reported on in this dissertation, focuses on designing *sociable* CSCL environments. Through the inclusion of social functionality, it is hoped for that social interaction for socio-emotional processes is enabled. This orientation towards social functionality (i.e., utility) means that the research concentrates on barriers raised by Ring 3. In addition, the research focuses on the effects of CMC systems on social interaction by examining social presence (see further) in CSCL environments integrating CMC systems. Therefore, the research also concentrates on barriers raised by Ring 2. It does not focus on the barriers in Ring 1 because much other research already focuses on them. It does, however, examine in a literature review how educational researchers have found strategies and solutions to cope with these barriers.

These aspects of the research determine the research activities, namely:

- Formulating a theoretical framework upon which the design of sociable CSCL environments can be based.
- Designing and implementing sociable CSCL environments.
- Performing empirical studies, that is, experiments for studying the effects of sociable CSCL environments deployed in asynchronous DLGs on social- and learning performances.

In order to carry out meaningful empirical research two more activities are added, those being:

- Formulating hypotheses about expected effects (which is a normal activity in every empirical study).
- Developing (as far as they do not exist) instruments for measuring phenomena related to the theoretical framework.

The first three activities roughly determine the basic structure of this dissertation, which is presented in more detail at the end of this chapter.

1.4 Theoretical Framework

The research is based upon a theoretical framework encompassing:

- The ecological approach to social interaction centered on the concept of social affordances (Gaver, 1996, Gibson, 1977, 1986; Kreijns, Kirschner, & Jochems, 2002),
- The concept of the sociability of CSCL environments (Kreijns, Kirschner, & Jochems, 2002), and
- Social presence theory (Gunawardena, 1995; Short, Williams, & Christie, 1976; Tammelin, 1998; Tu, 2000a, 2002c; Tu & McIsaac, 2002).

1.4.1 The Ecological Approach to Social Interaction: Social Affordances

The ecological approach to social interaction uses the concept of social affordances as central theme. Social affordances are the properties of a CSCL environment that act as social-contextual facilitators relevant for the learner's social interactions. This definition emphasizes the unique relationship between the CSCL environment and learners with respect to social interaction as does the definition of Bradner, Kellogg, and Erickson (1999) namely as "the relationship between the properties of an object and the social characteristics of a group that enables particular kinds of interaction among members of that group" (p. 153). Social affordances can be realized by independent devices (as suggested by the Bradner, Kellog, and Erickson definition) augmenting the CSCL environment, hence these devices are designated social affordance devices.

A typical example of a social affordance device in real-life settings is the coffee machine around which people may gather and have informal conversations about anything from task related problems to last night's football game or information about oneself (self-disclosure). Thus, these conversations contain fragments of both task-oriented and socio-emotional content. Here, we see social dynamics in action.

Proximity is an important dimension of social affordances. In our research we have operationalized social affordance devices by grounding them on the concept of tele-proximity (cf., Tang & Rua, 1994), that is, proximity that is artificially created with the aid of computers and networks with as goal the creation of group awareness: the up-to-the-minute knowledge about the others in their activities whether on-task or off-task (c.f., Borning & Travers, 1991). Social affordance devices based upon mechanisms for group awareness and tightly coupled with a set of communication media are called group awareness widgets (GAWs) (cf., Gutwin, Roseman, & Greenberg, 1996), tools aimed at increasing impromptu rather than planned encounters and increasing informal rather than formal communication both in on-task and off-task settings. In asynchronous distributed learning groups, social affordance devices also aim at bridging the time gap imposed by learning and working in a time-deferred mode.

Mechanisms for providing group awareness information may vary. For example, Xerox PARC and EuroPARC researchers use media spaces (Bly, Harrison, & Irwin, 1993). A media space is formed by the combination of audio, video, and computer networking technologies to provide group awareness about people working in collaborative groups. In contrast, a GAW displays group awareness information graphically and history information along a time-axis, thereby providing history. Other implementations of mechanisms for group awareness information may include abstract video images (Pederson & Sokoler, 1997a, 1997b) or sound (Ackerman, Starr, Hindus, & Mainwaring, 1997).

The set of communication media may include both asynchronous and synchronous media. Generally, a default set of CMC media is used: chat, computer conferencing, and e-mail. It may, however, be questioned whether such a set is optimal. With respect to the discussion about pitfalls and barriers, it is hypothesized that a different set of communication media may mitigate the negative effects of the barriers. Gay and Lentini (1995) suggest that a set should have a 'sufficient' variety of communication media so that learners can select the medium that suits their current needs. Research is needed to determine the right set of communication media in GAWs. That research is, however, beyond the scope of the research described in this dissertation.

1.4.2 The Sociability of CSCL Environments

The sociability of CSCL environments refers to how CSCL environments differ in their ability to facilitate the emergence of a *social space*; the human network of social relationships between group members which is embedded in group structures of norms and values, rules and roles, beliefs and ideals. To express the differences in the ability to create a social space, the term sociability is introduced. Sociability is defined as the extent to which the CSCL environment is able to give rise to a social space; or more precisely, the extent to which a CSCL environment is able to facilitate the emergence of a social space. No CSCL environment is in or of itself capable of creating a social space. People (i.e., learners/group members) and their activities (i.e., learning tasks) are needed to recognize and exploit this sociability potential of the CSCL environment. The research hypothesizes that the greater the sociability of an environment, the more it is likely that it will result in the emergence of a sound social space. A social space is designated to be ′sound′ if it is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction, and a strong sense of community. A sound social space determines, reinforces, and sustains the social interaction that is taking place amongst the group members.

1.4.3 Social Presence Theory

Short, Williams, and Christie (1976) characterize communication media in terms of their potential to communicate socio-emotional cues in such a way that the other person in the communication is perceived as 'physically' present. They define *social presence* as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (p. 65). This research defines social presence as the degree of psychological sensation in which the illusion exists that the other in the communication appears to be a 'real' physical person. Social presence affects the degree that social interaction takes place in CSCL environments (Gunawardena, 1995; Tammelin, 1998; Tu, 2000a, 2002c; Tu & McIsaac, 2002). Tu (2000a), linking social learning theory to social presence theory, concludes that "Social presence is required to enhance and foster online social interaction, which is the major vehicle of social learning" (p. 27); "If social presence is low the foundation of social learning, social interaction, does not occur" (p. 30). Garrison (1997b) contends that social presence is an important concept for understanding the social context and for creating a social climate in computer conferences.

1.4.4 Relationships between Sociability, Social Presence, and Social Space

The framework just presented suggests a number of relationships between the variables sociability, social presence, social space, and social interaction. These relationships are subsumed in the relationship model presented in Figure 1.3. Because the framework emphasizes the promotion of social interaction in the social psychological dimension, it complements those pedagogical techniques that emphasize social interaction in the educational dimension. Adding pedagogical techniques as a variable in the model acknowledges that in order to create a sound social space, the environment (i.e., the CSCL environment), the people 'inhabiting' the environment (i.e., the learners/group members), and the activities they carry out (i.e., those learning activities determined by the pedagogical techniques) are all equally important.

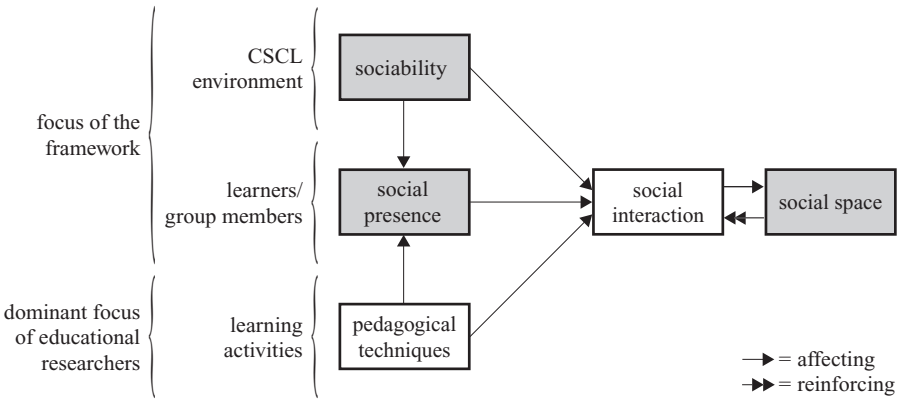

Figure 1.3 Model of Relationships between the Variables Sociability, Social Presence, Pedagogical Techniques, Social Interaction, and Social Space (Variables in the Grey Rectangles are those for Which an Instrument is Developed)

1.5 Hypotheses

The present research focuses on the following hypotheses implicated by the theoretical framework:

H_1: Social affordances contribute to the degree of perceived sociability of the CSCL environment

H_2: A higher perceived sociability of the CSCL environment increases the likelihood of the establishment of a sound social space

H_3: A higher perceived sociability of the CSCL environment increases the degree of perceived social presence

H_4: A higher perceived social presence increases the likelihood of the establishment of a sound social space.

1.6 Developing Instruments

A literature study on instruments for measuring the variables social space, sociability, and social presence revealed that they were either not existent (sociability) or were unsatisfactory (social space and sociability). Therefore, the present research has developed instruments for measuring each of the three variables social space, sociability, and social presence (see Figure 1.3).

1.7 Research Context

1.7.1 Characterization of DLGs

The research context is determined by the characterization of asynchronous DLGs typically encountered in distance education institutions such as the Open Universiteit Nederland (OUNL).

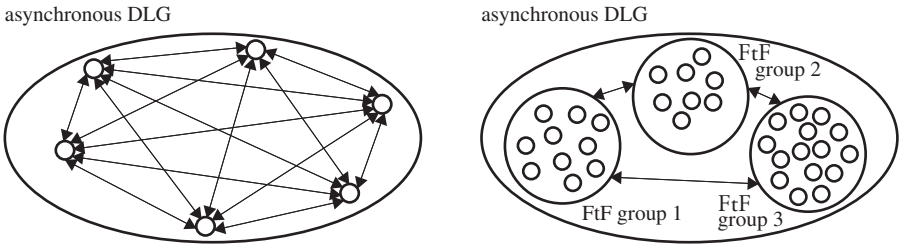

Figure 1.4 (left): Each student is a node in the network
(right): Each sub-group is a node in the network

The characterization encompasses:

- History: Participants are initially unacquainted with each other and the DLG, therefore, starts without a history. Face-to-face (e.g., kick-off) meetings are impractical due to the large geographic distance between participants.
- Asynchronicity: Collaboration is predominantly asynchronous and there is a long-term engagement (i.e., ranging from a couple of weeks to months). Time-deferred collaboration not only complicates the social-psychological and social processes taking place, but also complicates the task execution due to the need for task coordination and participation on problems. This in turn indirectly affects the social psychological and social processes.
- Sequencing: The DLG will be engaged in a number of tasks; the sequence of execution is not known in advance.
- Topology: We associate a node in an electronic network with a single computer connected to that network. Since OUNL-students usually work 'alone' and have their own computer, each group member is considered a node in the electronic network (Figure 1.4 left). Other educational settings, notably video conferencing, may use sub-groups of face-to-face contiguous members, each sub-group sharing one computer that connects the group with the computers of other sub-groups. Since a sub-group has only one computer, the sub-group is considered a single node in the network (Figure 1.4 right). The focus is on students working 'alone' with their own computer because the social interaction between individuals rather than between groups is the object of study.
- Group composition: Group composition comprises of group size, grouping of abilities, age, and gender. OUNL-groups typically have four to six members, but no more than twelve members. In addition, OUNL-groups are heterogeneous with respect to gender, age, and ability.

1.7.2 Interaction through Computers

The research context is also determined by the way CSCL environments are deployed in groups. Crook (1994, 1998) distinguishes three classes of interaction:

- Interaction *with* computers where an individual learner works on a computer-based learning program; the program is intended to 'replace' the instructor
- Interaction *at* and *around* computers where small groups of learners work on the same computer-based learning program at the same time; the program is intended to support the learners in their learning process

- Interaction *through* computers.

Because CSCL environments connect OUNL-students, all interaction between the students falls into the class of interaction through computers.

1.8 Structure of the Dissertation

1.8.1 Theory

The chapters 2 through 5 describe the theoretical issues related to the research.

Chapter 2 reports on the pitfalls and barriers imposed by the use of telecommunication media, in particular text-based CMC. It firstly discusses the two pitfalls educators may fall into when using CSCL, namely taking social interaction for granted and restricting social interaction to cognitive processes. The pitfalls connect to the three barriers organized as rings (see Figure 1.2). The chapter continues by describing the barriers in each ring. The first ring is concerned with the lack of CSCL pedagogy. The second is concerned with the social psychological effects and media effects on messages when traditional (e.g., audio only and video conferencing) and new communication media (e.g. e-mail and computer conferencing) are involved in communication activities. Media richness and social presence theory pertain to that media research. The third is concerned with the CSCL environment itself, that is, the lack of social functionality and issues about interaction design and usability.

Chapter 3 discusses a series of educational techniques that may be used to overcome the barriers. The impetus here is, however, more on the barriers in the first ring than on those in the second and third rings. This is the traditional focus of educational researchers. The chapter presents four techniques, namely applying collaborative learning in DLGs, incorporating interactivity into web-based CSCL environments, changing the instructor's and the learner's role in DLGs, and increasing social presence in DLGs. The last educational technique begins to break down the barriers in the second ring.

In Chapter 4, an alternative approach is described for coping with the barriers and which forms the central theme in this dissertation. This alternative approach suggests an ecological approach to social interaction implying that the primary object of study is the CSCL environment itself and not the educational techniques nor the pedagogical methods. Environmental properties of the CSCL environment –referred to as social affordances– are seen as being co-responsible for the degree in which social interaction is taking place. The alternative approach is formulated in a theoretical framework, which, in addition to the ecological approach, includes the concepts of sociability and social presence. The framework is used as a guideline for designing and implementing sociable CSCL environments. Therefore, the focus of this chapter is on the barriers of the third ring and partly on the barriers of the second ring, because the framework addresses social presence.

Based upon the theoretical framework in Chapter 4, Chapter 5 describes the design of a special kind of social affordance devices, namely GAWs. It discusses the dimensions that GAWs have and the goals of these GAWs. GAWs are the answer to *what* has to be designed in order to create sociable CSCL environments. The chapter continues with *how* these GAWs have to be implemented and discusses two important issues in this area: interaction design and usability.

1.8.2 Instrumentation

The chapters 6 through 9 focus on the instruments needed for performing the empirical research, namely a first GAW prototype and instruments for measuring social space, sociability, and social presence (see Figure 1.3). A close examination of the current literature revealed that although a number of instruments do exist for measuring social presence, these instruments tend to measure other variables as well (i.e., social cohesiveness and feelings towards the medium used). These social presence instruments are also used for measuring social climate or social environment. In addition, the literature revealed that no sociability or social space instruments exist. This led to the conclusion that instruments for measuring social space, sociability, and social presence had to be developed.

Chapter 6 reports on the realization of a first prototype of a GAW. It first describes its architecture in which an underlying network infrastructure is considered. This network infrastructure is centered on an event notification server (the open source SIENA event service is used) and a global repository (based on the open source MySQL application) running on a Linux™ based system. The GAW prototype augments a Microsoft® Sharepoint™ Team Services (SPTS) environment used as the CSCL environment. The chapter briefly describes this environment as well as two CMC-typed media that are used in conjunction with the GAW prototype and Microsoft® SPTS; these media are a web-based e-mail application (WebmailASP) and a web-based chat application (ZBIT chat).

Chapter 7 reports on the construction and validation of the Social Space Scale. The findings show that the Social Space Scale has potential for measuring social space.

Chapters 8 and 9 do the same for sociability and social presence respectively. Both instruments have potential for measuring the corresponding constructs.

1.8.3 Experimental

Chapter 10 reports on a pilot study, which is preliminary to a series of experiments testing the four hypotheses. This pilot study uses a distance course on human-machine interaction at the Department of Informatics of the OUNL. Distance learning groups in two conditions –with and without the use of a GAW prototype – were to be compared. However, due to a number of reasons (e.g., characteristics of the distance students at the Open Universiteit Nederland, the use of the Microsoft® SPTS CSCL environments), results were not obtained. The pilot made clear that, although not preferable, laboratory experiments should be conducted first and only then the field experiments.

1.8.4 Epilogue

Finally, Chapter 11 is a general discussion of four issues. Firstly, the findings of the research are summarized. Secondly, the weaknesses of the research are discussed and the findings are evaluated against relevant related research. Thirdly, the implications of this research for distance education, and in particular for the Open Universiteit Nederland, are expounded. Finally, contours of future research are suggested.

CHAPTER 2

Pitfalls and Barriers to Social Interaction

Abstract

Social interaction has been identified as a key element in group learning. This social interaction is not only necessary for stimulating cognitive processes but also for socio-emotional processes to occur, which are underlying group forming and group dynamics. The literature suggests that creating a sense of community, trust and belonging, and social cohesiveness amongst learners play an important role in facilitating learning behavior and in increasing learning performance. The problem is that not all computer-supported collaborative learning environments used by distributed learning groups appear to be able to enable social interaction and group dynamics. The use of communication media embedded in these computer-supported collaborative learning environments present a number of pitfalls and barriers that potentially impede social interaction. This chapter describes the two pitfalls educators have to avoid and the barriers that they have to be overcome to achieve this needed social interaction. Without it, the effectiveness of group learning may decrease.

This chapter is based on parts of:

Kreijns, K. & Kirschner, P. A. (2004). Designing sociable CSCL environments: Applying interaction design principles. In P. Dillenbourg (Series Ed.) & J. W. Strijbos, P. A. Kirschner, & R. L. Martens (Vol. Eds.), *Computer-supported collaborative learning: Vol 3. What we know about CSCL ... and implementing it in higher education* (pp. 221–244). Boston, MA: Kluwer Academic Publishers.

Kreijns, K., Kirschner, P. A., Jochems, W. (2003b, August). *Supporting social interaction for group dynamics through social affordances in CSCL: Group awareness widgets*. Paper presented at the 10th European Conference for Research on Learning and Instruction (EARLI). Padova, Italy.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003a). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior*, *19*(3), 335–353.

2.1 Introduction

Collaborative learning provides the social context where learners may become actively involved in cognitive processes such as grounding, critical thinking, and knowledge construction, which benefit deep learning and retention of the concepts learned (Biggs, 1987; Johnson, Johnson, & Stanne, 1985; Newman, Johnson, Webb, & Cochrane, 1997). Although a number of variables such as group size (Cooper, Prescott, Cook, Smith, Mueck, & Cuseo, 1990; Slavin, 1995), group composition (Brush, 1997; Webb, Nemer, Chizhik, 1998), task nature (Steiner, 1972), and learning styles (Grasha, 1996; Witteman, 1997) are identified as factors potentially influencing the effectiveness of collaborative learning, researchers have gradually concluded that ultimately all these factors affect –one way or another– one single key element: *social interaction*. For example, Hooper and Hanafin (1991) who studied the effects of group composition on learning, found that "achievement differences attributable to group composition correspond to differences in intra-group interaction" (p. 28). They concluded that "the nature of intra-group cooperation is potentially of greater importance than group composition per se" (p. 28). This confirms the notion that learning is fundamentally built up through the social interactions between learners (Biggs & Collis, 1982; Kearsley, 1995; Laurillard, 2002; Lethinen, Hakkarainen, Lipponen, Rahikainen, & Muukkonen, 2001; Moore, 1993; Schegloff, 1991; Vygotski, 1978; Wagner, 1997). For example, Kearsley (1995) states that "one of the most important instructional elements of contemporary distance education is interaction. It is widely held that a high level of interaction is desirable and positively affects the effectiveness of any distance educational course" (p. 83). Social interaction appears to be particularly important for achieving shared understanding and the construction of knowledge based on the social negotiation of views and meanings. Hiltz (1994) underlines this when she states that "the social process of developing shared understanding through interaction is the 'natural' way for people to learn" (p. 22).

Social interaction is not only important for the occurrence of cognitive processes for learning, but is equally important for socio-emotional processes entailing affiliation, attraction and impression formation, the development of social relationships and the creation of a sense of cohesiveness and community feelings (Harasim, 1991; Henri, 1992). *Affiliation* is the propensity people have to get in contact with others. A reason for affiliation within a collaborative DLG is that group members perceive that they are mutually dependent on each other for successfully accomplishing the working- and learning tasks, so they have to get in contact with each other. *Impression formation* is a social cognitive process in which one develops individuating impressions of the others, in other words, where group members 'get to know each other.' Each group member must develop individuating impressions of the co-members. Based upon these impressions, they can develop social work-relationships with the other group members. The kind of *social relationship* is, amongst other things, determined by the *attractiveness* of the co-member. Attractiveness is the feelings that a group member has about the other group members, which is influenced by affection, status, and competence.

Socio-emotional processes are the base of group forming and group dynamics, resulting in the establishment of a normative structure (encompassing norms, values and believes), an affective structure, group cohesiveness, a communication structure, and a role structure (Forsyth, 1999). A performing group usually develops in a number

of stages. Tuckman & Jensen (1977), based on Tuckman (1965), proposed a five stage model: forming, storming, norming, performing, and adjourning. Only groups reaching the stage of performing are oriented towards their learning tasks and are effectively accomplishing these. This is due to the existence of a *sound social space* in these groups, which is characterized by committed social relationships, strong group cohesiveness, trust and belonging, and a sense of community implying that the group has become a healthy community of learning. These qualities enable the reinforcement of social interaction for cognitive processes encompassing open critical dialogues without harming or offending any member because members know and trust each other. This notion is supported by Wegerif (1998) who observed that "forming a sense of community, where people feel they will be treated sympathetically by their fellows, seems to be a necessary first step for collaborative learning. Without a feeling of community people are on their own, likely to be anxious, defensive and unwilling to take the risks involved in learning" (p. 48). Once positive affective relationships and a sense of community have been established, enhanced task accomplishment may be achieved (Gunawardena, 1995). Feelings of community can increase the flow of information between (all) learners while encouraging support, commitment to group goals, cooperation among members, and satisfaction with group efforts. In other words, a sound social space promotes positive feelings between group members to such an extent that learners benefit by experiencing a greater sense of well-being and having a larger set of willing individuals to call on for support (Rovai, 2001, 2002a, 2002b).

A sound social space also contributes to a positive social climate within the group (Brandon & Hollingshead, 1999; Rourke, 2000; Rourke & Anderson, 2002). Guzzo and Dickson (1996) have found that *group cohesion* enhances task performance and effectiveness. Warketin, Sayeed, and Hightower (1997) found that "relational links among team members were found to be a significant contributor to the effectiveness of information exchange" (p. 975).

Trust is also important. *Trust* is defined as the cognitive and affective assurance of group members that they respect each other's interests and, therefore, can orient themselves towards each other's words, actions, and decisions with an easy conscience (Emans, Koopman, Rutte, & Steensma, 1996). Johnson and Johnson (1989) emphasize interpersonal trust as another factor enabling effective collaboration and consider it a central dynamic of promotive interaction. Lack of trust impedes cognitive processes taking place; "To disclose one's reasoning and information, one must trust the other individuals involved in the situation to listen with respect" (p. 72). Moreover, trust is needed because group members will not participate collaboratively if they do not know with whom they are communicating (Smith & Kollock, 1998). Strong personal relationships also allow members in a DLG to enthusiastically share knowledge (Von Krogh, Nonaka, Ichijo, 2000).

All of these findings suggest that *group dynamics* are important and may positively affect the learning outcome: "collaborative learning involves social interactions between participants, and the psycho-social processes underlying collaborative interactions could be an important factor that impact learning" (Jehng, 1997, p. 22). Similarly, Jacques (1992) stated that a "lack of attention to the socio-emotional dimension means that many of the task aims cannot be achieved. Without a climate of trust and cooperation, students will not feel like taking the risk of making mistakes and learning from them" (p. 72). Social interaction towards social-emotional processes should, therefore, be stimulated.

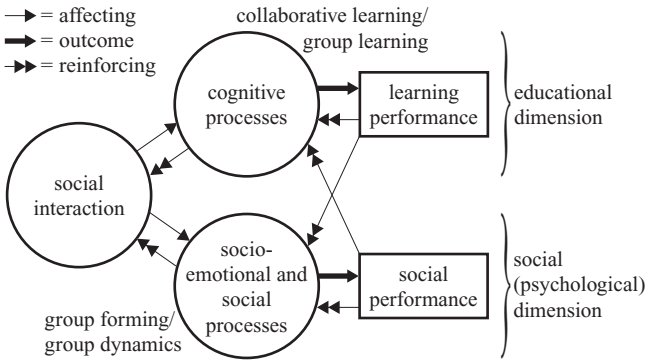

Figure 2.1 The Two Dimensions of Social Interaction

The two dimensions of social interaction –educational and (social) psychological– are depicted in Figure 2.1. This is in line with Hare and Davies (1994; see also Brown & Yule, 1983) who categorized interaction as either task-driven or socio-emotional. *Learning performance* encompasses variables like efficiency and effectiveness relative to the task outcome, retention of what is learned, and degree of shared understanding. *Social performance* encompasses variables like the degree of established social space, sense of community, and degree of trust.

As can be seen in Figure 2.1, learning performance and social performance not only 'reinforce' (see double arrows) their direct precursors cognitive processes (e.g., critical thinking) and socio-emotional/social performances (e.g., formation of group structures) respectively, but also 'cross-reinforce.' For example, if the group is successful in achieving the goals of the task, then this may increase the group cohesion (Mullen & Cooper, 1994), and if there is trust, then this reinforces open communication thereby enhancing critical thinking (Jacques, 1992; Rourke, 2000). If social interaction exists in both dimensions, collaborative learning will increase the effort to achieve, and promote caring and committed relationships, and increase participant's psychological health and well-being (Johnson & Johnson, 1992, 1994).

2.2 CSCL Environments

2.2.1 CSCL Environments Look Promising

Educators, educational technologists, and educational researchers generally believe that the emerging computer-supported collaborative learning (CSCL) environments are the long awaited, powerful learning environments that offer new pedagogical horizons that go beyond those in face-to-face settings. In addition to the 'anyplace-anytime' characteristic that these environments make possible, they are also seen as being able to increase learner's responsibility, initiative, participation, and social interaction because they facilitate these processes through the use of integrated CMC systems (Koschmann, Hall, & Miyake, 2002; Lethinen, Hakkarainen, Lipponen, Rahikainen & Muukkonen, 2001). Consequently, the learning experience is enriched both in the learner's satisfaction and the learner's learning outcome because the design of the CSCL environments is guided by relatively new educational paradigms such as active learning (Felder & Brent, 2001; McKeachie & Hofer, 2001; Silberman, 1996),

collaborative learning (Johnson & Johnson, 1994; Slavin, 1995), grounding (Clark & Brennan, 1991; Mulder, Swaak, & Kessels, 2002), constructivism (Bednar, Cunningham, Duffy, & Perry, 1995; Von Glaserfeld, 1995; Jonassen, 1994; Palincsar, 1998), and competence based learning (Keen, 1992; Van Merriënboer, Van der Klink, & Hendriks, 2002; Short, 1984).

2.2.2 Three Categories of CSCL Environments

Depending on which design criteria were used, CSCL environments that vary in educational functionality are implemented; some provide parsimonious functionality while others are the forerunners of future all-inclusive environments. Three categories of CSCL environments can be distinguished:

- The first category represents those CSCL environments that are actually CMC systems. Most CSCL environments fall into this category and are usually text-based computer conference systems (e.g., newsgroups or discussion boards) or e-mail based systems (e.g., list servers).
- The second category represents the highly specialized CSCL environments serving one or more educational functionalities. One class of educational functionality concerns the support of epistemic fluency (see Chapter 3; Morrison & Collins, 1996; see also Ohlsson, 1996) that emphasizes critical discourse and critical thinking (Duffy, Dueber, & Hawley, 1998; Garrison, Anderson, & Archer, 2000; Newman, Johnson, Webb, & Cochrane, 1997). One such CSCL environment is the Belvédère electronic environment (Paolucci, Suthers, & Weiner, 1995; Suthers, & Weiner, 1995). Belvédère stimulates (scientific) argumentation through the use of the graphical representation of knowledge as objects. Another class of education functionality concerns the support of epistemic fluency that emphasizes shared understanding (Clark & Brennan, 1991). A CSCL environment that supports this kind of educational functionality is CSILE.[I] CSILE use a collective knowledge database as the center of attention in a classroom. Its objective is to encourage learners to address issues, problems, and arguments instead of addressing the teacher or peers (Scardamalia & Bereiter, 1994, 1996). FLE (Future Learning Environment) is oriented towards epistemic interaction emphasizing progressive inquiry and knowledge building (Muukkonen, Lakkala, & Hakkarainen, 2001). A final example of a CSCL environment in this category is that of Soller (1999) and Soller, Lesgold, Linton, and Goodman (1999). They describe an intelligent CSCL environment that stimulates effective collaborative learning in three areas: conversation, active learning, and creative conflict. Communication occurs through a chat interface that prescribes that each sentence must start with a predefined sentence opener such as 'Can you tell me more' (request for elaboration) and 'I think' (suggestion); otherwise, one cannot continue. Dillenbourg (2002) calls this type of functionality 'scripting.'
- The third category represents the generalized (commercial) systems for course and courseware management, supporting whole classrooms such as Blackboard,[II]

[I] CSILE (Computer-Supported Intentional Learning Environment), developed at the Ontario Institute for Studies in Education, is commercially available since 1997 under the name Knowledge Forum. CSILE is also meant for classroom use.

[II] The Blackboard home site is http://www.blackboard.com.

WebCT[I] (Fuller, Awyzio, & McFarlane, 2001), and FirstClass.[II] Examples of non-commercial systems are BSCW[III] (Stahl, 2004; Sikkel, Gommer, & Van der Veen, 2001), Moodle,[IV] and dotLRN[V].

2.2.3 Inconclusive Findings

Educators expected CSCL environments to meet the envisioned expectations. Unfortunately, not all DLGs using the CSCL environments proved to be successful. The research literature shows inconclusive results: a vast body of it reports positive findings (e.g. Cronjé, 1997; Gunawardena, 1995; Koschmann, Feltovich, Myers, & Barrows, 1995; Lipponen, 1999; Tynjäla, 1999), but these are often explorative or present anecdotal evidence and rarely provide sound empirical evidence (Brush, 1998, Bullen, 1998, Rourke & Anderson, 2002). In contrast, there is also a vast body of the literature reporting mixed or negative findings. These findings can be classified into two interrelated categories. The first category lists failures regarding the learning process itself. For instance, Hallet and Cummings (1997), using a Web-based environment designed to promote authentic and interactive learning experiences, report that by "having the majority of assignments in public forums with the entire class posting at a given time, and with numerous prompts and encouragement from the instructor, it was hoped that interaction among students would occur naturally. This was not what took place" (p. 105). Mason (1991), Gregor and Cuskelly (1994), and Heath (1998) report similar or mixed findings.

The second category lists failures in group forming and group dynamics in the groups. Hiltz (1998), for example, argued that "One of the potential negative effects of online courses is a loss of social relationships and a sense of community that is usually present on a traditional campus" (¶ Abstract). Hughes and Hewson (1998) contend that the absence of face-to-face, peer, or teacher interaction leads to negative educational experiences because of social isolation and working in an apparently impersonal environment (cf., Taha & Caldwell, 1993). Gunawardena (1995) pointed out that "in computer conferences, the social interactions tend to be unusually complex because of the necessity to mediate group activity in a text based environment. Failures tend to occur at the social level far more than they do at the technical level" (p. 148). Finally, Hobaugh (1997) argues that the dynamics among group members is often the major cause of ineffective group action (cf., Bubaš, 2001).

These findings point to the impediment of social interaction and to the difficulty of achieving group forming and group dynamics despite the fact that CSCL environments have built-in CMC systems. The same communication media that are enabling social interaction are apparently, at the same time, impeding social interaction! Examining the body of the research literature reporting the mix and negative findings identifies two pitfalls (see next section) that may inhibit the successful deployment of CSCL environments. However, these pitfalls only explain why educators do not pay attention to this impediment of social interaction and the

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[I] The WebCT home site is http://www.webct.com.

[II] The FirstClass home site is http://www.softarc.com.

[III] The BSCW home site is http://bscw.gmd.de.

[IV] The Moodle home site is http://moodle.org/.

[V] The dorLRN home site is http://dotlrn.org.

difficulties in achieving the group formation and group dynamics; they do not explain why this happens. For this, another body of research literature was studied. This literature concerns computer-supported cooperative work, computer-human interaction, social psychology of using communication media, group dynamics, organizational behavior, and media theories. The study revealed a number of barriers that explain the phenomena. The next two sections will examine more in depth the pitfalls and barriers.

2.3 Pitfalls to Social Interaction

2.3.1 Taking Social Interaction for Granted

If social interaction is crucial in interactive group learning, then it must determine how to encourage, instrument and facilitate it. Kearsley (1995), found that almost all "recommendations emphasize that interactivity must be planned or it is unlikely to occur (or be meaningful)" (p. 87, 88). The same observation is also made by both Liaw and Huang (2000) who noted that in "a learning environment, interaction does not simply occur but must be intentionally designed into instructional programs" (p. 41) and Northrup (2001) who determined that the "social interaction of the course must, at least initially, be designed into the course" (p. 32). The problem is that most educators do not know what they have to do in order to encourage social interaction. Rourke and Anderson (2002) reported that "the special nature of interaction in asynchronous, text-based environments is not well understood. Several authors advise instructors not to neglect the social environment of the conference, but few offer research-based suggestions about exactly what this entails" (p. 260). Kearsley (1995) adds that "the idea that interaction must be explicitly designed in distance education courses seems a difficult concept for many instructors to accept or understand" (p. 88). Therefore, what remains is the observation that a majority of educators –consciously or unconsciously– takes social interaction for granted. They think that because social interaction is 'always' present in contiguous learning groups, the same will be true in DLGs. However, social interaction does not automatically emerge, even in contiguous learning groups. Rourke (2000) concluded that social interaction can no more be taken for granted in computer conferences than it can be in face-to-face settings such as lecture halls or small seminar settings. Putting six students in a room with a table, chairs, whiteboard, coffee, and donuts does not make an effective team.

This is the first pitfall, namely taking for granted that social interaction will automatically occur just because technology allows it. Although CSCL environments allow a certain degree of social interaction to take place, it is no more a matter of course than it is in face-to-face settings. Organizational researchers such as Olson and Olson (2000) note that ''with the invention of groupware, people expect to communicate easily with each other and accomplish difficult work even though they are remotely located or rarely overlap in time'' (p. 139). Wagner (1994) concludes that the ''growing 'folk' acceptance of a causal relationship between system interactivity [the degree a system allows for interaction] and instructional interaction has placed an unrealistic expectation on interactive technologies to ensure that instructional interaction do occur'' (p. 8). Therefore, just providing members of a distributed learning group with more communication media than they already have (but possibly with characteristics that make these more appropriate for certain kinds of communication activities which require social interaction) automatically neither fosters

nor ensures social interaction. Although these media can contribute to a more suitable condition for the execution of the communication tasks, they do not guarantee that the desired social interaction will take place. In other words, availability of communication media is necessary, but not sufficient.

2.3.2 Restricting Social Interaction to Cognitive Processes

Educators who recognize the first pitfall and take action to avoid it, often tend to limit their actions to the task context (i.e., tightly related to the collaborative execution of learning tasks) and the educational dimension (i.e., social interaction solely in service of the cognitive processes or other educational purposes). This, however, might not be enough. Rourke (2000) remarks that "if students are to offer their tentative ideas to their peers, if they are to critique the ideas of their peers, and if they are to interpret others' critiques as valuable rather than as personal affronts, certain conditions must exist (…) students need to trust each other, feel a sense of warmth and belonging, and feel close to each other before they will engage willfully in collaboration and recognize the collaboration as a valuable experience." He emphasizes that in order to elicit these conditions students need to trust each other, feel a sense of warmth and belonging, and feel close to each other before they will engage willfully in collaboration. Cockburn and Greenberg (1993), Gunawardena (1995), and Northrup (2001) stress the need for relationship building and sharing a sense of community and a common goal.

This research suggests a social (psychological) dimension of the social interaction in collaborative learning, which relates to the socio-emotional aspects of group forming and group dynamics. In other words, it relates to processes that have to do with getting to know each other, committing to social relationships, developing trust and belonging, and building a sense of (online) community. These processes are not directly related to the task in the strict sense. If group members are initially not acquainted with each other and the group has zero-history (which is often the case in distance education institutions like the Open Universiteit Nederland), group forming, developing a group structure, and group dynamics are very important for developing a learning community. Otherwise, the risk is very high that learners become isolated and depressed because they are confronted with a lonely learning experience. Contemporary CSCL environments may not provide adequate opportunities for social interaction, the development of friendships and camaraderie (Clark, 2000; Hiltz, 1997, 1998).

Wegerif (1998) emphasizes the point that "many evaluations of asynchronous learning networks understandably focus upon the educational dimension, either learning outcomes or the educational quality of interactions, overlooking the social dimension which underlie this" (p. 34). Adapting Gilroy's (2001) formula, it can be concluded that:

Valued Learning Experience = F (Pedagogy, Content, Community)

If any one of the three variables approaches zero, the function also approaches zero. This means that we need all the three variables to exist at the same time, i.e. a functional pedagogy for instruction, relevant content to be learned, and a performing community of learning. Otherwise, the learning experience will be low or will non-existent.

The validity of this formula is, for example, supported by Liaw and Huang (2000) who found that social and interpersonal interaction can directly foster the interaction between content and instruction. This 'objective' effect is compounded by the more 'subjective' effects found by Zhang and Fulford (1994) and Northrup (2001) who have suggested that students' perceptions of the efficacy of social interaction in a course can have significant effects on learning outcomes.

These observations lead to the second pitfall, namely restricting social interaction to solely the cognitive processes in learning and ignoring or forgetting the importance of the social (psychological) dimension of social interaction for group forming, group structure, and group dynamics, all of which are necessary for building learning communities. This is what McGrath (cited in McConnell, 1994,) calls the 'member support and group well being functions' which are so important in successful technology mediated group work, yet which are often neglected, or worse, never considered.

2.4 Barriers to Social Interaction

The utilization of CSCL environments has introduced a number of potential barriers that may impede social interaction. These barriers are either non-existent or not salient in face-to-face settings. There are three categories of barriers that are organized into three 'rings' (see Figure 2.2).

- Ring 1: CSCL pedagogy. The barrier raised here is that there is yet no suitable pedagogy that fits the specific CSCL context (i.e., the use of asynchronous DLGs and CSCL environments).
- Ring 2: CSCL communication media. This refers to the barriers raised by the limitations of the communication media regarding the transfer of different types of information.
- Ring 3: CSCL environment. This ring is concerned with barriers raised by the CSCL environment itself as a software product. The barriers in this ring can be divided into two categories. The first category is concerned with utility, the second category with interaction design and usability.

When all barriers are overcome, chances are high that social interaction, and consequently collaborative learning and group forming and group dynamics will occur in a CSCL environment. Each ring is now described in more detail in the next sections.

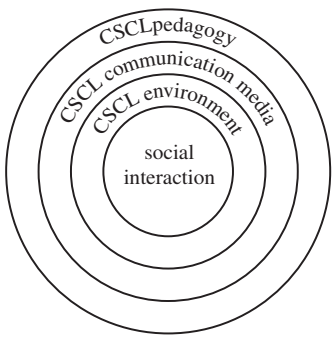

Figure 2.2 Rings of Barriers to Social Interaction

2.4.1 The First Ring: CSCL Pedagogy

The first ring is concerned with determining the right pedagogy to fit distributed learning groups in a CSCL setting. However, there is no CSCL pedagogy available that fully exploits the potential of CSCL environments and, at the same time, takes into account the effects that communication media may have on learning (Brandon and Hollingshead, 1999). Van Merriënboer (2002) observes that forms of e-learning in which learners actively work on rich tasks and where the active construction of knowledge and the acquisition of skills are central themes in a social process, are extremely rare if not non-existent. The absence of a CSCL pedagogy may tempt (distance) educators to use ad-hoc pedagogical techniques for collaborative learning. In most cases, this comes down to placing learners in groups and telling them to complete an instructional activity. This, however, does not guarantee that the group members will engage in social interaction and, thus, in collaborative learning activities (Johnson & Johnson, 1994). While this is true in face-to-face classroom, it may be even truer in CSCL environments (see the next section).

2.4.2 The Second Ring: CSCL Communication Media

The application of CMC systems in CSCL environments may induce new barriers or make a number of barriers already existent in face-to-face settings more salient. These barriers range from coordination problems to social psychological phenomena. The accumulation and the interplay of these barriers explain, to a certain degree, the impediment of social interaction and the hampering of group forming and group dynamics in CSCL environments. However, understanding the barriers in the second ring fully requires an understanding of the effects that communication media may have on a number of communication tasks. Several media theories explain the effects. Therefore, these media theories are first described before proceeding to describe the barriers.

2.4.2.1 *Communication Media Theories*

Social psychologists, researchers on organizational behavior, and (distance) educational researchers have raised questions about the effectiveness of communication media on a variety of issues. Social psychologists are interested in how differences in telecommunication media change the relational aspects of communication. Short, Williams, and Christie (1976) have proposed their *social presence theory* for examining this issue. Communication researchers are interested in whether matching communication media with messages, emerging from some communication activity, increase effectiveness in message transfer. *Media richness theory* (Daft & Lengel, 1986) represents this perspective. Educational researchers are interested how different media influence grounding. Clark and Brennan (1991), for example, present criteria that can be used to evaluate communication media and the cost it takes to achieve common ground using these media. Before going into too much detail on each perspective (and the corresponding theory), we present in the next sub-section a number of dimensions by which a communication medium can be characterized. This can be used as a reference framework for comparing communication media.

Characterization of Media along Functional and Technical Dimensions

Communication media consist of a number of channels that may differ in modality (i.e., text-based, audio, visual, tactile, etc.) and fidelity (i.e., the extent to which a communication channel is capable of accurately reproducing the sender's images and sound at the receiver's site). In addition, communication media are divided into immediate (i.e., synchronous) and delayed (i.e., asynchronous) media, and into simplex (i.e., one-way communication such as a radio), half-duplex (i.e., two-way communication through sharing the same channel such as a walkie-talkie), and full-duplex media (i.e., two-way communication through the use of an extra channel[I], the two channels being symmetrical such as a telephone). The advantage of full-duplex media is that they enable instantaneous feedback: feedback can be given while the message is being delivered[II]. Full-duplex communication requires media to be synchronous. Finally, communication media may differ in message distribution: one-to-one (e.g., e-mail), one-to-many (e.g., mailing lists), many-to-one (e.g., drop boxes), and many-to-many (e.g., computer conferencing). Along with these functional dimensions, communication media also have technical dimensions: Communication channels may differ in their capacity for transmitting information from sender to receiver (i.e., bandwidth), latency-time (i.e., the time-lag between sending the message and receiving this message caused by coding, transmitting, and decoding the message), reliability (i.e., can we rely on the communication media to function without failure?), and availability (i.e., can we rely on the communication media systems to be up-and-running without any time lost?).

These dimensions are illustrated in the following example: Internet desktop video-conferencing using a web-cam (e.g., Microsoft® Netmeeting™) can be characterized as a synchronous medium, which is actually made up of two other media: one for visual and one for audio information. Common desktop video-conferencing allows for full-duplex one-to-one communication. Visual channels require a higher channel capacity than the audio channel because visual information has a higher information density (see, Weaver and Shannon, 1963, from the perspective of information theory). However, due to heavy traffic load on internet, the required channel capacity may not always be available, resulting in delayed and distorted images and audio. Some latency time may be expected because of the high processing involved in the coding and decoding of the images. The particular desktop video-conference system determines its reliability, availability, and fidelity; common desktop video-conferencing systems have moderate levels of reliability and availability; they have low to moderate levels of fidelity.

Another example is face-to-face settings. Although these are 'unmediated' environments, they can be thought of as one single synchronous communication

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[I] Technically, channels are a artificial constructs, meaning that it is not necessary to have a wire for each channel. Through sharing, a single wire may have a multiplicity of channels. In half-duplex communication sharing is based on time-multiplexing using the same frequency; only one party at a time can talk. In full-duplex communication sharing is based on frequency-multiplexing; both parties can talk simultaneously.

[II] Kraus and Weinheimer (1966) call this kind of feedback concurrent feedback and Duncan (1973) calls it backchannel feedback. When researchers refer to the terms backchanneling cues (e.g., Walther, 1992, p. 54), they mean the feedback cues that are concurrently produced and sent back to the sender. Kraus and Weinheimer also define sequential feedback which is feedback produced after the message is entirely delivered.

medium comprising multiple channels covering all thinkable modalities[I]. Face-to-face settings allow for full-duplex communication and all the different message distributions are possible. Since technology is absent here, problems with low channel capacities, long latency times, moderate reliability, moderate availability, and low to moderate fidelity do not exist.

Media Richness Theory

Media richness theory (Daft & Lengel, 1986) and social presence theory (Short, Williams, & Christie, 1976) suggest that organizational task activities should be matched with appropriate communication media in order to achieve optimal communication efficiency and satisfaction (Rice, 1993). *Media richness theory*, concerned with reducing ambiguity or equivocality in task-related messages, suggests that task activities needing the exchange of rich information (e.g., strategic decision-making tasks) are best communicated via rich media. "Media richness represents the extent to which media are able to bridge different frames of reference, make issues less ambiguous, or provide opportunities for learning in a given time interval, based on the medium's capacity for immediate feedback, the number of cues and senses involved, personalization, and language variety" (Rice, 1993, p. 452–453). Communication media can be designated as rich media or lean media according to a blending of four criteria (Trevino, Daft, & Lengel, 1990), namely the *availability* of *instant feedback* (i.e., making it possible for communicators to converge quickly upon a common interpretation or understanding), the *capacity* to transmit *multiple cues* like body language and verbal sounds (i.e., to convey interpretations), the *use* of *natural language*, rather than numbers[II] (i.e., to convey subtleties), and the *personal focus* (i.e., personalization: the extent to which the senders can adapt their messages towards individual needs of the receivers). According to these criteria, media richness decreases from face-to-face to telephone, to e-mail, to written personal, to written formal, and finally to numeric formal media. When communication media are also positioned along the dimensions of the reference framework, it may be concluded that the more synchronous, full-duplex channels available, accounting for as much different types of modalities with the highest fidelity, the richer the medium is.

[I] With respect to the information channels, Allen (1994) points out that "humans in unmediated environments do not seem to frame their perceptions or actions in terms of information channels; rather, they appear to organize both their perception and their reasoning in terms of objects and agents of action. In spite of separate pathways for sensory information dictated by different cranial nerves for vision, olfaction, and audition, our capabilities of perception, memory, and language integrate across sensory modalities and our minds attend to avenues for exploration and action. " (p. 34). This means that we actually cannot think in terms of separate information channels but have to take a more integrative and holistic approach when studying the effects of multiple channels on the individual's perception.

[II] Originally, Daft and Wiginton (1979) defined nine different types of languages which are summarized by Daft, Lengel, & Trevino (1987) into two broad categories: natural language and numbers. Natural language represents the set of high variety languages (e.g., art, non-verbal cues, poetry, general verbal expression, jargon, linguistic variables) that are associated with the unrestricted use of symbols for increasing its expressive power. High variety languages can express a wide range of ideas, meanings, and emotions. Numbers represent the set of low variety languages (e.g., mathematics, probability theory, computer languages) that restricts symbols in their use. Low variety languages can express only a narrow range of ideas but give exact, unequivocal meaning to users.

Social Presence Theory

Social presence theory (Short, Williams, & Christie, 1976) is very similar to media richness theory. *Social presence theory* is concerned with interpersonal relationships rather than with message equivocality and suggests that task activities needing a strong interpersonal characteristic (i.e., tasks that depend on developing and maintaining mutual trust such as conflict-resolution tasks or negotiation tasks) require communication media that are high in social presence. Short, Williams, and Christie define social presence as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships …" (p. 65) and hypothesized "that telecommunications media vary in their degree of Social Presence, and that these variations are important in determining the way individuals interact" (p. 65). Other social presence researchers propose similar definitions. One group puts the emphasis on the awareness of the other in such a way that the other appears to be a 'real' physical person during the interaction (e.g., Gunawardena, 1995). Another group puts the emphasis on the competence to project oneself as a 'real' physical person in the interaction (e.g., Garrison, Anderson, & Archer, 2000). According to Short, Williams, and Christie social presence depends on the number of cues that can be transferred by the communication medium. These cues are expressed by vision (i.e., 'body language': facial expression, direction of gaze, posture, gestures, eye-contact), audition (i.e., voice volume, inflection loud/soft speaking), tactile (i.e., touch), and olfaction (i.e., the smells, body odors). They argue that social presence is an attribute of the medium (and here designated as *classical* social presence theory). Many educators reject that assumption arguing that the 'real' determinants are social by nature (e.g., Gunawardena, 1995) and are not the attributes of the medium. However, this dissertation considers social presence to be co-determined by the physical characteristics of the communication medium and by a contingency of social influence factors such as social context, social processes, and so forth (and is designated as *new* social presence theory). The dominant social presence measurement instrument is a set of four, 7-point semantic differential scales: personal–impersonal, sensitive–insensitive, warm–cold, and sociable–unsociable (Short, Williams, & Christie, 1976). The more personal, sensitive, warm, and sociable the medium is perceived, the higher social presence is. From classical social presence theory, face-to-face communication has the highest degree of social presence, followed by videoconferencing (i.e., video plus audio), audio-only (e.g., telephone), and writing. Although, CMC typed communication media are not considered in classical social presence theory, it is retroactively fitted to this theory and is viewed as being low in social presence because of its text-based characteristic. A more in-depth examination of social presence theory is found in Chapter 4.

Media Effects on Grounding Theory

Clark and Brennan (1991) have hypothesized on the influence of communication media on *grounding*: the process by which common ground (i.e., the set of mutual beliefs, knowledge, and assumptions) is achieved amongst group members in order to coordinate content and process. Apparently not aware of media richness theory and (classical) social presence theory, they defined a set of eight criteria (constraints) that determines the 'richness' of the media with respect to grounding. They are: *co-presence* (i.e., two interlocutors share the same physical environment), *visibility* (i.e., two

interlocutors are visible to each other; cf., visual modality), *audibility* (i.e., two interlocutors communicate by speaking; cf., audio modality), *contemporality* (i.e., one interlocutor receives at roughly the same time as the other produces; cf., latency-time), *simultaneity* (i.e., two interlocutors can send and receive at once and simultaneously; cf., synchronous, full-duplex media), *sequentiality* (i.e., two interlocutors' turns cannot get out of sequence; cf., half-duplex media), *reviewability* (i.e., one interlocutor can review the other's messages), and *revisability* (i.e., one interlocutor can revise messages for the other). The poorer a medium is, that is, is lacking one or more of the above constraints, the higher the cost for grounding because alternative grounding techniques have to be used. Clark and Brennan discuss 11 different types of costs: formulation, production, reception, understanding, start-up, delay, asynchrony, speaker change, display, fault, and repair (p. 142–145). They predict that "People should ground with those techniques available in a medium that leads to the least collaborative effort" (p. 140). In other words, if a set of media is offered, the medium that is the easiest will be selected.

Critique on Media Theories

Walther (1999) criticizes media richness theory and associated findings about how the various task activities are matched with the appropriate media. These findings are based upon projective research, that is, research in which subjects (i.e., managers) are asked what medium they would *likely* select if they had to accomplish a particular task activity with another person. In observing the *actual* use of communication media, subjects –as is often the case (cf., Veenman, Prins, & Verheij, 2003)– did not follow the predicted media selections, but were not ineffective regardless in using the alternative communication media. A number of researchers found that people use those communication media that are mandatory, available, preferred for a number of reasons, or they conform to group norms (Fulk, Schmitz, & Steinfield, 1990; Markus, 1994). Haythornthwaite (1997) found that results "more strongly support the view that group norms establish media use patterns rather than views of message-medium fit from information richness theory" (p. 900). O'Donovan (1998) found that there was limited support for media richness theory. He explored the impact of information technology on internal communication and found that "Face-to-face as predicted by the theory was the most preferred channel; however, e-mail is preferred to telephone-voice mail, which contradicts the theory. The results suggest that e-mail is perceived as 'less lean' than media richness theory states, or that the benefits of e-mail are seen more than compensatory for its 'leanness'" (p. 23). Additionally, Dennis and Kinney (1998) tested media richness theory in decision making tasks (an equivocal task) and found that although media richness was varied across multiplicity of cues and across immediacy of feedback, richer media did not improve decision quality, decision time, consensus change, or communication satisfaction when matched with higher equivocality, as was the case when lean media were matched with lower equivocality. They conclude that "the results found no support for the central proposition of media richness theory; matching media richness to task equivocality did not improve performance" (p. 256). Dennis and Kinney (1998) also found that increased multiplicity of cues and increased immediacy of feedback lead to better performance (p. 267). This finding supports grounding theory (Clark & Brennan, 1991) in its emphasis on the fact that (instantaneous) feedback and cues are important mechanisms in achieving common ground in the conversation. Veinott, Ohlson, Ohlson, and Fu

(1998) provide additional evidence that, if groups include members who are not native speakers, an increase in the multiplicity of cues is important for achieving common ground in tasks where meaning has to be negotiated.

The same critique that bears on media richness theory may –because of its similarities– equally be applied to classical social presence theory with respect to medium choice and the effectiveness of high social presence media on interpersonal message exchange (Walther, 1999). Also, the Clark and Brennan media-effects framework conceptually shows great resemblance to the media richness framework and, thus, is susceptible to the same critique: predicted media choice and actual media use may differ. Finally, empirical evidence is not available with regard to whether effectiveness in grounding is optimal when least-collaborative-effort media are selected.

Despite the critique given, these three theories are still important because they point-out that communication media do *have* effects due to the lack of cues, and that these effects must be dealt with, one way or another.

2.4.2.2 *The Barriers*

Impediment of Social Interaction

The mere use of CMC systems may cause feelings of discomfort or even dislike. In addition, the restriction to only text-based verbal communication may cause learners to feel insecure about whether certain parts of a CMC system (e.g., e-mail, forum discussion, chat) are appropriate media for the exchange of certain types of messages (e.g., bad news messages, complex task-oriented messages, announcements). This is related to the medium choice issue put forward in media richness theory and in classical social presence theory (Daft & Lengel, 1984; Rice, 1993; Short, Williams, & Christie, 1976). In addition, they may feel that they cannot express themselves clearly enough without being equivocal, thus, feelings of insecurity exist as to whether the message is correctly interpreted by the other. This feeling is increased by the lack of feedback that acknowledges the reception of messages. This refers to media richness theory with respect to the number of back-channelling cues available (Daft & Lengel, 1984). Similarly, learners may feel insecure about the other in the communication in a sense that the communication is bodiless and that they miss the non-verbal and visual cues that are normally present when people communicate face-to-face. Consequently, learners feel less sure than if they deal with a 'real' physical person. The impression of dealing with a 'real' person in communication refers to social presence theory (Short, Williams, & Christie, 1976). In addition, *communication apprehension* may contribute to the impediment of social interaction in CSCL environments. Jonassen (2000) observed that existing insecurities about CMC use may be amplified in case of communication apprehension and this can prevent learners from participating openly and fully (see also, Berge, 1995, 1997; Fishman, 1997). McCroskey (1984) defined communication apprehension as "an individual's level of fear or anxiety associated with either real or anticipated communication with another person or persons" (p. 78). Also, the student's attitudes towards CMC may influence the degree of social interaction (Muirhead, 2000). Brown, Fuller, and Vician (2002) extended communication apprehension to CMC anxiety, the combined phenomenon of (oral) communication apprehension, computer anxiety, and computer illiteracy. Finally, visible non-verbal communication provides social cues that are important in every conversation, that act as a mechanism for turn taking, for clarifying the message, and

for checking availability (is the other still paying attention). Lack of such cues may raise problems in coordinating the conversation (Whittaker & O'Connail, 1997).

In sum, Rourke (referring to Chen (1994) in Rourke & Anderson, 2002) observed that students who felt uncomfortable in a CSCL environment avoided social interaction, and consequently were less argumentative and were less willing to advocate their position on controversial issues or challenge others' positions. In general, they were more constrained in their interactions with other students.

Group Dynamics is Hampered

Visible non-verbal cues are important when people form individuating impressions of each other (Jacobson, 1999; Walther, 1992, 1993). It is argued that social context cues also play a role in *impression formation* (Kiesler, Siegel, & McGuire, 1984; Sproull & Kiesler, 1986). Social context refers to the *geographic* (i.e., a person's physical location in space and time), *organizational* (i.e., a person's location in the organizational hierarchy) and *situational* variables (i.e., features of the immediate communication situation). Examples of situational variables are relationships amongst senders and receivers, the topic of the communication, and the norms or social conventions appropriate to the situation. Sproull and Kiesler (1986) claimed that reduction of social context cues deter interpersonal impressions because "without nonverbal tools, a sender cannot easily alter the mood of the message, communicate a sense of individuality, or exercise dominance or charisma. (…) Communicators feel a greater sense of anonymity and detect less individuality in others" (p. 48). Impression formation is the basis of the process of forming affective relationships, which in turn is the basis of forming a group with an established effective structure and, thus, of developing a sound social space reinforcing social interaction. Because CMC is not capable of transferring the non-verbal cues and social context cues, past research argued that CMC impedes impression formation. Short, Williams, and Christie (1976) observed that in "most cases, the function of non-verbal cues has been in some way related to forming, building, or maintaining the relationship between interactants. The absence of the visual channel reduces the possibilities for expression of socio-emotional material and decreases the information available about the other's self-image, attitudes, moods, and reactions. So, regarding the medium as an information transmission system, the removal of the visual channel is likely to produce a serious disturbance of the affective interaction" (p. 59–60). The lack of visible non-verbal cues potentially leads to anonymity, deindividuation,[I] and depersonalization[II] (Jessup, Connolly, & Tansik, 1990; Lea & Spears, 1991). Deindividuation, in turn, may lead to uninhibited behavior, which in its extreme manifestation is, a flaming war (Collins, 1992; Thompsen, 1996; Wallace, 1999).

However, Walther (1992), in studying impression formation in CMC, found that field studies did not report the extreme behavior that laboratory studies did. He (1993) argues that this prior research has not taken into account the effects of time needed to accumulate all those socio-emotional cues in order to develop an individuating impression of the other. He elaborates this by stating that "time limitations in

[I] Deindividuation is defined as a loss of identity and a weakening of social norms and constraints associated with submergence in a group or crowd (Spears & Lea, 1992).

[II] Depersonalization exists when the focus is shifted from the social context to the content and context of the message (Spears & Lea, 1992).

computer conferencing experiments may pre-empt normal social cognitive patterns of impression development and the interpersonal communication which results from such impressions" (p. 385). Therefore, the negative outcomes, as predicted by social presence theory, are in these settings indeed going to be found. For this reason, Walther (1992, 1993) developed a social information processing (SIP) theory for impression formation. The core assumption of the SIP theory of Walther (1993) is that the transmission of socio-emotional cues and other patterns of communication using CMC happen at a significant lower rate than in face-to-face communication. But, if time limitation plays no role, the same personal impressions will be developed. Consequently, it will take longer before a group develops a sound social space and becomes a mature and performing group. In other words, time appears to be an important factor positively affecting the development of an affective structure and, therefore, the building of communities. If we take into consideration that even face-to-face groups need time for group forming and establishing an affective structure (Forsyth, 1999; Hobaugh, 1997) the 'time' we are talking about here, is –in fact– extra time needed due to CMC.

Grounding

Grounding, as stated earlier, is the process in which individuals develop and maintain a common ground with respect to knowledge, beliefs, and assumptions (Clark & Brennan, 1991) and has multiple functions. Common ground is needed in group learning; without it, group learning hardly takes place (Mulder, Swaak, Kessels, 2002). Common ground is also needed for building and sustaining group identity, for establishing cooperation, and for promoting interactions that support groupwork amongst group members (Lee, Danis, Miller, & Jung, 2001). In the earlier sub-section "Media Effects on Grounding Theory", we have seen that the easiest medium is selected for grounding in order to minimize cost in terms of required effort (Clark and Brennan (1991). This implies that the more effort needed, the longer it takes to achieve common ground. From that perspective, it can be argued that, as a result of using communication media such as CMC typed media, group forming and group dynamics is slowed down.

2.4.2.3 *Conclusion*

Barriers in Ring 2 are raised due to limitations of communication media with respect to the transfer of non-verbal cues. Media richness theory, social presence theory, and grounding theory discuss the consequences of these limitations. The limitation of media richness theory relate to message equivocality, social presence theory to the establishment of interpersonal relationships, and grounding theory to costs in grounding. Whatever theory is used, from the perspective of group forming and group dynamics, each theory ultimately elicits that these processes are difficult to achieve and maintain in mediated circumstances. This gives an argument that media effects have to be taken into account when CSCL environments are deployed in DLGs.

2.4.3 The Third Ring: CSCL Environment

CSCL environments by themselves may induce barriers that add to the impediment of social interaction and, therefore, to group formation and group dynamics. These barriers exist either because CSCL environments lack social functionality or because they are not well designed. CSCL environments that lack social functionality or an

attractive and usable graphical user interface may frustrate learners and, consequently, could demotivate them from using the CSCL environment. This, in turn, is detrimental to the collaborative learning process. These issues address utility on the one hand and interaction design and usability on the other hand.

2.4.3.1 *Utility*

Contemporary CSCL environments are predominantly *functional* CSCL environments because their design is guided by purely educational constraints, and as such do not pay attention to the social (psychological) aspects of collaborating through CMC. For example, the CSCL environment developed and implemented by Soller, Lesgold, Linton, & Goodman (1999) for promoting effective collaboration based on sentence openers is an example of a purely functional CSCL environment. Evaluations of the main experiment revealed that participants "expressed their desire to display certain emotions (in particular, frustration and approval) through the interface" (Soller, 1999, p. 19). Clearly, this environment lacks a possibility for expressing feelings and other forms of informal communication[I]. This example is substantiated by Bly, Harrison, and Irvin (1993) who stated that most "tools in computer-supported cooperative work (CSCW) are devoted to the computational support of task-specific activities …, but support for cooperative work is not complete without considering all aspects of the work group process. When groups are geographically distributed, it is particularly important not to neglect the need for informal interactions, spontaneous conversations, and even general awareness of people and events at other sites" (p. 29).

Although this citation stems from researchers in the area of CSCW, the notion is equally relevant for the CSCL[II] domain. Indeed, Cutler (1996) remarked that "current literature surrounding CMC [i.e., CSCL] is almost entirely task-based and focused on cost, efficiency, and productivity with little attention given either to the changes effected on the people or to the social relations created from using the communication technologies" (p. 320). Therefore, the CSCL community should pay attention to designing CSCL environments that account for these social psychological aspects, that is, they should concentrate on building *sociable* CSCL environments that incorporate a wide variety of social functionalities.

2.4.3.2 *Interaction Design and Usability*

CSCL environments often do not look attractive and/or are not seductive as a result of 'bad' interaction design (see for instance, Alben, 1996, 1997; Löwgren, 2001). Generally, when nice and attractive environments are presented, learners become more motivated to use these environments and become more willing to accept eventual deficiencies in the environment (c.f., Norman, 2002). In addition, CSCL environments sometimes do not meet the criteria of usability (see Section "Usability", Chapter 5) that are well known in the field of human-computer interaction (see for example, Shneiderman, 1998; Preece, Rogers, Sharp, Benyon, Holland, & Carey, 1994). Therefore, CSCL environments may not be pleasant to use and, in the worst case, learners may complain that these environments are not easy to learn and to

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[I] Being aware of the lack, Soller is planning to alleviate this shortcoming in future versions of this CSCL environment.

[II] In CSCL the focus is on collaborative learning in groups enabled by electronic environments (i.e., CSCL environments) rather than in CSCW where the focus is on working in teams.

handle. This may result in demotivated learners who exhibit a propensity to minimize the use of CSCL environments, that is, they will minimize the social interaction through these environments. In some cases, when technical systems are badly designed and unreliable, learners tend to drop out. This is an extra argument for looking more closely at interaction design and usability issues when designing (sociable) CSCL environments.

2.5 Summary and Conclusion

The transition of contiguous learning groups into distributed learning groups is not without problems. A number of educators think that all (learning and socio-emotional) processes associated with face-to-face settings easily transfer to settings in which CSCL environments are utilized. Consequently, these educators fall into two pitfalls. The first pitfall is thinking that social interaction is automatic in CSCL environments and, therefore, can be taken for granted as long as these environments facilitate communication. The second pitfall is thinking that group forming and group dynamics is also automatic and, therefore, the social interaction can be restricted to serve the cognitive processes that underlie learning. However, the use of CSCL environments raises a number of barriers that may exacerbate the negative implications of falling into the pitfalls resulting in a disaster, that is, learning performances will be low because there is no collaborative learning at all and, ultimately, members will drop out because of frustrations and dissatisfaction. Thus, educators must avoid falling into the pitfalls and the barriers must be overcome. This latter point is not easy, because of the 'breadth and depth' of these barriers. The barriers are organized in three categories, in this chapter designated as rings. The first ring is concerned with the barrier raised by the lack of a suitable CSCL pedagogy. The second ring is concerned with barriers raised by media effects encompassing message equivocality, the impediment of impression formation, the establishment of interpersonal relationships and a sense of community, and the potential danger of deindividuation and depersonalization. The third and last ring is concerned with barriers raised by the CSCL environment itself and encompasses utility, interaction design, and usability.

The focus of this dissertation is primarily on the barriers of the third ring, that is, it examines which social functionality is required for creating sociable CSCL environments and what criteria have to be met in order to achieve an attractive design with good usability (Chapters 4 and 5). Concurrently, but secondary, the focus is also on the barriers of the second ring. As long as traditional (text-based) communication media are used, the barriers in this ring will continue to exist, but being aware of these barriers allows for steps to be undertaken for mitigating the adverse consequences of media effects, for example, by increasing social presence (see Chapter 4, Section "Social Presence Theory"). Also, it is hoped for that when sociable CSCL environments are deployed, these barriers can be 'by-passed' in the sense that they may compensate for some of the media effects.

The next chapter describes how educators, educational technologist, and educational researchers apply strategies for overcoming the barrier in the first ring.

CHAPTER 3

Overcoming the Barriers: The Pedagogical Approach

Abstract

Computer-mediated worldwide networks have enabled education to shift from contiguous learning groups to asynchronous distribute learning groups (DLGs) utilizing computer-supported collaborative learning (CSCL) environments. Although these CSCL environments can support communication and collaboration, research and field observation report findings that are not always positive. Two pitfalls impede achieving the desired social interaction and group dynamics needed for learning in these DLGs, namely (1) taking for granted that participants will socially interact simply because the environment makes it possible and (2) neglecting the social and social psychological dimension of social interaction outside of the task context. This chapter describes the specific pedagogical techniques (distance) educators apply for avoiding the pitfalls and for overcoming the lack of a specific CSCL pedagogy which has been identified as a barrier in the first Ring.

This chapter is based on parts of:

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003a). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior*, *19*(3), 335–353.

Kreijns, K., & Kirschner, P. A. (2002a, May). *Two Pitfalls of Social Interaction in Computer-Supported Collaborative Learning Environments and How to Avoid Them*. Paper presented at the 29th Onderwijs Research Dagen (ORD). Antwerpen, Belgium.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Journal of Education Technology & Society*, *5*(1), 8–22. Retrieved April 1, 2004, from http://ifets.ieee.org/periodical/vol_1_2002/v_1_2002.html.

3.1 Introduction

Computer-mediated worldwide networks have enabled education to shift from contiguous learning groups to asynchronous distribute learning groups (DLGs) utilizing computer-supported collaborative learning (CSCL) environments. Although these CSCL environments can support communication and collaboration, research and field observations report findings that are not always positive such as low participation rates, varying degrees of disappointing collaboration and, consequently, low performances in terms of quality of learning and learner satisfaction (Gregor & Cuskelly, 1994; Hallet & Cummings, 1997; Heath, 1998; Hobaugh, 1997; Hughes & Hewson, 1998; Mason, 1991; Taha & Caldwell, 1993).

Two pitfalls impede achieving the desired social interaction and group dynamics needed for learning in the DLGs, namely (1) taking for granted that participants will socially interact simply because the environment makes it possible and (2) neglecting the social and social psychological dimension of social interaction outside of the task context. This problem is compounded by the lack of a specialized CSCL pedagogy (Brandon & Hollingshead, 1999; Van Merriënboer, 2002) causing (distance) educators to seek for alternative approaches to fill this gap. Because CSCL is all about collaboration, it seems natural to use 'traditional' classroom-based collaborative techniques as a point of departure for avoiding the pitfalls and for overcoming the lack of a specialized CSCL pedagogy. Rochelle and Teasley (1995) define collaboration as a "coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (p. 70).

Collaborative learning is seen as an effective pedagogical method for learning. Slavin (1983, 1987, 1995; as cited in Brush, 1998, p. 10–11) "has examined over 100 studies in which cooperative learning groups were compared with individual instruction and found that a majority (nearly 75%) reported a significant increase in achievement levels for students participating in cooperative learning groups." Similarly, a recent meta-analysis of 164 studies of eight collaborative learning methods at all educational levels has shown that all of the eight methods significantly increased learner achievement (Johnson, Johnson, & Stanne, 2000).

However, the shift from learning in face-to-face groups to DLGs requires re-examination of whether classroom-based collaborative techniques are equally successful in DLGs using CSCL environments. Regrettably, as Brush (1998) pointed out, "research specifically investigating the effects of cooperative[1] learning with advanced computer-based instruction such as ILSs [Integrated Learning Systems] is limited and does not provide a great deal of insight into the methods with which cooperative learning strategies can be effectively integrated into ILS activities" (p. 11). Bullen (1998) similarly noted that "there is limited empirical support, however, for the claims made about the potential of computer conferencing to facilitate higher level thinking" (p. 3) as did Rourke and Anderson (2002) who stated that although "computer conferencing has been used for educational purposes for over ten years, systematic research reports are only beginning to appear." They conclude that "there is a paucity of theories, tools, and cumulative results upon which to build" (p. 271).

[1] The next section discusses the collaborative versus cooperative perspective. In this dissertation, the terms collaborative and cooperative are used as synonyms.

Though classroom-based collaborative techniques are presently the only option, the extent to which they are exploited may vary. In particular, the manner in which collaboration itself is activated in asynchronous DLGs may differ. This chapter discusses a number of these methods proposed by educators, educational technologists, and educational researchers who deal with distance education or web-based instruction. Before discussing these methods, (classroom-based) collaborative learning is first described in detail.

3.2 Collaborative Learning

3.2.1 Collaborative Learning and Cooperative Learning

There seems to be an almost irresolvable discussion as to what `collaborative' and `cooperative' learning are and what their differences and commonalities are. This is fueled by the fact that educational researchers often have different purposes, goals, and perspectives (e.g., whether the terms denote processes or states) which prohibit a clear distinction between the two approaches to group learning. Panitz (1997) sees collaboration as a philosophy of interaction and personal lifestyle and cooperation as a structure of interaction designed to facilitate accomplishment of an end product or goal through people working together in groups. Slavin (1997) associates cooperative learning with well-structured knowledge domains and collaborative learning with ill-structured knowledge domains. Roschelle and Teasley (1995) state that cooperation "is accomplished by the division of labour among participants, as an activity where each person is responsible for a portion of the problem solving (...)", while collaborative learning involves the "(...) mutual engagement of participants in a coordinated effort to solve the problem together" (p. 70). This perspective is supported by Lethinen, Hakkarainen, Lipponen, Rahikainen, and Muukkonen (2001) who see the distinction as being based on different ideas of the role and participation of individual members in the activity.

The debate is still going on and it is beyond the scope of this chapter to determine which definition or perspective is most appropriate. It is, however, more important to stress that there are far more similarities than differences between the two (Kirschner, 2001). Kirschner (2001) notes that in both:

- learning is active;
- the teacher is usually more a facilitator than a "sage on the stage";
- teaching and learning are shared experiences;
- students participate in small-group activities;
- students must take responsibility for learning;
- students are stimulated to reflect on their own assumptions and thought processes; and
- social and team skills are developed through the give-and-take of consensus-building;

Since there are far more commonalities than differences we consider the two –for argument's sake– to be equivalent and use the term 'collaborative' in this dissertation.

3.2.2 The Effects of Collaborative Learning

Collaborative learning is considered important because of the social interaction it embodies, which leads to:

- *Critical thinking* (Bullen, 1998; Garrison, Anderson, & Archer, 2001; Newman, Johnson, Webb, & Cochrane, 1997; Norris & Ennis, 1989). Norris & Ennis (1989) define critical thinking as thinking that is reasonable and reflective and is focused on what to believe or do. They identify four categories of critical thinking skills, namely clarification, assessing evidence, making and judging inferences, and using appropriate strategies and tactics. Garrison (1992) distinguishes five stages of critical thinking, namely problem identification (a triggering event arouses interest in a problem), problem definition (define problem boundaries, end and means), problem exploration (ability to see the heart of problem based on deep understanding of situation), problem applicability (evaluation of alternative solutions and new ideas), and problem integration (acting upon understanding to validate knowledge).
- *Shared understanding* (Clark & Brennan, 1991; Mulder, Swaak, & Kessels, 2002). Shared understanding, or common ground, is the set of mutual beliefs, knowledge, and assumptions (Clark & Brennan, 1991).
- *Knowledge construction* (Littleton & Häkkinen, 1999; Salomon & Perkins, 1998). Veldhuis-Diermanse (2002) operationalizes knowledge construction as "adding, elaborating, and evaluating ideas, summarizing and evaluating external information and linking different facts and ideas" (p. 13).
- *Deeper level learning* (Biggs, 1987, 1999). With respect to deep learning, in "surface learning, they [the learners] skim, memorize, and regurgitate for tests; when deep learning, they try to develop a critical understanding of material. Deep learners integrate new learning into their knowledge, while when surface learning, uninterpreted information transfer occurs from book, to brain, to examination paper" (Newman, Johnson, Webb, & Cochrane, 1997, p. 484–485).
- *Long-term retention* of the learned material (Johnson, Johnson, & Stanne, 1985). Most researchers refer to long-term retention as the degree to which the material learned is still retained in memory after expiration of a certain time. The time can be hours but also a couple of months.

Collaborative learning also provides opportunities for developing social and communication skills, developing positive attitudes towards other group members and the learning material, building social relationships and developing group cohesion (Dillenbourg, Baker, Blaye, & O'Malley, 1995; Johnson & Johnson, 1989, 1994; Mesh, Lew, Johnson, & Johnson, 1986).

If collaborative learning is applied to realistic ill-structured, complex tasks in an authentic context[1], it is considered to positively increase the effects of collaborative learning just discussed (deeper level learning, critical thinking, shared understanding, long term retention), the effectiveness for social construction of knowledge (Jonassen,

[1] Savery and Duffy (1995) argue that an authentic context does not mean that a learner must be placed in a actual authentic real-life context which is completely the same as the professionals have. They note that rather "the learner should engage in scientific activities which presents the same 'type' of cognitive challenges. An authentic learning environment is one in which the cognitive demands, i.e., the thinking required, are consistent with the cognitive demands in the environment for which we are preparing the learner" (p. 33). Further, providing an authentic context is not an exclusive concept to constructivistm. Reigeluth (1991) points that educational technologist already for a long time has been striving to contextualize learning (p. 34). Also, Jonassen (1991b) remarks that other cognitive models such as situated cognition also premises a authentic context (p. 36).

1991a, 1991b, 1994), and the development of competencies (Jochems, 1999; Keen, 1992).

A critical note is needed here. Social constructivism is neither an approach to nor a model for instructional design. It is a *philosophy of learning* based on the idea that knowledge is constructed by learners based on their mental and social activity (Vygotsky, 1978; Kirschner, 2001). Constructivism holds that in order to learn, learning needs to be situated in problem solving in real-life contexts (Brown, Collins, & Duguid, 1989) where the environment is rich in formation and where there are no right answers. Jonassen (1991b) emphasizes this when he declares that "the context is everything" (p. 35). Engaged in authentic tasks, the mind produces mental models that are representations of the learner's perceptions. These models are used to explain, predict, or infer phenomena in the real world (Jonassen, 1994). The validity of the mental models is continuously tested against new experiences from the interaction with the physical and social environment, in which meanings are socially negotiated through interactions with others where multiple perspectives on reality exist (von Glaserfeld, 1995). This reflexivity is essential and must be nurtured. Finally, all of this is best (and possibly only) achieved when learning takes place in ill-structured domains (Spiro, Coulson, Feltovich, & Anderson, 1988). The use of case-based problems that are derived from or delivered from real-life does meet this requirement. The case, however, should not be stripped of the natural real-life uncertainty and complexity. Removing the complexity may result in oversimplification, which is considered a serious matter because the case may only be looked at from one perspective. Spiro, Feltovich, Jacobson, and Coulson (1991) points to the potential danger: "In an ill-structured domain, that single perspective will miss important aspects of conceptual understanding, may actually mislead with regard to some of the fuller aspects of understanding, and will account for too little of the variability in the way knowledge must be applied to new cases" (p. 29).

Competency-based learning is defined as learning based on the acquisition of knowledge, skills, and attitudes and the application of these in an ill-structured environment (Kirschner, Vilsteren, Hummel, & Wigman, 1997). There is a growing concern in professional contexts about performance levels of new recruits and existing staff (Boyatzis, 1982; De Snoeck, 1997). Graduates of universities have the knowledge necessary to do the job, but miss the 'higher order skills' and attitudes necessary to do the job properly (competencies). Competencies are abilities that enable learners to recognize and define new problems in their domain of study and (future) work as well as solve these problems (Kirschner, Vilsteren, Hummel, & Wigman, 1997). In other words, a competency is the ability to operate effectively in ill defined and ever changing environments where participants apply knowledge, skills, and attitudes adequately to the task situation at hand (Keen, 1992; Jochems, 1999). Competency-based education allows learners to acquire those skills and attitudes in a variety of situations (transfer) and over an unlimited time span (lifelong learning) (Van Merriënboer, 1999).

In sum, social interaction is a key within collaboration. It is this process, this set of interpersonal activities, that makes collaboration. Therefore, if there is collaboration then social interaction can be found in it, and if there is no social interaction then there is no collaboration. Without social interaction, all of the high flying ideas about constructivism, critical thinking and competency-based learning are worthless and significantly lowering the chance of achieving a new educational future as envisioned by Kirschner (2001) stating "that traditional didactic instruction and instructional

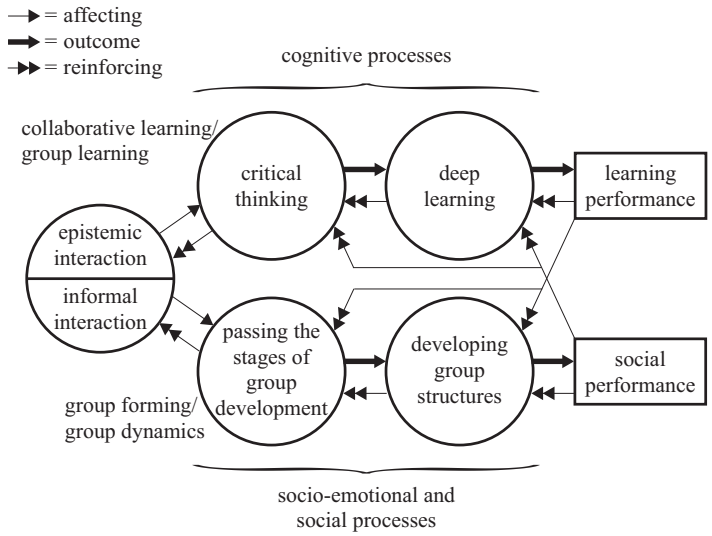

Figure 3.1 Cognitive Processes encompass Critical Thinking and Deep Learning. Socio-Emotional and Social Processes encompass the Passing of Stages of Group Development and the Development of Group Structures

design models –at least at the level of higher post-secondary education– must be relegated to the past. The future (and even the today) of learning is constructivist design and development of collaborative and cooperative learning situation in powerful integrated electronic environments" (p. 1).

3.2.3 Epistemic Interaction

Collaborative group learning can positively affect individual academic learning performances by incorporating specific activities in the learning task to promote 'epistemic fluency.' Morrison & Collins (1996) define epistemic fluency as "the ability to identify and use different ways of knowing, to understand their different forms of expression and evaluation, and to take the perspectives of others who are operating within a different epistemic framework" (p. 109).

An example of how 'epistemic fluency' can be achieved is the application of a set of epistemic tasks within the group learning tasks. Ohlsson (1996) suggest the following epistemic tasks (see p. 51):

- Describing: To describe is to fashion a discourse referring to an object or event such that a person who partakes of that discourse acquires an accurate conception of that object or event
- Explaining: In explaining an event of some sort, the discourse is fashioned such that a person who partakes of that discourse understands why that event happened
- Predicting: To make a prediction is to fashion a discourse such that a person who partakes of the discourse becomes convinced that such and such an event will happen

- Arguing: To argue is to state reasons for (or against) a particular position on some issue, thereby increasing (or decreasing) the recipient's confidence that the position is right
- Critiquing/Evaluating: To critique a cultural product (descriptions, explanations, arguments and the like) is to fashion a discourse such that a person who partakes of the discourse becomes aware of the good and bad points of that product
- Explicating: To explicate a concept is to fashion a discourse such that a person who partakes of that discourse acquires a clearer understanding of its meaning
- Defining: To define a term is to propose a usage for that term.

However, as Baker, De Vries, Lund, and Quignard (2001) point out "people do not argue or explain with respect to any topic, with anyone and in any situation" (p. 89).

Figure 3.1 is a reworking of Figure 2.1 taking into account the semantic network of critical thinking, deep learning, and group learning of Newman, Johnson, Webb, and Cochrane (1997).

3.2.4 Activating Collaborative Learning

Educational researchers agree that just placing students in groups does not guarantee that collaboration is going to happen (Brush, 1998; Johnson & Johnson, 1989, 1994a; Soller 1999). Hwong, Caswell, Johnson, and Johnson (1992) stress that group membership is not enough to motivate students to collaborate. In addition, as Mesh, Lew, Johnson and Johnson (1986, 1988) pointed out, opportunities for interpersonal interaction is not enough either for encouraging collaboration. These educational researchers have concluded that the incentive of collaboration has to be structured within the groups. A complex of simultaneously applied instructional approaches, each reinforcing, and complementing the other, can enhance collaborative learning and social interaction amongst group members. All of these instructional approaches result in group members socially interacting in ways that encourage elaboration, questioning, rehearsal, and elicitation. We discuss two approaches, namely:

- The direct approach, which entails structuring a task specific learning activity
- The conceptual approach, which entails applying a set of conditions that enforce collaboration.

Each approach[I] is discussed in more depth in the next sub-sections.

3.2.4.1 *Structure a Task Specific Learning Activity*

The direct approach involves the use of specific collaborative techniques to structure a task specific learning activity (e.g., writing a report). A number of such specific collaborative techniques have been developed and proven to be effective. Each technique can be used as a template for adaptation to a slightly different learning activity. However, the more the learning activity deviates from the task specific learning activity, the original technique was developed for, the less appropriate the technique becomes.

[I] Johnson, Johnson, & Smith (1991) have made the distinction between the direct approach and the conceptual approach.

Examples of the direct approach are:

- Student Teams-Achievement Divisions (STAD) (Slavin, 1994)
- Jigsaw and Jigsaw II (Aronson, Blaney, Stephan, Silkes, & Snapp, 1978; Slavin, 1990)
- Structured Academic Controversy (Johnson & Johnson, 1994b, 1995)
- Reciprocal teaching (Palincsar & Brown, 1984, 1986)

Student Teams-Achievement Divisions (STAD)

STAD is a collaborative technique developed by Slavin (1994) in which three stages are distinguished: teaching, teamwork, and individual assessment. In the teaching stage, the teacher presents the learning material that has to be mastered in the teamwork stage. In that stage, students in heterogenous teams comprising four members help each other to build an understanding of the academic content. In the individual assessment stage, team members must show their individual knowledge on a quiz (or equivalent procedure) without any help. The team is rewarded based on the degree to which the individual team members have improved over their own past records, using a system called 'achievement divisions.' The main idea behind STAD is motivating members to encourage and help each other to master the skills presented by the teacher. If members want their team to earn team rewards, members must help their co-members to learn the material.

Jigsaw and Jigsaw II

Jigsaw (Aronson, Blaney, Stephan, Silkes, & Snapp, 1978; Slavin, 1990) is a technique that fits the situation in which students have to learn from written material (e.g., textbooks, fact sheets). In Jigsaw, the academic content is broken into as many sections as there are team members in the heterogenous groups. Team members have to study their section of the content with members of the other teams who have to study the same section; together they form an 'expert group.' After they have become an 'expert' on that section, the students return to their original teams to share what they have learned. Team members are assessed on their individual knowledge of the whole content. Because there is no team reward in Jigsaw, the Jigsaw technique may be seen as high in task interdependence[I] and low in reward interdependence[II] (Slavin, 1990). Jigsaw II is the improved version of Jigsaw. It differs from Jigsaw in two ways. Firstly, students all read (i.e., learn) the whole content, but focus on their sections. Secondly, it also differs in that it uses the same team reward structure as STAD. Jigsaw II is, thus, high in both task interdependence and reward interdependence (Slavin, 1990).

[I] Task interdependence is a type of positive interdependence where students perceive that they can reach their goals for learning if and only if other students in the learning group also reach their goals (Johnson & Johnson, 1994a). In the case of task interdepence the interdepency is created by means of the task, that is, the group cannot accomplish the task unless every member is doing his or her part of the task. Task interdependence "exists when a division of labor is created so that the actions of one group member have to be completed if the next group member is to complete his or her responsibilities. That is, the overall task is divided into subunits that must be performed in a set order for the task to be completed" (Johnson & Johnson, 1989, p. 25).

[II] Reward interdepence is another type of positive interdepence. Reward interdepence exists "when each group member receives the same reward for successfully completing a joint task" (p. 24).

Structured Academic Controversy

Structured Academic Controversy fits situations in which controversial subjects are discussed. Within structured academic controversy, students learn in groups of four members. In each group dyads are formed, which prepare one side of a controversial subject. The dyads try to convince each other of their opinion, thereby refuting the opposing opinion and rebutting attacks on their own position. Dyads also have to change roles and try to argue from the opposite position. Finally, the group tries to reach consensus on the controversial subject (Johnson & Johnson, 1994b, 1995).

Reciprocal Teaching

Reciprocal teaching was developed by Palincsar & Brown (1984, 1986) to enhance student's text comprehension. Students and the teacher enter in a dialogue about the content of the text, actively employing four comprehension strategies: clarifying, questioning, predicting, and summarizing. In *clarifying*, students construct meaning from the text material and monitor their reading to ensure that they in fact understand what they read. In *questioning*, students are stimulated to think about the kind of information that is significant enough that it could provide the substance for a question. In *predicting*, students –given the text material– hypothesize about what will happen next, or could happen in a particular context. In *summarizing*, students identify, paraphrase, and integrate the most important information in the text and communicate them in an understandable fashion. One of the students performs the teacher's role here; each student in turn will play this role on a new portion of the text material (e.g., a new section).

3.2.4.2 *Apply a set of Conditions that Enforce Collaboration*

The conceptual approach involves tailoring a general conceptual model of collaborative learning to the desired or chosen circumstances, such that specific types of collaboration can be created and/or enforced. The conceptual model can be applied in any subject area for any age student, and is highly adaptable to changing conditions. Main proponents of this approach are Johnson and Johnson (1989, 1992, 1994) and Sharan and Sharan (1992). Many other researchers have adopted the conceptual approach (e.g., Brandon & Hollingshead, 1999; Brush, 1998; Cooper, Robinson, & McKinney, 1994; Soller, 1999; Strijbos, 2001). The advantage of the conceptual approach is that it can be applied to virtually all specific collaborative settings including those that involve task specific learning activities. A drawback is that it requires more effort and understanding of the learning conditions from the instructors in order for them to assemble their own collaborative techniques (Johnson & Johnson, 1989, 1994).

Johnson and Johnson (1974, 1994) developed a conceptual model based upon the theory of cooperation and competition that Deutsch (1949, 1962) derived from Kurt Lewin's (1935, 1948) field theory. According to Johnson, Johnson, and Smith (1991, see also: Johnson & Johnson, 1989, 1992, 1994a; Johnson, Johnson, & Holubec, 1990), effective cooperation can only be achieved when the following five conditions structure the collaboration:

- Positive interdependence. "Positive interdependence is the perception that one is linked with others in a way so that one cannot succeed unless they do (and vice

versa) and/or that their work benefits one and one's work benefits them" (Johnson & Johnson, 1989, p. 24).

- Individual accountability. "Individual accountability exists when each student's performance is assessed and the results are given back to the group and the individual" (Johnson, Johnson, & Smith, 1991, p. 26). In other words, member's individual performance contribute to the determination of the group reward rather than that it being based solely on the overall group performance and thus neglecting the individual contributions. Individual accountability ensures that group members are doing their share of the work.
- Promotive interaction. "Promotive interaction may be defined as individuals encouraging and facilitating each other's effort to achieve, complete tasks, and produce in order to reach the group's goals" (Johnson & Johnson, 1989, p. 29).
- Interpersonal and small-group skills. These skills are needed when learners are learning within a group. Johnson and Johnson (1991) note, for example, that students who have not been taught how to work effectively with others cannot be expected to do so: "Placing socially unskilled individuals in a group and telling them to cooperate does not guarantee that they are able to effectively do so. Persons must be taught the social skills for high quality collaboration and be motivated to use them" (p. 30).
- Group processing. The group determines which behavior a group should continue or change for maximizing their success based upon their reflection of how the group has performed up to this point. Johnson, Johnson, and Holubec (1990) argued that group processing exists when groups discuss their progress and decide what behaviors to continue or change.

It is important to note that although Johnson and Johnson list their conditions separately, they are highly related. Positive interdependence, for example, results in promotive interaction; and promotive interaction requires group members to possess a certain degree of small-group skills. If the conditions are met, collaboration –according to Johnson and Johnson (1989)– will increase the effort exerted by teams to achieve, the quality of the relationships between participants, and the participants' psychological health ("the ability (cognitive capacities, motivational orientations, and social skills) to develop, maintain, and appropriately modify interdependent relationships with others to succeed in achieving goals", p. 138) and their social competence.

Other researchers have found similar sets of conditions that enforce collaborative learning. For example, Cooper, Robinson, and McKinney (1994) note six conditions, namely positive interdependence among group members, individual accountability for evaluation or in grading, appropriate assignments to groups, teacher as coach or facilitator, explicit attention to social skills, and face-to-face problem solving.

3.2.4.3 *Negative Effects of Collaboration are Dissolved*

The negative effects, often present in non-cooperative groups, disappear or are reduced in a 'natural' manner when Johnson and Johnson's conditions of individual accountability and positive interdependence are met.

The most noteworthy negative affects address (see also, Hooper, 1992):

- Free-rider or hitchhiking effect (Kerr, 1983; Kerr & Bruun, 1983). This occurs if individual effort is perceived to be unnecessary, as is the case when the whole

group receives one grade that may be based on the performance of a sub-group, for example, the ones who do a substantive share of the work.

- Social loafing (Comer, 1995; Kerr & Bruun, 1981; Latané, Williams, & Harkins, 1979). This occurs if individual effort is perceived to be unnecessary, as is the case when the group is too big to notice individual efforts. Social loafing resembles free-riding in that the social loafer and free-rider are both benefiting from the group outcome and reward without exerting effort to contribute to the group performance. The social loafer differs from the free-rider in that the first lacks the motivation to add to the group performance, whereas the last tries to profit from others while minimizing essential contributions.
- Sucker effect (Kerr, 1983; Kerr & Bruun, 1983). This occurs as soon the ones who do the substantive share of the work become aware of free-riding in the group. Members of that group refuse to further support the noncontributing members and therefore reduce their own individual efforts.
- Rich-get-richer effect (Cohen & Lotan, 1997; Cohen, Lotan, Scarloss, & Arellano, 1999). This occurs in mixed ability groups. Group members with high ability and motivation take over key roles in order to benefit themselves. As a result, the high ability group members interact more in the group, and learn more from the task while the low- ability members interact less and, therefore, in turn learn less.

3.2.5 Conclusion

Now that collaborative learning has been discussed, the next section discusses how educators, educational technologists, and educational researches have applied techniques for encouraging collaborative learning in asynchronous DLGs and other techniques for avoiding both pitfalls. This may range from using task specific learning activities or applying a set of enforcing conditions to the application of social presence theory.

3.3 Avoiding the Pitfalls

Because the shift of contiguous learning groups to asynchronous DLGs is fairly recent, (distance) educational researchers are involved in an ongoing process of formulating, finding and examining adequate strategies that can lead to avoiding the pitfalls and, ultimately, to a solid CSCL pedagogy. Until that point is reached, educators, educational technologists, and educational researchers use strategies, which they think are effective for online- and distance learning. The next sections present a number of such strategies that all have a base in collaborative learning principles.

3.3.1 Avoiding the First Pitfall

The first pitfall was that social interaction is taken for granted. Three categories of strategies can be discerned from current educational research aimed at stimulating social interaction for avoiding this pitfall, namely:

- Changing the instructor's and learner's role in DLGs
- Improving interactivity in web-based CSCL environments
- Activating collaborative learning in CCL environments

3.3.1.1 *Changing the Instructors' and Learners' role*

One group of educational researchers has primarily examined the ways instructors could play a (new) role in stimulating social interaction between group members in CSCL environments and how members should socially interact within the group. Three factors drive this changing of roles. Firstly, there is a shift from teacher-centered to learner-centered learning. Secondly, there is a shift from individual learning to group learning. Finally, there is a shift from contiguous learning groups to asynchronous DLGs (the main focus in this dissertation). While the first two shifts originate from the change in educational paradigms (social construction of knowledge, competence-based learning), the last originates from the increased use of CSCL environments and as such has caught the attention of many (distance) educators. Different educational researchers present different suggestions.

Simonson (1995), for example, states that the instructor must strive "(…) to make the experience of the distance learner as complete, satisfying, and acceptable as that of the local learner" (p. 12). Gunawardena (1995) suggests a number of issues that must be developed to enhance achieving academic objectives in computer conferences, such as protocols for CMC interaction, procedures for signing on and using the system, etiquette for CMC discussion, and techniques for managing information overload. In addition, she notes that "conference moderators should facilitate discussions by recognizing all contributions initially, summarizing frequently, and weaving ideas together" (p. 163).

Burge (1994), examining online courses, found four types of peer behaviors required in online collaborative learning namely participation (e.g., giving alternative perspectives, attending to the experiences of others), response (e.g., giving constructive feedback, answering questions), affective feedback (e.g., use of a person's name, being patient, complimenting others), and focused messaging. She also found two types of instructor behavior, namely discussion management (e.g., providing structure, pacing and focusing the class discussions), and contribution (e.g., giving fast and relevant technical help, sending timely and individualized content-related messages and feedback).

Hiltz (1998) concludes that collaborative learning requires a different role of the instructor: "the role of the teacher changes from transferring knowledge to students (the 'sage on the stage') to being a facilitator in the students' construction of their own knowledge (the 'guide on the side') (¶ 3. What is collaborative learning?) meaning that the instructor must take care that the group adopts a structure of interaction that is collaborative in nature by molding, modeling and encouraging the desired behavior while the students must be able and willing to participate regularly.

Finally, Newman, Johnson, Webb, and Cochrane (1997) suggest for first level groupware (including computer conference) that it is the task of the teacher to design a learning context that encourages critical thinking. Thereby, teachers and learners should change methods to fit in with the tools' limitations (p. 486).

3.3.1.2 *Improving Interactivity in Web-Based CSCL Environments*

Another group of researchers specifically focuses on improving interactivity[I] in web-based CSCL environments allowing collaborative learning activities to occur (Gilbert & Moore, 1998; Liaw & Huang, 2000; Northrup, 2001).

Different researchers define different classes of social interaction. Zhang and Fulford (1994) distinguish between interactivity that relates to learner-content interaction and interactivity that relates to social interaction outside the instructional context. In other words, to social interaction in the social psychological/social dimension. Gilbert and Moore (1998) have narrowed their interpretation of social interaction down to include only the variety of socio-emotional and affective exchanges between learners in the task context and define instructional interaction as being primarily a learner-content interaction. They state that "it is important to distinguish between interactivity which is primarily social in nature and interactivity which embraces key instructional objectives" (p.31), thus supporting Zhang and Fulford's (1994) classification. Moore (1993) distinguishes three classes of interaction: interaction between learners (i.e., peer interaction), interactions between learners and their instructors who are the experts of the subject material, and learning-content interaction (i.e. interaction between learners and the subject of study). Hillman, Willis, and Gunawardena (1994) suggest that interaction between learner and learner-interface of the technologies used to deliver instruction (i.e., the CSCL environment) as a fourth class of interaction. Alternatively, Northrup and Rasmussen (2000) suggest a fourth class as the interaction between learner and feedback, expressed in terms of acknowledgements and assessment outcomes related to the completion of a learning activity that closes the communication loop.

Based upon these classifications of interaction, educational researchers propose ways to build interactivity into web-based CSCL environments. Gilbert and Moore (1998), for example, discuss four systems (or web design tools) that differ in their degree of interactivity, and how this interactivity can be tailored to facilitate activity types found in social interaction and instructional interaction. The systems are: the world wide web, groupware systems (e.g., Microsoft® Exchange®, IBM/Lotus Domino®), programming tools (e.g., Macromedia® Authorware® or Click2Learn® Toolbook®), and hybrid course design programs (e.g., WebCT). Considering the level and type of interactivity desired, the degree of control by instructors or learners, and the type of instruction desired (including collaborative learning), the 'right' web design tool(s) can be determined. Liaw and Huang (2000) supplement the theoretical thinking of Gilbert and Moore and go into more depth with respect to the advantages of using the web as a medium for interactivity for web-based learning. Within the context of social and instructional interaction, Northrup (2001) proposes a framework of interaction attributes in which each attribute embeds possible strategies and tactics that can be used to facilitate instructional and social interactivity. The framework includes interaction with content, collaboration, conversation, intrapersonal interaction, and

[I] According to Wagner (1994) there is a difference between interactivity and interaction. She associates interactivity with the degree a delivery technology is capable of establishing a two-way connection between distributed participants for the exchange of audio, video, text and graphical information. (Social) interaction on the other hand is associated with behaviors where individuals and groups directly influence one another. Many authors, however, use the terms interchangeably or do not make clear what they mean with the terms. For most of the time they use the term interactivity when actually interaction is meant. In this dissertation the terms interactivity and interaction are used conform with Wagner's interpretation. However, when referring to authors, the term is used which the original authors have used, although this may be incorrect.

performance support. She first discusses the pedagogical techniques used to promote the interaction and then the web-based software tool that creates the interactivity needed to support these.

Nevertheless, just building interactivity into web-based CSCL environments does not guarantee social interaction (see the first pitfall). However, as long as educators do not recognize the pitfalls they will continue to emphasize the interactivity component in CSCL environments. Wagner (1997) takes a first step in the right direction in noting that "Distance learning practitioners –particularly instructors and program administrators– seem to view interactivity as the defining attribute of a contemporary distance learning experience" (p. 19). But "(…) it may be that focusing on real-time, technologically enabled interactivity as a defining attribute of distance learning is an artefact of the past" (p. 21). So, crudely saying, just putting a forum on the web and labeling it 'café' or 'lobby' is not the way. It is more important to focus on the actors or agents (group members, instructors, content) who are to be involved in the social interaction. Building interactivity in (web-based) CSCL environment is a necessary part of the total solution (without this potential for interactivity social interaction is by definition impossible), but is often a waste of time and resources without the strategies that support collaboration and the development of a community of learners, the other part. These strategies are discussed in the next section.

3.3.1.3 *Activating Collaborative Learning in CSCL Environments*

Finally, there is a group of educational researchers that draw on those approaches for collaborative learning that have proven to be successful in classroom settings (Brush, 1998; Harasim, 1991, Hooper, 1992; Soller, Lesgold, Linton, & Goodman, 1999). Hiltz (1998), for example, suggests from her empirical studies that "collaborative learning strategies, which require relatively small classes or groups actively mentored by an instructor, are necessary in order for Web-based courses to be as effective as traditional classroom courses" (¶ Abstract) because collaborative learning can overcome some of the disadvantages of asynchronous CMC. Brush (1998), in reviewing a number of successful strategies on collaborative learning reported in the literature, mentions three key components that were present in each, namely positive interdependence, individual accountability, and collaborative skills. These three are also part of Johnson and Johnson's conceptual model, thus at least partially reaffirming its validity. To be successful, CSCL environments must be equipped with additional tools that support these three key components (Brush, 1998). He, for example, suggests that if positive interdependence is created through group roles (see, for example, Strijbos, Martens, Jochems, & Broers, in press), then the environment should prompt and remind the group members of their roles throughout the learning activity (see, for a suggestion, De Laat & Lally, in press).

Another example is Soller (1999, see also: Soller, Goodman, Linton, & Gaimari, 1998; Soller, Lesgold, Linton, & Goodman, 1999), who reviewed research in educational psychology and CSCL. Based upon this review, along with empirical data from a study conducted by her (1996), she proposes a model of collaborative learning comprising five characteristics exhibited by effective collaborative learning teams:

- Participation. The active involvement of a learner in a collaboration act executed by the group of learners, that is, the learner contributes to the achievements of the group.

- Social grounding skills. Those skills that allow members to naturally take turns questioning, clarifying and rewording co-members' comments by playing characteristic roles such as questioner, mediator, clarifier, facilitator, or motivator. Doing so means that members establish and maintain a shared understanding of meanings (Soller, 1999)
- Collaborative learning conversation skills. These are skills that aid in "knowing when and how to question, inform, and motivate one's teammates, knowing how to mediate and facilitate conversation, and knowing how to deal with conflicting opinions" (Soller, 1999, p. 8). Thus, skills that promote epistemic fluency. These skills are related to Johnson and Johnson's condition of interpersonal and small-group skills.
- Performance analysis and group processing. These are activities that give students the opportunity to individually and collectively assess their performance. During this self-evaluation, each student learns individually how to collaborate more effectively with his teammates and the group as a whole reflects on its performance (Soller, Lesgold, Linton, & Goodman, 1999). These activities are related to Johnson and Johnson's condition of group processing.
- Promotive interaction. Promotive interaction is the process in which group members verbally promote each other's understanding through support, help, and encouragement (Soller, 1999) "ensuring that each student receives the help he [sic] needs from his peers is key to promoting effective collaborative interaction" (p. 10). This characteristic is related to Johnson and Johnson condition of promotive interaction.

Soller, Lesgold, Linton, and Goodman (1999) have developed an intelligent collaborative learning system that supports only one facet of the collaborative learning model, the collaborative learning conversation skills. Because these skills are aimed at epistemic interaction, they use a sentence opener-based communication interface with sentence openers such as 'To justify (…)' and 'Can you explain how (…).' In this way, they explicitly coerce effective peer interaction in the group.

Clark (2000) suggests combining interactivity, collaborative learning methods, and a changed instructor's role in order to 'triangulate' (i.e., using multiple methods) the support for social interaction. He suggests the use of e-mail, public-, private-, and gated conferences, and shared document capabilities based upon their effects on instructor-student- and student-student collaboration. In gated conferences, for example, reading another's contribution before giving one's own contribution is prohibited. This inhibits both plagiarism and the simple acknowledgement of a previous contribution. With respect to collaborative learning methods, he proposes using epistemic techniques such as debate, group projects, and group paper. Finally, Clark suggests that instructors should play a different role than in face-to-face groups. In this new role, they must give mandatory class introductions, avoid dominating in discussion, and avoid taking control over discussions. In his view, using these guidelines will lead to effective collaborative learning while not neglecting the social aspects of it.

A note of caution is needed here. All of these suggestions assume that the learning groups have already reached the stage of becoming a performing group, that is, that all members know each other, that there is *group cohesion*, and that members are willing to help each other. However, this stage is hard to achieve in DLGs, despite the availability of modern CSCL environments. Fostering group cohesion in DLGs is

more difficult than maintaining it. Hiltz (1998) acknowledges this problem when she states that "even when collaborative learning is used, the current 'state of the art' of systems plus pedagogy seems to lead to less feeling of community than is typically obtained in face to face small group interaction."

3.3.1.4 *Seven Element Taxonomy*

Examining the strategies in the previous section more closely and how educational researchers have imposed conditions to realize CSCL, reveals that these strategies are based on the manipulation of seven 'primitive' elements that each affect collaboration. These elements can be synthesized into a seven element taxonomy. The elements are:

- Appropriate 'teacher' behavior (e.g., teachers should weave ideas together).
- Appropriate member behavior (e.g., members should socially support each other).
- Nature of the learning tasks (e.g., tasks should stimulate idea generation, intellectual activities, and judgment/evaluation processes).
- Member roles (e.g., members should be questioners and explainers).
- Task resources (e.g., knowledge or physical resources should enable task execution).
- Goal definition (e.g., there should be a clear description of the purpose of the collaboration).

Table 3.1
The Seven Element Taxonomy Applied to the Work of Gunawardena, Burge, Brush, and Soller

	Seven-Element Taxonomy						
	Appropriate teacher behavior	Appropriate learner behavior	Learning tasks	Roles	Resources	Formative evaluation/ feedback	Summative evaluation/ reward
Gunawardena (1995)							
Conference moderators	√						
Burge (1994)							
Instructor behavior	√						
Peer behavior		√					
Brush (1998)							
Positive interdependence			√	√	√		√
Individual accountability							√
Collaboration skills		√	√			√	√
Soller (1999, 2000)							
Participation		√					
Social grounding skills		√		√			
Collaboration skills		√	√			√	
Performance analysis/ group processing						√	
Promotive interaction	√	√		√			

- Formative evaluation with feedback from peers or from educators (e.g., providing peer comments on intermediate group products, asking if everyone is still on track).
- Summative evaluation and reward structure (e.g., giving points to the finalized group products).

This taxonomy, on the one hand, provides educators and instructors with concrete 'rules-of-thumb' for developing pedagogical techniques to stimulate collaboration, member participation, and/or social interaction. It can also be used to classify research efforts. Johnson and Johnson (1989), for example, advocate positive interdependence as a key for successful collaboration. Using or combining primitive elements from the taxonomy such as member roles and goal definition, can create positive interdependence. This can, in turn, create goal interdependence, which is defined by Johnson and Johnson (1989) as the state in which "individuals perceive that they can attain their goals if and only if the other individuals with whom they are cooperatively linked attain their goals" (p. 181).

The taxonomy is applied to the work of Gunawardena, Burge, Brush, and Soller to demonstrate how it works. Table 3.1 depicts the primitive elements derived from their set of factors and the way in which these researchers have made use of them to stimulate collaborative activities, and thus social interaction, so as to establish an effective collaborative learning group.

3.3.2 Avoiding the Second Pitfall

The strategies for avoiding the second pitfall, namely that group forming and group dynamics are automatic and, therefore, social interaction can be restricted to the support of cognitive processes only, are closely linked to strategies for encouraging social interaction for avoiding the first pitfall mainly because the same researchers are involved. Two categories of strategies are discerned here, namely:

- Orienting social interaction for group forming and group dynamics
- Increasing social presence in DLGs

3.3.2.1 *Orienting Social Interaction for Group Forming and Group Dynamics*

Though Gilbert and Moore (1998) distinguish between social interaction and instructional interaction (see the previous Section "Improving Interactivity in Web-Based CSCL environments"), they do not elaborate on exactly what social interaction will establish, only that it will help "create a positive (or a negative) learning environment" (p. 30), and, therefore, that it should be supported. Northrup (2001) states that "when collaborative teams of students work toward project completion, there is still the need for relationship building in the learning community. Relationship building is a necessary component of collaboration and communication" (p. 32). She further states that "given that the nature of online learning is 'anytime …anywhere,' the potential for isolation and frustration exists. The social interaction of the course must, at least initially, be designed into the course. Through collaboration and communication, the opportunity for learning more about peers and connecting them in non-task specific conversation is more likely to occur. Although social interaction may have very little to do with a course, it is still valued as the primary vehicle for student communications in a Web-based learning environment" (p. 32).

Educational researchers, recognizing the social psychological dimension of social interaction, propose a number of guidelines and strategies to encourage it. Gilbert and

Moore (1998), for example, suggest that different levels and types of desired interaction, social as well as content or instructional, between teacher, learner, and the group determine which groupware, web-based service, or programming tool is needed to meet the requirements.

Those educational researchers oriented towards social interaction for group forming and group dynamics feel that providing enough opportunities for this type of social interaction will positively affect learning performances (Jehng, 1997). Liaw & Huang (2000) noted that "the social interaction [in the social (psychological) dimension] in a course can also have significant effects on learning outcomes. In other words, social and interpersonal interaction are able to directly foster content and instructional interaction" (p. 43).

Interestingly, Zhang and Fulford (1994) suggested that the student's *perceptions* of the efficacy of social interaction in a course can have significant effects on learning outcomes. Northrup (2001) too finds that "the perception of the efficacy of this type of social interaction [i.e., for group forming and group dynamics] can impact the learning outcomes of the course" (p. 32). Yet, it is clear that social interaction in the social (psychological) dimension has to take place, but it is unclear what frequency, volume, and quality this type of social interaction must have in order to be effective, at least, in the perception of the members.

3.3.2.2 *Increasing Social Presence in DLGs*

Those educational researchers favoring increased social presence (Gunawardena, 1995, 1997; Rourke and Anderson, 2002; Rourke, Anderson, Garrison, & Archer, 1999; Tu, 2000a, 2002c) explain the lack social interaction observed in DLGs from a social presence perspective. Due to a lack of social presence, CMC hampers impression formation and thus also hampers the building of social relationships that are at the basis of developing affective structures within the group. As a result, a social space and a sense of community are not likely to emerge. Social interaction is impeded in such a context.

According to Gunawardena (1995), the development of both social presence and a sense of community are the key to promoting collaborative learning and knowledge building. Based upon two empirical studies, she determined that social presence –the user's perception of the medium– can be cultured through the creation of conducive learning environments, the training of participants in how to create social presence, and the building of a sense of community, for example, through moderation. She suggests that moderators of computer conferences should promote the creation of conducive learning environments by training CMC participants to create social presence in a text-based medium and by building a sense of community by having moderators "start the conference with introductions and social exchanges if the system used is a listserv, or create a separate area for social chit chat in a conferencing system" (p. 163). This, however, requires instructors to learn to adapt their actions to media to develop relevant interaction skills. In her view, "it is these skills and techniques, rather than the medium, that will ultimately impact students' perception of interaction and social presence" (p. 165).

Tu (2000a) lists a number of factors that affect the degree of perceived social presence and categorizes them in three main dimensions, namely (1) *social context*, comprising elements such as task orientation, privacy, topics, and social relationships, (2) *online communication*, comprising elements such as communication anxiety,

computer expertise, and (3) *interactivity*, emphasizing the potential for immediate feedback. These three dimensions of perceived social presence should be considered "if one examines CMC as a learning environment or is applying student learning and socio-cultural learning to the CMC environment" (p. 34).

3.4 Summary and Conclusion

Using DLGs for educational instruction is in vogue, stimulated by developments in internet and new information and communication technologies. Advanced CMC systems are being developed and integrated in CSCL environments, thereby relaxing the constraints of time and space. Educators, educational technologists, and educational researchers are in a hurry to unleash what they see as the potential of these CSCL environments for collaborative learning based social construction of knowledge and competence-based learning. Nevertheless, despite the promises of contemporary CSCL environments, a vast number of field-observations and other research point to disappointing results.

The key to the efficacy of collaborative learning is social interaction, and the lack of it is the major factor causing the poor results found for collaborative learning. This lack of social interaction is (1) due to the assumption that social interaction will automatically take place because the environment permits it and (2) because social interaction is usually restricted to only the cognitive aspects of learning, ignoring or forgetting that social interaction is equally important for affiliation, impression formation, building social relationships and, ultimately, the development of a healthy community of learning. Also, possibly due to its novelty, distributed group learning in a CSCL environment does not have its own (proven) pedagogy. These are the issues that are difficult to achieve in CSCL environments and, therefore, need the special attention of distance educators, designers, and researchers. This chapter has discussed a number of strategies that have been proposed for avoiding the two pitfalls and at the same time for providing a substitute for the lack of a specialized CSCL pedagogy.

However, Hiltz (1998) concludes that collaborative learning is a necessary, although not sufficient method for building and sustaining online learning communities. Therefore, all the strategies discussed in this chapter are just one part of the complete solution.

The propensity to focus singularly on the cognitive aspects of learning has led to the design of avowed *functional* CSCL environments, that is, environments that solely support and guide social interaction towards critical thinking, argumentation, or socially constructing meaning. However, these functional CSCL environments seem to forget that *human beings* are involved in learning. For this reason, another part of the solution is situated in the design of *sociable* CSCL environments that provide non-task contexts for allowing off-task communication (e.g., casual communication) and that help increase the number of impromptu encounters in task and non-task contexts for allowing frequent and informal communication. This is subject of the next two chapters.

CHAPTER 4

Overcoming the Barriers: The Ecological Approach

Abstract

Contemporary computer-supported collaborative learning environments are predominantly functional, focusing almost solely on the support of cognitive processes for learning. However, members of asynchronous distributed learning groups using these functional environments feel isolated and remote and, consequently, cannot establish relationships with each other resulting in a failure to achieve trust and a sense of community. The barrier here is that these purely functional environments lack social functionality. This barrier is identified in the present research as a barrier in the third Ring. This chapter advocates designing and implementing sociable computer-supported collaborative learning environments and proposes a theoretical framework as a guideline for designing and implementing such sociable environments. The framework comprises three foci: the ecological approach to social interaction, the concept of sociability, and social presence theory. Because the framework also addresses social presence, barriers that exist in the second Ring are occasionally addressed.

This chapter is based on parts of:

Kreijns, K., Kirschner, P. A., Jochems, W., & Van Buuren, H. (2004b). *Measuring perceived social presence in distributed learning groups*. Manuscript submitted for publication.

Kreijns, K. & Kirschner, P. A. (2004). Designing sociable CSCL environments: Applying interaction design principles. In P. Dillenbourg (Series Ed.) & J. W. Strijbos, P. A. Kirschner, & R. L. Martens (Vol. Eds.), *Computer-supported collaborative learning: Vol 3. What we know about CSCL ... and implementing it in higher education* (pp. 221–244). Boston, MA: Kluwer Academic Publishers.

Kreijns, K., Kirschner, P. A., Jochems, W. (2003b, August). *Supporting social interaction for group dynamics through social affordances in CSCL: Group awareness widgets*. Paper presented at the 10th European Conference for Research on Learning and Instruction (EARLI). Padova, Italy.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Journal of Education Technology & Society*, *5*(1), 8–22. Retrieved April 1, 2004, from http://ifets.ieee.org/periodical/vol_1_2002/v_1_2002.html.

4.1 Introduction

In order to design and implement successful CSCL environments, a number of variables must be examined that determine their success. In almost all cases, the sole variables under attention of educational researchers are those that deal with the design of educational functionality in CSCL environments. As a result, CSCL environments are designed to be predominantly functional, supporting all or a part of the cognitive processes for learning. However, learners are only involved in cognitive processing without the possibility of socializing, because the environment forces them to be 'on-task' only, will fail to develop trust, social cohesiveness, and a feeling of belonging to the group. In other words, these environments lack a social functionality[I]. Both the groups as entity and the learners in such groups will ultimately perform poorly. Possibly this myopic view of how these environments should be designed caused Jones (1995) to question the potential of CSCL systems for the production of a social space. He mused, "Could [these environments] perhaps reproduce 'real' social relationships in a 'virtual' medium?" (p.14).

This emphasis on functionality is a direct consequence of falling into one or both pitfalls, namely taking for granted that social interaction will automatically take place in DLGs just as it also 'just occurs' in contiguous learning groups and taking for granted that just because an environment might provide tools and functions that can support group forming and group dynamics, this will also automatically occur in those mediated environments. Falling into these pitfalls is not surprising because educators see themselves as being responsible for teaching students something, and anything that distracts the learner's attention away from learning in the classroom should be avoided. This way of thinking is often carried over to working in DLGs as well. This does not mean that functional CSCL environments do not need to be designed and developed. Without educational functionality, CSCL environments lose a great deal of their meaning and may become virtually useless for collaborative learning purposes. Learners must be supported in their critical thinking (Garrison, Anderson, & Archer, 2000), deep learning (Biggs, 1987) and in reaching a shared understanding (Clark & Brennan, 1991) in order to get the collaborative task done. Thus, when CSCL environments are designed, these considerations constrain their design. They are necessary, but *not* sufficient. Software engineers and programmers might possibly strengthen this educational vision. Firstly, their knowledge of teaching and learning is shaped/constrained by their own, long experience. In most instances, this means 12 to 16 years of traditional classroom education. Secondly, they use an intuitive approach of online learning that favors functional design of CSCL environments. This approach is shaped by what they learned in their programming courses where functionality and elegance were grounding principles. Finally, their intuitive approach is strengthened when they come into dialogue with those educators who are not aware or ignore the psychosocial dynamics of online groups. As a result, everything of the design of CSCL environments is almost solely in support of learning.

Gale's (1991) observation that "working in teams is essentially a social process" but "despite its enormous potential impact, this is an area hardly touched upon by office systems" (p. 61) is equally applicable to CSCL environments. Complementary to pedagogical techniques discussed in the previous chapter, this chapter advocates the

[I] Preece (2000) refers to 'social functionality' as 'sociality'

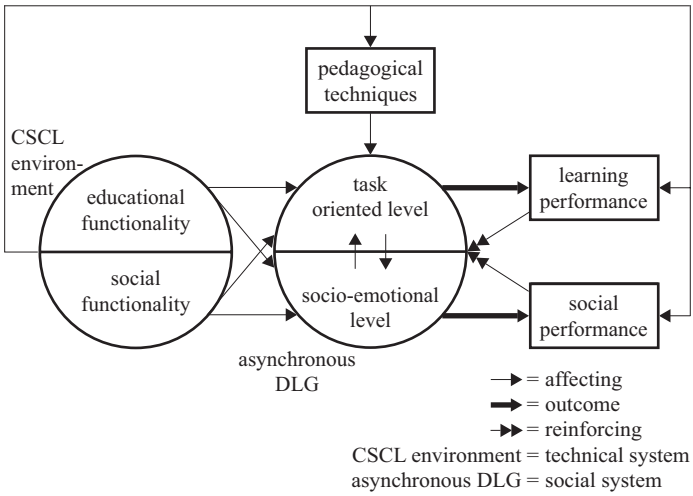

Figure 4.1 Functionalities of CSCL Environments

encouragement of social interaction by technically augmenting the CSCL environment in such a way that it will provoke social interaction for both cognitive processes and socio-emotional processes, although the latter is emphasized in the present research. In other words, the intention is to create sociable CSCL environments that meet as many of the social psychological needs of learners through the explicit embedding of social functionality apart from educational functionality. Within the area of human computer interaction and computer-supported cooperative work, researchers have already become aware that virtual groups need such sociable environments (Bly, Harrison, & Irwin, 1993; Donath, 1997; Feenberg, 1989). Sproull & Faraj (1997) noted that people "on the net are not only solitary information processors but also social beings. They are not only looking for information; they are also looking for affiliation, support and affirmation. Thinking of people on the net as social actors evokes a metaphor of a gathering. Behaviors appropriate at the gathering include chatting, discussing, arguing, and confiding. People go to a gathering to find others with common interests and talk with or listen to them. When they find a gathering they like, they return to it again and again." (p. 38).

All this leads to the conclusion that it is necessary to embed a kind of social functionality within the CSCL environment. Figure 4.1 depicts the two functionality classes of a sociable CSCL environment. The figure also depicts how the CSCL environment as a technical system may affect the asynchronous DLG as a social system[I]. Social psychologists (e.g., Forsyth, 1999), researchers of organizational behavior (e.g., Bales 1950) and linguistic and psychoanalytic researchers (e.g., Bion, 1961; Brown & Yule, 1983) have discovered that groups operate simultaneously on two levels and that each level influences the performances on the other level. The first level considers the task accomplishments in which the primary processes (getting the

[I] A *system* is a set of interacting, interdependent components which, used in combination, accomplish something that no single component can do alone. As such, this can include a *social system* (i.e., the asynchronous DLG) which is defined as "a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal" (Rogers, 1995, p. 23).

task done) take place. The second level considers the socio-emotional aspects. Here, the secondary processes (developing relationships, trust building, etc.) take place. The two levels are associated with learning performance and social performance respectively. Learning performance encompasses outcomes like competence growth, retention of what has been learned, and increased knowledge. Social performance is concerned with committed social relationships, the development of a sound social space, and so forth. Both kinds of performances reinforce the cognitive and socio-emotional processes within each level. For example, if all group members feel that they are going to succeed in their task then this affects feelings of success that in turn affect group cohesion and the sense of community in a positive direction. As is often indicated in the educational research literature, pedagogical techniques directly affect how groups collaborate while working on the tasks. The formulation of the task (e.g., conjunctive versus disjunctive tasks[1]; see Steiner, 1972), the group composition (heterogenous or homogenous groups; see Hooper & Hannafin, 1991), the structuring of the incentive of collaboration within groups using positive interdependency and individual accountability (Johnson & Johnson, 1992, 1994; Slavin, 1995), and the guidance and coaching of learners (Burge, 1994, Gunawardena, 1995) are all examples of how pedagogical techniques can be used to influence the group learning process.

Designing sociable CSCL environments requires a theo retical framework upon which such a design can be based. This chapter proposes a framework that comprises three foci, namely: the ecological approach to social interaction, the concept of the sociability of CSCL environments, and the concept of social presence of the DLG. Applying the framework in designing sociable CSCL environments may mitigate the negative effects of the barriers in the second and third Ring. The next sections describe each of the foci of the theoretical framework.

4.2 Focus 1: The Ecological Approach to Social Interaction

The present research hypothesizes that taking an ecological approach to social interaction increases the likelihood that social interaction is going to occur in asynchronous DLGs. If this approach is used in conjunction with collaborative pedagogical techniques such as those advocated by Johnson and Johnson (1989, 1992, 1994) and Slavin (1985), then the encouragement of social interaction is maximized.

The ecological approach to social interaction was inspired by Gaver (1996) who, in turn, was inspired by the seminal work "An Ecological Approach to Visual Perception" of the perceptual psychologist Gibson (1986). Gibson proposed an alternative theory – as opposed to the traditional cognitive theory– to explain animal behavior. He designated this alternative theory as a theory of 'direct perception', or as 'the ecological approach.'

4.2.1 Background: Gibson's Ecological Approach to Visual Perception

Gibson's (1977, 1986) ecological approach to visual perceptions is based upon three major ideas, namely: information, affordances, and information pickup.

[1] Conjunctive tasks are those tasks in which the contribution of the weakest member governs the group product. Disjunctive tasks are tasks in which the group accepts only one of the available individual contributions as its own.

4.2.1.1 *Information: the Ambient Optical Array*

Gibson's (1977, 1986) starting point to visual perception is not –as the cognitivist approaches suggested– light that stimulates the retinal image which subsequently provides information for visual perception, but the environmental information that is available in patterns of light that can be thought of as an ambient optic array. This optic array provides unambiguous information about substances, their surfaces, and the layout of these surfaces.

This starting point underlines Gibson's belief that visual perception is best described in terms of ecology and not in terms of (classical) geometry or physics. Ecological geometry encompasses surfaces and edges, because surfaces can be perceived since they are substantial, textured, and generally opaque whereas edges indicate the transition of one surface into another. In contrast, classical geometry encompasses planes and lines that can only be visualized but not perceived. Classical physics explains how light as electromagnetic waves can propagate through a medium and how it can stimulate receptors when viewed as photons. However, it cannot explain how the environment is perceived. Instead, ecological optics (i.e., ecological physics) describes how perception is based on information, contained in arrays of light. The surfaces, boundaries, objects, and layout of the environment structure that information. This structure may change when the head is moving. According to Gibson, these changes are relevant for extracting the relative permanent aspects of the environment because a static array does not allow for extracting these aspects.

4.2.1.2 *Affordances and Two Reciprocal Relationships*

Gibson (1977, 1986) related animal behavior to the mutuality of animal and environment. This reciprocal relationship emphasizes the notion that animal and environment have to be evaluated as one inseparable entity. One cannot study animal behavior by considering the animal apart from its context. The context is the environment with its structure, its building elements, and the relationships between them, including all the other creatures living in that environment. Also, an environment cannot be studied as single whole without the animal in it. Co-evolution of animal and environment has determined that both complement each other and have to be considered as a Siamese twin.

In addition to this reciprocal relationship, Gibson also related animal behavior to the notion that the interaction of the animal with its environment is a result of the coupling between what is being perceived and the consequent action on that perception. This is the principle of *perception-action coupling*. What is perceived is what the properties of the environment *afford* to the needs and the affectivities (i.e., capabilities for action) of the animal. Gibson considered the properties of the environment that have the ability to afford a function, to be particularly important as an explaining mechanism for animal behavior and he came up with the neologism *affordance* (i.e., opportunity for action). "The affordance of anything is a specific combination of the properties of its substance and its surfaces with reference to an animal" (Gibson, 1977, p. 67). In other words, the affordance of anything is what it 'offers the animal, what it provides or furnishes, either for good or ill' (Gibson 1986, p. 127). The affordance offered by a terrain that is solid, rigid, and flat is walking by an animal only if the animal has legs for walking.

Affordances need not be perceived. For affordances to be perceived the animal must be sensitive to the information in the optic array which may depend on the purposes and status of the animal. Therefore, irrespective of whether affordances are perceived, they exist as the objective properties of the environment. Besides, affordances are not only offered by objects but can also be offered by other creatures or even by certain events. A group of wolves affords organized hunting; every wolf can play her or his role in the hunt. The event of a predator looming affords that it is time to run and to find a safe place. However, this perspective of creatures and events as affordances is incompletely described in Gibson's work because most of the time affordances are discussed with reference to things (i.e., dead objects) or properties of environments[1].

4.2.1.3 *Information Pickup: Perceiving Affordances*

Yet, affordances alone are not sufficient for explaining animal behavior because they represent the static part. According to Gibson, the theory of affordances should be accompanied by a theory on how these affordances are perceived in such a way that they lead to action (behavior) and make the dynamics come into play. That theory is the theory of *direct perception*: "(…) when I assert that perception of the environment is direct, I mean that it is not mediated by retinal pictures, or mental pictures. Direct perception is the activity of getting information from the ambient array of light. I call this a process of information pickup that involves the exploratory activity of looking around, getting around, and looking at things" (p. 147). In other words, direct perception means the pickup of information from the ambient array of light thereby revealing properties of the environment without any information processing.

Gibson's theory of information pickup is a radical theory. The ambient optical array does not only provide information on the environment but also on what the environments and the objects in it afford to the animal in terms of terrain, shelter, nutrition, and so forth. This "implies that the 'values' and 'meanings' of things in the environment can be directly perceived. Moreover, it would explain the sense in which values and meanings are external to the perceiver." (Gibson, 1986, p. 127) It is radical because cognitivists believe that values and meanings are internal; meaning is not in the world but in the mind.

The following example will clarify the concept of affordances a bit more (in the case of humans): A log can be considered to have a sit-affordance. If a hiker has walked for hours and passes the log on a walk along small country roads, (s)he might perceive the sit-affordance of the log as a function of the degree of fatigue. A very tired hiker will sit on the log but will not lie down (unless the log is fairly long, i.e., also has a lie-affordance). A fit hiker might not even notice the sit-affordance of the log and pass it by or even 'tightrope' walk it. In that case, the log is no more than a piece of wood with no further meaning or a plaything respectively.

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[1] Indeed, researchers that applied the ideas of Gibson in their research domains have concluded that his ideas are powerful, yet incomplete and prone to misunderstanding. In addition, the same researchers often declare that they do not entirely agree with Gibson's theories for one or more reasons. Gibson, himself, has put a number of critical issues on the research agenda of ecological psychology, including "perceiving other animals and persons ('together with what they persistently afford and what they momentarily do')" and "perceiving events (and their affordances)" (Gibson, 1982).

4.2.1.4 *Summary*

Taking these together, affordances:

- are what the environment offers, provides, furnishes, and invites.
- are directly perceived through information pickup, requiring no information processing.
- imply a reciprocal relationship between an environment and its inhabitants.
- imply a reciprocal relationship between perception and action.
- are relative to the animal. A dragonfly may perceive a pond as a walking surface, a fish as a biotope, while for an elephant water is for drinking and cooling.
- are invariant. They are perceived as static components in the ambient optical array; their values and meanings are persistent.
- are holistic. Perceiving objects actually means perceiving their affordances and not their geometrical or physical properties.
- are properties of the environments. They exist whether or not they are perceived or realized.
- can be afforded by other creatures and events.

4.2.2 The Application of Gibson's Theory to Social Interaction

4.2.2.1 *Social Affordances*

Gaver (1996) did not coin the term social affordances, but used the term 'affordances for interaction' instead to indicate the special functionality of the affordances, i.e. to stimulate all possible interaction between humans. However, a few researchers have used the term social affordance. For example, Wellman (1999) used the term social affordances in the context of e-mail. Though he did not define the term, he referred to it in a footnote to a colleague who suggested using the term. Pederson and Sokoler (1997a) also used the term (p. 51). They did not describe the term any further either.

The lack of a definition has led the present research to define the term analogously to the definition of technological affordances formulated by Gaver[I] (1991). Social affordances are defined as those properties of the CSCL environment that act as social contextual facilitators relevant for the learner's social interaction. When they are perceptible, they invite the learner to act in accordance with the perceived affordances,

[I] Gaver (1991, 1992) used the concept of technology affordances to refer to those properties of computer screen objects that are related to their usability. Computer screen objects are part of a graphical computer interface, for example, a scroll bar and a selection box. Norman (1990, 1992, 1993) used the concept of affordances to refer to the usability of physical objects. For example, the usability of a teapot is determined by its design: a teapot is useless if the teapot handle and spout are on the same side. In contrast to these technical affordances, social affordances refer to those properties that are related to social functionality, thus, they address the utility aspects of CSCL environments that enable social functioning of DLGs. However, implementing social affordance devices may involve the perspective of technical affordances as a guideline for increasing its usability. Gibson (1977, 1986) did not clearly distinguish between utility and usability in his theory about affordances: having utility in mind, he often describes usability in terms of usable or not usable. For example, a chair is either 'sit-on-able' or not 'sit-on-able'; a chair is not 'sit-on-able' when the sit-surface is too high or too low relative to the position of the human knees. The approach of social affordances in the present research is more in line with Mark's (1987) definition of affordances, namely as the functional utility of certain environmental objects or object complexes taken with reference to individuals and their action capabilities.

i.e., start a task or non-task related interaction or communication. As can be seen from this definition, social affordances can be linked to an educational context, more specifically to the context of CSCL environments. Independent devices augmenting the CSCL environment can realize social affordances; hence, these devices are designated social affordance devices.

4.2.2.2 *Two Relationships of Social Affordances*

Social affordances have –in accordance with Gibson's theory– two reciprocal relationships:

- The first is the reciprocal relationship between the group member and the CSCL environment: On the one hand, the CSCL environment must fulfill the social intentions of the member as soon as these intentions crop up. On the other hand, the social affordances must be meaningful and must support or anticipate the social intentions of the group member.
- The second relationship is perception-action coupling. Once a group member becomes salient (perception), the social affordances will not only invite but also guide another member to initiate a communication episode with the salient member (action). The salience of the other member may depend upon factors such as expectations, focus of attention, and/or current context of the fellow member.

The relationships are closely related and interdependent. Perception and action are the result of both the intentions of the group member and the social affordances of the CSCL environment. Similarly, intentions and social affordances elicit both perception and action. The two relationships are depicted in Figure 4.2.

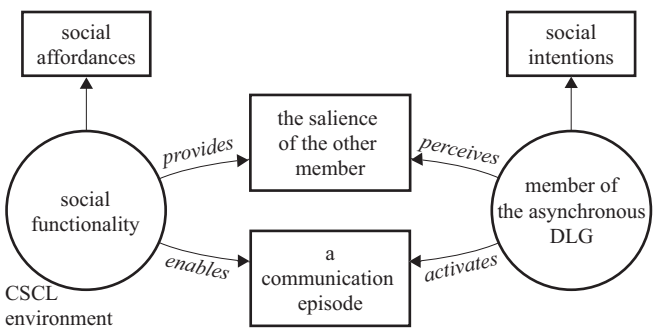

Figure 4.2 The Two Relationships of Social Affordances

4.2.2.3 *Aims of Social Affordances*

The aims of the social affordances in the present research are to:

- Stimulate informal and casual conversations. Studies of informal communication in organizations have suggested that informal communication facilitates the transfer of essential information related to task-specific activities (Isaacs, Tang & Morris, 1996). Researchers on organizational behavior and computer-supported cooperative work point to the role informal communication plays in teams with respect to the execution of work-related tasks, coordination of group activity, transmission of office culture, and social

functions such as team building (Kraut, Fish, Root, & Chalfonte, 1990; Whittaker, Frohlich, & Daly-Jones, 1994).

- Stimulate impromptu encounters[I]. Impromptu or chance encounters stimulate informal conversations. Johansen, DeGrasse, and Wilson (1978), for example, studying the social interactions in a research scientists' network, found that the many chance meetings turned into professional colleagueships and friendships over time. In addition, research showed that most interactions in the work environment take place during chance encounters (Kraut, Fish, Root, & Chalfonte, 1990; Whittaker, Frohlich, & Daly-Jones, 1994).
- Bridge the 'time gap' imposed by asynchronicity. Asynchronicity means that people (i.e., the learners) are not co-present while working and learning. This makes impromptu encounters impossible and may strengthen feelings of isolation and other social psychological effects as have been discussed in Chapter 2. It is hypothesized that bridging the time gap will mitigate these effects. For example, a learner who is only active during the late evenings may never encounter a fellow learner if all the co-learners of the group are active in the morning. This would give the impression to the late evening learner of being alone in the CSCL environment and possibly to the morning learners that she or he is not doing his or her share (just as the day people are invisible to the night people, so is the night owl invisible to the day people). However, if the activities of the morning learners are presented to the late evening learner and vice versa, this could have an impact on every aspect of the learning process as well as on the socio-emotional level, because now the late evening learner can not only react to those past events, but at the same time knows that the others were actively doing many interesting things.

4.2.2.4 *Proximity*

All three aims imply that proximity is an important dimension of social affordances. The first two aims address proximity of place (i.e., spatial proximity) and the third proximity of time (i.e., temporal proximity).

Spatial Proximity

Within the context of CSCL environments proximity is a virtual proximity (i.e., tele-proximity) rather than physical proximity. Physical proximity refers to the close distance that exists between people measured in meters. Usually someone in close proximity is someone within walking distance, that is, who can be reached within a couple of seconds or minutes. In a working setting, close proximity is about 30 meters (Kraut, Egido, & Gallegher, 1990). In contrast, virtual proximity cannot be measured

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[I] Kraut, Fish, Root, & Chalfonte (1990) distinguished between four types of encounters:

- Planned. These are pre-arranged meetings
- Intended. These are explicitely sought by one party
- Opportunistic. These are anticipated by one party but occur only when the parties happen to meet each other. Bradner, Kellogg, and Erickson (1999) call this type of interaction 'waylaying.'
- Spontaneous. These are unanticipated by either party. These represent the chance or impromptu encounters.

In this dissertation, impromptu (or chance) encounters refer to both opportunistic and spontaneous encounters.

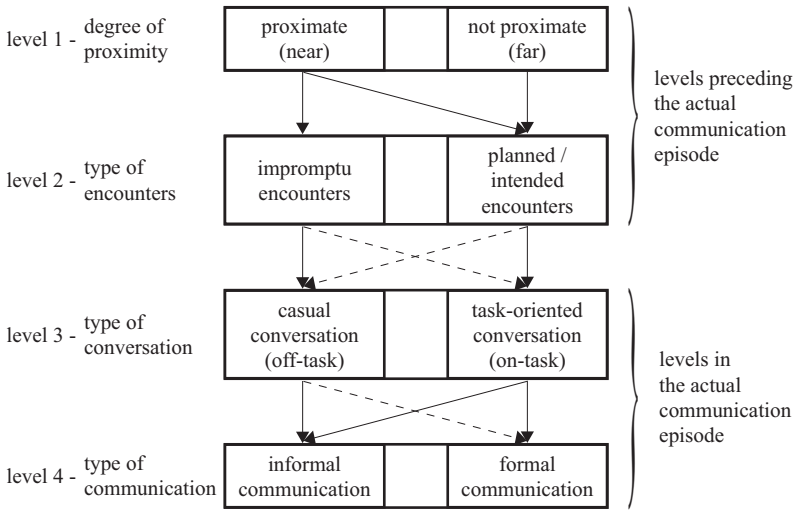

Figure 4.3 The Effects of Proximity

in meters, but rather in terms of visibility of the other; the degree to which someone can sense the presence of the other. Research on the effects of (physical) proximity has shown that proximity facilitates impromptu encounters and informal or casual conversations. Festinger, Schachter, and Back (1950) found that proximity leads to social relationships and even close friendships between people. Wellman (1992) and Wellman and Wortley (1990) found that social support increases and personal ties are stronger when people work and live nearby due to frequent impromptu encounters enabling spontaneous conversations covering the exchange of a multitude of various (socio-emotional) content.

Other researchers, like the organisational communication researchers Kraut, Egido, and Galagher (1990), found that most high quality interactions in the work environment take place during impromptu encounters because informal conversations also ease the transfer of essential information. This may lead to new collaborative relationships because common interests can develop. Informal communication, thus, is also important with respect to the task-oriented activities (Isaacs, Tang, & Morris, 1996; Whittaker, Frohlich, & Daly-Jones, 1994).

Finally, Kiesler and Cummings (2002) examined a number of studies on the benefits of proximity to relationships and group interaction under four conditions: the mere presence of others, face-to-face communication, shared social settings, and spontaneous communication. They found that physical proximity better serves the purpose of creating and sustaining strong work relationships than virtual proximity does. Communication technology is more likely to be effective when groups are cohesive than when they are not. Structured management is needed in case groups lack cohesion. However, Walther (2002) is more optimistic about that.

These findings are synthesized in Figure 4.3. The arrows in the figure may have different global meanings, ranging from 'will encourage' to 'will affect' to 'will lead to.' Solid arrows have the connotation of 'highly', 'more' or 'strong', dashed arrows of 'less' or 'weak'. For example, a feeling of 'proximity' (level 1, top left) will encourage both impromptu and planned encounters (level 2), while a lack of this feeling (level 1, top

Figure 4.4 The Coffee-machine as a Real Life Social Affordance Device

right) might encourage only planned encounters. The figure roughly depicts the effects of when people are in close proximity to each other. The four levels are degree of proximity (near—far), type of encounters (impromptu—planned/intended), type of conversation (on-task—off-task), and type of communi-cation (informal—formal).

Example of Real Life Social Affordance Device based upon Spatial Proximity

A canonical example of a real life social affordance device that exploits the effects of spatial proximity is the coffee machine/water cooler (Figure 4.4). The coffee machine/water cooler is a place where people gather and have casual conversations and communicate informally with each other[I]. These impromptu encounters offer

[I] It is important that when two persons are in the proximity of each other they will not pass without saying a word. A coffee machine/water cooler requires a person to stop for a while, and during that time, another person may arrive at the coffee machine/water cooler. Thus, the two persons are together in a time interval. The larger the time interval, the higher the probability will be that the two persons will have a conversation. In the hallway, the time interval is just as large as it takes for passing, which is usually short (a few seconds) when two person are coming from opposite directions. The probability that they will talk to each other is, therefore, low. Because the coffee machine/water cooler makes the effects of proximity more salient than the hallway, it is a better example than the hallway. For his reason we choose the coffee machine/water cooler as an example of a social affordance device rather than the hallway, although the hallway definitely is a social affordance device.

serendipitous moments to exchange not only task related information but also socio-emotional information. The coffee machine/water cooler becomes a place where people can get to know each other, learn and experience whom they can trust, who the experts are, what the interest of others are, and so on.

Temporal Proximity and Traces

The last aim addresses proximity of time (i.e., temporal proximity). Proximity of time refers to the short time-interval that exists between the presences of people at the same location measured in seconds. For example, one person may enter the classroom and leave it after a while. Shortly after this person has left, a second person may enter the classroom. The two persons are said to be in close temporal proximity. Being in close temporal proximity, however, does not alter their behavior because the two persons are not aware of the special circumstance they are in. In this respect, it does not matter whether the second person enters the classroom as soon as the first person has left it, or the day after. However, when the first person has left a trace (or footprint) that identifies her or him in addition to some indication of the time the trace was created, the second person may react on this trace. Mechanisms such as traces can be used for bridging the time gap. Traces make people become aware of the temporal proximities that exist amongst them. They may function as anchor points to start an informal conversation. In the CSCL environment, traces can be representations of the activities the learners were doing.

Example of Real Life Social Affordance Device based upon Traces

Think of the traces left by colleagues in their offices (Figure 4.5). A pile of articles and books on Bluetooth technology (see e.g., Deitel, Deitel, Niento, & Steinbuhler, 2002) left at some place on the desk of a colleague indicates that the colleague is interested in this wireless communication technology. The pile of books represents the footprint of an activity (collecting or reading the books) done in the past. A possible library date

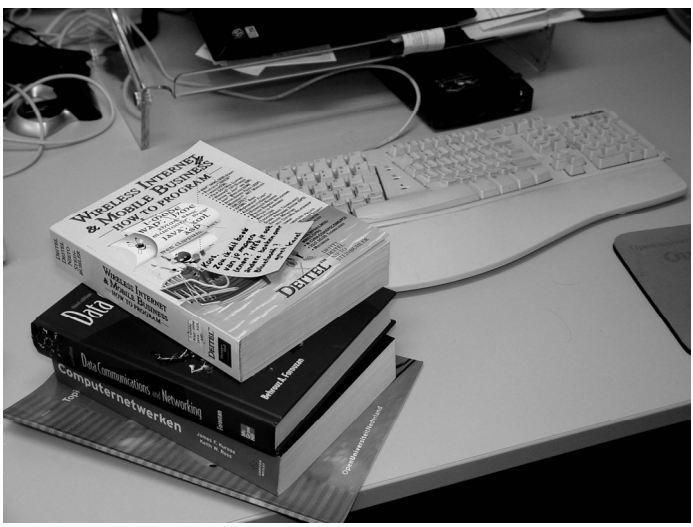

Figure 4.5 Post-it® Sticker as a Trace for Bridging the Temporal Proximity

marker represents the recency of the collections. If you also are interested in Bluetooth technology, you can discuss it with your colleague if she happens to be behind her desk (synchronous communication) or, by absence, leave a Post-it® sticker on that pile with a message that you wish to talk to her. The Post-it® Sticker is a new trace, and because it carries a message, it is at the same time a form of asynchronous communication. If the date and time is added to the Post-it®, then she may decide to contact you immediately or later based on that time-stamp. Because traces may provoke social interaction, they can be designed as social affordance devices.

The two real-life examples show, that the kind of social affordance devices may vary from things like coffee machines/water coolers, which are rather fixed devices that cannot be altered or moved, to very simple things like a pile of books that may have disappeared the next day. The examples also show that there are 'stronger' (the coffee machine) and 'weaker' (a pile of books) social affordance devices.

4.2.3 Related Research

Some researchers in the field of computer-supported cooperative work and computer human interaction have applied the concept of social affordances in their research. Bradner, Kellog, and Erickson (1999) define social affordances as "the relationship between the properties of an object and the social characteristics of a group that enable particular kinds of interaction among members of that group" (p. 153). Their definition is very similar to the definition of the present research.

Procter and McKinley (1997) defined social affordances as "(…) making the potential for social (inter)action visible" (p. 90). Their definition is analogous to Norman's (1992) definition of (perceived) affordances that is making the potential for action visible. "Affordances is a strange word, a technical term that refers to the properties of objects—what sorts of operations and manipulations can be done to a particular object" (p. 19).

Although using the same term 'social affordances', the objectives of each of these researchers is different (Table 4.1). The present research uses the concept of social

Table 4.1
Different Objectives of Social Affordances

	Kreijns, Kirschner, and Jochems (2002)	Bradner, Kellog, and Erickson (1999)	Proctor and McKinley (1997)
Dimension of social affordances	proximity	translucency	history
Social affordances	awareness of others in their activities	visibility, awareness, and accountability	awareness of rating and recommender information related to web pages
Action afforded	- increase impromptu encounters - stimulate informal communication	- provide opportunistic interactions - provide informality	social navigation
(Inter)action aimed at	communication	social behavior (p. 130)	finding the needed information
Ultimate goal	the taking place of group forming/group dynamics resulting in a sound social space	adoption of groupware systems/CMC technology (p.115)	reducing the information overload
Context	CSCL: (asynchronous) distributed learning groups	CSCW: (asynchronous) distributed work groups (i.e., teams)	recommender systems for web pages

affordances to increase the number of impromptu encounters, to stimulate informal communication, and to bridge the 'social' time gap due to the asynchronous mode of learning and working together. The goal is to encourage social dynamics which is hypothesized to lead to the emergence of a sound social space within DLGs. Bradner, Kellog, and Erickson (1999) aim to increase accountability through social translucency with respect to social behavior ('I know that you know that I know'-principle). Their goal is the adoption of groupware systems in teams within an organization. Proctor and McKinley (1997) aim at social affordances for facilitating social navigation. Social navigation is "moving 'towards' a cluster of other people, or selecting objects because others have been examining them" (Dourish & Chalmers, 1994, p. 1). Traces of visitors of web pages are used for implicit ratings for social filtering, which in turn, facilitates social navigation because social filtering creates a kind of recommender system for web pages.

4.3 Focus 2: The sociability of CSCL environments

The subject of the present research is sociable CSCL environments. In order to understand the typical characteristics of sociable environments, studies of the urbanist Whyte (1980) on human behavior in urban settings are important to consider. Whyte wondered how newly planned spaces were actually working out. His research question was why some spaces, notably parks, plazas and streets, have become places that are attractive for people to gather and to socialize while other spaces did not. He labeled those attractive spaces as sociable places. Many of Whyte's theories form the foundation of the Project for Public Spaces[I] (PPS). In addition, Gehl (2001) studied the physical conditions needed in public spaces for increasing the opportunities to meet, see, and hear other people.

4.3.1 Background: Designing Sociable Public Urban Places

4.3.1.1 *The Sociability of Public Places*

Both Whyte (1980) and Gehl (2001) suggest that the space in public spaces and between buildings can be intentionally designed to foster and support social interaction among the users of the space. Gehl (2001) remarks that though "the physical framework does not have a direct influence on the quality, content, and intensity of social contacts, architects and planners can affect the possibilities for meeting, seeing, and hearing people—possibilities that both take on a quality of their own and become important as background and starting point for other forms of contact" (¶ Three Types of Outdoor Activities).

If a place is more sociable then it will attract more people. According to Whyte (1980) the "best-used places are sociable places, with a higher proportion of couples than you find in less used places, more people in groups, more people meeting people, or exchanging goodbyes" (p. 17–18). Studies of public places have shown that sociable places met physical conditions such that people are able to meet each other, have social talks, watch other people, sit where they like, and look at public art. It has been shown that food, retail activities and programmed activities attract people to visit these places, but also accessibility, visibility for increasing the sense of security, and comfortability are attracting factors. Interestingly, the "elements of a good city space, then, are basics,

[I] The Project for Public Spaces home site is http://www.pps.org.

and it is interesting to note how many of them are natural—people to watch, sun to bask in, trees to sit under, water to splash in and listen to" (Whyte, 1980, p. x). Additionally, Whyte (1980) elaborated on this a bit: "Warmth is just as important as sunlight. (...) What people seek are suntraps. And the absence of winds and drafts are as critical for these as sun (...) There are all sorts of good reasons for trees (...) Trees ought to be related much more closely to sitting spaces than they usually are (...) Water is another fine element (...) One of the best things about water is the look and feel of it (...) It's not right to put water before people and then keep them away from it (...) Another great thing about water is the sound of it" (p. 44, 46, 47–48).

According to Davies, Pinkett, Servon, and Wiley Schwarz (2003) "Sociability is a critical 'x' factor in placemaking anywhere, but it holds a particular value with respect to neighborhoods in transition, as it allows people to come to know each other across race and class lines, or at least become comfortable with different cultural public expressions and interactions. In addition, places that foster comfortable social interactions in this way allow issues to be addressed and perhaps solved. For example, residential streets with low automobile speeds allow children to play and all residents to walk, thus fostering sociability and perhaps the formation of a block club that can address safety and cleanliness issues. With respect to CTCs [communication technology centers as public spaces], we sought to answer the following: Are people helpful to others with problems? Is the population diverse (e.g. women and men, seniors and teens, representative of the community's ethnic diversity)? Do we see groups and individuals mixing, and relationships forming, that were not formed previously? The answers to these questions can serve as indicators of sociability" (p. 13).

4.3.1.2 *The PPS's Place Map*

Sociability alone is not enough. According to PSS, sociability is only one quality that determines the successfulness of public spaces. PPS has identified four qualities from their research that includes more 1000 studies of public places that are critical for any public space:

- The space must be *accessible* and well connected to its surroundings, both visually and physically. A successful public space is easy to get to and get through; it is visible both from a distance and up close
- People need to be engaged in *activities*. Activities are the basic building blocks of a place. Having something to do gives people a reason to come and return. When there is nothing to do, a space will generally be empty
- The space must be *comfortable*. Comfort includes perceptions about safety, cleanliness, and the availability of places to sit. The importance of giving people the choice to sit where they want is generally underestimated
- It should be a *sociable* place, one where people meet each other and take people when they come to visit. This is a difficult quality for a place to achieve, but once attained it becomes an unmistakable feature.

These qualities, or key attributes, are denoted in what PPS calls the Space Map (Figure 4.6). Of course, in the context of the present research the focus is on the sociability quality issue of urban places. Nevertheless, the three other qualities can be easily translated to 'qualities' of CSCL environments. In CSCL environments the quality 'activities' translate to the educational activities, the quality 'accessible' and

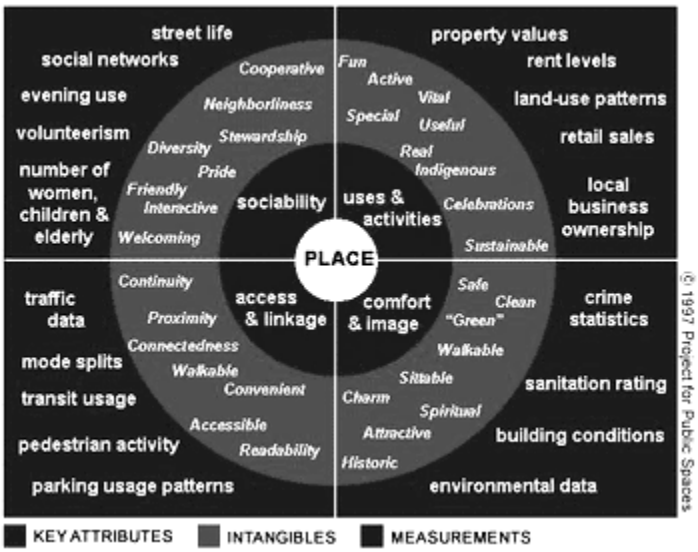

Figure 4.6 PPS's Place Map

'comfortable' roughly translate to respectively usability issues and interaction design issues.

4.3.1.3 *Increasing the Sociability of Public Spaces*

Although urbanists are not aware of affordances, they use the concept all the time. An example: Milanski (1997) observed in Chicago during the summer that a large number of office workers ate their lunches outside in public parks and plazas. Despite great design effort, many plazas and neighborhood parks remained unattended. One reason is that the park benches were apparently not attractive as a sitting place to have a conversation with others or for doing other things. The solution was an L-shaped park bench that has the 'affordances' that the other benches did not have. Milanski points

Figure 4.7 "Long flat surface invites sleeping. Notice how the sitting person can remain separate but still glance into other spaces" (Milanski, 1997, p. 23)

out that the long flat surfaces, for example, invite for sleeping (see the Parkbench prototype in Figure 4.7). He further points out that the "L-shape of the bench allows groups of 2 or 3 to communicate easily. It also allows individuals to withdraw from the conversation by simply turning away. The staggered seating also creates backrests for some people. Individuals can choose a seat facing away from another group. This allows them to feel alone despite close proximity. Different surface heights make each person's personal space clear" (p. 19). Milanski suggests that using these park benches in those plazas and parks, would make them more sociable.

4.3.2 The Sociability of CSCL Environments

A few researchers in the area of computer-supported cooperative work have adopted the ideas of Whyte (1980) and Gehl (2001) in their research (e.g., Busher & Hughes, 1999; Donath, 1997). The present research's interpretation of sociability perfectly matches the ideas and thoughts of Whyte and Gehl, namely the design of sociable places through physical conditions that enable them to bring people together and permit them to socially interact with each other.

Like public spaces, CSCL environments differ in their degree of sociability. *Sociability*[1] is defined here as the extent to which the CSCL environment is able to facilitate the emergence of a social space. The *social space* is the human network of social relationships amongst the group members embedded in group structures of norms and values, rules and roles, beliefs and ideals. The hypothesis is that the higher the sociability, the more likely it is that social interaction will take place or, if present, will increase, and the more likely it is that this will result in a sound social space and the establishment of a community of learning. A social space is *sound* if it is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction, and a strong sense of community. A sound social space determines, reinforces, and sustains the social interaction taking place amongst group members. Systems with low sociability may experience problems with the emergence of a social space. However, it is not said that this will not arise, but different rates and patterns are expected.

The present research postulates that social affordance devices contribute to the degree of sociability of CSCL environments because they constitute those 'physical' conditions that create opportunities for social interaction as meant by Whyte (1980) and Gehl (2001).

Finally, it is important to notice that both Whyte and Gehl studied public spaces, that is, places that are 'far' from the task context. So, the inclusion of social affordance devices in the CSCL environment that do not restrict themselves to the task context but also consider non-task contexts is likely to increase the CSCL environment's sociability.

4.3.2.1 *Non-Task Contexts*

In traditional classroom settings social interaction for socio-emotional processes not only occurs during classes, but also –and predominantly– outside the classroom, thus,

[1] Preece (1999, 2000) clearly views sociability as a property of a social system or a virtual community and deals with the set of social policies that support the community's purpose. Thus, sociability is a feature of human social systems.

in non-task contexts. The hallway, the library, and other public places provide opportunities for learners to meet and socialize. Hence, the present research conjectures that non-task contexts will foster these processes more than task contexts will. This is because non-task contexts are usually characterized by informal and casual conversations –often initiated by impromptu encounters– and may deal with a broad range of (task and non-task) subjects allowing serendipitous opportunities for getting to know one other. These conversations show an abundance of exchange of socio-emotional and affective information that contributes to impression formation, the creation of social relationships, group cohesion and ultimately to a sense of community. Gilbert and Moore (1998) argued that "social interaction between students and teachers and between students and students can sometimes have little to do with instructional learning, but can still help to create a positive (or a negative) learning environment" (p. 30). Similarly, Northrup (2001) contended that through social interaction "the opportunity for learning more about peers and connecting them in non-task specific conversation is more likely to occur. Although social interaction may have very little to do with a course, it is still valued as the primary vehicle for student communications in a Web-based learning environment." (p. 32). Rovai (2001, 2002a, 2002b) found that group members who had the opportunity to meet each other outside the CSCL environment developed more and deeper relationships when contrasted to groups whose members had not had that opportunity. Underlying Rovai's (2001, 2002a, 2002b) explanation is that impromptu encounters favor informal communication and that informal communication eases the transfer of socio-emotional cues more than formal communication can. Thus, the more impromptu encounters, the more informal communication and, thus, the more exchange of socio-emotional content adding to the process of getting to know each other.

Harasim (1991) confirmed that social communication is an essential component of educational activity and an online environment should, therefore, provide space for informal discourse. She suggests that an online cafe can contribute to creating a sense of community within the group, forging a social bond. This, in turn, can offer important motivational and cognitive benefits to the learning activities. Bannan-Ritland, Bragg, and Collins (in press) argued that off-task activities encourage interacting on an informal basis, emphasising the natural social aspects of human communication. This contributes to the concepts of trust, community building, collegiality and fun and recreation. They concluded that these elements are necessary components of any successful learning experience and are even more important when a

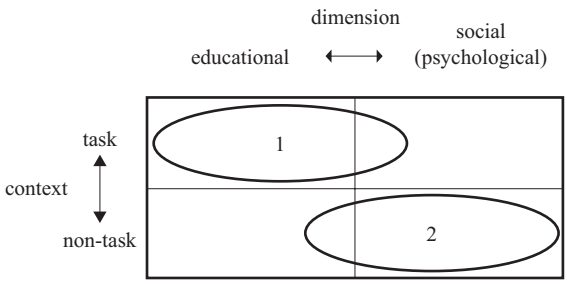

Figure 4.8 Area 1 Depicts the Traditional Focus of Educators. Area 2 Depicts the Focus that Should Be Supported in Sociable CSCL Environments

course is delivered primarily online.

In addition, the provision of non-task contexts allows redirection of casual conversations away from task contexts, thereby reducing the fear of many educators that too much casual conversation and too little task-oriented conversation during the collaborative activities occur, causing groups to be counterproductive and irritating some group members who want to go on with the tasks (Keegan, 1988; Rourke & Anderson, 2002). Redirecting casual conversation to non-task contexts implies that these environments potentially provide more opportunities for exchanging socio-emotional cues than task contexts can, because casual conversation is informal by nature.

However, functional CSCL environments rarely offer such off-task contexts, despite the suggestions of some researchers to do this.

4.4 Focus 3: Social Presence Theory

4.4.1 Background: Classical Social Presence Theory

4.4.1.1 *Origin and Definition*

Social presence theory was originally developed by Short, Williams, and Christie (1976) to explain interpersonal effects between two interlocutors in an organizational context when using telecommunication media such as telephone, audio channels, closed-circuit video channels, and face-to-face meetings. They characterized each communication medium in terms of its potential to communicate verbal and non-verbal cues conveying socio-emotional information in such a way that the other is perceived as 'physically' present. They hypothesized that the more verbal and non-verbal cues can be transmitted, the higher the perception of the 'physical' presence of the other will be. Non-verbal cues are expressed by vision (e.g., facial expression, direction of gaze, posture, gestures, eye-contact; in other words: 'body language'), audition (e.g., voice volume, inflection, soft speaking), tactile (e.g., touching, shaking hands), and olfaction (e.g., smells, body odors). According to Birdwhistell (1970), non-verbal cues pass information from one individual to the other (i.e., they elaborate the information) and integrate the communication process (i.e., they are help keep the system in operation and regulate interaction process). Additionally, non-verbal cues play help guide the turn-taking process (Whittaker & O'Connail, 1997) and play an important role in both impression formation (the process of getting to know the other) and building interpersonal relationships (Short, Williams, & Christie, 1976; Walther, 1992, 1993).

Short, Williams, & Christie (1976) defined social presence as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships (…)" (p. 65). They hypothesized that telecommunications media vary in their degree of social presence and suggested that these variations play an important role in determining the way individuals interact. More precisely, they stated social presence "varies between different media, it affects the nature of the interaction and it interacts with the purpose of the interaction to influence the medium chosen by the individual who wishes to communicate" (p.65).

4.4.1.2 *Factors Influencing the Degree of Social Presence*

Short, Williams, and Christie (1976) initially held the physical and technological characteristics of a telecommunication medium to be solely responsible for its degree of social presence. In other words, they saw social presence as an *objective* quality of the communication medium. They eventually relaxed their view to include the *subjective* qualities of the medium as a contributor to social presence. They saw social presence "as a single dimension representing a cognitive synthesis of all these factors [i.e. factors that are non-verbal cues] as they are perceived by the individual to be present in the medium. Thus, the capacity to transmit information about facial expression, direction of looking, posture, dress and non-verbal vocal cues, all contribute to the Social Presence of a communications medium. How they contribute, the weights given to all these factors, is determined by the individual, because we conceive of Social Presence of a medium as a perceptual or attitudinal dimension of the user, a 'mental set' towards the medium" (p. 65). Although they admit to a subjective quality of the medium, they still favored the objective perspective when it came to theoretically explaining the variations in the degree of social presence between different communication media. For this reason, the kind of social presence proposed by Short, Williams, and Christie (1976) can be designated as a 'technological' social presence (Tu, 2000a).

4.4.1.3 *The Use of Social Presence Theory*

Social presence theory is often used to rank telecommunication media according their degree of social presence. This ranking in descending order is: face-to-face communication, video-conferencing, and finally audio-only (e.g., the telephone). The theory also contends that communication media higher in social presence are more appropriate when interpersonally involving tasks are in carried out (Rice, 1993; Steinfield, 1986). In other words, task activities needing a strong interpersonal characteristic such as tasks that depend on developing and maintaining mutual trust such as conflict-resolution tasks or negotiation tasks require communication media that are high in social presence. This is because, according to the theory, media higher in social presence are more effective channels for trust building and, consequently, of social influence (see for social influence: Fulk, Schmitz, & Steinfield, 1990; Spears & Lea, 1992). Based upon this reasoning, the theory hypothesizes that media choice can be predicted: "users of any given communications medium are in some sense aware of the degree of Social Presence of the medium and tend to avoid using the medium for certain types of interactions; specifically, interactions requiring a higher degree of Social Presence than they perceive the medium to have" (Short, Williams, & Christie, 1976, p. 65).

4.4.1.4 *Social Presence and the Concepts of Intimacy and Immediacy*

Short, Williams, and Christie (1976) related two other social psychological concepts to social presence, namely intimacy (Argyle & Dean, 1965) and immediacy (Wiener & Mehrabian, 1968). Both concepts were originally developed in face-to-face situations, but influenced social presence theory of communication media.

Intimacy is an equilibrium theory postulating that communicating participants will reach an optimum level of 'intimacy' in which conflicting approaches and avoidance forces are in equilibrium. Short, Williams, and Christie (1976), referring to Argyle and Dean (1965), saw intimacy as "a function of eye-contact, proximity, conversation

topic and so on; changes in one will produce compensating changes in the others (…) eye-contact is generally sought after, but too much creates discomfort; for instance, eye-contact is reduced when people are placed very close together" (p. 53). Another example of the desire to reach an optimum level of intimacy is when "(…) two people, if they are seated face-to-face, will try to adjust their seating positions until an equilibrium is reached" (p. 72). Short, Williams, and Christie (1976) suggested that social presence of the communications medium should be included in the list of factors contributing to intimacy. Lombard and Ditton (1997) support the suggestion noticing that a "medium high in presence as social richness [social presence] allows interactants to adjust more of these variables and therefore more precisely adjust the overall level of intimacy" (¶ 'Presence as Social Richness'). They referred with 'these variables' to the original list of intimacy behaviors extended by others to include posture and arm position, trunk and body orientation, gestures, facial expressions, body relaxation, touching, laughter, speech duration, voice quality, laughter, olfactory cues, and others.

With respect to *immediacy*, Short, Williams, and Christie (1976) saw it as "a measure of the psychological distance which a communicator puts between himself and the object of his communication, his addressee, or his communication. According to Wiener and Mehrabian, negative affect, low evaluation, and non-preference for any of these things are associated with non-immediacy in communications" (p. 72). Immediacy or non-immediacy can be conveyed non-verbally and verbally. According to Gunawardena (1995): "Immediacy enhances social presence" (p. 151). Lombard and Ditton (1997) support this relationship noting that although "language and therefore immediacy can be varied within any medium that can transmit language, it seems logical to expect immediacy and presence as social richness to be correlated (…)" (¶ 'Presence as Social Richness').

4.4.2 Towards a New Social Presence Theory

4.4.2.1 *Extending Social Presence Theory*

Classical social presence theory was developed within the confined context of synchronous communications involving face-to-face, audio, or close-circuit video telecommunication media. Therefore, from this perspective, social presence can only be perceived while participating in a real-time communication episode. Social presence theory was proposed neither for *asynchronous* communication nor for *text-based* communication media (i.e., computer-mediated communication (CMC). Despite the fact that asynchronous, text-based communication is the inherent characteristic of CMC, social psychologists, communication researchers, and (distance) educational researchers have applied social presence theory to it. The consequences of extending social presence theory to text-based CMC and asynchronous communication are now examined.

4.4.2.2 *Social Presence and Synchronous, Text-Based CMC*

Social presence theory can be applied to synchronous, text-based CMC, such as real-time chat without problems. Because of its real-time character, the communicating individual *knows* that the other is co-present which is affirmed by the dynamics of the communication, namely the immediate responses, feedback, and the continuous flow of (verbal) cues which reinforce and sustain the perceived social presence. However, it

can be argued that the perceived degree of social presence is lower than audio only or video because text-based communication is deprived of the transmission of non-verbal cues, although the use of emoticons can compensate for this deficiency to some degree.

4.4.2.3 *Social Presence and Asynchronous Communication*

Applying social presence theory to asynchronous communication is problematic because the other is not necessarily co-present. The absence of the other prohibits perception of the other and thus, in the classical definition, there cannot be any social presence. Indeed, Benschop (2004) notices that communication scientists consider e-mail as a communication media that may also provoke social presence but he objects that e-mail just lacks the media richness and the directness of interaction that is needed to create a feeling of social presence (¶ Sociale aanwezigheid [Social presence]). Individuals, however, may *experience* the presence of the other in asynchronous communication. This *psychological* experience of the other can be designated as *psychological presence*, a substitute for the missing social presence in asynchronous communication. Psychological presence is evoked through the activation of a mental model of the other, for example, when an e-mail message written by the other is read.

This mental model is defined as the internal representation of the other that individuals construct in their minds, and its construction is affected by the individuating impressions an individual has made of the other. According to Walther (1992, 1993), accumulated relational messages originating from previous episodes of asynchronous and synchronous communication with the other contribute to the forming of an individuating impression of the other. This mental model not only affects the perceived degree of psychological presence, but it also affects the social presence in a real-time communication episode. It makes a difference if individuals already know the other in the conversation. If this is the case, then this may increase the degree of social presence (cf., Tu, 2002b).

Communication researchers, however, do not differentiate between psychological presence and social presence, because the effects of perceiving social presence or experiencing psychological presence are believed to be comparable. To be compatible with those researchers, we also use the term social presence in those cases where, technically speaking, we would actually denoting psychological presence.

To sum up, psychological presence does not depend on perception while social presence does. Reading an e-mail message that was posted yesterday cannot generate a sense of social presence, because the other is not there. Nevertheless, some degree of psychological presence may exist at the moment the e-mail message is read.

4.4.2.4 *Re-examining Factors Influencing the Degree of Social Presence*

The subjective weighing of transmitted cues cannot completely explain observed differences in perceptions of social presence and online behavior. Other factors apparently affect the degree of perceived social presence.

Here, one group of researchers adheres to the position of what can be called 'technological determinism' and another group to the position of 'social determinism.' Depending on the position taken, different factors are in focus.

Concurrently, the same researchers have different interpretations of what social presence is and, consequently, use definitions that are in concordance with their interpretations.

Technological Versus Social Determinism

Social presence theory as developed by Short, Williams, and Christie (1976) is a prime example of technological determinism in that, in their view, the technology determines social presence. Garrison, Anderson, and Archer (2000) challenged this technological determinism perspective stating that they "do not believe that the effects of media per se is the most salient factor in determining the degree of social presence that participants develop and share through the mediated discourse" (p. 94). Others (e.g., Gunawardena, 1995; Tu, 2002b) took an even extremer position and declared that the attributes of the communication media are irrelevant in the perception of social presence. They take the position that social factors solely determine the social presence.

These two extreme positions illustrate what Spears, Postmes, Wolbert, Lea, and Rogers (2000) called the 'technological versus social determinism' controversy. They pointed out that 'simple' theories over-generalize ICTs' social effects such as the tendency "to assume that ICTs' effects are due to characteristics of the technology or that these are constructed by social factors" (p.8). From their studies, they concluded that "the diversity of social effects precludes that technology is singularly good or bad, and that technology determines the social effects. Conversely, social determinism cannot account for invariable technological effects: not every use of ICTs is as flexible as these theories claim. Moreover, social determinism often is relativistic, which restricts its power of prediction and practical use" (p.8). This dissertation supports them when they advocate that "a theory of the social effects of ICT must emphasize that the use and effect of the new technologies are co-determined by technological features (anonymity, isolation, and asynchrony) and social psychological factors (identities, social relations and social practices)" (p. 8).

Definitions of Social Presence

In this dissertation, three types of definitions of social presence are distinguished. Each of these types is now discussed. The first type is *social presence as the psychological sensation of the other as 'physically' real*. Gunawardena (1995) adapted the social presence definition of Short, Williams, and Christie (1976) to "the degree to which a person is perceived as a 'real person' in mediated communication" (p. 151). In her view, the development of social presence is the key to promoting collaborative learning and knowledge building and is a predictor of learner satisfaction (Gunawardena & Zittle, 1997). Gunawardena (1995) concluded from two studies on social presence in text-based computer conferences that "although CMC is described as a medium that is low in non-verbal cues and social context cues, participants in conferences create social presence by projecting their identities and building online communities" (p. 163). The finding that social presence can 'be cultured' was originally suggested by Johansen, Valee, and Spangler (1988).

This, however, does not happen spontaneously. Instructors and moderators "need to learn to adapt to telecommunications media by developing interaction skills that create a sense of social presence. It is these skills and techniques, rather than the medium, that will ultimately impact students' perception of interaction and social presence" (Gunawardena, 1995, p. 165). As techniques, she suggested that instructors and moderators facilitate discussions by recognizing all contributions initially, summarizing frequently, and weaving ideas together. She further suggested facilitating introductions and social exchanges in the initial learning sessions to enable participants

to get to know each other and to develop a working relationship built on trust. (p. 158, 163; see also Johansen, Valee, & Spangler, 1988).

The second type is *social presence as the psychological sensation of feeling connected to the other*. Tu (2000a, 2001, 2002a, 2002b, 2002c) uses a variety of definitions of social presence. He defined social presence to be the degree "of person-to-person awareness, which occurs in a mediated environment" (Tu, 2002b, p. 34) and as the degree "of feeling, perception and reaction of being connected on CMC to another intellectual entity" (Tu, 2002c, p. 2; cf., Tu & McIsaac, 2002).

In his view, social presence is a key variable for determining the social interaction in group learning. He (2000a, 2001) identified three main variables contributing to social presence, namely:

- Social context. Social context is constructed from the users' characteristics and their perceptions of the CMC environment. According to Tu (2002a, 2000b), social context is determined by task orientation (Steinfield, 1986), trust (Cutler, 1995), availability of CMC, CMC access locations, recipients and social relationships (Walther, 1992), and social processes (Walther, 1992). Tu (2002a, 2000b) hypothesized that if participants are not familiar with each other and the conversation is task oriented and more public the degree of social presence will degrade.
- Online communication. In Tu's (2002a, 2000b) opinion, online communication relates to the attributes of the language used online and its application. He also stresses that it is important that students have basic computer literacy skills and online language skills. He (2002a) agreed with Gunawardena (1993) that, otherwise, students may develop communication anxiety (see for communication anxiety, McCroskey, 1984). Students possessing both skills showed to be more interactive than those who did not have the skills. Garramone, Harris and Anderson (1986) found that in bulletin board systems the more interactive students were the higher their degree of social presence was as perceived by others. In addition, Tu (2002a) pointed to Perse, Burton, Kovner, Lears, and Sen (1992) who found a positive relationship between social presence and the students' perception of their own computer expertise.
- Interactivity. Tu (2002c) defines interactivity as the active communication and learning activities that users engage in and the utility of the communication styles. The potential for feedback and the immediateness of responses given both affect the degree of social presence (Garramone, Harris, & Anderson, 1986). In addition, Tu (2002a) also sees task types, topics (Argyle & Dean, 1965), and groupsize affecting interactivity and, thus, indirectly affecting the degree of social presence.

In agreement with Witmer (1997), Tu (2002a) suggested two (main) variables that can potentially affect the degree of perceived social presence. Both variables concern the perceived privacy in CMC environments:

- System privacy. System privacy is the actual security of CMC technologies offered, including the likelihood that the CMC system will allow unknown others to read, send, or resend messages to or from someone else (including yourself).
- Feelings of privacy. This refers to the "perception of privacy psychologically, mentally, culturally, or conditionally rather than actual security" (Tu, 2002a,

p. 297). The perceived degree of social presence is low in settings that are perceived to be less private (Champness, 1972; Steinfield, 1986).

Tu (2002b) found a weak (tough significant) correlation between social presence and privacy and that "this correlation may vary with different subjects, media and contexts" (p.43). Therefore, it is not clear whether privacy actually affects social presence.

Finally, the third type is *social presence as the competency to project oneself as 'physically' real*. Garrison (1997a) expanding on Gunawardena's (1995) perspective that social presence can be cultured, defined it "the degree to which participants are able to project themselves affectively within the medium" (p. 6). Garrison, Anderson, and Archer (2000) adopted this definition in their framework for analyzing critical thinking in computer conferences and redefined it as "the ability of participants in a community of inquiry to project themselves socially and emotionally, as 'real' people (i.e., their full personality), through the medium of communication being used" (p. 94). In other words, they maintain that the competency to develop social presence *is* social presence. They argued that it is important because it functions as "a support for cognitive presence, indirectly facilitating the process of critical thinking carried on by the community of learners (…) and is a direct contributor to the success of the educational experience" (p. 89). Cognitive presence, social presence, and teaching presence are the three corner stones of their community of inquiry (see for this community of inquiry, Archer, Garrison, Anderson, & Rourke, 2001).

Rourke, Anderson, Archer, and Garrison (1999) developed three categories of social expressions defining social presence[I]:

- Affective responses: expressions of emotions (e.g., use of emoticons, conspicuous capitalization; see, Beals, 1991; Gunawardena & Zittle, 1997; Kuehn, 1993; Poole 2000), use of humor (e.g., irony, teasing, cajoling, sarcasm; see, Baym, 1995; Edgins & Slade, 1997; Poole, 2000), and self-disclosure (e.g., presenting details of personal life, expressing vulnerability; see, Cutler, 1995; Fåhræus, 1999; Hillman, 1999; Poole, 2000; Shamp, 1991).
- Interactive: continuing a thread, quoting from others' messages, referring explicitly to others' messages (see, Edgins & Slade, 1997), asking questions and getting feedback (see, Fåhræus, 1999), complimenting or expressing appreciation, and expressing agreement (see, Gorham & Zakahi, 1990; Walberg, 1984)
- Cohesive: vocatives (addressing participants by name; see, Edgins & Slade, 1997; Fåhræus, 1999), using inclusive pronouns (addressing the group as we, us,

[I] These three categories are the synthesized result of two earlier literature studies by the authors. In the first study, Garrison, Anderson, and Archer (2000) proposed three prospect categories of social expressions, namely: emotional expression, open communication (risk-free expression), and group cohesion (for encouraging collaboration) and suggested that the social expressions can be used as indicators of a template for content analyzing discussion boards. In the second study, Rourke and Anderson (2002) proposed a similar, yet different, categorization of social expressions; these are: interactive (i.e., social expressions that communicate mutual attention and awarene ss for the purpose of building and sustaining social relationships and to provide evidence that the others are attending to one's messages), reinforcing (i.e., social expressions that communicate social reinforcement for the purpose of encouraging participation, strengthening posting behavior, and attenuating evaluation apprehension), and affective (i.e., expressions that communicate emotion and feelings of mood for establishing social cohesiveness amongst group members through trust building, reducing inhibition due to communication apprehension, and for facilitating impression formation). It is important to note that the publishing date of the respective articles does not reflect the date these articles are written.

our group; see, Mehrabian. 1969; Gorham & Zakahi, 1990), and phatics or salutations (e.g., greetings, closures; see, Bußmann, 1998; Fåhræus, 1999).

Researchers such as Swan (2002) used this categorization system of social expressions and added a few more expressions that are social. The social expressions may also be used as guidelines for instructors and teachers to encourage learners to develop their online social presence (Rourke & Anderson, 2002). For example, Stacey (2002b) explicitly teaches her students social practice, to introduce them, and to use the features of the conference software for replying, quoting, and creating threads.

4.4.2.5 *Other Variables affecting Social Presence*

Three variables primarily contribute to an increase of social presence, namely.

- Social affordances: It is hypothesized that social affordances affect social presence. This hypothesis is supported by tele-presence research that examines variables affecting the sense of teleportation of a tele-operator to a remote location, either a physical environment or a computer-generated virtual environment (see e.g., Lombart & Ditton, 1997; Sheridan, 1992). In their survey of research on tele-presence in virtual reality, Schuemie, Van der Straaten, Krijn, and Van der Mast (2001) refer to research that links tele-presence with Gibson's (1986) ecological theory of perception. Drawing on that particular research (e.g., Flach & Holden, 1998) and on the position that telepresence and social presence are similar constructs (Biocca, Harms, & Burgoon, in press), it may be concluded that the CSCL environment's ecological qualities - such as having social affordances - are likely to affect social presence.
- Mental model: It is also hypothesized that the mental model one has of the other person contributes to social presence. This mental model is defined here as the internal representation that learners' construct of the other and which is used while interacting with the other person. One dimension of the mental model is the individuating impression of the other. According to Walther (1992, 1993), accumulated relational messages originating from episodes of social interaction contribute to the creation of an individuating impression of the other person. See also Storck and Sproull (1995) about the effects of impression formation in video conferencing. Additionally, the use of e-language (a mix of paralanguage and the utility of emoticons) adds to impression formation (Derks, Kreijns, & Bos, 2004) and, thus, to the mental model of the other.
- Pedagogical techniques: Finally, a number of (distance) educators propose pedagogical techniques that may positively contribute to social presence. Gunawardena (1995), for example, concluded that the user's perception of the medium could be cultivated through the creation of conducive learning environments, training participants how to create social presence, and building a sense of online community. Moderators of the computer conference are central in this approach: they should guide and structure the collaborative activities; they "should facilitate discussions by recognizing all contributions initially, summarizing frequently, and weaving ideas together." (p. 163).

Figure 4.9 depicts the relationships between these variables. It depicts how sociability, social presence and pedagogical techniques affect social interaction and how, in turn, social interaction affects the emergence of a social space. It also depicts how sociability, mental model, and pedagogical techniques affect the degree of perceived social presence.

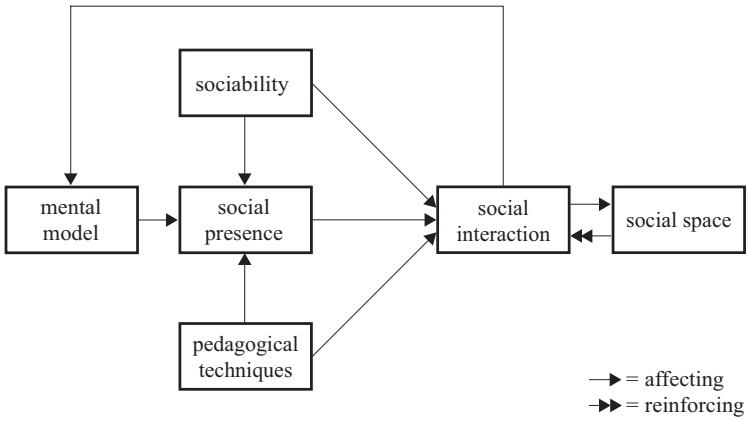

Figure 4.9 Social Interaction and Social Presence

4.5 Summary and Conclusions

This chapter started with the conclusion that sociable CSCL environments should be designed and implemented. In order to do this, a theoretical framework is needed that provides the guidelines for accomplishing this task. This chapter presents such theoretical framework. This framework has three foci: the ecological approach to social interaction, which sees social affordances as the mechanism through which social interaction possibly could be evoked, the concept of sociability as the degree to which a CSCL environment facilitates the emergence of social space, and the theory of social presence. It is hypothesized that social affordances contribute to sociability. Sociability, in turn, is hypothesized to affect social presence. Finally, sociability and social presence are hypothesized to contribute to the emergence of a social space.

The theoretical framework complements the pedagogical techniques. Together they complete the picture, that is, the environment (i.e., the CSCL environment expressed in terms of sociability), the people 'inhabiting' the environment (i.e., the learners/group members expressed in terms of social presence), and the activities they carry out (i.e., those learning activities determined by pedagogical techniques expressed in terms of instruction) are all necessary for achieving a good learning experience.

Knowing that social affordance devices are required means that they have to be operationalized. The next chapter describes how this can be done.

CHAPTER 5

Designing and Implementing GAWs

Abstract

Social affordance devices are proposed in the previous chapter as a solution for designing social functionality into computer-supported collaborative learning environments. Group awareness widgets (GAWs) are one possible operationalization of social affordance devices: they provide awareness of the whereabouts of the members of the group (i.e., where they are and what they are doing) while at the same time providing them with a set of communication media. This chapter presents a specification for designing and implementing GAWs. It is hypothesized that GAWs augmenting the functional CSCL environments can transform them into sociable computer-supported collaborative learning environments. These sociable CSCL environments (i.e., the GAWs) are the answer on *what* has to be designed in order to cope with the barriers in the third Ring regarding the utility issue. The next question is *how* these sociable computer-supported collaborative learning environments (i.e., the GAWs) should be designed and implemented in order to be usable and attractive, thereby addressing those barriers in the third Ring that deal with interaction design and usability issues. Hence, this chapter also discusses interaction design, which includes usability issues.

This chapter is based on parts of:

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Kreijns, K. & Kirschner, P. A. (2004). Designing sociable CSCL environments: Applying interaction design principles. In P. Dillenbourg (Series Ed.) & J. W. Strijbos, P. A. Kirschner, & R. L. Martens (Vol. Eds.), *Computer-supported collaborative learning: Vol 3. What we know about CSCL ... and implementing it in higher education* (pp. 221–244). Boston, MA: Kluwer Academic Publishers.

Kreijns, K., Kirschner, P. A., Jochems, W. (2003b, August). *Supporting social interaction for group dynamics through social affordances in CSCL: Group awareness widgets*. Paper presented at the 10th European Conference for Research on Learning and Instruction (EARLI). Padova, Italy.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Journal of Education Technology & Society*, *5*(1), 8–22. Retrieved April 1, 2004, from http://ifets.ieee.org/periodical/vol_1_2002/v_1_2002.html.

5.1 Introduction

The previous chapter proposed the use of social affordance devices as a solution to transform functional CSCL environments into sociable environments. The one important dimension of social affordances is proximity. Consequently, an operationalization of a social affordance device must take proximity as a point of departure. Group awareness fulfills this requirement because it provides tele-proximity. Group awareness is awareness of the whereabouts of the members of the group (i.e., where they are and what they are doing); it is an awareness that is artificially created with the aid of computers and networks. Social affordance devices exploiting group awareness are designated as group awareness widgets (GAWs).

Dourish and Bellotti (1992) point to awareness in general as an important concept in CSCW. They relate awareness to the shared workspace in order to achieve a smooth coordination between and within loose- and tight group activities or, in other words, between and within collaboration. They present the following definition of (workspace) awareness: "Awareness is *an understanding of the activities of others*, which provides a *context for your own activity*" (p. 107).

Gutwin and Greenberg (1998) refined that definition of workspace awareness[I] as "the up-to-the moment understanding of another person's interaction with the shared space" (p. 511); the shared workspace could be, for example, a shared text editor. Workspace awareness, thus, encompasses information about knowing who is present, where they are working, what their activities are, what their intentions may be, what their next activities might be, and so on. Gutwin, Roseman, and Greenberg (1996) developed a series of workspace awareness widgets which are little software tools that graphically provide a specific kind of awareness information. The designation 'group awareness widget' is derived from 'workspace awareness widget.' Neither Dourish and Belloti (1992) nor Gutwin and Greenberg (1998) considered the socio-emotional aspects of working together in teams.

Sociable CSCL environments (i.e. GAWs) are the answer to *what* has to be designed in order to cope with the barriers in the third Ring with respect to utility. However, knowing *what* has to be designed is one thing. The next important thing is *how* to implement those sociable CSCL environments (i.e. GAWs) in ways that make them both attractive and usable. It is important to distinguish between utility on the one hand and interaction design and usability on the other hand. *Utility* has to do with the functionality of the system that it offers to the user. Utility is important. A system

[I] Apart from group awareness and workspace awareness, other kinds of awareness exist that may contribute to the effectiveness of group collaboration. Gutwin (1996) list the following kinds of awareness: organizational awareness (knowledge of how the group activity fits in the larger purposes of an organization), situation awareness (understanding of the state of a dynamic system), informal awareness (general knowledge of who is around in the work community), social awareness (the information that a person maintains about others in a social or conversational context), and structural awareness (knowledge about such things as people's roles and responsibilities, their position on an issue, their status, and the state of various group processes). Pederson and Sokoler (1997a, 1997b) implicate awareness in situations that matters presence awareness of the others and activity awareness of the others. Tollmar, Sandor, and Schömer (1996) discuss social awareness, which is the umbrella term for all kinds of awareness that involve people. Finally Boyer (1998) and Palfreyman and Rodden (1996) introduce presence awareness and user awareness. Both forms of awareness present business and personal information about the other along with some status indication about her or his availability.

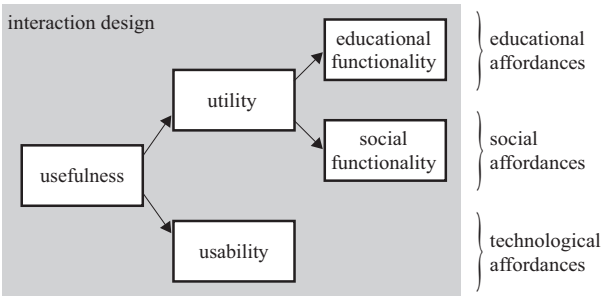

Figure 5.1 Usefulness = Utility + Usability

that is attractive and easy to use but is useless because it has no functionalities that support the user in what the user wants to accomplish is, in fact, worthless. In CSCL environments, the utility is determined by educational functionality and by social functionality.

Usability refers to the ease of use of a system or artefact so that users can interact and perform their tasks in an intuitive way. A system (e.g., a CSCL environment) or artefact (e.g., a video recorder or an Automated Teller Machine) with good usability "supports rapid learning, high skill retention, low error rates and high productivity [and] is consistent, controllable, and predictable, making it pleasant and effective to use" (Preece, 2000, p. 27).

Interaction design is also important in CSCL environments and is concerned with the user's experience, which is affected by many factors including attractiveness of the system/artefact and its aesthetics. Interaction design also includes usability. A system/artefact with high utility (lots of functions and features) but which is unattractive or hard to use (e.g., a high featured video recorder) is, like the before mentioned system with good usability but no functionality, worthless. The Section "Interaction Design" of this chapter discusses interaction design and usability in more depth. This section also provides guidelines to help the process of interaction design and usability.

Neglecting interaction design principles and heuristics may lead to the design and implementation of CSCL environments that lack an attractive and usable graphical user interface. Such bad designed environments may frustrate learners and, consequently, could demotivate the learners from using them. This, in turn, is detrimental to the collaborative learning process. Nielsen (1994a, 1994b) defined *usefulness* to be utility plus usability. Figure 5.1 summarizes the discussion here.

The figure also depicts where technological and educational affordances should be positioned. Gaver (1991, 1992) suggests technology affordances for increasing the usability of user interfaces on computer screens. Similarly, Norman (1990, 1992) has defined technical affordances for increasing the usability of everyday objects. Since technology and technical affordances are the same, this dissertation uses the term technological affordances to cover both. Kirschner (2002) defines educational affordances as those characteristics of an artefact that determine if and how a particular learning behavior could possibly be enacted within a given context. In other words, the chosen educational approach –the artefact– is instrumental in determining if and how individual and group learning (e.g., collaborative learning) can take place. Educational affordances can be defined –analogous to social affordances– as the relationships between the properties of an educational intervention and the characteristics of the

learners (for CSCL: learner and learning group) that enable particular kinds of learning by him or her (for CSCL: members of the group too).

This chapter first elaborates on GAWs and after that on interaction design.

5.2 Group Awareness Widgets

Social affordance devices can be operationalized by GAWs. These widgets consist of three parts:

- Group awareness
- History awareness
- A set of communication media.

The next three sub-sections discuss group awareness, history awareness and the composition of the set of communication media.

5.2.1 Group Awareness

Group awareness is the condition in which a group member perceives the presence of the others and where these others can be identified as discernible persons with whom a communication episode can be initiated. (cf., Borning & Travers, 1991; Gajewska, Manasse, & Redell, 1995). This type of awareness is in the CSCW and HCI domain the dominant type of awareness. Dieberger (2000) considers awareness of other people's activities to be an essential ingredient for collaborative work. Group awareness can be generated in different ways. A common way is the application of media spaces, which involves the use of cameras in variable and fixed positions, monitors, audio connections, and computers. Alternative but less commonly used ways to create group awareness are:

- The application of audio cues (Ackerman, Starr, Hindus, & Mainwaring, 1997; Singer, Hindus, Stifelman, & White, 1999).
- The application of signal processed audio and visual cues, resulting in distorted audio or other forms of sound cues like soundscapes and in abstracted, blurred or other forms of visual cues (Zhao & Stasko, 1998; Pederson, 1998; Pederson & Sokoler, 1997a, 1997b)[I].

5.2.1.1 *Media Spaces*

The provision of group awareness[II] was inspired by media space research conducted at Rank Xerox EuroPARC (Cambridge, England), and Xerox PARC (Palo Alto, California). A *media space* is an environment that is built from video, audio, and

[I] In contrast with media spaces that use 'undistorted' slow video images of groups or individuals, Pederson and Sokoler (1997a, 1997b) have a different approach for achieving group awareness. They re-map the captured audio and video signals across media using signal processing. The processed signals are then presented ('displayed') as pure abstract representations of room activity and people presence. The visual representations use several symbolic mappings. An example of re-mapping is sound that is mapped into the number of seagulls flying in from the right. Pederson and Sokoler's approach is motivated by four reasons: to preserve privacy, to provide a non-attention demanding awareness system, to minimize bandwidth use, and the option that the presentation of the data may be accommodated to individual preferences (for example: audio in stead of video). Early findings showed that indeed users perceived a sense of remote activity and a sense of remote presence.

[II] Researchers at PARC and EuroPARC, as well as other CSCW researchers, use the term group awareness, general awareness, shared awareness, informal awareness, and peripheral awareness interchangeably.

computing technologies. More specifically (Bly, Harrison, & Irwin, 1993), a media space is defined as an "electronic setting in which groups of people can work together, even when they are not resident in the same place or present at the same time. In a media space, people can create real-time visual and acoustic environments that span physically separate areas. They can also control the recording, accessing and replaying of images and sounds from those environments" (p. 30). Video equipment (cameras, monitors, microphones, and speakers) is placed in the offices of the researchers and in some public areas. Computer screens display low-resolution grabbed video images, simple animations, or glances. The grabbed video images are updated periodically at a time-interval determined by the observer of those images. The images typically show the researchers at their desks. An animation is a series of images grabbed in a rapid succession and then repeatedly displayed. Animations are useful for detecting activity and to disambiguate scenes. A glance is a one-way full video connection of a few seconds duration, just enough to see if a particular colleague is in her or his office and whether or not he or she is busy. Glances are generally used to check for an appropriate moment of contact.

Examples of the Xerox prototype systems are Polyscope[I] (Borning & Travers, 1991, p. 14–16), Vrooms (Borning & Travers, 1991, p. 16–18), and Portholes[II] (Dourish & Bly, 1992). Gaver, Moran, McLean, Lövstrand, Dourish, Carter et al. (1992) present an overview of some media space systems used at EuroPARC.

One of the issues, that arise when media space technology is used, is related to *privacy*. This is an ever-recurring problem when media spaces are used. You might feel quite uncomfortable when you know that someone might be observing you, without being notified about this. This particularly applies to glancing, in which a full video of you appears on your colleague's screen. This makes video images and glances very intrusive. However, Xerox PARC and EuroPARC researchers suggest that one-way glances have advantages that justify their usage and believe that social convention will regulate privacy concerns. They state that at "EuroPARC, our privacy protection depends to a great deal on social convention—indeed, our culture initially provided our only protection. It is assumed that people will use the system [i.e., the media space] with 'good' intentions; that is, that they will not seek information with the intent of using it to harm anybody. Simply speaking, we trust one another. At the same time, social convention encourages people to control their own equipment: They are free to turn their camera to face a wall or out a window; they may keep their

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[I] Polyscope (Borning & Travers, 1991, p. 14–16) is an initial prototype at EuroPARC that permits users to look simultaneously at a number of frame-grabbed video images of colleagues who have their offices dispersed within the same building. Instead of an image, an animation can be displayed. The collection of images is displayed in a window providing the observer general awareness of his/her colleagues. Clicking on an image opens a pop-up menu, which allows an observer to initiate glance or videophone connections. Polyscope users can determine which information is being made available and optionally may select whether or not they want symmetry.

[II] Portholes (Dourish & Bly, 1992) augments Polyscope by also including the offices in buildings at Xerox PARC. Portholes features three different user interfaces (clients), all of which are variations of one another. Clicking on an image opens a dialog box, which, depending on which client is used, allows a Portholes observer to initiate a glance connection (only for EuroPARC users), or to write e-mail, or to listen to pre-recorded digital audio message. Portholes has the same aim as Polyscope. Dourish and Bly (1992): "we are investigating ways in which media space technology can support distributed work groups through access to information that supports general awareness" (p. 541). Dourish and Bly observe that Portholes is used in two modes: Portholes is used as a basis for community building and Portholes is used for getting information about the status of colleague, especially for location of the colleague.

microphones switched off, and so forth" (Gaver, Moran, McLean, Lövstrand, Dourish, Carter et al., 1992, p. 30). Other researchers do not fully agree with this and suggest that this might be the reason that these systems will not fully support informal communication and unintended encounters.

To handle issues related with privacy, Xerox PARC and EuroPARC researchers have formulated two design principles: control and symmetry. Control enables the user to regulate the kind of information that is being made available to the observer; symmetry requires that in turn, information delivery will be reciprocal (Borning & Travers, 1991). Whatever the case, it is clear that privacy and intrusiveness will have to be addressed by any system creating group awareness. Examples of systems that took these issues into account are MONTAGE (Tang & Rua, 1994) and OfficeWalker[I] (Obata & Sasaki, 1998).

Although media space researchers neither examined the social psychological aspects nor the details of group forming and group dynamics of mediated communication, they report that informal communication did establish collaborative relationships (Kraut, Fish, Root, & Chalfonte, 1990).

5.3 History Awareness

History awareness is the structured collection of all traces; hence, it provides an overview of temporal proximities. History awareness is provided in this dissertation as a means for bridging the time gap imposed by working and learning in a time-deferred mode. Each trace can be used for getting in touch with each other. However, the provision of history awareness may have more implications. It does not only give insight in when and for how long a group member is engaged in a particular activity, but it also gives insight into this group member's behavior patterns with respect to that activity. This insight is enlarged when this behavior pattern is combined with the behavior patterns of all the other activities the group member is engaged in. The resultant overall behavior pattern summarizes how the member is learning, when certain activities are given priority over other activities, when periods of inactivity are, and so forth. One step further is combining all the behavior patterns of the group members, which give insight in how the group is functioning, if it is indeed a performing group or a group that has not yet started. It may reveal the temporal

[I] OfficeWalker uses an interaction model, based on interactional distance among users, for reducing the problem of intrusiveness and facilitating unintended interactions with unexpected partners. The sense of distance is achieved by providing public and private places. Each public virtual place (the hallway) has a number of private physical places (your colleague's offices) attached to it. Contacting a colleague for conversation happens in two phases. First, by entering the hallway you become a visitor of the public space. This means that your computer screen will show you the slowly scanned video images of other vistors in the hallway. Also, slowly scanned video images of each of your colleague's office are displayed. All images show people from a fair distance. In the second phase, when you click on the image of a colleague's office, a two-way glance connection will be initiated, and a full video of you will be transmitted from a closer distance, meaning that you want to start a conversation. Your colleagues in their private offices will see on their screens slow video images of every visitor in the hallway, showing each visitor from a fair distance, and the offices of their neighbors. Because neither of your colleagues know what your intentions are, they may not pay all too much attention to you. At the moment you want to have a conversation with your colleague, this colleague will see you more closely through the initiated glance connection. Your colleague still can neglect your request for conversation, or initiate a full blown video connection. Unintended interactions are supported by the fact that neighboring colleagues, and other visitors in the hallway, may notice your presence in the hallway and may wish to start a conversation with you. An experiment confirmed that the problem of intrusivness was reduced and unintended interaction was partly supported.

rhythms of members, but also whether some group members are active participants or not.

Such history awareness information can become particularly interesting if communication patterns are made visible, for example the traffic of e-mail messages. Based upon that information, a sociogram (a social network analysis tool first proposed by Moreno, 1932, 1934) can be derived (a special program may derive the sociogram and depicts this graphically to the group members).

Also, history awareness information can be used for inferring certain behavior and based upon the inferences can notify group members. For example, a member may not be active for a while causing the system to notify other members about this situation suggesting that the inactive member possibly needs some help. Certain 'agents' are based upon this.

To summarize, insight in the behavior patterns of the group members by the group members can increase the group performance.

Research on the impact of the history awareness on the activities of a group member is limited. Begole, Tang, Smith, and Yankelovich (2002) have analyzed visualizations of history awareness of distributed groups. Their aim "was to explore how patterns in people's work activity would help identify convenient times to make contact" (p. 334). Traces in their history awareness, however, cannot be used for getting in contact with those who caused the traces; they function only as picture elements for building an overall view of the work activities.

5.4 Set of Communication Media

A question that now arises concerns the composition of the set of communication media accompanying the awareness information. What kind of communication media should this set contain? One suggestion is to use the default set commonly present in CSCL environments, which traditionally consists of the following CMC typed media: chat (i.e., text-based, synchronous), computer conferencing (i.e., text-based, asynchronous), and e-mail (i.e., also text based, asynchronous).

However, other sets may seem appropriate if one takes into account the literature overview about social presence and media richness theory presented in Chapter 3. Since collaborative learning encompasses a variety of activities, from the perspective of media richness theory and classical social presence it seems appropriate first to categorize the different desired activities according to their needs for rich information exchange and strong interpersonal socio-emotional exchange and then to assign each activity a most appropriate communication medium. Those selected media may then become part of the set of communication media. This perspective holds that it is important not to restrict the media selection to CMC typed media since media richness research concludes that "CMC, because of its lack of audio or video cues, will be perceived as impersonal and lacking in normative reinforcement, so there will be less socioemotional (SE) content exchanged" (Rice & Love, 1987, p. 88). Similarly, from the perspective of classical social presence, CMC typed media being low in social presence may potentially lead to de-individuation and de-personalization because the communication is less social and more task-oriented (Connolly, Jessup, & Valacich, 1990; Rice & Love, 1987)). Therefore, from the media richness perspective and from the classical social presence perspective, the use of such a default set of communication media, as indicated before, seems not to be a good idea and this set should be extended with other types of communication media. However, as the section Communication

media theories shows, assumptions and predictions of media richness theory and classical social presence theory are not fully supported by research.

Quite ironically, from the perspective of media richness theory and classical social presence theory, Walther (1999; see also Walther, Slovacek, & Tidwell, 2001) found that the use of photographic images or video connections yields no better task performance and dampens hyperpersonal effects when compared to CMC type media (see, Walther, 1996). For this reason, Walther (1999) concludes that visual cues have little place in CMC. He explained the persistent preference for multimedia from the principle of least effort in media preferences, which in his opinion may provide less effective communication. Walther (1999) argued that "increased effort at the cognitive level, to think through and keep track of messages and other users, and at the behavioral level, in the construction, editing, and management of text-based messaging, invites certain benefits that are lost when communication is ethereal" (¶ Social interaction as social interaction). These findings suggest to be wary of using pictures of group members or video conferencing systems.

It is clear that composing a good set of communication media is not a trivial act. It is important that the communication channels contain different media (synchronous as well as asynchronous). Gay and Lentini (1995), for example, found that different communication media are used in different ways to increase the depth and breadth of the interaction of the communication task the participants of the study were involved in. Their findings suggest that DLGs will be more productive when the groups have different communication media at their disposal[1]. In addition, medium choice cannot be predicted and, thus, members should have a pool from which they can select. Medium choice can be anything between a random choice (i.e., members just use the communication medium at hand), a choice based upon selecting the least-collaborative-effort medium (i.e., members use the easiest medium, Clark & Brennan, 1991; Walther, 1999), or a choice based upon a rational consideration (i.e., members use a suitable medium, for instance, the communication activity can be accomplished using that medium). Social influence (Fulk, Schmitz, & Steinfield, 1990) may also affect media choice (e.g., group norms may decide the choice of the medium, see Haythornthwaite, 1997) as do other factors encompassing personal preferences and prior positive experiences with particular media.

Finally, it is important that the communication media are tightly coupled with the displays of awareness data and that each medium is directly accessible. Any threshold that may hinder getting in contact with the other as soon the need for this crops up must be removed (cf., perception-action coupling). "In a social environment users can be quite capricious and it is important to capture the moment when he or she feels the need to write a specific message or chat with a user; the command set must be easily accessible." (Vallée, 1992, p. 185).

5.5 Designing the GAW

The design of a GAW has much in common with the design of a media space. Both provide tele-proximity facilitating impromptu encounters and informal communication.

[1] The findings of Gay and Lentini contrast the actual situation observed by O'Malley (1995). She states that of all available communication media, the dominant and preferred communication medium in both co-located and distance learning settings is limited to only asynchronous computer conferencing.

However, there are significant differences in:

- Topology
- Group awareness data generation and presentation
- Multiplicity of group awareness data
- On-task versus non-task contexts
- Persistency of connections and history data

5.5.1 Topology

In Xerox media space research, cameras and monitors were set up in the offices of each of the members of the research team at Xerox PARC in Palo Alto, California, and at EuroPARC, in Cambridge, England, for connecting the two sites. Cameras and monitors were also placed in public areas. Researchers at each site were already acquainted with each other and could meet each other face-to-face. Researchers across sites had also met each other before (Bly, Harrison, & Irwin, 1993). This is thus a social network with two central nodes; each central node represents a sub-group of team members who are in the physical proximity of each other (see also Figure 1.4b). In the present research, we have a social network in which each node represents a single group member (see also Figure 1.4a).

5.5.2 Group Awareness Data Generation and Presentation

A GAW does not achieve tele-proximity by using a mix of video, audio and computers in order to invoke group awareness. Instead, a GAW will use a computer screen for displaying graphical representations of the group members. Because the group members are using a CSCL environment, the environment itself should generate all the necessary awareness data.

5.5.3 Multiplicity of Group Awareness Data

The achieved tele-proximity in media space research is addressed by only one 'type' of awareness data. This type consists of the availability and interruptability of the team members. If the researcher is not in the office, he or she is not available for a communication episode. If the researcher is in the office but is engaged in a conversation, he or she is not to be interrupted. In addition, the group awareness data is limited to information on which researchers are present, where they are, and a global indication of what they are doing, that is, you see that someone is working at the computer or having a discussion with a colleague, but you remain uninformed about the kind of activity or the subject of the discussion unless this is explicitly asked for via the available communication channels. In order to provide greater resolution of the activities and to expand group awareness by including awareness data about the many kinds of activities, the concept of commonalities is introduced. *Commonality* is a term that is used in the present research for referring to a mutually shared thing, activity, use, idea, back-ground, interest, status, and so forth. It thereby associates a specific type of awareness data to a specific context (namely, that of what has defined the commonality). The use of more than one commonality allows different types of concurrent group awareness data. The commonalities used in media space research can, for example, be identified as 'being in the office of professor Kirschner and having a discussion' and 'being in a public place drinking coffee.' Examples of commonalities not found in media-space research are 'visiting the ACM digital library', 'writing a

paper about pipeline data-hazards in microprocessors', and 'having an interest in active learning theory.'

5.5.4 Task versus Non-Task Contexts

In media space research, group awareness was primarily oriented towards collaborative working activities (on-task context). In the present research, group awareness is primarily oriented towards the facilitation of social- and social psychological processes that are responsible for building an affective structure within the group. For that reason, commonalities in non-task contexts will be used for acquiring different types of off-task group awareness information.

5.5.5 Persistency of Connections and History Data

In contrast to media space research, the present research does not require persistent connections per se to communicate group awareness. A more practical and realistic situation is the situation in which group members expose their own distributions of connection times and durations. This is a consequence of the fact that group members take part in deferred collaboration. In order to let group members know what has happened while they were not connected to the internet all the group awareness data are centrally logged. Of course, not all kinds of information are eligible to be logged due to the nature of the data (e.g. long streams of video data) and due to technological constraints (e.g. systems have limited memory). For these situations, substitutes must be found to replace or represent the genuine data. The logged group awareness data can be regarded as the history of the group members' activities. When group members connect to the internet, this history is presented to them along with recent group awareness data. Both history and group awareness data are continuously updated at regular short time-intervals: the recent group awareness data become part of the history, and up-to-the-minute group awareness data become the recent data. By inspecting the history, the group member can, for example, see where fellow members were yesterday and what they were doing. Going back to the example of day people and night owls, such data informs the night owl that there are others (she is not alone) and informs the others that the night owl is doing good work. It even informs the night owl that it might be a good idea to log on in the morning every now and then for more contact.

Inspection of the recent group awareness data shows which fellow group members are also currently online.

5.5.6 Summary

From the discussion above, we may conclude that GAWs are determined by:

- Whether or not a history is included (history awareness)
- The number of commonalities involved through which the different types of group awareness data are acquired
- The distribution of commonalities on both task-oriented level and socioemotional-oriented level.

5.5.7 A Mock-Up of a GAW

In order to make the GAW more concrete, a mock-up of a GAW is presented as one of the many possibilities that could be designed and implemented. Figure 5.2 presents how such a GAW *could* look to achieve a number of commonalities. This example is only meant to give a first impression of how some data *might* be displayed. Chapter 9 presents a first prototype of a GAW, which is strongly based upon ideas expressed by the mock-up.

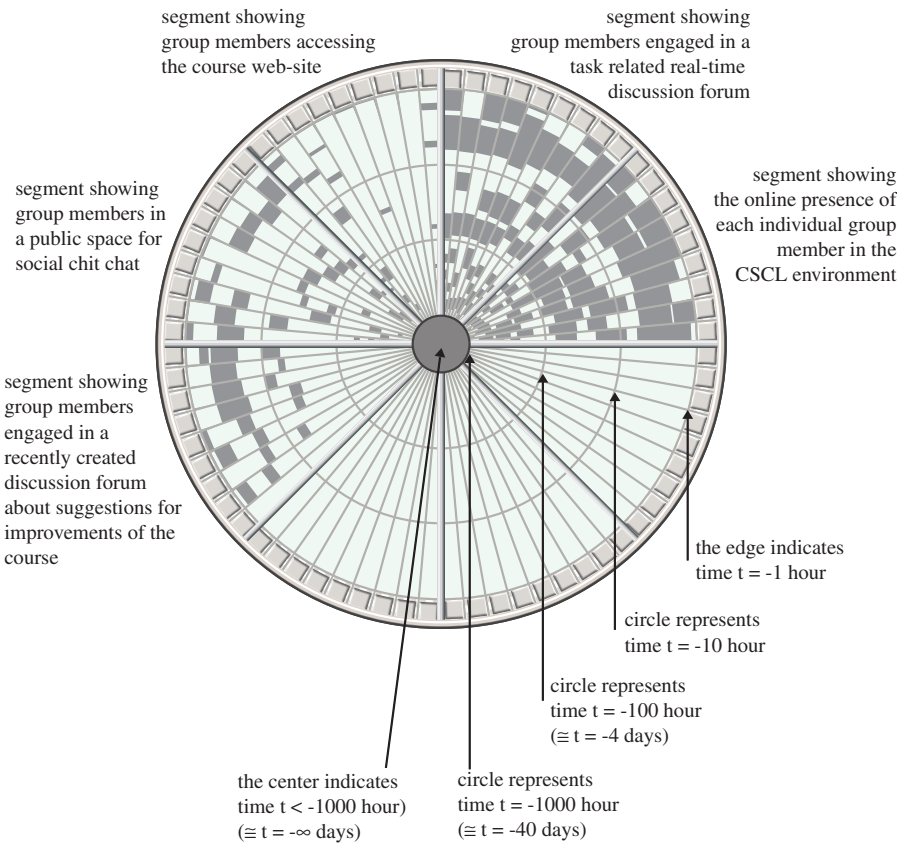

Figure 5.2 Mock-up of a GAW

5.5.7.1 *Managing Group Awareness through Inspectors*

In this GAW, we assume the existence of a number of *inspectors* (representing a type of software agent), each of which is responsible for exactly one commonality. The perceived group awareness results from graphically displayed data collected over time by these inspectors. An inspector logs specific members' behavior, that is, their actions, utterances and expressions that address the commonality the inspector is responsible for. Depending on the kind of members' behavior, and thus on the type of data that

have to be collected, inspectors may be 'everything' from an intelligent autonomous software agent to a simple piece of software, such as a counter. Inspectors may be customized to meet certain member needs. If, for example, the inspector's commonality is a website (e.g., a virtual team library), the member may specify the URL of that web site. Members can also define personal sets of inspectors. Through selection of a subset of inspectors from a (large) predefined list, members can select the kinds of social awareness that they either need or wish. Defining a personal subset of inspectors is not definitive. Members may augment their personal subset by adding new inspectors from the predefined list, replacing old inspectors or even defining a completely new personal subset of inspectors.

5.5.7.2 *User Interface*

Each inspector graphically displays its collected data in a separate segment within a window, each having its own time-axis. When a DLG member is engaged with the inspector's subject of focus (e.g., the member is in the virtual team library), the inspector will display a stroke along the time-axis. The stroke-length is an indication of the duration of the engagement. If a member has multiple engagements with the same subject, but at different times, then the inspector will associate the member with a series of strokes. An inspector logs the behavior of multiple members.

The time-scale chosen is not linear, but logarithmic.' This enables displaying both a point that is close to time 't = 0' (now), and a point that is close to time 't = $-\infty$' (long time ago). Strokes close to time 't = 0', indicate engagements that just happened a moment ago; these strokes are detailed. When strokes are time 't = 0', this indicates that the stroke-owners are currently online. Strokes in the neighborhood of point 't = $-\infty$', indicate engagements that happened a long time ago: these strokes are compressed and less detailed.

The window containing all the segments is displayed as a circle. Figure 5.2 gives an impression of this. As can be seen, 't = 0' is on the edge of the circle and 't = $-\infty$' is at the center. If an inspector detects an engagement, the segment associated with the inspector will start to display a stroke at time 't = 0.' As time passes, the strokes will move towards the center. Due to the logarithmic time-axis, this movement will gradually slow down. As a result, the area around the center will become full of strokes.

Using a logarithmic time-axis and displaying the segments as depicted in Figure 5.2, reflects a way of giving more attention to recent events than to events that occurred longer ago. The longer the time passed, the more an event loses its topical value.

5.5.7.3 *Communication*

The system will provide real-time communication as well as asynchronous communication. Clicking on the edge of a segment will open a dialog box (not shown in Figure 5.2) displaying the names of the DLG members who are currently online and are associated with the segment. Clicking on a name opens a second dialog box in which the allowed communication modes appear. This may be text-only, audio-only, or video conferencing. A request for conversation is sent prior to opening the communication channel. Asynchronous communication modes will encompass e-mail and other asynchronous possibilities (e.g., real audio files, et cetera).

5.6 Interaction Design

At this point, it is clear *what* has to be designed, namely sociable CSCL environments (i.e. the GAWs). The next step is *how* sociable CSCL environments (i.e., the GAWs) should be designed and implemented. The answer to that question is via interaction design. *Interaction design* is a fairly recent discipline that is closely linked, but different from human-computer interaction[I] (HCI) (Alben, 1997; Bolullo, 2001; Forlizzi & Ford, 2000; Löwgren, 2001, 2002; Norman, 2002; Reimann, 2001; Shedroff, 2001). As a relatively new discipline, there is yet no commonly agreed upon definition of interaction design nor what the exact scope of this field is. In addition, it lacks a thorough theoretical framework although researchers are trying to propose one (e.g., Forlizzi & Ford, 2000). However, it is clear that interaction design is concerned with aesthetics (or attractiveness) and emotion, and with the usability of user interfaces. It also deals with the utility of the application, which means that the application must meet the requirements that define the set of functionalities the application has to fulfill (see also Figure 5.1). Without taking into account interaction design principles and/or heuristics, CSCL environments may become unattractive or even ugly, difficult to understand, and complex to use. No matter how functional they are, ill-designed CSCL environments may undermine the learner's motivation to use the environments because they are frustrating and distract learners from carrying out the study tasks. If social affordance devices, such as GAWs, are developed, interaction design should be applied to these devices. Thus, CSCL environments should ideally be designed in multidisciplinary teams of educational technologists, software engineers (i.e., the 'programmers'), interaction designers, usability engineers, instructors, and students.

In the next subsection, the (confounding) relationship between interaction design and HCI is briefly discussed. The subsequent subsections delineate the scope of interaction design and describe the attempt of some researchers to formulate a more precise definition of interaction design. Then, a brief overview of HCI is presented. Finally, the purpose of interaction design is discussed and a plea is made for the inclusion of interaction design in the design process of CSCL environments, in particular in the design and implementation process of social affordance devices.

5.6.1 Interaction Design and Human-Computer Interaction

Some researchers have the misconception that interaction design and HCI are quite similar, thereby confounding the discussion about the relationship between the two. This is not surprising when comparing the definitions of interaction design and HCI. One definition given to interaction design is that of Preece, Rogers, and Sharp (2002) who define it as "… designing interactive products to support people in their everyday and working lives." (p. 6). The 'Association for Computing Machinery Special Interest Group on Computer-Human Interaction' defined HCI as a discipline "which is concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." (Hewett et al., 1996, ¶ 2.1 Definition of HCI).

According to Löwgren (2002), the observation made by Salomon (see interview by Preece, Rogers, & Sharp, 2002, p. 33) that "(…) interaction design is a design discipline (…)" should be taken seriously. Identified as a design discipline, interaction design cares less about science and engineering than about understanding what kind of

[I] Human-computer interaction (HCI) is also referred to as computer-human interaction (CHI).

interactivity should be designed into systems or (software) products. This is in contrast to HCI where science and engineering are the context. Reimann (2001) confirms Salomon's observation: "Interaction design as a discipline borrows theory and technique from traditional design, psychology, and technical disciplines. It is a synthesis, however - more than a sum of its parts, with its own unique methods and practices. It is also very much a *design* discipline, with a different approach than that of other scientific and engineering disciplines" (¶ How is interaction design different?).
With this in mind, the different roles scientists, engineers, and interaction designers have are discernible (Dykstra-Erickson, Mackay, & Arnowitz, 2001): "Scientists are trained to study pre-existing natural phenomena as objectively as possible, traversing back and forth between theory and empirical observations. They focus on the 'why.' Engineers are trained to produce solutions to technical problems. Engineers, then, focus on the 'how.' Practitioners [interaction designers, visual designers, web architects], on the other hand, have widely diverse educational backgrounds, and their focus is on 'what' - the production or crafting of HCI artefacts" (p. 111).

5.6.2 Definition of Interaction Design

In an attempt to define interaction design more precisely, researchers commonly first separate the two terms 'interaction' and 'design', and look what definition or description applies to these.

- Interaction. Shedroff (2001) sees interaction as a continuous process of action and reaction between two parties whether living or machines. The inclusion of machines as a party in the interactions is, however, doubted by some researchers. Suchman (1997), for example, observed the problem that humans and machines have with achieving mutual intelligibility. She, therefore, proposed that "the term 'interaction' might best be reserved to describe what goes on between persons, rather than extended to encompass relations between people and machines." (¶ Abstract).
- Design. Krippendorff (1989) elicits an etymology of *design* that goes back to the Latin root *signare* which means making something, distinguishing it by a sign, giving it significance, designating its relationship to other things, owners, users, or gods. Based on this original meaning, Krippendorff states that design is making sense (of things).

Though two insights can be used for formulating a definition of interaction design, the literature does not present one satisfactory definition on interaction design. Although Preece, Rogers, and Sharp (2002) have given a definition, it was criticised by Löwgren (2001) and, additionally, their definition resembles too closely the definition of HCI (Hewett et al., 1996, ¶ 2.1 Definition of HCI). Reimann (2001) defines interaction design as "a discipline dedicated to define the behavior of artefacts, environments, and systems (i.e., products)." (¶ How is interaction design different?). According to Thackara (2001), interaction design determines "the value of a communication service to its users, and the quality of experience they have when using it." (¶ Why is interaction design important?). It is not the intention of this dissertation to present a new definition. Instead, the dissertation will use the term in the same way as Löwgren (2002) and Alben (1997; see later this chapter) do.

5.6.3 Human-Computer Interaction

According to Dix, Finlay, Abouwd and Beale (1998), HCI is: "(…) the study of people, computer technology and the ways these influence each other. HCI is concerned with how computer technology can be made more usable by people. This requires an understanding of at least three things: the computer technology, the people who interact with it and what is meant by 'more usable.' However, there is a fourth aspect which is implicit in the simple definition: understanding the work that people are trying to perform by using technology." (p. xv).

5.6.3.1 *Usability*

Central to HCI is the usability of a system. Usability is concerned with whether a system allows for the accomplishment of a set of tasks in an efficient and effective way that satisfies the user. Usability is not a single dimension. Nielsen (1994a, 1994b), Shneiderman (1998), and others distinguish five facets:

- Learnability. The CSCL environment should be easy to learn for novice users. The user should rapidly start using the environment doing some basic tasks, such as uploading a first draft of a document to a shared space or posting messages to a discussion board. The popularity of the Blackboard[I] is explained by many of its users in its ease of learning by both educators and students.
- Ease of use. Once the user becomes an experienced user, the CSCL environment should be easy to use allowing for high levels of productivity. Access to and using the various parts of the environment should almost be an autonomous act. Learnability and ease of use are not independent of each other. It often turns out that if a CSCL environment is difficult to learn, it will also be difficult to use. Belvédère, in its original form, had so many objects and relations (high specificity and complexity: De Jong, Ainsworth, Dobson, Van der Hulst, Levonen, Reimann, et al., 1998; Stenning & Oberlander, 1995) that it was very difficult to learn to use. Much of the discussion that took place within that environment was not about the problem to be solved, but rather on how to use those objects and relations (Suthers, Weiner, Connely, & Paolucci, 1995).
- Memorability. If a CSCL environment is not used for some time, the user should still be able to use it without to learn everything all over again. Therefore, its use should be easy to remember.
- Error frequency. Ideally, a CSCL environment should prevent users from making errors. In practice, this is impossible and users will make errors. Thus, the environment should take care that the error rate is kept low, that the consequences of making errors are not catastrophic, and that a means is provided to recover easily from errors.
- Satisfaction. A CSCL environment should also be pleasant to use and may have some aesthetic appeal making the environment attractive. Users will be subjectively satisfied when they use this environment.

In order to achieve usability, a number of design principles (Norman, 1990) and prescriptive usability principles (Nielsen, 2001) are formulated. Regarding the scope of HCI, it is not surprising that HCI has extended its field to include web usability (e.g., Nielsen, 1999).

[I] The Blackboard home site is http://www.blackboard.com.

5.6.3.2 *Technological Affordances*

Interestingly, the concept of affordances can also be applied to usability as many books on HCI suggest (e.g., Preece, Rogers, Sharp, Benyon, Holland, & Carey, 1994. p. 80–82, 277–281). These books propose using affordances in the spirit of Gaver (1991, 1992) and Norman (1990, 1992). Gaver suggests the use of technology affordances to increase the usability of graphical user interfaces (GUIs) and Norman (1990, 1992) appropriates the term technical affordances as a conceptual tool for discussing the design of everyday artefacts in relation to their usability. They speak about perceptible and perceived affordances respectively.

Perceptible affordances are those affordances in which there is perceptual information available that match the actual affordances of an object; if the perceptual information suggests a non-existent affordance or does not match the actual affordances, the affordances are designated by Gaver (1991, p. 80) as false affordances. For instance, if the door is locked and no sign is visible to reveal this state, the door handle still affords pulling the door in order to open it. In that locked state, the door handle is a false affordance. If the affordances exist but perceptual information is missing then the affordances are hidden, such as is the case with a secret door; a secret door will not make any information perceptible that would reveal how it can be used. As all doors, even a secret door has a passing-through affordance, which is an affordance at the utility level, but the affordances at the usability level are deliberately missing. In this exceptional example, despite the door having hidden affordances it is still a very useful door because it performs its function well, that is, being secret. Thus, in fact, the secret door has two affordances at the utility level: providing a passage and being secret. However, in general, affordances should not be hidden if the artefacts are to be useful; not all doors should be secret.

Norman distinguished between real affordances (affordances that are there but may or may not reveal themselves; in Gaver's terms, the latter are hidden affordances) and perceived affordances (affordances that reveal themselves because they exhibit all the information that is needed to be perceived including the clues about its proper operation). While focusing on the latter, Norman (1999) hoped to mitigate the confounding situation by explicitly using the term 'perceived affordances' instead of just using the unqualified term 'affordances.' Norman (1990) related perceived affordances to the design aspects of an object suggesting how it should be used: "Design is about [real and perceived affordances], but the perceived affordances are what determine usability" (p. 123).

Both researchers emphasize the importance that affordances must be perceived otherwise artefacts are useless. In other words, it's not only about the existence of the affordance itself, but also of its *perceptibility* to the prospective user (i.e., being there is not enough, it also has to be seen as such/for what it is meant). Here, Norman and Gaver deviate from Gibson's original concept of affordances, which did not include the constraint of perceptibility.

As mentioned before, Norman (1999) focuses more on the usability of products and less on the usability of screen-based products, that is, GUIs. He argues that "affordances, both real and perceived, play very different roles in physical products than they do in the world of screen-based products. In the latter case, affordances play a relatively minor role: cultural conventions are more important" (p. 39)[I]. Others, in

[I] For a discussion of the affordances of graphical user interfaces, constraints and cultural conventions, see Kirschner (2002).

contrast, do not agree with this and apply his concept of perceived affordances in screen-based products. In their reasoning, affordances do make sense in screen-based products when seen from a certain, non-physical perspective. They argue that scrollbars do afford scrolling and buttons clicking, that is: they are technology affordances. (Perceived) technological affordances offer a framework from which all the aspects affecting HCI-usability can be studied. As Gaver (1991) put it, "the notion of affordances is appealing in its direct approach towards the factors of perception and action that make interfaces easy to learn and use. (…) More generally, considering affordances explicitly in design may help suggest ways to improve the usability of new artefacts" (p. 83).

5.6.4 Where Interaction Design Goes Beyond HCI

Interaction design as a design discipline opens the possibilities for further innovation, whereas HCI does not. Löwgren (2002) states that "HCI has contributed a great deal to the elimination of obvious problems for the users, but its focus on goals, tasks, and usability makes it rather limited in terms of positive innovation." HCI analyses what 'is' through the execution of controlled experiments. This approach is very much exemplified by Ben Shneiderman (see the interview in Preece, Rogers, & Sharp, 2002, p. 457–459).

HCI encompasses the study of the design[I] and evaluation of user interfaces and specifically of graphical user interfaces (GUIs) (Dix, Finlay, Abowd, & Beale, 1998; Preece et al., 1994; Shneiderman, 1998). HCI places less emphasis on functionality, although it is acknowledged as important. "Systems with inadequate functionality frustrate the user and are often rejected or underutilized. If the functionality is inadequate, it does not matter how well the human interface is designed" (Shneiderman, 1998, p. 12). The *utility* of the system is thus the set of functionalities a system incorporates. In the case of a sociable CSCL environment, the utility encompasses both educational and social functionality. Usability and utility are both components of the *usefulness* of a system. Interaction design includes the usefulness of a system within its scope.

In addition, at the user interface level, interaction design avoids a rigid approach to capturing all human behavior (the acting out of intentions to achieve an objective) within prescriptions, thinking that if the list of prescriptions is large enough, a system will correctly respond to every possible situation imaginable. This was and sometimes still is the HCI approach to solve the interaction 'problem' between the user and the machine/computer. For example, Shneiderman (1998) represents users' intentions in structure like trees. Suchman (1987) views such a set of prescriptions of human intentions as plans. She argues that the problem with plans is that they deny the occurrence of new situations requiring a change of the original plan (which usually cannot be changed) or the execution of other plans (which are not there). New situations are, for example, altered intentions of the user, or altered circumstances in which the user operates or works.

Furthermore and most importantly, interaction design is concerned with aesthetics and emotion, and how the interaction may appeal to and benefits the users, in a way that it absorbs the user within the interaction itself.

[I] Design here has another connotation: it is associated with the design of a system focusing on the organization and architecture of the graphical components and their relationships.

In real life, one example of such a social affordance device (at least for the younger people) is the mobile phone. Although all mobile phones may have similar functionality and more or less comparable usability, some phones can be personalized (e.g., Nokia phones) by choosing a different front, thereby making it a more attractive phone for its user. Furthermore, most people prefer the more attractive but harder-to-use phones to those easier-to-use ones. This is equally important for GAWs in software.

Norman (2002) suggests that aesthetics and usability are connected, as are affect and cognition. He claims to have evidence that pleasant things work better and are easier to learn, and that *attractive things work better*. However, a warning is in place here. Dormer (1993, quoted in Dykstra-Erickson, Mackay, & Arnowitz, 2001, p. 109) observed: "For many American designers, there was no conflict between market-oriented and sales-dominated consumerism and design that has been achieved rationally and which performs properly. Nevertheless, a generation of products has emerged (…) that look nice but are difficult to use (…) Such ergonomic failures indicate that good performance remains more elusive than good looks."

Dormer's observation fits Norman's view in that as long as the design is pleasant, people are willingly tolerant of minor difficulties, irrelevancies and blockages, but that there is never an excuse for really major faults in the design (p. 40–41). Norman emphasises that usability is still an important issue in good designs: "(…) beauty and usability are in balance. An object that is beautiful to the core is no better than one that is only pretty if they both lack usability." (p. 42). Although the statements of Norman and Dormer apply to products in general, they are applicable to software systems as well.

To sum up, the focus of HCI is on how people interact and communicate with computer systems through user interfaces, which are evaluated through usability studies. Interaction design, on the other hand, is presumed to be much broader, entailing all of the aspects discussed above. However, both HCI and interaction design are grounded in academic disciplines (e.g., computer science, cognitive psychology, social sciences, anthropology, informatics, engineering) and design disciplines (e.g., graphic design, industrial design, film industry); for a more complete overview, see Preece, Rogers, and Sharp (2002, p. 8).

5.6.5 Goal of Interaction Design: The User Experience

The ultimate goal of interaction design is condensed in the term 'user experience.' Preece, et al. (2002) explain that interaction design is "about creating user experiences that enhance and extend the way people work, communicate and interact" (p. 6). Alben (1997) states that human experience is the essence of interaction design. Some interaction designers (e.g., Shedroff, 2001) go a step further and even talk about 'experience design' instead of interaction design.

If the user experience is the ultimate goal of interaction design, then it is important to define what user experience is and to determine whether or not it is one-dimensional. Forlizzi and Ford (2000) try to capture the different kinds of user experience and how it relates to interaction design. Alben (1997) distinguishes six facets of interaction design that shape experience: vision, discovery (sub-facets are: learning, surprise, and seeing things from a vantage point other than your own), common sense, truth, passion, and heart; and describes user experience as "(…) all the aspects of how people interact with something—how well they understand how it

works; the way it feels in their hands; how they feel about it while they are using it; how well it serves their purposes; the way it fits into the context in which they are using it; and how well it contributes to the quality of their lives. If these experiences are engaging and productive, then people value them. This is quality of experience" (p. 10). Alben's (1997) facets contrast with an earlier set of facets: understanding the user, effective design process, a final product that is needed, learnable and usable, manageable, appropriate mutable, and offers a satisfying aesthetic experience (Alben, 1996). The first set of facets addresses the human qualities involved in design while the latter set addresses the rational and logical qualities of design. That set is used as a criterion to judge designs for the 'ACM interactions Design Awards' (Alben, 1997, p. 10). However, defining user experience and determining its facets can be classified as a work-in-progress; new insights might be expected in the near future.

5.7 Summary and Conclusions

This chapter discusses a possible operationalization of social affordance devices. If proximity is a dimension of social affordances, then spatial proximity can be operationalized by grounding it on group awareness and temporal proximity on history awareness. Group awareness provides insight in the whereabouts of each group member, what they are doing, and if they are interruptable. Commonalities are introduced as a mechanism for providing the different kinds of group awareness. History awareness is created through the traces (or footprints) left by the group members while they are doing things. In order to be a social affordance device, communication tools must be tightly integrated with both types of awareness information in order to preserve the perception-action coupling. If these issues are realized by software, the result is a group awareness widget (GAW) that can be incorporated in the CSCL environment, transforming it to a sociable CSCL environment. However, such a GAW must also meet the criteria of being attractive and of good usability. It is recognized that issues dealing with aesthetics are difficult to define because they refer to subjective qualities. In contrast, usability can be determined empirically. Now that the elements composing the GAW are clearly outlined, a first prototype of a GAW can be realized (i.e., programmed). This is outlined in the next chapter.

CHAPTER 6

Realizing a First GAW Prototype

Abstract

Basically, a group awareness widget (GAW) prototype displays different kinds of awareness information and provides access to a set of communication media. However, it has also the task of collecting the awareness information and distributing this information to all group members. In order to accomplish this task, it is obvious that the GAW prototype is much more than solely a user interface. This chapter describes the client-server architecture of the GAW prototype along with a description of three basic units that are used as building blocks for the GAW prototype, namely a GAW client, a GAW relay server, and a GAW server. The GAW client-server architecture uses an event notification server for distributing notifications –conveying the awareness information– across the internet to the group members. Also, a global repository is used for storing the notifications. The GAW server consists of components realizing these two functions. The GAW client includes the user interface component and the GAW relay server is used for passing notifications to the GAW server. The GAW prototype has to be used in conjunction with a computer-supported collaborative learning environment. This chapter briefly describes the Microsoft® Sharepoint™ Team Services application that is used as such environment. The GAW prototype and Microsoft® Sharepoint™ Team Services form an 'instrument' that can be used in experiments investigating social affordances.

This chapter contains parts of:

Kreijns, K., & Kirschner, P. A. (2002b). Group awareness widgets for enhancing social interaction in computer-supported collaborative learning environments. In D. Budny & G. Bjedov (Eds.), *Proceedings of the 32nd ASEE/IEEE Frontiers in education conference* (session T3E). Piscataway, NJ: IEEE. Retrieved April 1, 2004, from http://fie.engrng.pitt.edu/fie2002/index.htm.

6.1 Introduction

Basically, the group awareness widget (GAW) prototype displays different kinds of awareness information and provides access to a set of communication tools (see the previous chapter). The GAW prototype is, however, *not* the user interface, although this is the only thing group members see. Nevertheless, the user interface is commonly referred to as the 'GAW.' Obviously, the GAW prototype is much more than solely a user interface, it also has to collect and distribute the awareness information from and to group members, which is a not trivial task.

The GAW prototype provides small devices that can detect particular activities or changes of activities, which are commonly designated as events. A group member going online is an example of an event. All other group members have to be notified of this event so as to become aware that that member has gone online. A special mechanism is taking care of this, namely the event notification server. Events are transferred as notifications –conveying the awareness information– across the internet to the event notification server. Subsequently, the event notification server will notify each group member of the event by sending them the notification. All notifications are stored in a global repository. Notifications have to be persistent because group members will continuously log on and off and, therefore, cannot rely on being simultaneously present with others in the computer-supported collaborative learning (CSCL) environment. Also, group members may work offline in the CSCL environment. Consequently, notifications produced by online group members while a group member is offline, and notifications produced by the group member while working offline, have to be synchronized as soon as the offline group member logs on.

In order to fulfill the above functionalities, the GAW prototype implements a client-server architecture. In addition, the GAW prototype is not a stand-alone system, but complements a CSCL environment. For experimental purposes, the CSCL environment has to be as plain as possible with respect to its social affordances. The Microsoft® Sharepoint™ Team Services version 1.1[I] (SPTS) fulfills the requirements and, therefore, is chosen as CSCL environment.

This chapter describes the client-server architecture of the GAW prototype along with a description of three basic units that are used as building blocks for the GAW prototype, namely a GAW client, a GAW relay server, and a GAW server. It would go beyond this dissertation to describe in exact detail each basic unit and the client-server architecture; instead, they are described at a high level. This is followed by a section describing the GAW prototype's user interface in more detail. The chapter proceeds to describe the Microsoft® SPTS application. Finally, the CSCW community has a history of research on awareness tools related to the present research. The chapter closes with a description of one representative example, namely Babble.

6.2 The GAW Prototype

The GAW prototype is built from basic units that realize the client-server architecture. There are three basic units, namely a GAW client, a GAW relay server, and a GAW server. Each of these basic units, in turn, consists of a number of components. The next sub-sections describe these basic units and their components.

[I] The Microsoft® SPTS home site is http://www.microsoft.com/sharepoint/previous.

6.2.1 The GAW client

The GAW client resides on the group member's computer and includes a user interface component, which consists of a sidebar and two tickertapes. The sidebar contains a number of segments that graphically display the different kinds of group awareness information along with the corresponding history awareness information. One tickertape along the top of the screen is used for displaying messages posted by group members, the other, located directly under the first, is used for displaying notification messages. The user interface component is loosely coupled with a web-based e-mail and chat client. This means that when, for example, the e-mail client is invoked, the web-browser supplied with the URL[I] of the site hosting the e-mail client is started. Thus, the e-mail client (and the chat-client) do not reside on the member's computer but are hosted on another computer.

In the present research, Microsoft® SPTS is chosen as CSCL environment. Likewise the e-mail and chat client, Microsoft® SPTS is a web-based application that can only be accessed through a web-browser supplied with the URL of the site hosting the Microsoft® SPTS application[II]. It is not necessary that Microsoft® SPTS is hosted by the same computer that hosts the e-mail and chat client. In this chapter, a situation is described in which separate host computers are used. Figure 6.1 depicts the applications that can be accessed from the group member's computer. The sidebar and the two tickertapes are not depicted, because they are inside the GAW client.

The second component of the GAW client is a local repository for storing all the notifications that are received from the GAW server. This local repository, therefore, contains all of the awareness information and is synchronized at regular time intervals if the group member is online. The user interface component reads this repository and processes/transforms this information into graphical information.

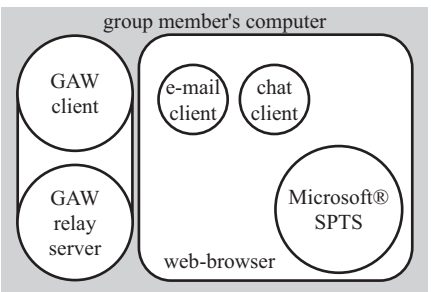

Figure 6.1 The Applications that are Accessible from the Group Member's Computer. Because the E-mail and Chat Client as well as the Microsoft® SPTS Environment are Web-Based, a Web-Browser is Needed for Accessing Them.

[I] URL is the abbreviation of Uniform Resource Locator. URLs are used to address internet locations. For example, 'http://' followed by a symbolic address referring to the web-page.

[II] In this GAW prototype, the e-mail and chat client, and Microsft® SPTS are all web-based applications. Consequently, they cannot be accessed while being offline and, thus, working offline is effectively impossible.

6.2.2 The GAW Relay Server

In order to become aware of the member's activities related to the GAW client itself, the e-mail and chat client, and the Microsoft® SPTS, small devices that can detect particular activities or changes of activities –commonly designated as events– are incorporated at strategic places in the software of these applications. These small devices are called event notification generators. Notifications generated by event notification generators have to be transferred to the GAW server and this requires a GAW relay server. The GAW relay server's only function is to pass notifications from event notification generators to the GAW server. As soon as the GAW relay server receives a notification, it checks if there is a connection to the internet. If that is the case, the notification is immediately transferred to the GAW server, otherwise the notification is temporarily stored. The GAW relay server uses a synchronization buffer for this function. All notifications received are stored in this synchronization buffer as long as the internet connection is failing, but as soon as the connection is available, the synchronization buffer is emptied.

A GAW relay server is necessary on every computer that hosts applications incorporating event notification generators. Thus, the group member's computer hosting the GAW client should host a GAW relay server (in Figure 6.1, this GAW relay server is depicted) as should the computer hosting the e-mail and chat client and the computer hosting the Microsoft® SPTS application.

6.2.3 The GAW Server

The GAW server is hosted by a separate computer which is 'always' available. The GAW server consists of two main components. The first component encompasses the event notification server and the second the global repository.

6.2.3.1 *Event Notification System*

An event notification system can be considered a network service responsible for distributing events as notifications across the internet from one source to a number of interested parties. An event is a representation of something that has happened at a specific moment in terms of a description of what has happened, but which has no duration (Mansouri-Samani & Sloman, 1997; Rosenblum & Wolf, 1997). An example of an event is the act of logging on to a computer. A notification is a formal description of an event in terms of a list of named attributes of simple data types such as strings and integers (Fitzpatrick, Kaplan, Mansfield, Arnold, & Segall, 2002). Hence, notifications can be processed while events cannot. Sources of notifications are called *producers* and interesting parties are called *consumers*. Generally, consumers have to subscribe to producers of events, otherwise the event notification system will not pass the notifications on to these consumers.

SIENA

Carzaniga, Rosenblum, & Wolf (2001) describe an 'ideal' event notification system as "an application-independent infrastructure that supports the construction of event-based systems, whereby generators of events publish event notifications to the infrastructure and consumers of events subscribe with the infrastructure to receive relevant notifications" (p. 332).

Three such systems are:

- The configurable awareNESS envIronmEnt (NESSIE) (Prinz, 1999).
- Elvin (Arnold, Segall, Boot, Bond, Lloyd, & Kaplan, 1999; Segall & Arnold, 1997).
- The Scalable Internet Event Notification Service[I] (SIENA) (Carzinga, Rosenblum, & Wolf, 1998, 2001). Marquès & Navarro (2001) have successfully used SIENA in their World-Wide Groups Infrastructure (WWG).

Of these event notification servers, SIENA seems to be the most promising because of its expressiveness and scalability. *Expressiveness* refers to the number of built-in functionalities of the event notification system, which translates to the application programmer as a versatile schema for modeling data as well as the selectivity in accessing data of interest (Carzaniga, 1998). In other words, it deals with how well the interests of the consumers are captured by the event service. *Scalability* means that a system is able to grow gracefully (Carzaniga, 1998), and, thus, is related to the number of users that can be supported.

Another promising aspect is filtering. SIENA supports a simple filtering mechanism, a list of attribute constraints, each containing an attribute name, an operator, and a value. Constraints are logically ANDed. Filters are used in SIENA as a mechanism to implement subscriptions. Table 6.1 depicts an (arbitrary) example of a SIENA notification and a SIENA filter: all notifications with respect to opening the GAW between January 1, 2003, and December 31, 2003, are passed. So, the example notification is blocked. In the example, opening the GAW client goes along with an initial message, which expires after ten minutes.

Finally, SIENA is an open source application, which means that its use is free and modifications are allowed as long as the GNU General Public License[II] is applied. SIENA is written in C++ but a Java version is also available.

For all these reasons, the GAW prototype implements the SIENA event service, version 1.4.2.

Table 6.1
Example of a SIENA Notification and a SIENA Filter

Notification attribute = (type, name, value)	Filter attribute constraint = (type, name, operator, value)
String Class = GAWopen	String Class = GAWopen
Date TimeStamp = 1/15/2004 23:12:01	Date TimeStamp > 1/1/2003 0:0:0
String GroupName = group9	Date TimeStamp < 12/31/2003 23:59:59
String UserName = Kreijns	
String Message = Hello world!	
Integer Expires = 10	

Notifications in the GAW Prototype

The GAW prototype has defined nine types of notifications (see Table 6.2). The GAW client, the e-mail and chat client, and the CSCL environment generate the different types of notifications.

[I] The SIENA home site is http://www.cs.colorado.edu/serl/dot/SIENA.html.

[II] The text of it can be found at http://www.cs.colorado.edu/~carzanig/siena/software/LICENSE.txt. See also http://www.gnu.org/.

Table 6.2
Notification Types in the GAW Prototype

	Description of the Notification	Precise text that appears in GAW client	Event notification generator
1	Connect and disconnect from internet	Going on- and offline (internet)	Microsoft® SPTS
2	Opening and closing the GAW client	Starting and stopping the GAW	GAW client
3	Posting a tickertape message	User (tickerbar) message	Tickertape
4	Posting a tickertape idea	New ideas from users	Tickertape
5	Browsing the course web site	Visits to course web-sites	Web site
6	Opening and closing the e-mail client	Visit to the mail-server	e-mail client
7	Opening the chat-client	Visit to the chat-server	Chat client
8	Posting an e-mail message	Entering a chat message	Chat client
9	Posting a contribution to the discussion forum	Posting a forum message	Discussion forum

Software Requirements for the Software

In order to generate notifications, it must be possible to insert codes implementing the event notification generators at strategic locations in the source code of the applications. Because the present research encompasses the programming of the GAW client and tickertape, the insertion of event generators is not a problem. The e-mail and chat client are common applications that can be bought or retrieved from open sources. Hence, these applications do not need to be programmed, but the source code must be available when bought or downloaded from the open source. In the present research, Active Server Pages (ASP) code is preferred. The use of ASP code makes it easy to insert pieces of code that implement the event notification generators in the applications.

A piece of code is given here that implements a generic event notification generator:

```
<script language=vbscript runat=server>
Function EventNotification(sNotName, sUserName, sElem(), sVal())

  Dim fso, ms, sNot, i, sExtraArg
  sNot = ""
  If UBound(sElem) <> UBound(sVal) Then
    Exit Function
  End If
  sNot = sNot & Chr(1) & "SEvent" & Chr(2) & sNotName & Chr(3)
  sNot = sNot & Chr(1) & "SUserName" & Chr(2) & sUserName & Chr(3)
  For i = 0 To UBound(sElem)
    sExtraArg = Chr(1) & sElem(i) & Chr(2) & sVal(i) & Chr(3)
    sNot = sNot & sExtraArg
  Next
  sNot = sNot & Chr(4)
  Set fso = CreateObject("Scripting.FileSystemObject")
  If fso.FileExists("//./mailslot/GAWEventService") Then
    Set ms = fso.CreateTextFile("//./mailslot/GAWEventService", True)
    ms.Write(sNot)
    ms.Close
  End If

End Function
</script>
```

In this piece of code, the GAW relay server is called the 'GAWEventService.' An example application is:

```
Dim sElems(0),sVals(0)
sElems(0) = "ContactWith"
sVals(0) = "Pinxteren"
sUserName = "Kreijns"
EventNotification "WebVisit", sUserName, sElems, sVals
```

6.2.3.2 *Persistent Global Repository*

SIENA is used for notification distribution, but since notifications are volatile and working and learning is done in a time-deferred mode, it has to be used in conjunction with a global repository that will serve as the intermediary between the GAW clients and SIENA. The GAW server includes a management system for the global repository that has to handle:

- Storage and retrieval of notifications
- User information such as the number of groups and their members
- Other important system information

The open source application MySQL[I] is chosen as database system for the implementation of the persistent global repository.

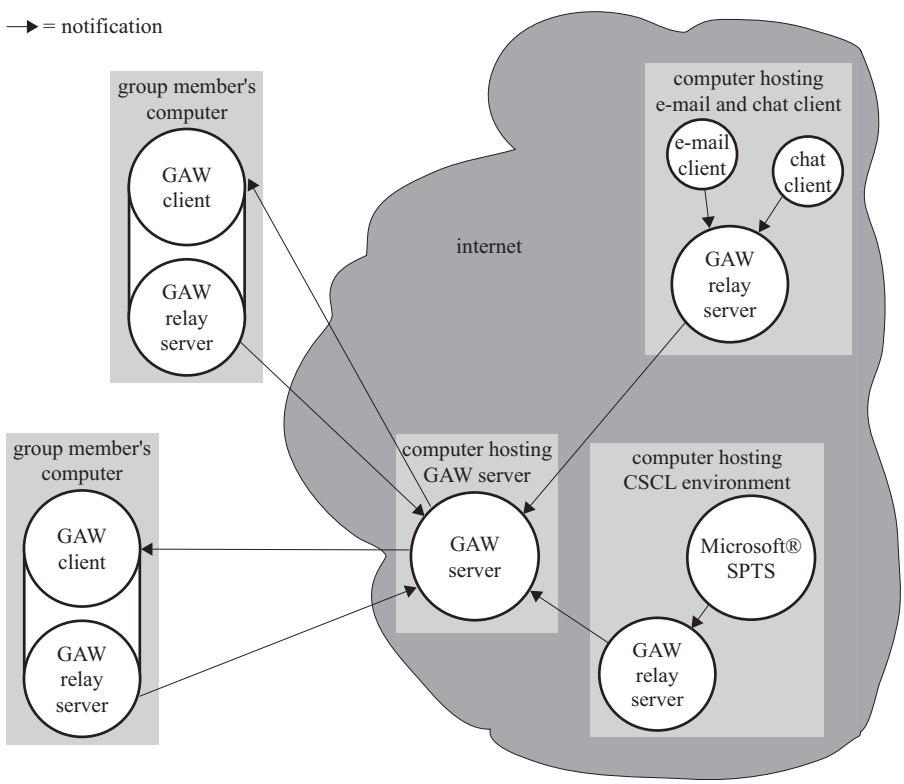

Figure 6.2 Client-Server Architecture of the GAW Prototype

[I] The MySQL home site is http://www.mysql.com.

6.2.3.3 *Architecture*

Now that all building blocks have been described, the GAW prototype's architecture is depicted in Figure 6.2.

6.3 The GAW User Interface

The GAW user interface is a component of the GAW client and is the part members see. The GAW user interface is a sidebar visible on the right side of the computer screen. There are also two tickertapes on the top of the screen (see Figure 6.3). Figure 6.3 also shows Microsoft® SPTS. The two tickertapes and Microsoft® SPTS are described in later sub-sections.

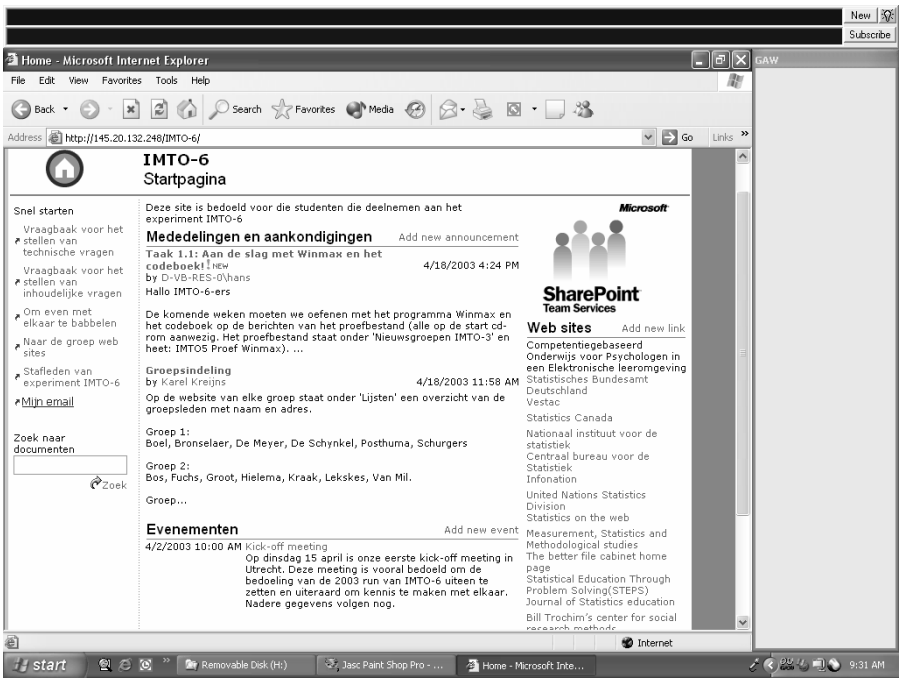

Figure 6.3 The GAW User Interface Showing the (Empty) Sidebar on the Right Side and Two Tickertapes on the Top of the Screen

6.3.1 The Sidebar as Container for Group Awareness Information

This sidebar in Figure 6.3 is empty but can contain a number of segments, each segment providing group awareness information about the members regarding some commonality (see Chapter 5). The sidebar can be made smaller or larger by dragging the left edge of the sidebar with the mouse.

One such segment is depicted in Figure 6.4. This segment resembles the segments in Figure 5.2 (Chapter 5) except that the segment is now a rectangle and the timeline is not logarithmic but linear. The segment displays, for the most part, history

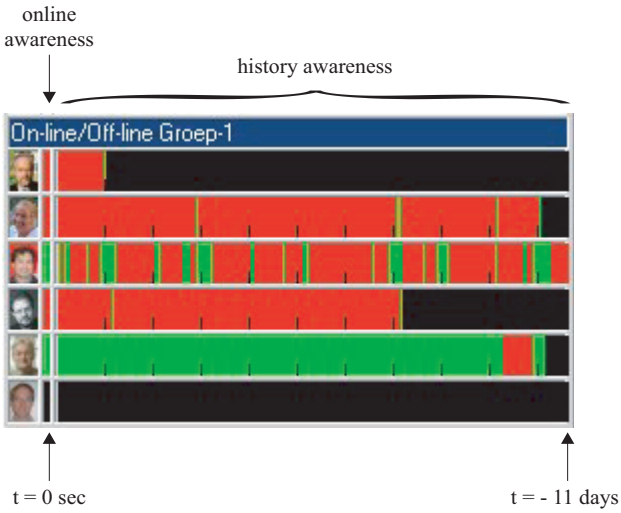

Figure 6.4 Segment Showing the Connection Times and Online Durations of the Members of this Group

awareness information. The history awareness information reveals the patterns of online behavior of the group members. Black areas indicate that the GAW has not yet been installed. Red (grey) areas indicate periods of time that the GAW is closed and green (white) areas indicate periods of time that a member has opened the GAW indicating that at these time periods the member has been online and was engaged in her or his working and learning activities. The small part at the left side displays online awareness information. In this case, red (grey) means the member is offline and green (white) that the member is online.

Adding a segment to the sidebar is simply done by right clicking with the mouse on the blue bar of the sidebar. In the pop-up menu that appears, one menu item is for adding a segment. Clicking on that menu item will cause a dialog box to pop-up in which the segment can be specified (Figure 6.5).

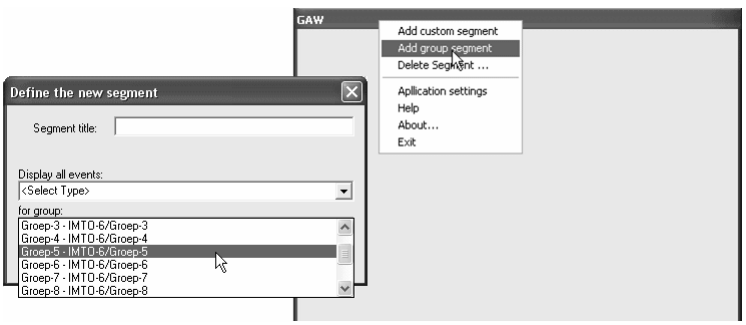

Figure 6.5 Adding a Segment to the Sidebar

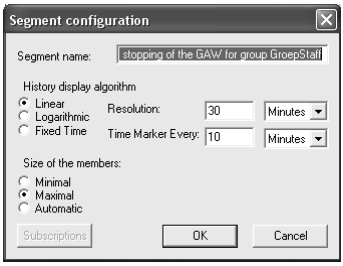

Figure 6.6 Changing the Settings of the Segment

The unit of time, the size, and other aspects of the segment can be changed. A pop-up menu appears when right clicking with the mouse on the blue bar of the segment. Selecting the menu item for configuring the segment causes a dialog box to pop-up in which the settings can be changed (see Figure 6.6).

Once the segments are added to the sidebar, members may use them to contact other members. Clicking on a picture causes a dialog box to pop-up that contains the member's information as well as buttons for opening a chat and for writing an e-mail message. This is depicted in Figure 6.7. The member's information can only be modified by its owner. This can be accomplished by clicking on one's own picture.

It is also possible to left click on the green areas. In that case, the associated notification information will be displayed in a window.

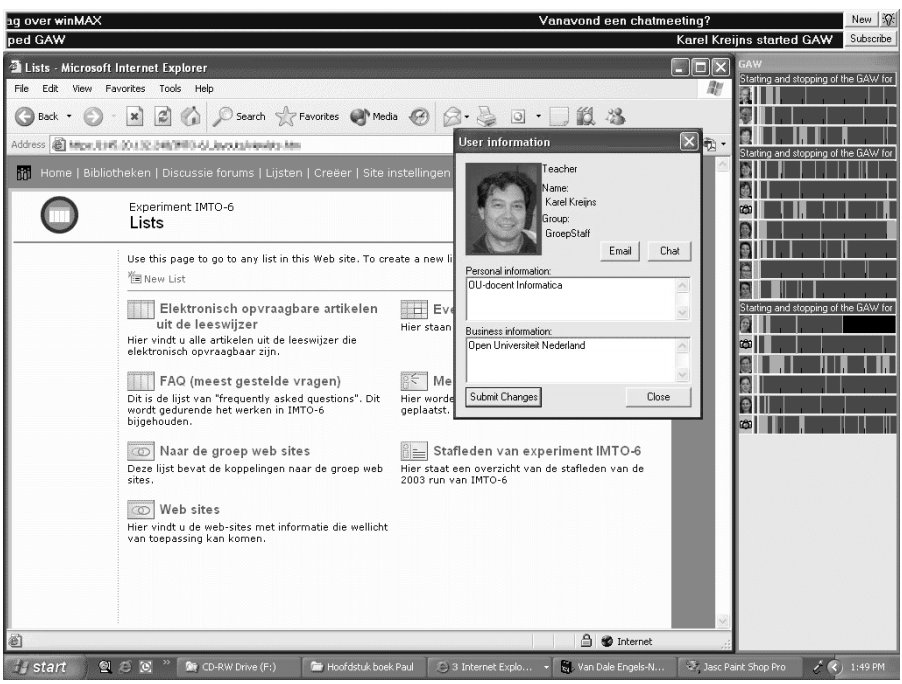

Figure 6.7 Dialog box Containing the Member's Information and Two Buttons for Launching the Chat Client and for Writing an E-mail Message

6.3.2 Communication Media

6.3.2.1 *Tickertape*

A tickertape is a scrolling one-line window in which short messages are displayed that will disappear or fade away after a certain time. Tickertapes have the advantage that they occupy a minimum of screen real estate. Therefore, they can always be visible without disturbing the user while working with other applications.

Research on Tickertapes

CSCW researchers have explored the effects of using a tickertape. Parsowith, Fitzpatrick, Kaplan, and Segall (1998; see also, Fitzpatrick, Kaplan, Mansfield, Arnold, & Segall, 2002), for example, have designed Tickertape and observed that working teams of a semi-commercial research center found four purposes for it:

- Work. Tickertape allows for short, 'bursty' interactions with colleagues about working issues.
- Social activities. Tickertape is useful for organizing social activities such as meal breaks and quitting time.
- Leisure. Tickertape also proved be useful for off-task news. For providing this functionality, Tickertape was coupled to an online newsservice. Extracted headline news was redirected to Tickertape.
- Newswatcher service. In combination with a filtering mechanism, Tickertape allows for displaying specific Usenet news postings that are relevant for the user.

The GAW Tickertape

The GAW client includes two tightly integrated tickertapes. Figure 6.8 (up) depicts the two tickertapes as does Figure 6.8 (down). Both tickertapes are placed on top of the screen. The upper tickertape of the GAW client allows for interpersonal interaction. Here, group members can post messages to the tickertape (see Figure 6.9, left) and others may react on them by clicking on the text of the messages while they are visible on the tickertape. The maximum length of the message is set to 40 characters to force users to keep their messages short. Clicking on the text of a message opens a dialog box revealing the name of the message sender (see Figure 6.9, right). The dialogue box also shows a time stamp, a copy of the message and a button for invoking the dialog box of the sender. This latter dialog box contains the sender's information and buttons for opening a chat and for writing an e-mail message, thus, giving group members the opportunity to react either synchronously or asynchronously. The dialog box of the sender has already been discussed.

Figure 6.8 (up): A User Message is Visible on the Upper Tickertape
(down): A Notification Message is Visible on the Lower Tickertape

Figure 6.9 (left): Dialog box for Posting a Message
(right): Dialog box for Reacting to a Message

The upper tickertape also allows ideas to be posted. Ideas can be elaborated on by attaching a comment it (see Figure 6.10, left). Generating ideas can help group members in their thinking on problem solving tasks (Bitter-Rijpkema, 2004). Reacting to an idea is similar to reacting to a message: by clicking on the text of an idea visible on the tickertape, a member can contact the member who posted the idea through the dialog box that opens (see Figure 9.11, right).

The lower tickertape is meant for displaying notifications such as when members open or close the GAW client. Members may subscribe to the types of notifications they want to see; the GAW client, as noted, has defined nine different types of notifications. Members may apply a filter to each type of notifications. For a specific type, a filter determines the subset of notifications that are seen (i.e., all notifications, only the notifications of the specified group, or only the notification of the specified member). A group can be any group known by the GAW server, and a member can be any member, thus even a member of different group. Usually, members only wish to see the notifications caused by members of their own groups. Here, the filter is set to block all notifications except those originating from the group that the member belongs to. Again, as was the case for messages and ideas, clicking on the text of the notification opens a dialog box, which allows a member to contact the member issuing the notification.

The scrolling speed of the text of the messages and ideas in the upper tickertape and

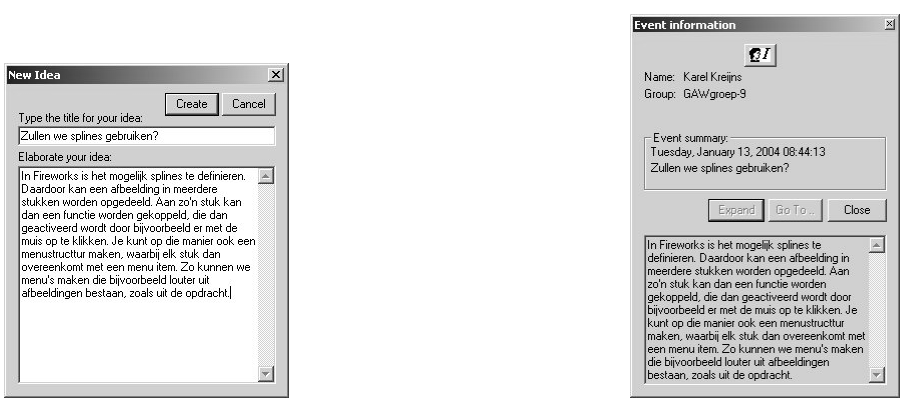

Figure 6.10 (left): Dialogue box for Posting an Idea
(right): Dialogue box for Reacting to an Idea

the notifications in the lower tickertape can be set separately by the member as can the time that they are visible on the tickerbars.

6.3.2.2 *Chat*

The GAW client is loosely coupled with a chat client meaning that potentially any client can be used. However, because the ASP code of the event notification generators must be inserted in the chat program and because it must be generally possible to modify the chat program, the number of chat programs which can be chosen is limited to those written in ASP code.

The chat program chosen for the GAW prototype is ZBIT Chat[I] version 2.1. ZBIT Chat offers basic chat functionality together with the following features:

- Private conversations.
- Creation of rooms, which disappear at the moment that there is no one visiting the chat.
- Emoticons.
- Format of text in bold, italic, or underlined
- Logging of conversations on the server. (NB. These logs cannot be accessed by the members).
- A Microsoft® Access® compatible database table (i.e., a .MDB file) for storing account information (i.e., the username and password).
- Is programmed in ASP using JavaScript, VBScript, and dynamic HTML (DHTML).

Some ZBIT Chat modules (i.e., .ASP files) were completely rewritten and new

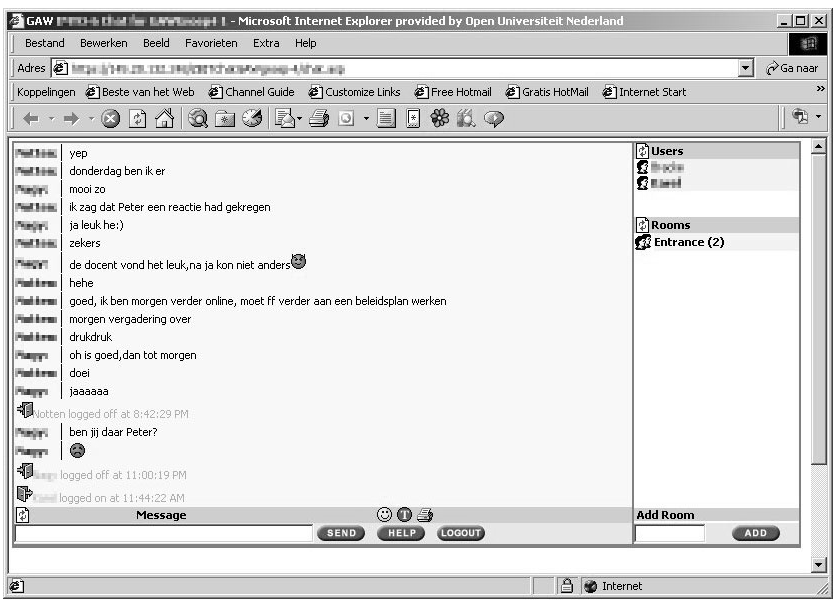

Figure 6.11 Screendump of ZBIT Chat Client

[I] The ZBIT chat home site is http://www.zbitinc.com.

modules were added to allow for automating the login procedure using the username and password from the Microsoft ® SPTS environment or from the GAW prototype, depending on where it is invoked. In addition, some modifications were made to its appearance and the set of emoticons was extended. The ZBIT Chat client is depicted in Figure 6.11.

6.3.2.3 *E-Mail*

For the same reasons as in the case of the chat client, the GAW client is loosely coupled with an e-mail client. The e-mail program chosen is WebmailASP[I] version 2.1. The e-mail client is fully featured including an address book and folder management (for creating, moving, and deleting folders). Additionally WebmailASP has the following technical features:

- A Microsoft® Access® compatible database table (i.e., .MDB file) for storing data such as username and password but also all messages received, sent, or deleted.
- Is programmed in ASP using JavaScript and VBScript.

Similar to the ZBIT Chat client, WebmailASP modules (i.e., .ASP files) have been rewritten and new modules were added, but nothing was changed in the appearance. Figure 6.12 depicts the WebmailASP client.

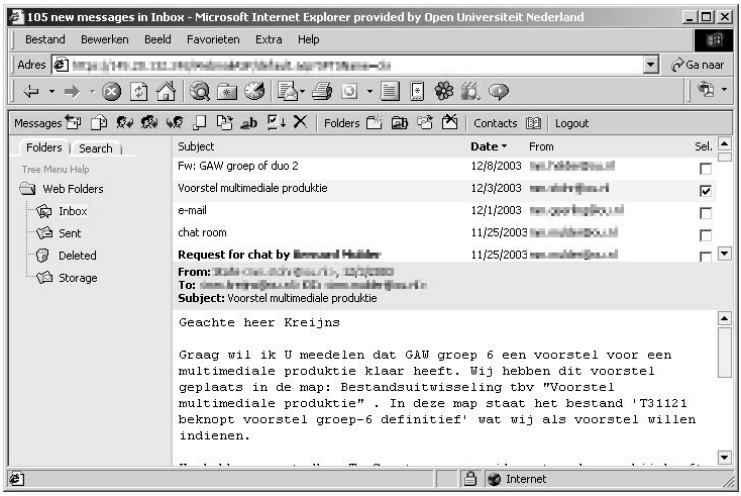

Figure 6.12 Screendump of the WebmailASP Client

[I] The WebmailASP home site is http://www.webmailasp.net.

6.4 Microsoft® SPTS

In the present research, Microsoft® SPTS version 1.1[I] is chosen as CSCL environment. This application is briefly described here.

6.4.1 Features of Microsoft® SPTS

Microsoft® SPTS is a web-based application. It has the following main features:

- Communication. Microsoft® SPTS uses threaded discussion boards as a communication platform (Figure 6.13). The use of e-mail is possible, but the standard installed e-mail client of the member is used because Microsoft® SPTS itself does not provide this functionality.
- Document exchange using document libraries. Document libraries are folders that allow for storing documents uploaded by group members so that they can be shared. Meaningful names must be given to these folders so that it is clear what type of documents is stored in the folders.
- Links. Links are lists of shortcuts to favorite web pages.

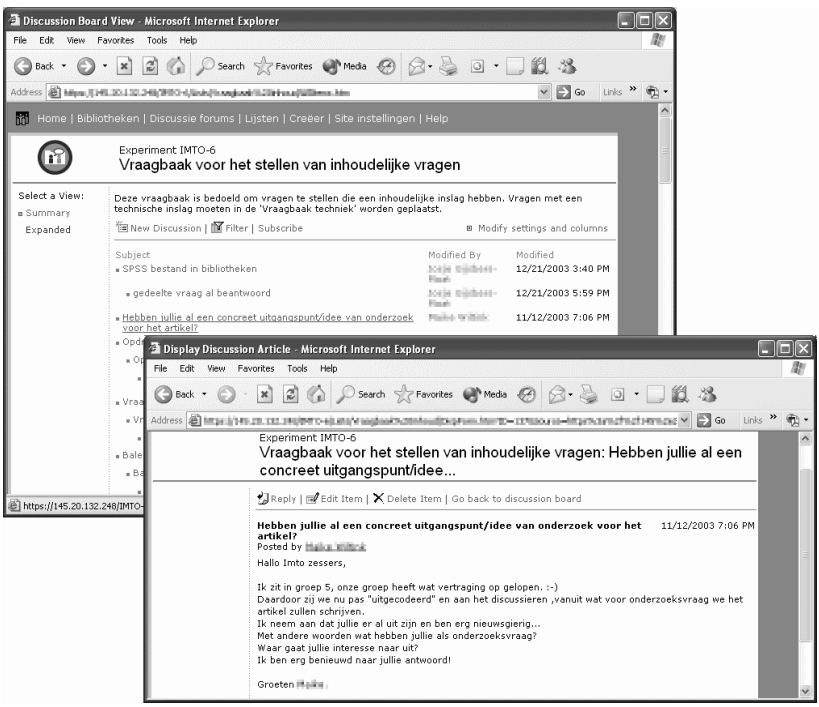

Figure 6.13 Opening a New Item in the Discussion Board

[I] The Microsoft® SPTS home site is http://www.microsoft.com/sharepoint/previous. However, this application is no longer available at retail. Its successor is Microsoft® Windows® Sharepoint® Services 2003. Its home site is http://www.microsoft.com/windowsserver2003/technologies/sharepoint/default.mspx.

- Announcements. Announcements are placed on the home page of the SPTS web site. Members can post news and other information, which can be seen by every group member.
- Events. Course related events in Microsoft® SPTS are used to keep each member informed about upcoming meetings or deadlines. Events are also placed on the home page of the web site.
- Roles. Roles are used to define access (i.e., which web pages can be accessed and which cannot?) and permission (i.e., which information can be modified and which cannot?) levels in the Microsoft® SPTS web site.
- Administration. Microsoft® SPTS uses the Windows® 2000 Server for making user accounts. A user-password system is needed because field experiments will be performed using regular distance courses of the Open Universiteit Nederland. It must be guaranteed that only the students (i.e., participants of the experiment) subscribed to these courses can access the SPTS web sites associated with these courses.

6.4.2 Technical Features

The Microsoft® SPTS application does not allow its web-pages to contain ASP code, but –as a solution– allows the inclusion of 'inline frames' using Microsoft® FrontPage®. The inline frames serve as gateways to web pages that may contain ASP code. This way, a connection is made to the ZBIT chat client and the WebmailASP client.

6.5 Related Research: Babble

In this closing section, one example from the computer-supported cooperative work research is described here that is closely related to the present research, namely Babble. Babble represents the current state of the computer-supported cooperative work community on research on awareness and social affordances.

6.5.1 General Description of Babble

Babble was originally created in August, 1997, by David N. Smith (see, Erickson, Smith, Kellogg, Laff, Richards, Bradner, 1999), a senior programmer at IBM's T. J. Watson Research Center. Babble is a chat-like communication tool that resembles a standard chat tool in that typed messages are transmitted across the internet, which are then displayed in a separate pane of the receiver's chat window. In addition, a list of users currently using Babble and a list of topics are displayed in another pane (see Figure 6.14). Babble also allows one-to-one private chats.

Babble, however, is different from a standard chat tool in two aspects (Erickson & Kellogg, 2000, p. 71–73). First, all conversations of every topic are persistent. This means that whole conversation from the very moment it was started until the last sentence entered is permanently available for inspection and for continuing the conversation. This feature, thus, allows for asynchronous and semi-synchronous conversations and actions. Because the pane displaying the current topic conversation is a window, it only shows a small part of the whole conversation; scrolling enables seeing other parts of the conversation. In other words scrolling enables accessing the conversation history. Secondly, a *social proxy* (also referred to as Babble's Cookie) is available. A social proxy is a minimalist graphical representation of other users that

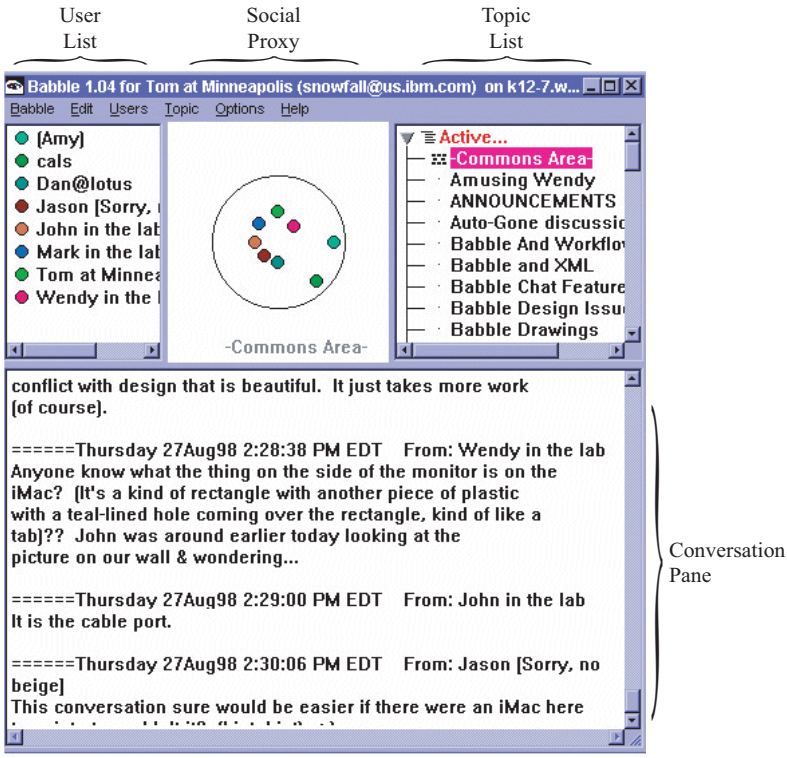

Figure 6.14 The Babble Interface
(Source: Erickson, Smith, Kellogg, Laff, Richards, and Bradner, 1999)

depicts their presence and activities. It consists of a large circle to represent the conversation and colored dots –marbles– to represent the individuals. A marble inside the circle represents a user who is currently engaged in the current topic conversation. Marbles outside of the circle represent users engaged in other topic conversations. Any interaction of the user with Babble causes her or his marble to move to the center of the circle rapidly; if a following interaction fails to occur, the marble will drift to the edge of the circle slowly. The proxy gives a sense of the number of users engaged in conversations, the amount of conversational activity, whether users are gathering or dispersing, and who it is coming or going.

Bradner, Kellogg, and Erickson (1999) observed four types of communicative practice in Babble. The first is *waylaying* in which a person is waiting for another person to become active in Babble. As soon as that person shows-up a (private) communication episode can start. Waylaying is used for expertise selection and by managers to assign work to their subordinates. This latter group developed a resistance to log into Babble because it made them too accessible for their managers and it threatened their autonomy. The second practice is *unobtrusive broadcast* of information. One can broadcast a message without a specific receiver in mind, for example, for asking questions (the answering of these questions is not too urgent). Because no one is explicitly addressed, no one is obligated to look or even to answer

the questions. Users preferred this use of Babble because it enabled them to request or share information without interrupting others. The third –and a side effect– is *staying in the loop*. Staying in the loop means that by questioning and answering, the group can infer who is working on what and how that work is progressing. In other words, such communication patterns provide information that is passively shared and provide awareness about the activities of others. Finally, the last practice is *discussion sanctuary*. The use of separate servers and a firewall in addition to appropriate Babble clients enabled several Babbles to be distinguished and, thus, members of one Babble are unable to enter the other Babble. Users have the feeling that they have secure communication and restricted access control; strangers cannot enter. Consequently, their communication is informal and allows for a free-flowing exchange of ideas only meant for the group that they are part of.

6.5.2 History Awareness in Babble

History awareness is realized in Babble through a *timeline* social proxy (Erickson & Laff, 2001). This timeline shows the history of the members' presence and activities thereby providing cues on those who are actively participating in the conversation and those who are lurkers in addition to cues on how the conversation is developing and if rhythms are discernable in the conversation, that is, busy and quit moments in the conversation. The timeline social proxy is depicted in figure 6.15. Every member is represented by a row. A colored thick segment means that a member is or was engaged in the current topic conversation. A grey thin segment parts means that the member is or was engaged in other topic conversations. Vertical marks indicate contributions to the conversation. The timeline ranges one week in the past.

6.5.3 Adoption of Babble

Interestingly, the adoption of Babble was evaluated from the perspective of social affordances. The communication practices are considered a consequence of its social affordances. As Gibson (1986) pointed out, affordances are for good or bad. Bradner, Kellogg, and Erickson (1999) observed that waylaying is a bad affordance for subordinates because they feared that Babble would be used by managers to assign work to them, but was experienced as a good affordance for all other groups (without managers but with information seekers and experts). Thus, depending on the group characteristic, social affordances may or may not be exploited. Bad affordances may cause Babble not to be adopted by a specific group.

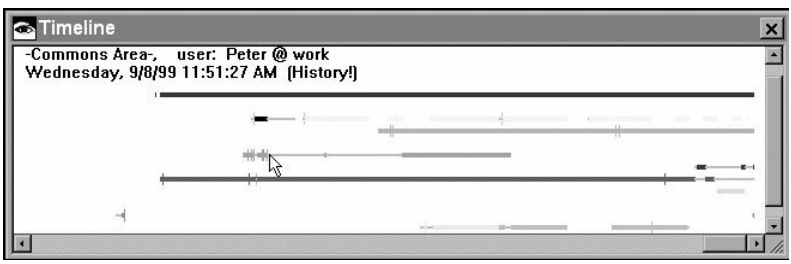

Figure 6.15 The Timeline Social Proxy
(Source: Erickson and Kellogg, 2003)

Also, a group needs to gain some experience with Babble before its social affordances are perceived and valued for their appropriateness.

6.5.4 Conclusion

In this section, Babble has been described as being essentially a chat tool that –in contrast to other chat tools– also displays group awareness and history information on the participants involved. On the other hand, it is also possible to view Babble as a social affordance device because it provides group awareness information on others involved in the chat while it at the same time provides a communication medium to contact them, namely the bare chat tool itself. If a GAW[I] is described as a device that provides multiple kinds of group awareness information and at the same time a set of communication media, then Babble can be described as a minimalist GAW because it only provides one single kind of group awareness and one type of communication medium. However, though Babble is a social affordance device, it cannot be used in the experiments for several reasons. Firstly, in the present research it is the intention to examine the effects of multiple kinds of awareness and the provision of multiple communication media. Babble cannot be extended to fulfill this requirement. Secondly, Babble should always be open; it is not possible to close the bare chat so that only the social proxy is visible. This is a disadvantage because Babble consumes a considerable amount of real screen estate. Thirdly, technical reasons prohibit the use of Babble. Babble is a prototype system developed for intranet use, whereas the experiments require internet use.

6.6 Acknowledgement[II]

Hans van Pinxteren of the Dutch software firm Computer Solutions has deployed the SIENA event service and the MySQL database system on a server running the SuSE Linux™ Professional version 8.0[III] operating system. He has programmed the GAW server, GAW Relay server and the GAW client together with the two tickertapes within a time span of five months. Howard Spoelstra has setup two servers running the Microsoft® Windows® 2000 Server operating system, installed the Microsoft® Internet Information Service, and deployed the Microsoft® SPTS.

[I] Here, the reference is made to a GAW in its most general meaning and not to the GAW prototype (this chapter). The GAW prototype is just one of the many possible instantiations of a GAW (Chapter 5), which in turn is only one possible operationalization of a social affordance device (Chapter 4).

[II] I was the main architect of the GAW prototype and programmed all the 'glue' software that was needed for linking the ZBIT chat and WebmailASP client to the Microsoft® SPTS application and to the GAW prototype.

[III] The SuSE Linux™ home site is www.suse.de.

CHAPTER 7

Measuring Perceived Quality of Social Space

Abstract

Computer-supported collaborative learning environments usually support distributed learning in groups. Although these environments have the potential to facilitate working in groups, they often do not fulfill this potential because of their inability to provide a sound social space where social relationships exist and where a sense of cohesiveness and community is achieved. This article reports on the construction and validation of a self-reporting (Dutch-language) Social Space Scale. The raw Social Space Scale was launched in three different distance education courses from the Open Universiteit Nederland using two different computer-supported collaborative learning environments. Factor analysis revealed that the Social Space Scale has two interpretable factors, which are identified as the Positive Group Behavior dimension and the Negative Group Behavior dimension. The raw Social Space Scale was refined thereby reducing the number of test items from 44 to 20; each dimension encompasses ten items. The internal consistency was .81 for the total scale, and .92 for the Positive Group Behavior dimension and .87 for the Negative Group Behavior dimension. A nomological network was used for further validation. The findings suggest that the Social Space Scale has potential to be useful as a measure for social space. However, it must be realized that this measure is a first step and further validation research is needed.

This chapter is based on:

Kreijns, K., Kirschner, P. A., Jochems, W., & Van Buuren, H. (in press). Measuring Perceived Quality of Social Space in Disributed Learning Groups. *Computers in Human Behavior*.

7.1 Introduction

The effectiveness of group learning in an asynchronous distributed learning group depends largely on the social interaction that takes place during the collaborative activities in a computer-supported collaborative learning (CSCL) environment (Hiltz, 1994; Kearsley, 1995; Muirhead, 2000; Wagner, 1994, 1997; Swan, 2002). Social interaction encourages critical thinking (Garrison, Anderson, & Archer, 2000; Newman, Johnson, Webb, & Cochrane, 1997), is a prerequisite for shared understanding amongst group members (Clark & Brennan, 1991), allows the social construction of knowledge (Bednar, Cunningham, Duffy, & Perry, 1995; Glaserfeld, 1995; Jonassen, 1994; Palincsar, 1998), and supports the acquisition of competences (Keen, 1992; Short, 1984). All these notions confirm that social interaction is a *condition sine qua non* for group learning (Vygotsky, 1978).

Social interaction is not only important for cognitive processes for learning, but is equally important for socio-emotional processes such as affiliation and impression formation, the development of social relationships and the creation of a sense of cohesiveness and community (Harasim, 1991; Henri, 1992). These qualities determine the existence of a sound social space which is essential for reinforcing social interaction. We define a social space to be the network of social relationships amongst the group members embedded in group structures of norms and values, rules and roles, beliefs and ideals. We designate a social space to be ′sound′ if it is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction, and a strong sense of community. A sound social space determines, reinforces and sustains the social interaction that is taking place amongst the group members and enables open critical dialogues that neither harm nor offend group members because they know and trust each other (Rourke, 2000). These feelings of community can increase the flow of information between (all) learners while encouraging support, commitment to group goals, cooperation among members, and satisfaction with group efforts. In other words, a sound social space promotes positive feelings between group members such that learners benefit by experiencing a greater sense of well-being and having a larger set of willing individuals to call on for support (Rovai, 2001, 2002a, 2002b). Finally, a sound social space contributes to a positive social climate/online-atmosphere within the group (Brandon & Hollingshead, 1999; Rourke, 2000; Rourke & Anderson, 2002).

The two dimensions of social interaction - educational and (social) psychological - are depicted in Figure 7.1 (Kreijns, Kirschner, & Jochems, 2003a). This is in line with Hare and Davies (1994; see also Brown & Yule, 1983) who categorized interaction as either task-driven or socio-emotional. Learning performance encompasses variables like efficiency and effectiveness relative to the task outcome, retention of what is learned, and degree of shared understanding. Social performance encompasses variables like the degree of established social space, sense of community, and degree of trust. As can be seen from Figure 7.1, learning performance and social performance not only 'reinforce' (see arrows) their direct precursors cognitive processes (e.g., critical thinking) and socio-emotional/social performances (e.g., formation of group structures) respectively, but also 'cross-reinforce.' For example, if the group is successful in achieving the goals of the task, then this may increase the group cohesion (Mullen & Cooper, 1994), and if there is trust, then this reinforces open communication thereby enhancing critical thinking (Jacques, 1992; Rourke, 2000).

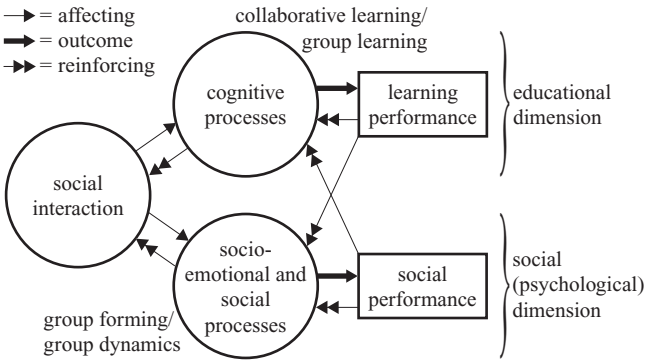

Figure 7.1 The Two Dimensions of Social Interaction

If social interaction exists in both dimensions, collaborative learning will increase the effort to achieve, promote caring and committed relationships, and increase participant's psychological health and well-being. (Johnson & Johnson, 1992, 1994).

Despite the fact that social interaction is important for socio-emotional processes, it is often ignored or forgotten by (distance) educators and researchers because they solely concentrate on cognitive processes and task contexts. In fact, by doing so, these educators take –consciously or unconsciously– group dynamics for granted (Kreijns, Kirschner, & Jochems, 2003a). This 'one-sided' educational focus largely determines the set of requirements in the design of CSCL environments. As a result, *functional* CSCL environments are implemented. In such functional environments, the group dynamics are –if they do occur– a second order effect. This observation is supported by Cutler (1996) who remarked that "current literature surrounding CMC is almost entirely task-based and focused on cost, efficiency, and productivity with little attention given either to the changes effected on the people or to the social relations created from using the communication technologies" (p. 320).

Our research on fostering and enhancing social interaction in (asynchronous) distance learning groups is aimed at the design and implementation of *sociable* CSCL environments. Sociable CSCL environments include, apart from educational functionality, a social functionality that increases the likelihood that a sound social space will emerge (Kreijns, Kirschner, & Jochems, 2002; Kreijns & Kirschner, 2004).

To determine if a particular CSCL environment provides a sound social space as well as to help designers and developers maximize such a space, it is necessary to have an instrument that measures the degree of the perceived quality of the social space in distributed learning groups.

A study of the literature revealed that there is no such social space measure, but that there are a number of instruments available that claim to measure related aspects such as social climate and social presence (Gunawardena, 1995; Gunawardena & Zittle, 1997; Rourke & Anderson, 2002; Short, Williams, & Christie, 1976; Tammelin, 1998, Tu, 2000a, 2002b; Tu & McIsaac, 2002). Social presence is the degree of illusion that the other in the communication appears to be a 'real' physical person. Close study of these existing instruments (see next section) led us to the conclusion that these instruments measure aspects of social space, social climate, social presence, sociability (see for sociability, Kreijns, Kirschner, & Jochems, 2002), and the effects of using certain pedagogical techniques in varying degrees (see for an overview of these

pedagogical techniques, Kreijns, Kirschner, & Jochems, 2003a). None of them, however, measured what we consider social space. For this reason, we have developed and validated our own measurement instrument: the Social Space Scale.

7.2 Existing Instruments

A number of existing instruments purport to measure social climate and social presence. Rourke and Anderson (2002) measured the *social climate of computer conferencing* by using six, 5-point bipolar (semantic differential) scale items (see Appendix 1). These bipolar scale items are commonly used to measure the degree of *social presence*. Short, Williams, and Christie (1976) used four, 7-point bipolar scale items (see Appendix 1) for measuring social presence. These four scale items were, and still are, the dominant social presence measure for many researchers. Gunawardena (1995) extended these four scale items with 13 new scale items, resulting in a questionnaire of 17, 5-point bipolar scale items (see Appendix 1). She used the scale, here referred to as Social Presence Indicators, for soliciting the *students' reactions on a range of feelings toward the medium of CMC*. Gunawardena and Zittle (1997) developed an alternative social presence measure, called the Social Presence Scale, consisting of 14, 5-point Likert-scale items (e.g., 'The moderators created a feeling of an online community' and 'I felt that my point of view was acknowledge by other participants in GlobalEd'; GlobalEd is a listserv based discussion board). They contended that the Social Presence Indicators measure the 'intimacy' dimension of social presence (intimacy: see Argyle & Dean, 1965) whilst, in contrast, the Social Presence Scale measures the 'immediacy' dimension of it (immediacy: see Wiener & Mehrabian, 1968).

From our study, we conclude that it is not clear what all these instruments are *actually* measuring since the items tend to overlap (see Appendix 1) or are not within the space of interest associated with the construct. Gunawardena and Zittle's (1997) Social Presence Scale, for example, includes items such as 'Discussions using the medium of CMC tend to be more impersonal than face-to-face discussions.' Thus, the question arises whether these instruments measure social climate, social presence, feelings of the learners towards CMC, and the intimacy or immediacy dimension of social presence. The authors of these instruments also add to the confusion. Rourke and Anderson (2002) are not consistent in using the term social climate. They also use the term 'social environment' and, when referring to the instrument measuring social climate, they use the term social presence (we also have to take into account that their definition of social presence is different from that of Short, Williams, and Christie (1976)). Gunawardena (1995) stated that the 17, 5-point bipolar scale items (the Social Presence Indicators) measures the students' perception of computer-mediated communication (CMC) as a social medium although she defined social presence as "the degree to which a person is perceived as a 'real person' in mediated communication" (p. 151). This is not the same thing! Gunawardena also suggested a relationship between social climate and social presence, yet this relationship is not clearly described. Finally, Gunawardena and Zittle (1997) stated, for example, that their Social Presence Scale measures the immediacy dimension of social presence. However they also state that the Social Presence Scale measures the "Perceived sense of 'online community', the degree of social comfort with CMC" (p. 14). In sum, we conclude that these existing instruments measure varying degrees of aspects of an amorphous set of variables, including social space, social climate, social environment, social presence, sociability, feelings toward CMC, and the effects of using certain

pedagogical techniques, but not social space as total concept. Moreover, not all the measurement instruments have construct validity nor do they present data (if any exists) as to their internal reliability. This confounding situation led us to the conviction that we need to develop our own social space measure. The (refined) Social Space Scale is discussed in the next section.

7.3 The Social Space Scale

The Social Space Scale is a self-reporting measure for assessing the perceived quality of the social space that exists in distributed learning groups and consists of two parts. The first part assesses the students' feelings regarding their own behavior and/or the other

Table 7.1
The Social Space Scale

No. Item	Item	*M*	*SD*	Component 1 Positive Group Behavior	Component 2 Negative Group Behavior
Positive Group Behavior					
1	Group members felt free to criticize ideas, statements, and/or opinions of others	3.29	1.03	.69	
3	We reached a good understanding on how we had to function	2.44	1.32	.75	
5	Group members ensured that we kept in touch with each other	3.10	1.11	.79	
7	We worked hard on the group assignment	2.90	1.30	.76	
9	I maintained contact with all other group members	2.78	1.31	.76	
11	Group members gave personal information on themselves	2.82	1.07	.62	
13	The group conducted open and lively conversations and/or discussions	2.59	1.15	.85	
15	Group members took the initiative to get in touch with others	2.84	1.11	.87	
17	Group members spontaneously started conversations with others	2.66	1.10	.72	
19	Group members asked others how the work was going	3.15	1.12	.70	
Negative Group Behavior					
2	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized[a]	3.99	.94		.74
4	Group members were suspicious of others[a]	4.37	.72		.79
6	Group members grew to dislike others[a]	4.22	1.09		.66
8	I did the lion's share of the work[a]	4.00	.97		.57
10	Group members obstructed the progress of the work[a]	3.94	1.09		.60
12	Group members were unreasonable[a]	4.37	.89		.90
14	Group members disagreed amongst each other[a]	4.47	.81		.69
16	The group had conflicts[a]	4.49	.85		.66
18	Group members gossiped about each other[a]	4.72	.70		.68
20	Group members did not take others seriously[a]	4.72	.58		.60

Note. For items (refined Social Space Scale) 1–12: Judgments were made on 5-point Likert scales (1 = *not applicable at all*; 2 = *rarely applicable*; 3 = *moderately applicable*; 4 = *largely applicable*; 5 = *totally applicable*). For items (refined Social Space Scale) 13–20: Judgments were made on 5-point Likert scales (1 = *very rarely or never* (on the average less than once a month), 2 = *rarely* (on the average once a month), 3 = *sometimes* (on the average a few times a month), 4 = *often* (on the average a few times a week), 5 = *always or very often* (on the average a few times a day)).

[a]These items were reverse coded for analysis.

group members' behavior in the group. This part contains Likert scale items with 1 = 'not applicable at all' to 5 = 'totally applicable.' The second part assesses perceived frequency of specific group members' behaviors in the group. That part contains Likert scales with 1 = 'very rarely or never' to 5 = 'always or very often.' The (refined) Social Space Scale is depicted in Table 7.1. The four last columns show statistical data discussed in the Results section.

7.4 Method

7.4.1 Participation

Data was collected from 186 students in three distance education courses at the OUNL. The first 'course' is the Virtual Environmental Consultancy (VEC) of the Department of Natural Sciences. VEC is a Virtual Company Innovation Project aimed to deliver authentic contexts to students. Thirty-five students (25 males, 10 females) from four higher education institutions participated in VEC: the OUNL (8 males, 2 females), the University Maastricht (UM; 3 males, 6 females), the University Twente (UT; 7 males, 1 female), and the Fontys University of Professional Education (Fontys; 7 males, 1 female). OUNL- and UM students were assigned to one of five groups; four groups had four participants, the remaining group had three participants. All UT students were assigned to one group; this group had eight participants. Finally, Fontys students were assigned to one of two groups; both groups had four participants. Groups could choose a case from a pool of 13 cases (e.g., 'Criteria for sustainability in environmental and planning interventions') and had to produce an Environmental Advice Report. Students used eRoom version 5.4 (http://www.eroom.com) as their CSCL environment that contains a collection of collaborative work tools including a file storage system, voting system, real-time chat, and forum groups. Folders are used to organize the collaborative work tools.

The two other courses were taken from the Statistics Education Innovation Project (Van Buuren & Giesbertz, 1999) at the Department of Psychology at the OUNL. Thirty-eight adult undergraduates (all OUNL students; 6 male and 32 female) enrolled in the first course (in this study designated as 'Stat 1') and were assigned to one of seven groups consisting of five or six members each. However, two female students were non-starters and did not participate from the very beginning of the course. During the course, ten students (2 males, 8 females) dropped out. Consequently, group sizes were decreased; four groups had three participants, one group had four participants and the remaining two groups had five participants. All seven groups had to study the same study-material emphasizing practicing psychological experimentation and the use of ANOVA. Groups had to produce a prototype of a research paper. The groups made use of Studynet, the CSCL environment of the OUNL. In Studynet, asynchronous communication takes place through newsgroups and real-time communication via Microsoft® Netmeeting™. Telephone and e-mail use were prohibited.

One hundred and thirteen adult undergraduates (all OUNL students, 34 male and 79 female) enrolled in the second course (in this study designated as 'Stat 2'). Students were assigned to one of eight 'slow' groups, eight 'fast' groups, or two 'free' groups. Slow and free groups had approximately twice the time of fast groups to complete the course (10 months and 6 months respectively). Collaboration was compulsory for the slow and fast groups, and voluntary for the free groups. Half of the slow groups and

half of the fast groups had four members; the remaining slow and fast groups had eight members. The group sizes of the two free groups were respectively 5 and 12 members. However, this course had six female students that were non-starters. During the course, due to practical issues, a few changes with respect to group membership occurred. In addition, one slow group discontinued and one new free group was formed. All groups had to study the same study-material emphasizing the use of questionnaires, moderation analysis with ANOVA, and regression methods. Stat2 groups used Studynet CSCL environment as well. Here too, e-mail and telephone were prohibited.

7.4.2 Procedure

The VEC course started at the beginning of March 2002 and lasted 14 weeks in which there were three face-to-face meetings, namely a kick-off meeting at the start of the course, an evaluation meeting halfway through the course, and a closing meeting at the end of the course. The questionnaire including all the measures, was administered electronically (using Dipolar Professional Quest™ software[I], release 2.2) just after the second face-to-face meeting. From the 35 students only 11 students (31.4 %) responded to the questionnaire from which 9 students (25.7 %) responded to all items. All respondents were either OUNL- or UM students. Although response was low, we had agreed with those responsible for the course that students were to be asked only once for filling in the questionnaire.

Stat 1 started at the end of November, 2001. The course lasted 18 weeks in which two face-to-face meetings were organized: an introduction and an evaluation meeting. The same electronic questionnaire as in the VEC was launched here. From the number of students that actually started (26 students; 38 initial students less 2 non-starters and less 10 dropouts), 18 (69.2 %) students responded. The distribution is as follows: one group had one response, three groups had two responses, one group had three responses, and two groups had four responses.

Stat 2 started in the middle of January, 2002. The same questionnaire was launched too at the students of Stat 2. From the number of students that still participated (93 students; 113 initial students less 6 non-starters and less 14 dropouts), 50 (53.8 %) students responded. Two students who dropped out also returned the questionnaire. The total number of respondents is, therefore, 52. In more detail: from the 29 students of the fast groups, 20 (69.0 %) students responded; from the 41 students of the slow groups, also 20 (48.8 %) students responded and one student who dropped out. From the 23 students of the free groups, 10 (43.5 %) students responded and one student who dropped out. The distribution of the responses in the fast groups is as follows: three groups had only one response, one group had two responses, two groups had three responses, one group had four responses, and one group had five responses. The distribution in the slow groups is as follows: one group had only one response, three groups had two responses, two groups had four responses, and one group had six responses. Finally, the distribution of the responses in the free groups is as follows: one group had two responses, one group had three responses, and one group had six responses.

[I] The Dipolar home site is http://www.dipolar.com.au.

7.4.3 Instruments

To validate the Social Space Scale, we selected four measures dealing with constructs related to social space, or to aspects of it, as reference measures namely:

- Social Presence Indicators (Gunawardena, 1995)
- Social Presence Scale (Gunawardena & Zittle, 1997)
- Work-Group Cohesiveness Index (Price & Mueller, 1986)
- Group Atmosphere Scale (Fiedler, 1962, 1967)

For validation we used Campbell and Fiske's (1959) criterion that related constructs in a nomological network (Cronbach & Meehl, 1955) should exhibit moderate to high correlations, but not too high since extreme correlation could be interpreted as equivalency.

7.4.3.1 *The Gunawardena Social Presence Indicators*

We already addressed Gunawardena's (1995) Social Presence Indicators in the previous section. She used this measure for assessing a range of feelings students have toward the medium of CMC, which she implicitly sees as the degree of perceived social presence. Her Social Presence Indicators actually measure, amongst other things, varying degrees of social climate, social presence, social space, and sociability. The constructs underlying these variables are all part of a nomological network not only because they have a relationship with social space but also because one of them *is* social space. However, we believe the items of the Social Presence Indicators measure many aspects of sociability, less of social presence aspects, and even lesser aspects on social space. We, therefore, expect a low to moderate correlation between the Social Presence Indicators and the Social Space Scale with respect to the Positive Group Behavior dimension.

It is difficult to predict the correlation between the Social Presence Indicators and the Negative Group Behavior dimension of the Social Space Scale. It is unclear what the effects of a CSCL environment low in sociability and social presence are on group behavior in the negative dimension. On the one hand, past research on social presence theory have suggested that CMCs low in social presence may cause de-individuation and depersonalization effects, possibly leading to uninhibited behavior (Jessup, Connolly, & Tansik, 1990; Lea & Spears, 1991). On the other hand, Walther's (1992) social information processing (SIP) theory rebuts these suggestions. Therefore, we put this correlation for the moment aside. In our study, we have translated the items of the Social Presence Indicators into Dutch.

7.4.3.2 *The Gunawardena and Zittle Social Presence Scale*

We have also addressed the Gunawardena and Zittle (1997) Social Presence Scale in the previous section. They construct validated the Social Presence Scale using a bi-variate correlation analysis between the aggregated scores of the items of the Social Presence Scale and six selected bi-polar items of the Social Presence Indicators. The authors, therefore, argued that the Social Presence Scale could be used to "accurately measure the intended social presence parameters" (p. 17). Because Social Presence Indicators and Social Presence Scale measure the same phenomena, the same reasoning as with the Social Presence Indicators is valid here. Thus, here too we do expect a low to moderate correlation between this Social Presence Scale and our Social Space Scale with respect to the Positive Group Behavior dimension. With respect to the

correlation between the Social Presence Scale and the Negative Group Behavior dimension of the Social Space Scale, the same considerations as with the Social Presence Indicators on this aspect, are applicable here. Therefore, we also put this correlation aside for the moment. We slightly adapted their Social Presence Scale to fit our particular setting and then translated the items into Dutch.

7.4.3.3 *The Price and Mueller Work Group Cohesion Index*

Price and Mueller (1986) developed their Work Group Cohesion Index to measure work-group cohesion in an organizational context. They define work-group cohesion as "the extent to which employees have close friends in their immediate work units" (p. 252). We consider a distributed learning group to be similar to 'employees in their immediate work unit.' The Work Group Cohesion Index consists of five, 5-point Likert scale items ('To what extent: were the other team mates friendly?' '…were the other team mates helpful?', '…did other team mates take a personal interest in you?', '…do you trust the other team mates?', and '…do you look forward to work again with the same team mates?'). Social cohesiveness is an attribute of social space and, therefore, social cohesiveness as a construct is part of the nomological network. We expect a high correlation between the Work Group Cohesion Index and the Positive Group Behavior dimension of the Social Space Scale. If social cohesiveness is low then this may indicate, for example, that a sense of community is failing or that affective relationships could not developed. One reason (amongst many others) could be negative behavior in the group, for example, group members violate trust. Based upon this reasoning, we expect a (very) low correlation with the Work Group Cohesion Index and the Negative Group Behavior dimension of the Social Space Scale. Here too, all items were translated into Dutch.

7.4.3.4 *Fiedler's Group Atmosphere Scale*

Fiedler (1967) developed the Group Atmosphere Scale, a semantic differential scale with 8-point bipolar scales (see Appendix 7.1). Although Fiedler's Group Atmosphere Scale is used for leaders in contiguous groups, we use this scale for distributed learning groups where all members rate the group atmosphere, which we consider to be an alternative term for social climate. Instead of using 8-point scales, we used 5-point scales. A sound social space contributes to (a positive) group atmosphere and social climate. For this reason, the construct group atmosphere is part of the nomological network. The correlation between the Group Atmosphere Scale and the Social Space Scale in the Positive Group Behavior dimension is expected to be moderate because a sound social space contributes to a positive group atmosphere (i.e., social climate) and vice versa. If the group atmosphere is low then this is possibly due to problems within the group but other reasons may be valid as well. We, therefore, expect a (very) low correlation between the Group Atmosphere scale and the Social Space Scale in the Negative Group Behavior dimension.

However, the Group Atmosphere Scale is also very similar to the Social Presence Indicators (which adds to our belief that the Social Presence Indicators are indeed measuring aspects of social climate). We, therefore, actually expect the correlation to be somewhat lower than the magnitude of the correlation between the Social Space Scale and the Social Presence Indicators.

7.5 Construction, Dimension, and Refinement of the Raw Social Space Scale

7.5.1 Constructing the Raw Social Space Scale

When we constructed the raw Social Space Scale, we had no systematic approach in mind other than that we were guided by the literature as to determine what the characteristics of a good or bad social space might be. As a result, 44 items were constructed that deliberately overrepresented the social space construct. We intended to remove redundant items in a later refinement process, which would also remove those items that are psychometrically 'rejected.' The advantage of such a method was that we could postpone the decision of which items to include in the final Social Space Scale up to the moment that we had gained a clearer picture of the meaning of the various items.

7.5.2 Determining the Dimensionality of the Social Space Scale

In order to determine the dimensionality of the Social Space Scale we applied a factor analysis (Principal Component Analysis using Varimax rotation) on the scores of all 174 items of the questionnaire. The questionnaire contained, amongst others, the raw Social Space Scale, the Social Presence Indicators, the Social Presence Scale, the Group Atmosphere Scale, and the Work Group Cohesion Index. The raw Social Space Scale contained 44 items and was considered to be one-dimensional. The total sample was 79 students, which is relatively low considering the 174 items of the question-naire. This means that results should be interpreted with some reservation.
The factor analysis was used to:

- reject the preposition of one-dimensionality of the social space construct,
- determine interpretable factors, and
- help select items of the raw Social Space Scale that could be removed (see the next, second, phase).

The analysis revealed 37 components possessing eigenvalues of 1.0 or greater (Kaiser-Gutman Rule). However, according to Hofstee (1999), the criterion of 1.0 is too liberal and he argued that only components possessing eigenvalues of 4.0 should be considered (p. 126–127). The latter criterion revealed six components. A scree test (Cattell, 1966) revealed a clear break after the third component. These three components were interpretable (i.e., at least one measure was able to produce an interpretation for each one of the three factors).

The majority of initial items of the raw Social Space Scale loaded higher than .40 (see Stevens, 1992, for this criterion) exclusively on component two or three. This means that the social space construct is not one-dimensional. These two components are interpreted as the *Positive Group Behavior*-dimension (component two) and the *Negative Group Behavior*-dimension (component three) of the social space construct (see Table 7.1).

7.5.3 Removing test items of raw Social Space Scale

The raw Social Space Scale, consisting of the 44 items, was refined in four steps. The first step was to remove those items whose load on component two or three were less than .40 (5 items), or who loaded higher on the other components than on component two or three (2 items). The second step was a careful semantic examination of the

items. Items that show similarities with or were (semantically) identical to items on the *other* scales were removed (11 items). The third step was removal of items not associated with positive or negative group behavior (4 items), or which were almost (semantically) identical to another item *within* the raw Social Space Scale (1 item).

The fourth and final step was aimed at balancing the items in the dimensions Positive Group Behavior and Negative Group Behavior with no more than ten items in each dimension (removed 1 item).

The items removed in the second and third step were those items that we considered to be redundant. The refinement process did not create a scale that under-represented the social space construct. The refined Social Space Scale is depicted in Table 7.1 along with mean and standard deviation. With respect to the loadings, a second factor analysis (Principal Component Analysis using Varimax rotation) was performed on the final 20 items thereby focusing on a two-factor solution. The screeplot revealed a clear break after the second component, confirming the two-dimensionality of the Social Space Scale and legitimating the two-factor solution. Both components showed strong loadings. The two factor solution explained 54.59 per cent of the total variance (the first component explained 30.14 per cent and the second 24.45 per cent).

7.6 Results

7.6.1 Internal Consistency and Validity

Cronbach's alpha was calculated for this refined Social Space Scale and for each factor. The resultant of the calculation is .81 (Social Space Scale), .92 (factor representing the Positive Group Behavior-dimension), and .87 (factor representing the Negative Group Behavior-dimension) respectively, showing that the Social Space Scale has a high internal consistency.

The content validity of the Social Space Scale was established via face-validity. The items were developed based upon a search in the literature regarding social interaction via CMC, group development and group dynamics, social presence, trust building, and creating sense of community.

7.6.2 Pearson Bi-Variate Correlations

We applied a Pearson bi-variate correlation (2-tailed) analysis on the aggregate scores of the items of the Social Space Scale and the other measures (see Table 7.2). Our predictions on how the Social Space Scale would correlate with the other measures –with respect to both strength as the direction– seem to be fulfilled with respect to the Positive Group Behavior-dimension. The low correlations with respect to the Negative Group Behavior-dimension are explained by the fact that the other measures address positive experiences rather than negative ones (i.e., more social presence, better group atmosphere); these measures have, therefore, no relationship with the Negative Group Behavior dimension of the Social Space Scale.

7.6.3 Factor Analysis Involving the Other Scales

Finally, we applied factor analysis (Principal Component Analysis using Varimax rotation) on the 20 items of the refined Social Space Scale together with the items of each of the other scales, thus, factor analysis was applied four times. Each time, we

Table 7.2
Pearson Bi-variate Correlation Coefficients Between Social Space Scale and the Other Scales

Scale	Social Space Scale		Social Presence Indicators (Gunawardena, 1995)	Social Presence Scale (Gunawardena & Zittle, 1997)	Work Group Cohesion Index (Price & Mueller, 1986)	Group Atmosphere Scale (Fiedler, 1962)
	Positive Group Behavior	Negative Group Behavior				
Social Space Scale						
Positive Group Behavior	–					
Negative Group Behavior	-.18	–				
Social Presence Indicators	.58**	.01	–			
Social Presence Scale	.62**	.01	.85**	–		
Work Group Cohesion Index	.70**	.28*	.59**	.66**	–	
Group Atmosphere Scale	.55**	.12	.92**	.82**	.66**	–

** $p < .01$, 2-tailed
* $p < .05$, 2-tailed

restricted the extraction to a fixed number of factors because the purpose of this analysis was not to reveal components, but rather to examine the extent to which the other scales measured the same phenomenon as the Social Space Scale.

We argued that the Social Presence Indicators and the Social Presence Scale both measure some aspects of social space. We, thus, expected a certain number of items (those items that measure a particular aspect of social space) of both measures to load highly on the factor representing the Positive Group Behavior-dimension of the Social Space Scale. However, on the other hand, we removed some items from the raw Social Space Scale that were similar with or (semantically) identical to items of the other scales. Therefore, the actual number of items of the Social Presence Indicators and Social Presence Scale loading higher than .40 on that factor was expected to be low. Except for the Social Presence Scale, we expected that items (again, those items that measure particular aspects of social space) of the Social Presence Indicators would also load on the Negative Group Behavior-dimension because the bi-polar items were also capable of assessing negative experiences. Items of the Social Presence Scale only assessed positive experiences, with the exception of items 1, 9, 10, and 11 (see Table 7.3a–d); the items 9, 10, and 11 were not considered in this study.

We had stated that a sound social space was characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction and a strong sense of community. Thus, group cohesiveness was an attribute of, but not the same as social space. Consequently, the Social Space Scale that we developed included, amongst other things, items that (indirectly) addressed group cohesiveness. If a separate measure was used that assessed group cohesiveness such as the Work Group Cohesion Index, we expected that all its items would load higher than .40 on the same factor representing the Positive Group Behavior-dimension of social space (i.e., by definition all items were measuring the social cohesiveness aspect of social space). We did not expect items to load higher than .40 on the factor representing the Negative

Group Behavior-dimension of social space because the items of the Work Group Cohesion Index did not assess negative experiences.

Table 7.3a
Factor Analysis on the Scores of the Items of
the Social Space Scale and the Social Presence Indicators

No. Item	Item	Factor Analysis 1 Social Space Scale and Social Presence Indicators		
		Factor 1 'Social Presence'	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior
Social Space Scale: Positive Group Behavior				
1	Group members felt free to criticize ideas, statements, and/or opinions of others		.69	
3	We reached a good understanding on how we had to function		.76	
5	Group members ensured that we kept in touch with each other		.76	
7	We worked hard on the group assignment		.74	
9	I maintained contact with all other group members		.73	
11	Group members gave personal information on themselves		.54	
13	The group conducted open and lively conversations and/or discussions		.84	
15	Group members took the initiative to get in touch with others		.83	
17	Group members spontaneously started conversations with others		.67	
19	Group members asked others how the work was going		.64	
Social Space Scale: Negative Group Behavior				
2	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized[a]			.72
4	Group members were suspicious of others[a]			.79
6	Group members grew to dislike others[a]			.64
8	I did the lion's share of the work[a]			.57
10	Group members obstructed the progress of the work[a]			.57
12	Group members were unreasonable[a]			.89
14	Group members disagreed amongst each other[a]			.69
16	The group had conflicts[a]			.66
18	Group members gossiped about each other[a]			.68
20	Group members did not take others seriously[a]			.60
Social Presence Indicators				
1	stimulating – dull[a]	.85		
2	personal – impersonal[a]	.71		
3	sociable – unsociable[a]	.61	.47	
4	sensitive – insensitive[a]	.67		
5	warm – cold[a]	.65	.42	
6	colorful – colorless[a]	.62	.41	
7	interesting – boring[a]	.80		
8	appealing – not appealing[a]	.87		
9	interactive – non-interactive[a]	.67	.48	
10	active – passive[a]		.64	
11	reliable – unreliable[a]	.47		
12	humanizing – dehumanizing[a]	.76		
13	immediate – non-immediate[a]	.62		
14	easy – difficult[a]	.49		.45
15	efficient – inefficient[a]	.73		
16	unthreatening – threatening[a]			
17	helpful – hindering[a]	.79		

[a]These items were reverse coded for analysis.

Table 7.3b
Factor Analysis on the Scores of the Items of
the Social Space Scale and the Social Presence Scale (adapted)

No. Item	Item	Factor Analysis 2 Social Space Scale and Social Presence Scale		
		Factor 1 Positive Group Behavior	Factor 2 'Social Presence'	Factor 3 Negative Group Behavior
Social Space Scale: Positive Group Behavior				
1	Group members felt free to criticize ideas, statements, and/or opinions of others	.76		
3	We reached a good understanding on how we had to function	.77		
5	Group members ensured that we kept in touch with each other	.74		
7	We worked hard on the group assignment	.76		
9	I maintained contact with all other group members	.74		
11	Group members gave personal information on themselves	.49		
13	The group conducted open and lively conversations and/or discussions	.81		
15	Group members took the initiative to get in touch with others	.76		
17	Group members spontaneously started conversations with others	.53	.48	
19	Group members asked others how the work was going	.60		
Social Space Scale: Negative Group Behavior				
2	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized[a]			.73
4	Group members were suspicious of others[a]			.78
6	Group members grew to dislike others[a]			.65
8	I did the lion's share of the work[a]			.56
10	Group members obstructed the progress of the work[a]			.57
12	Group members were unreasonable[a]			.90
14	Group members disagreed amongst each other[a]			.71
16	The group had conflicts[a]			.68
18	Group members gossiped about each other[a]			.70
20	Group members did not take others seriously[a]			.61
Social Presence Scale (adapted)				
1	Messages in the CSCL environment were impersonal[a]		.62	
2	The CSCL environment is a an excellent medium for social interaction		.74	
3	I felt comfortable conversing through this text-based CSCL environment		.87	
4	I felt comfortable introducing myself in the CSCL environment		.80	
5	The introduction(s) enabled me to form a sense of online community in which I was part of		.75	
6	I felt comfortable participating in discussions in the CSCL environment	.43	.63	
7	The moderators created a feeling of an online community		.60	
8	The moderators facilitated discussions in the CSCL environment		.49	
9	Discussions in CSCL environments tend to be more impersonal than face-to-face discussions[b]			
10	Discussions in CSCL environments are more impersonal than audio teleconference discussions[b]			
11	Discussions in CSCL environments are more impersonal than video teleconference discussions[b]			
12	I felt comfortable interacting with other participants in the CSCL environment		.70	
13	I felt that my point of view was acknowledge by other participants in the CSCL environment	.61	.46	
14	I was able to form distinct individual impressions of some participants even though we communicated only via this text-based CSCL environment		.54	

[a]These items were reverse coded for analysis.
[b]These items were not considered in this study

Table 7.3c
Factor Analysis on the Scores of the Items of
the Social Space Scale and the Work Group Cohesion Index

No. Item	Item	Factor Analysis 3 Social Space Scale and Work Group Cohesion Index	
		Factor 1 Positive Group Behavior	Factor 2 Negative Group Behavior
Social Space Scale: Positive Group Behavior			
1	Group members felt free to criticize ideas, statements, and/or opinions of others	.65	
3	We reached a good understanding on how we had to function	.70	
5	Group members ensured that we kept in touch with each other	.78	
7	We worked hard on the group assignment	.71	
9	I maintained contact with all other group members	.71	
11	Group members gave personal information on themselves	.63	
13	The group conducted open and lively conversations and/or discussions	.82	
15	Group members took the initiative to get in touch with others	.85	
17	Group members spontaneously started conversations with others	.72	
19	Group members asked others how the work was going	.73	
Social Space Scale: Negative Group Behavior			
2	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized[a]		.76
4	Group members were suspicious of others[a]		.81
6	Group members grew to dislike others[a]		.62
8	I did the lion's share of the work[a]		.61
10	Group members obstructed the progress of the work[a]		.61
12	Group members were unreasonable[a]		.88
14	Group members disagreed amongst each other[a]		.71
16	The group had conflicts[a]		.65
18	Group members gossiped about each other[a]		.65
20	Group members did not take others seriously[a]		.57
Work Group Cohesion Index			
1	To what extent were the other team mates friendly? [a]	.63	
2	To what extent were the other team mates helpful? [a]	.78	
3	To what extent took the other team mates a personal interest in you? [a]	.73	
4	To what extent did you trust the other team mates? [a]	.60	.53
5	To what extent do you look forward to work again with the same team mates? [a]	.73	

[a]These items were reverse coded for analysis.

Table 7.3d
FactorAnalysis on the Scores of the Items of
the Social Space Scale and Group Atmosphere Scale

No. Item	Item	Factor Analysis 4 Social Space Scale and Group Atmosphere Scale		
		Factor 1 'Group Atmos-phere'	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior
Social Space Scale: Positive Group Behavior				
1	Group members felt free to criticize ideas, statements, and/or opinions of others		.72	
3	We reached a good understanding on how we had to function		.79	
5	Group members ensured that we kept in touch with each other		.75	
7	We worked hard on the group assignment		.77	
9	I maintained contact with all other group members		.71	
11	Group members gave personal information on themselves		.49	
13	The group conducted open and lively conversations and/or discussions		.81	
15	Group members took the initiative to get in touch with others		.82	
17	Group members spontaneously started conversations with others		.63	
19	Group members asked others how the work was going		.58	
Social Space Scale: Negative Group Behavior				
2	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized[a]			.73
4	Group members were suspicious of others[a]			.80
6	Group members grew to dislike others[a]			.64
8	I did the lion's share of the work[a]			.58
10	Group members obstructed the progress of the work[a]			.58
12	Group members were unreasonable[a]			.90
14	Group members disagreed amongst each other[a]			.70
16	The group had conflicts[a]			.68
18	Group members gossiped about each other[a]			.66
20	Group members did not take others seriously[a]			.60
Group Atmosphere scale				
1	warm – cold[a]	.65		
2	interesting – boring[a]	.77		
3	accepting – rejecting[a]	.73		
4	satisfying – frustrating[a]	.80		
5	enthusiastic – unenthusiastic[a]	.88		
6	productive – non-productive[a]	.85		
7	cooperative – uncooperative[a]	.71		
8	supportive – hostile[a]	.80		
9	successful – unsuccessful[a]	.80		

[a]These items were reverse coded for analysis.

With respect to the Group Atmosphere Scale, we argued that a sound social space contributes to (a positive) social climate since social climate is a related, yet different construct than social space. Therefore, we did not expect items to load more than .40 on both factors of social space. The results are depicted in Table 7.3a–d; only items with factor loading of .40 and higher are shown.

All items associated with the Positive Group Behavior-dimension were salient on the same factor, as was also the case with those items associated with the Negative Group Behavior-dimension (but on another factor). With the exception of the Work Group Cohesion Index, the items of the other scales (Social Presence Indicators, the Social Presence Scale, and the Group Atmosphere Scale) were salient on the remaining factor. This observation suggests that the Social Space Scale is potentially a pure measure for social space.

In general, our expectations have been met. The fact that there were a very few loadings higher than .40 on the factor representing the Negative Group Behavior-dimension of social space is due to the fact that only the Social Presence Indicators are capable of assessing negative experiences (as far the items assess the aspect of social space) and to the fact that negative experiences were not collected.

7.7 Discussion of possible limits

The validation of the Social Space Scale has some weak points that limit the study. Firstly, the number of cases was 79. A general rule of the thumb is that there must be at least five (Gorsuch, 1983) to ten cases (Nunnally, 1978) per item. The raw Social Space Scale contained 44 items, meaning that we actually needed 220 up to 440 cases to derive this measure.

Secondly, there were five samples (VEC, Stat 1, Stat 2 fast, Stat 2 slow, and Stat 2 free) that have been collapsed in order to obtain the 79 cases. We agree these samples have different characteristics (e.g., time aspects, CSCL environments, task type) which mean that they actually cannot be collapsed into one big sample. Indeed, a series of one-way ANOVA's revealed that the samples VEC and Stat 1 are comparable, as are the samples Stat 2 fast, Stat 2 slow, and Stat 2 free; the samples VEC and Stat 1 are not comparable to the samples Stat 2 fast, Stat 2 slow, and Stat 2. However, as this study is explorative, we did collapse the samples to obtain a high number of cases.

Thirdly, we are aware that the factor structure of the Social Space Scale might be affected because of the incomparable samples. However, the limited number of cases (79 cases) relative to the number of samples (five samples), and the number of groups (33 groups) prohibits a detailed analysis on the group level. Therefore, we have to rely on the analyses on the individual level. Again, we point out that this study is explorative and that issues at the group level will be examined in future research.

Finally, we used the same cases for the factor analysis on the items of the refined Social Space Scale and the other scales: Social Presence Indicators, Social Presence Scale, Work Group Cohesion Index, and Group Atmosphere Scale. This implicates that the result (Table 7.3) might take advantage of the chance characteristic of the 79 cases from which the Social Space Scale was derived.

In view of these weak points, we must stress that the findings in this study only suggest that the Social Space Scale has potential to be useful as measures for social space.

7.8 Conclusion

Socio-emotional processes underlie group forming, group dynamics, and the building of group structures, leading to the establishment of a sound social space. Such sound social space is important since it facilitates and reinforces social interaction and, in turn, influences the effectiveness of collaborative learning. Though this is true in both contiguous and distributed learning groups, socio-emotional processes in the latter are far more difficult to achieve and sustain than in contiguous groups due to its mediation via computer-supported collaborative learning (CSCL) environments.

In order to examine socially enhanced environments there is also a need for an instrument measuring the perceived quality of the social space that exists in a distributed learning group. This article presented the Social Space Scale. It must be realized that this measure is a preliminary 'first step.' More experiments are need for corroborating the findings so far. In fact, we are just doing content analysis on the postings of a discussion board of the course Stat 1 using the community of inquiry model developed by Garrison, Anderson, and Archer (2000) and related instruments for assessing teaching presence, cognitive presence and in particular social presence (see, Rourke, Anderson, Archer, & Garrison, 1999). It would go beyond the scope of this article to discuss this model and relate the three kinds of presences with social space. However, future articles will report on this issue and present results.

7.9 Acknowledgements

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Appendix 7.1
Three Social Presence Scales and the Group atmosphere scale

Item	Social Presence Indicators (Gunawardena, 1995)	Social Presence (Short, Williams, & Christie, 1976)	Social Climate/ Social Presence (Rourke & Anderson, 2002)	Group Atmosphere Scale (Fiedler, 1962)
stimulating – dull	√			
personal – impersonal	√	√	√	
sociable – unsociable	√	√		
sensitive – insensitive	√	√		
warm – cold	√	√	√	√
colorful – colorless	√			
interesting – boring	√			√
appealing – not appealing	√			
interactive – non-interactive	√			
active – passive	√			
reliable – unreliable	√			
humanizing – dehumanizing	√			
immediate – non-immediate	√			
easy – difficult	√			
efficient – inefficient	√			
unthreatening – threatening	√			
helpful – hindering	√			
trusting – untrusting			√	
disinhibiting – inhibiting			√	
close – distant			√	
friendly – unfriendly			√	√
accepting – rejecting				√
satisfying – frustrating				√
enthusiastic – unenthusiastic				√
productive – non-productive				√
cooperative – uncooperative				√
supportive – hostile				√
successful – unsuccessful				√

CHAPTER 8

Measuring Perceived Sociability of CSCL Environments

Abstract

Most (a)synchronous computer-supported collaborative learning (CSCL) environments can be characterized as *functional* environments because they focus on functional, task-specific support, often disregarding explicit support for the social (emotional) aspects of learning in groups which are acknowledged by many educational researchers to be essential for effective collaborative learning. In contrast, *sociable* CSCL environments emphasize the social (emotional) aspects of group learning. The variable sociability is defined as the extent to which sociable environments are able to facilitate the emergence of a sound social space with attributes comprising trust and belonging, a strong sense of community, and good working relationships.

This explorative study deals with the construction and validation of a self-reporting (Dutch language) Sociability Scale for determining the perceived degree of sociability of CSCL environments. The Sociability Scale consists of ten items, is one-dimensional, and its internal consistency is .92. A nomological network was used for further validation. Due to the relatively small numbers of respondents (n = 79), the findings are, however, limited but promising suggesting that (1) the Sociability Scale has potential to be useful as a measure for sociability and (2) further work based on a larger sample will be meaningful.

This chapter is based on:

Kreijns, K., Kirschner, P. A., Jochems, W., & Van Buuren, H. (2004a). *Measuring perceived sociability of computer-supported collaborative learning environments*. Manuscript submitted for publication.

8.1 Introduction

A great deal of the educational literature on collaborative learning is devoted to the social interaction taking place during collaboration (Gunawardena, 1995; Hiltz, 1994; Kearsley, 1995; Muirhead, 2000; Wagner, 1994, 1997). Johnson, Johnson, and Stanne (1985) emphasize that "the cognitive processes most necessary for deeper level understanding and the implanting of information into memory, such as elaboration and metacognition, occur only through dialogue and interaction with other people" (p. 675). Similarly, Hiltz (1990) states that "knowledge is not something that is 'delivered' to students in this process [of collaborative learning], but something that emerges from active dialogue among those who seek to understand and apply concepts and techniques" (p. 135). A recent, extensive meta-analysis of collaborative learning research (Johnson, Johnson, & Stanne, 2000) has shown that collaboration significantly increased learning. Beyond this 'cognitive' increase, developing social and communication skills, developing positive attitudes towards co-members and learning material, building social relationships, and group cohesion are also seen as positive effects of collaborative learning (Dillenbourg, Baker, Blaye, & O'Malley, 1995; Johnson & Johnson, 1989, 1994; Mesh, Lew, Johnson, & Johnson, 1986).

The emergence of computer-mediated worldwide networks has enabled a shift from collaborative learning in contiguous learning groups to collaborative learning in asynchronous distribute learning groups by utilizing computer-supported collaborative learning (CSCL) environments connected to these networks. The communication between learners and instructors is mediated through subsystems (e-mail, discussion forums, chat) embedded or integrated within the CSCL environment. Although the CSCL environments support social interaction and collaboration, empirical research and field observation show findings that are not always positive about their working (Hallet & Cummings, 1997; see also Heath, 1998). Hobaugh (1997), for example, observed that inadequate group dynamics amongst group members in online groups "is often the major cause of ineffective group action; unfortunately, either very little attention is devoted to it, or it is not well understood by instructors or students, or both" (¶ 'Planning for Interaction'). Indeed, educational researchers predominantly focus on the support of social interaction aimed at cognitive processes for collaborative learning (the educational dimension of social interaction) and less on the support of social interaction aimed at socio-emotional processes underlying group dynamics; the so-called social (psychological) dimension of social interaction. Moreover, the majority of these researchers– consciously or unconsciously – take for granted that group dynamic processes occur in CSCL environments, just as in face-to-face settings, although this may be not true. In addition, it appears that researchers think that encouragement for group dynamics is not needed because they believe that the only thing learners want to do is to learn and everything that distracts from that (i.e., group dynamics) should be avoided. Finally, there is also a group of researchers who forget to pay attention to group dynamics because they are not aware of the importance of group dynamics and its implications for collaborative learning. In sum, most researchers simply forget, neglect or ignore to study and support the group dynamics within the CSCL environment. As a result *functional* CSCL environments are developed. This conclusion is confirmed by Cutler (1996) who remarked that the "current literature surrounding CMC [computer-mediated communication] is almost entirely task-based and focused on cost, efficiency, and productivity with little

attention given either to the changes effected on the people or to the social relations created from using the communication technologies" (p. 320). In general, typical functional CSCL environments are those where the CMC subsystem *is* the CSCL environment.

However, a growing number of researchers from a variety of disciplines (e.g., computer-supported cooperative work, social psychology, organizational behavior) point out that this functional perspective alone is a very limited one. Forgetting, neglecting or ignoring social psychological processes such as group forming, establishing group structures, and sustaining social relationships is considered a pitfall (see Kreijns, Kirschner, & Jochems, 2003a). Sproull and Faraj (1997) stressed that "People on the net are not only solitary information processors but also social beings. They are not only looking for information; they are also looking for affiliation, support and affirmation. Thinking of people on the net as social actors evokes a metaphor of a gathering. Behaviors appropriate at the gathering include chatting, discussing, arguing, and confiding. People go to a gathering to find others with common interests and talk with or listen to them. When they find a gathering they like, they return to it again and again" (p. 38). Donath (1997) advocates the design of online social environments. She believes that in order to foster the development of vibrant and viable online communities, the environment must provide the means to communicate social cues and information. This means that users of an environment must be able to perceive the social patterns of activity and affiliation and the community using it must be able to develop a fluid and subtle cultural vocabulary. In other words, what we actually need are *sociable* CSCL environments, that is CSCL environments with both educational functionality and social functionality (referred to as *sociality* by Preece, Rogers, & Sharp, 2002), as depicted in Figure 8.1. Such sociable CSCL environments not only fulfill the learning needs of the students, but also fulfill their social (psychological) needs, thereby making a complete learning experience.

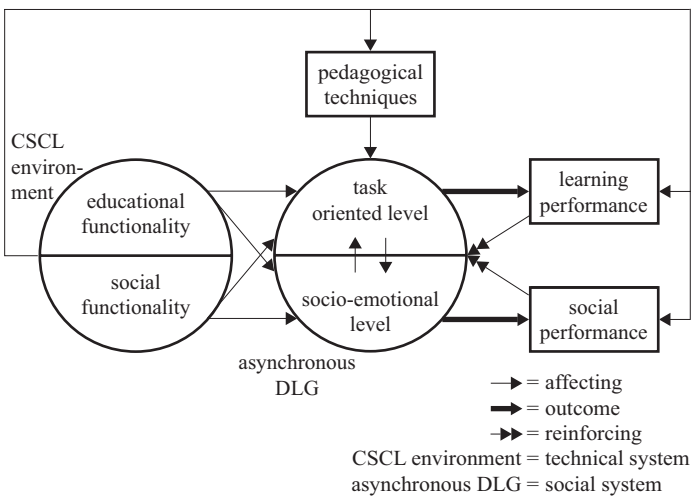

Figure 8.1 The CSCL Environment Affecting the Learning- and Social Performances of an Asynchronous DLG

Sociable CSCL environments enable and facilitate socio-emotional processes such as affiliation and getting to know each other, which aim at developing interpersonal relationships, trust building, social cohesiveness and a sense of community and the emergence of a sound social space. Johnson & Johnson (1989) see interpersonal trust as a major factor enabling effective collaboration: "To disclose one's reasoning and information, one must trust the other individuals involved in the situation to listen with respect" (p. 72). Forsyth (1990), Shaw (1981), and Guzzo and Dickson (1996) all have found social cohesiveness positively mediates group performance. Wegerif (1998), for example noted that "forming a sense of community, where people feel they will be treated sympathetically by their fellows, seems to be a necessary first step for collaborative learning. Without a feeling of community people are on their own, likely to be anxious, defensive and unwilling to take the risks involved in learning" (p. 48). Gunawardena (1995) argues that online constructivist learning environments may promote collaborative learning "only if participants can relate to one another, share a sense of community and a common goal. The development of social presence and a sense of online community becomes key to promoting collaborative learning and knowledge building" (p. 164).

Within distance educational settings such as those found at open universities (e.g., the Open Universiteit Nederland), the application of sociable CSCL environments can be a critical success factor. When groups are formed in these settings, the group members initially do not know each other and the group has zero-history. Social CSCL environments can help to develop group dynamics in a positive direction, thereby reducing feelings of loneliness and isolation and thus reducing dropout (Phillips, 1990; Rovai, 2001, 2002a, 2002b).

Our research on fostering and enhancing *social interaction* in (asynchronous) distance learning groups is aimed at the design and implementation of *sociable* CSCL environments. The research is based upon a theoretical framework (see Kreijns, Kirschner, & Jochems, 2002; Kreijns & Kirschner, 2004) encompassing:

- The ecological approach to social interaction (Gaver, 1996, Gibson, 1986);
- The concept of the sociability of CSCL environments (Kreijns, Kirschner, & Jochems, 2002); and
- Social presence theory (Gunawardena, 1995; Short, Williams, & Christie, 1976; Tammelin, 1998; Tu, 2000a, 2002c; Tu & McIsaac, 2002).

It is beyond the scope of this article to discuss in detail the first and last of these issues of the framework but this discussion can be found in Kreijns, Kirschner, and Jochems (2002) and Kreijns and Kirschner (2004). In contrast, the second issue is relevant for this article and, therefore, we discuss it shortly here. The sociability of CSCL environments refers to how CSCL environments can differ in their ability to facilitate the emergence of a social space; the human network of social relationships between group members which is embedded in group structures of norms and values, rules and roles, beliefs and ideals. To express the differences in ability in the creation of a social space, the term sociability is introduced. Kreijns, Kirschner, & Jochems (2002) define sociability "to be the extent the CSCL environment is able to give rise to (…) a social space" (p. 14). In other words, the extent to which a CSCL environment is able to facilitate the emergence of a social space. No CSCL environment is in itself or of itself capable of creating a social space, people are needed to recognize and exploit this sociability potential of the CSCL environment. We hypothesize sociability is one other

factor influencing social interaction: the greater the sociability of an environment, the more likely it is that social interaction will take place and that it will result in the emergence of a sound social space. We designate a social space to be ´sound´ if the social space is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction, and a strong sense of community. A sound social space determines, reinforces, and sustains the social interaction that is taking place amongst the group members. Social affordances contribute, amongst other factors, to the sociability of CSCL environments.

Because our framework emphasizes the promotion of social interaction in the social (psychological) dimension, it complements existing pedagogical techniques that emphasize social interaction in the educational dimension. The framework acknowledges that in order to create a sound social space, the environment (i.e., the CSCL environment), the people 'inhabiting' the environment (i.e., the learners/group members), and the activities they carry out (i.e., those learning activities that are determined by the pedagogical techniques) are all equally important. The focus of our framework, however, is on the first two aspects (CSCL environments and the group members of DLGs) only. The theoretical framework uses a number of variables that affect social interaction in CSCL environments. Social interaction, in turn, affects the creation of a social space. Figure 8.2 summarizes the relationships between the variables and pinpoints the relative importance of sociability in the whole picture. We added the variable pedagogical techniques for completeness.

In order to study the various relationships we need an instrument that measures the perceived sociability of CSCL environments. However, the current body of literature revealed that there is no instrument available that measures the sociability of CSCL environments. Therefore, we have to develop and validate such instrument. The (refined) Sociability Scale is presented in the next section.

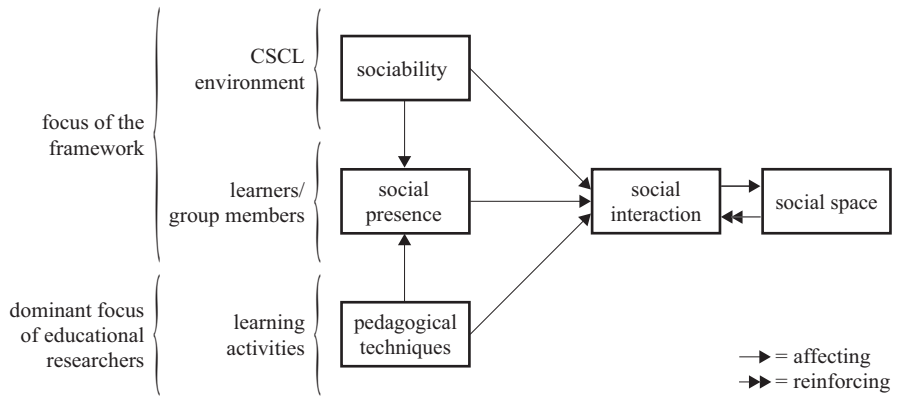

Figure 8.2 Relationships between the Variables Sociability, Social Presence, Pedagogical Techniques, Social Interaction, and Social Space

8.2 The Sociability Scale

The Sociability Scale is a self-reporting questionnaire for measuring the perceived sociability of a CSCL environment. This scale consists of ten items (see Table 8.1). The four last columns show statistical data discussed in the Results section.

Table 8.1
The Sociability Scale

No. Item	Item	*M*	*SD*	Component 1 Sociability
1	This CSCL environment enables me to easily contact my team mates	3.30	1.03	.77
2	I do not feel lonely in this CSCL environment	2.90	1.18	.69
3	This CSCL environment enables me to get a good impression of my team mates	2.58	.98	.80
4	This CSCL environment allows spontaneous informal conversations	2.75	1.14	.68
5	This CSCL environment enables us to develop into a well performing team	2.76	1.05	.80
6	This CSCL environment enables me to develop good work relationships with my team mates	3.19	1.05	.84
7	This CSCL environment enables me to identify myself with the team	2.96	1.07	.79
8	I feel comfortable with this CSCL environment	3.44	1.06	.83
9	This CSCL environment allows for non task-related conversations	3.61	.99	.69
10	This CSCL environment enables me to make close friendships with my team mates	2.49	1.13	.73

Note. Judgments were made on 5-point Likert scales (1 = *not applicable at all*; 2 = *rarely applicable*; 3 = *moderately applicable*; 4 = *largely applicable*; 5 = *totally applicable*).

8.3 Method

8.3.1 Participation

Data was collected from students in three distance education courses at the Open Universiteit Nederland (OUNL). The first 'course' was the Virtual Environmental Consultancy (VEC) of the Department of Natural Sciences. VEC is a Virtual Company Innovation Project aimed to provide authentic environments to students in order to maximize competence building (Ivens, Van Dam-Mieras, Kreijns, Cörvers, & Leinders, 2002; Westera, Sloep, & Gerrissen, 2000). Thirty-five students (25 males, 10 females) from four higher education institutions participated in VEC: the OUNL (8 males, 2 females), the University Maastricht (UM; 3 males, 6 females), the University Twente (UT; 7 males, 1 female), and the Fontys University of Professional Education (Fontys; 7 males, 1 female). OUNL- and UM students were assigned to one of five groups; four groups had four participants, the remaining group had three participants. All UT students were assigned to one group; this group had eight participants. Finally, Fontys students were assigned to one of two groups; both groups had four participants. Groups could choose a case from a pool of 13 cases (e.g., 'Criteria for sustainability in environmental planning and interventions') and had to

produce an Environmental Advice Report. Students used eRoom version 5.4 (http://www.eroom.com) as their CSCL environment.

The two other courses were taken from the Statistics Education Innovation Project (Van Buuren & Giesbertz, 1999) at the Department of Psychology. Thirty-eight adult undergraduates (all OUNL students, 6 male and 32 female) enrolled in the first course and were randomly assigned to one of seven groups consisting of five or six members each. Among these students, two female students were non-starters (i.e., they did not participate from the very beginning of the course). Also, during the course ten students (2 males, 8 females) dropped out. Consequently, group sizes were decreased; four groups had three participants, one group had four participants and the remaining two groups had five participants. All groups had to study the same study-material emphasizing psychological experimentation and the use of ANOVA. Groups had to produce a prototype of a research paper. The groups made use of Studynet, the CSCL environment of the OUNL. In Studynet, asynchronous communication is made available through newsgroups and real-time communication via Microsoft® Netmeeting™. Use of telephone and e-mail were prohibited.

One hundred and thirteen adult undergraduates (all Dutch OUNL students, 24 male and 79 female) enrolled in the second course. Students were randomly assigned to one of eight 'slow' groups, one of eight 'fast' groups, or one of two 'free' groups (in total 18 groups). Slow and free groups had approximately twice the time of fast groups to complete the course (10 months and 6 months respectively). Collaboration was compulsory for the slow and fast groups, and voluntary for the free groups. Half of the slow groups and half of the fast groups had four members; the remaining slow and fast groups had eight members. The group sizes of the two free groups were respectively 5 and 12. Among these students, six female students were non-starters. During the course 14 students dropped out (4 males, 10 females) and 18 students moved to another group. Consequently, groups changed in composition and in group size. Moreover, one slow group discontinued and one new free group was formed. As a result, among the fast groups there were three groups with two members, one group with three members, one group with four members, two groups with five members and one group with six members. Among the slow groups there were two groups with four members, three groups with six members, one group with seven members, and one group with eight members. Finally, among the free groups there were one group with seven members and two groups with eight members. All groups had to study the same study-material emphasizing the use of questionnaires, moderation analysis with ANOVA, and regression methods. The groups of the second statistics course also used the Studynet CSCL environment. Here too, e-mail and telephone were prohibited.

8.3.2 Procedure

The Virtual Environmental Consultancy course lasted 14 weeks in which there were three face-to-face meetings, namely a kick-off meeting at the start of the course, an evaluation meeting halfway through the course, and a closing meeting at the end of the course. The questionnaire including all the measures, was administered electronically (using Dipolar Professional Quest™ software[1], release 2.2) just after the second face-to-face meeting. From the 35 students 11 students (31.4 %) responded to the questionnaire from which 9 students (25.7 %) responded to all items. All respondents

[1] The Dipolar home site is http://www.dipolar.com.au.

were either OUNL- or UM students. Although response was low, we had agreed with those responsible for the course that students were to be asked only once for filling in the questionnaire.

The first course from the Statistics Education Innovation Project lasted 18 weeks in which three face-to-face meetings were organized. The same electronic questionnaire was launched. From the number of students that actually participated (26 students; 38 initial students minus the number of non-starters minus the number of dropouts) 18 (69.2 %) students responded to the questionnaire. The responses were as follows: one group had one response, three groups had two responses, one group had three responses, and two groups had four responses.

The second course from the Statistics Education Innovation Project had a variable length. Slow and free groups had 10 months to complete the course while fast groups had six. At the time the questionnaire was launched, slow and free groups were still studying while the fast groups had completed the course. From the number of students that still participated (93 students; 113 initial students minus the number of non-starters and minus the number of dropouts), 50 (53.8 %) students responded. Two students who dropped out also returned the questionnaire. The total number of respondents is, therefore, 52. In more detail: from the 29 students of the fast groups, 20 (69.0 %) students responded; from the 41 students of the slow groups, also 20 (48.8 %) students responded and one student who dropped out. From the 23 students of the free groups, 10 (43.5 %) students responded and one student who dropped out. The distribution of the responses in the fast groups is as follows: three groups had only one response, one group had two responses, two groups had three responses, one group had four responses, and one group had five responses. The responses in the slow groups were as follows: one group had only one response, three groups had two responses, two groups had four responses, and one group had six responses. Finally, the distribution of the responses in the free groups is as follows: one group had two responses, one group had three responses, and one group had six responses.

8.3.3 Instrumentation

In our validation process, we used five measures that deal with constructs that are related to the sociability construct. These measures are:

- Social Space Scale (Kreijns, Kirschner, Jochems, Van Buuren, in press)
- Social Presence Indicators (Gunawardena, 1995)
- Social Presence Scale (Gunawardena & Zittle, 1997)
- Work-Group Cohesiveness Index (Price & Mueller, 1986)
- Group Atmosphere Scale (Fiedler, 1962, 1967)

We briefly describe each of these measures in the next sub-sections.

8.3.3.1 *The Social Space Scale*

The Social Space Scale (Kreijns, Kirschner, Jochems, Van Buuren, in press) measures the degree of the perceived quality of the social space that exists in a(n) (asynchronous) distributed learning group. The scale has two dimensions: Positive Group Behavior and Negative Group Behavior. Each dimension contains ten, 5-point Likert scale items. Examples of the test items are: 'Group members felt free to criticize the ideas, statements, and/or opinions of others', 'Group members gave personal information on themselves', and 'Group members grew to dislike others.' Because sociability

contributes to social space, we expected a moderate correlation between the Social Space Scale and the Sociability Scale. A high correlation would mean that the Sociability Scale is measuring aspects of social space (or vice versa). Like the Sociability Scale, the Social Space Scale was constructed and validated in an explorative study.

8.3.3.2 *The Gunawardena Social Presence Indicators*

Gunawardena (1995) used a questionnaire of a total of 17, 5-point bipolar scale items (see Appendix 8.1) to assess a range of feelings students have towards CMC. She equated this to the perceived social presence. In this study, we refer to these bi-polar scale items as the Social Presence Indicators. We expected a high correlation between this measure and the Sociability Scale because we believed the test items to measure, amongst other things, many aspects of the sociability of CMC (e.g., see the item 'sociable – unsociable'). For inclusion in our questionnaire, the items of the scale were translated into Dutch.

8.3.3.3 *The Gunawardena and Zittle Social Presence Scale*

The Gunawardena and Zittle (1997) Social Presence Scale is an alternative scale for measuring social presence and, thus, can be used interchangeably with the Social Presence Indicators. The Social Presence Scale, consists of 14, 5-point Likert-scale items (see Appendix 8.2). Examples of test items are: 'I felt comfortable conversing through this text-based medium' and 'The moderators created a feeling of an online community.' We slightly adapted the items of their Social Presence Scale to fit our particular setting and then translated them into Dutch. For the same reasons as with the Social Presence Indicators, we expected a high correlation between the Social Space Scale and the Sociability Scale. In this study, we did not consider the items 9, 10, and 11, because they go beyond the scope of our interest (i.e., the sociability construct).

8.3.3.4 *The Price and Mueller Work Group Cohesion Index*

Price and Mueller (1986) developed their Work Group Cohesion Index to measure work-group cohesion in an organizational context. The Work Group Cohesion Index consists out of five, 5-point Likert scale items (see Appendix 8.3). Sociability is affecting social space, and an attribute of social space is social cohesiveness. Therefore, we expected a moderate correlation between the Sociability Scale and the Work Group Cohesion Index. The items of the measure were translated into the Dutch language too.

8.3.3.5 *Fiedler's Group Atmosphere Scale*

Fiedler (1967) developed the Group Atmosphere Scale, which makes use of an 8-point scale for determining the atmosphere in a group as perceived by the group members (see Appendix 8.4). Instead of using 8-point scales we used 5-point scales to concur with the other scales used. Sociability is affecting group atmosphere (social climate). We, thus, expected a moderate correlation between our Sociability Scale and the Group Atmosphere Scale. Nevertheless, since the Group Atmosphere Scale is also very similar to the Social Presence Indicators, we expected the correlation to be of the same magnitude as the correlation between Sociability Scale and Social Presence Indicators. The items of the Group Atmosphere Scale were translated into Dutch.

8.4 Construction and Refinement of the Raw Sociability Scale

8.4.1 Constructing the Raw Sociability Scale

When we constructed the raw Social Space Scale, we had no systematic approach in mind other than that we were guided by the literature as to determine what good sociability consists of (e.g., Donath, 1997). Additionally, the construction of the test items of Sociability Scale was based upon our approach to increase sociability, that is, group awareness, communication, and potential for facilitating the creation of a community (of learning). As a result, the raw Sociability Scale was composed of 34 test items addressing these elements. This number of items deliberately overrepresented the sociability construct. We intended to remove redundant items in a later refinement process, which would also remove those items that were psychometrically 'rejected.' The advantage of such a method was that we could postpone the decision of which items to include in the final Sociability Scale up to the moment that we would have gained a clearer picture of the meaning of the various items.

8.4.2 Removing Test Items of the Sociability Scale

The raw Sociability Scale was refined in three steps. In the first step, 24 items from the 34 initial test items were removed because they either addressed a utility aspect (feature) such as 'This CSCL environment enabled me to see who of the group members are logged in' or a usability aspect such as 'This CSCL environment has easy access to the communication media.' Although these items can be associated with sociability, they are generally used for assessing the usefulness (Shneiderman, 1998) of a CSCL environment. Therefore, we decided not to include the items in the Sociability Scale. In the second step, a factor analysis (Principal Component Analysis, no rotation) was performed on the remaining test items. This step revealed that the Sociability Scale is one-dimensional (using the scree test of Cattell, 1966). The step was also used to remove the few test items that did not load higher than .40 (see for this criterion, Stevens, 1992) exclusively on the first factor (removed zero items). The third and last step was to reduce the remaining test items further to ten without losing too much of explained total variance (removed zero items, we already had ten items).

The resulting refined Sociability Scale is depicted in table 8.1. The three last columns show respectively mean M, standard deviation SD, and loading on the first and only factor (a new factor analysis (Principal Component Analysis, no rotation) was performed on the ten final test items). The factor explained 58.52 per cent of the total variance.

8.5 Results

8.5.1 Internal Consistency and Validity

Cronbach's alpha for the refined Sociability Scale was .92 revealing a high internal consistency. The content validity of the Social Space Scale was established via face-validity. The items were developed based upon a search in the literature regarding social interaction via CMC, group development and group dynamics, social presence, trust building, and creating sense of community.

8.5.2 Pearson Bi-Variate Correlations

We applied a Pearson bi-variate correlation (2-tailed) analysis on the aggregate scores of the test items of the Sociability Scale and each of the measures Social Space Scale, Social Presence Indicators, Social Presence Scale, Work Group Cohesion Index, and Group Atmosphere Scale. Table 8.2 depicts the correlations. As can be seen, correlations are, both with respect to the strength as the direction, as expected. The low and negative correlation between the Negative Group Behavior-dimension of the Social Space Scale and the Sociability Scale is explained by the observation that the Sociability Scale does not measure negative experiences as does the Social Space Scale (Kreijns, Kirschner, Jochems, Van Buuren, in press).

Table 8.2
Pearson Bi-variate Correlation Coefficients Between the Different Scales

Measure	Sociability Scale
Social Space Scale	
Positive Group Behavior	.60**
Negative Group Behavior	-.08
Social Presence Indicators	.83**
Social Presence Scale	.85**
Work Group Cohesion Index	.60**
Group Atmosphere Scale	.78**

** $p < .01$, 2-tailed.

8.5.3 Factor Analysis Involving Sociability Scale and Social Space Scale

Finally, we applied factor analysis (Principal Component Analysis using Varimax rotation) on the ten test items of the refined Sociability Scale and the twenty test items of the Social Space Scale. We restricted the extraction to only three factors because the purpose of this analysis was not to reveal factors, but rather to confirm the uniqueness of the scales with respect to each other. Because the Social Space Scale has two dimensions and the Sociability Scale only one, the restriction was set to three. By uniqueness, we mean that although the scales may be related (see correlation data in Table 8.2), they do not measure the same phenomena. The result of this analysis is given in Table 8.3. The factor loadings show that the two scales measure two different phenomena.

8.6 Weakness of the Study

The validation of the Sociability Scale has some weak points that limit the study. Firstly, the number of cases was 79. A general rule of the thumb is that there must be at least five (Gorsuch, 1983) to ten cases (Nunnally, 1978) per item. The raw Social Space Scale contained 34 items, meaning that we actually needed 170 up to 340 cases to derive this measure.

Table 8.3
Factor Analysis of the Scores of
the Items of the Social Space Scale and the Sociability Scale

No. Item	Item	Factor 1 Sociability	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior
Social Space Scale: Positive Group Behavior				
1	Group members felt free to criticize ideas, statements, and/or opinions of others		.76	
3	We reached a good understanding on how we had to function		.80	
5	Group members ensured that we kept in touch with each other		.75	
7	We worked hard on the group assignment		.78	
9	I maintained contact with all other group members		.73	
11	Group members gave personal information on themselves	.44	.48	
13	The group conducted open and lively conversations and/or discussions		.82	
15	Group members took the initiative to get in touch with others		.79	
17	Group members spontaneously started conversations with others	.53	.53	
19	Group members asked others how the work was going		.56	
Social Space Scale: Negative Group Behavior				
2	Group members felt that they were attacked personally when their ideas, statements and/or opinions were criticized[a]			.74
4	Group members were suspicious of others[a]			.79
6	Group members grew to dislike others[a]			.66
8	I did the lion's share of the work[a]			.57
10	Group members obstructed the progress of the work[a]			.59
12	Group members were unreasonable[a]			.90
14	Group members disagreed amongst each other[a]			.69
16	The group had conflicts[a]			.66
18	Group members gossiped about each other[a]			.69
20	Group members did not take others seriously[a]			.60
Sociability Scale				
1	This CSCL environment enables me to easily contact my team mates	.75		
2	I do not feel lonely in this CSCL environment	.77		
3	This CSCL environment enables me to get a good impression of my team mates	.75		
4	This CSCL environment allows spontaneous informal conversations	.70		
5	This CSCL environment enables us to develop into a well performing team	.65	.49	
6	This CSCL environment enables me to develop good work relationships with my team mates	.75		
7	This CSCL environment enables me to identify myself with the team	.62	.50	
8	I feel comfortable with this CSCL environment	.77		
9	This CSCL environment allows for non task-related conversations	.68		
10	This CSCL environment enables me to make close friendships with my team mates	.74		

[a]These items were reverse coded for analysis.

Secondly, there were five samples (VEC, first statistics course, second statistics course: fast, second statistics course: slow, and second statistics course: free), that have been collapsed in order to obtain the 79 cases. We agree that these samples have different characteristics (e.g., time aspects, CSCL environments, task type) which

mean that they actually cannot be collapsed into one big sample. Indeed, a series of one-way ANOVA's revealed that the samples VEC and first statistics course are comparable, as are the samples second statistics course: fast, second statistics course: slow, and second statistics course: free; the samples VEC and first statistics course are not comparable to the samples second statistics course: fast, second statistics course: slow, and second statistics course: free. However, as this study is explorative, we did collapse the samples to obtain a high number of cases.

Finally, we used the same cases for the factor analysis on the items of the refined Sociability Scale and the Social Space Scale. This implies that the result (Table 8.3) might take advantage of the chance characteristic of the 79 cases from which both scales were derived.

In view of these weak points, we must stress that the findings in this study only suggest that the Sociability Scale has potential to be useful as a measure for assessing the sociability of CSCL environments.

8.7 Conclusion

Social interaction is considered the dominant factor affecting collaboration in groups and thus learning performances in those groups. In addition, social interaction is also a dominant factor in group forming and group dynamics. That is, the social interaction found in group learning is also responsible for developing new groups into mature well performing groups in which an affective structure is established characterized by social relationships, social cohesiveness, and a sense of community. These are the attributes of a social space. A sound social space allows for open communication that is beneficial for the collaborative activities and the exchange of essential information.

If we are to design and develop technologically, educationally, *and* socially functional CSCL-environments we need to not only consider these aspects in our designs and implementations (the designers perspective), but we also need to determine how the users (our students) perceive these environments. The Sociability Scale presented here on the one hand operationalizes the different aspects of sociability so that the designer (technical and educational) can take account of the different aspects of sociability in her/his design. On the other hand, it gives the designers/ developers a tool with which they can accurately measure whether their work has borne fruit.

For this reason it is important that factors are identified that foster social interaction for socio-emotional processes in a CSCL environment or that the CSCL environment in and by itself adds to an increase of this kind of social interaction, for example, through the incorporation of social affordance devices (Kreijns, Kirschner, & Jochems, 2002) that enhance the sociability of the environment. But the effects of these latter strategies need to be measured in order to determine the effectiveness of each on sociability and thus on the creation of a sound social space. It is important to develop a measurement instrument to determine the sociability of an environment, i.e. the Sociability Scale. The Sociability Scale will, in our case, help to develop the right social affordance devices, in the sense that they are indeed effective in their contribution to the sociability.

This article presented the Sociability Scale. However, it must be realized that this measure is a preliminary 'first step' because the findings are limited due to the small number of respondents. Nevertheless, the findings are promising, suggesting that further work based on a larger sample will be meaningful. Also, more experiments are

needed for corroborating the findings so far. And this is precisely what we are now doing. Through content analysis of the messages of the discussion forum used in the first statistics course, we hope to find support for the Sociability Scale. In addition, we will use other instruments such as a social space instrument and a social presence instrument that triangulate the user's perception of the sociability of CSCL environments.

8.8 Acknowledgements

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Appendix 8.1
The Gunawardena Social Presence Indicators

No. Item	Item	*M*	*SD*
1	stimulating – dull[a]	3.73	1.13
2	personal – impersonal[a]	3.05	1.04
3	sociable – unsociable[a]	3.20	1.08
4	sensitive – insensitive[a]	2.75	.91
5	warm – cold[a]	2.97	.86
6	colorful – colorless[a]	2.92	1.06
7	interesting – boring[a]	3.81	1.04
8	appealing – not appealing[a]	3.47	1.12
9	interactive – non-interactive[a]	3.72	1.09
10	active – passive[a]	3.44	1.15
11	reliable – unreliable[a]	3.76	.77
12	humanizing – dehumanizing[a]	3.20	.93
13	immediate – non-immediate[a]	3.24	1.09
14	easy – difficult[a]	3.46	1.21
15	efficient – inefficient[a]	3.29	1.16
16	unthreatening – threatening[a]	3.29	.68
17	helpful – hindering[a]	3.63	1.03

Note. Judgements were made on 5-point bipolar scales (1 = *positive rating*, 5 = *negative rating*).
[a]These items were reverse coded for analysis.

Appendix 8.2
The Gunawardena and Zittle Social Presence Scale (adapted)

No. Item	Item	*M*	*SD*
1	Messages in the CSCL environment were impersonal[a]	3.52	.81
2	The CSCL environment is a an excellent medium for social interaction	3.01	1.03
3	I felt comfortable conversing through this text-based CSCL environment	3.70	.85
4	I felt comfortable introducing myself in the CSCL environment	3.61	.95
5	The introduction(s) enabled me to form a sense of online community in which I was part of	2.78	1.25
6	I felt comfortable participating in discussions in the CSCL environment	3.67	.89
7	The moderators created a feeling of an online community	2.32	1.07
8	The moderators facilitated discussions in the CSCL environment	2.44	1.19
9	Discussions in CSCL environments tend to be more impersonal than face-to-face discussions[a]	2.78	1.00
10	Discussions in CSCL environments are more impersonal than audio teleconference discussions[a]	2.95	1.00
11	Discussions in CSCL environments are more impersonal than video teleconference discussions[a]	2.75	1.07
12	I felt comfortable interacting with other participants in the CSCL environment	3.73	.96
13	I felt that my point of view was acknowledge by other participants in the CSCL environment	3.28	.82
14	I was able to form distinct individual impressions of some participants even though we communicated only via this text-based CSCL environment	2.92	1.07

Note. Judgements were made on 5-point Likert scales (1 = *strongly disagree*, 2 = *disagree*, 3 = *agree/disagree*, 4 = *agree*, 5 = *strongly agree*). The items 9, 10, and 11 were not considered in this study.
[a]These items were reverse coded for analysis.

Appendix 8.3
The Price and Mueller Work Group Cohesion Index

No. Item	Item	*M*	*SD*
1	To what extent were the other team mates friendly? [a]	3.95	.64
2	To what extent were the other team mates helpful? [a]	3.76	.98
3	To what extent took the other team mates a personal interest in you? [a]	3.09	.99
4	To what extent did you trust the other team mates? [a]	4.16	.74
5	To what extent do you look forward to work again with the same team mates? [a]	3.11	1.14

Note. Judgements were made on 5-point Likert scales.
Item 1: 1 = *very friendly*, 2 = *quite*, 3 = *somewhat*, 4 = *very little*, 5 = *not friendly at all*
Item 2: 1 = *very helpful*, 2 = *quite*, 3 = *somewhat*, 4 = *very little*, 5 = *not helpful at all*
Item 3: 1 = *very interested*, 2 = *quite*, 3 = *somewhat*, 4 = *very little*, 5 = *not interested at all*
Item 4: 1 = *a great deal*, 2 = *quite a lot*, 3 = *somewhat*, 4 = *very little*, 5 = *no trust at all*
Item 5: 1 = *very much*, 2 = *quite a bit*, 3 = *somewhat*, 4 = *very little*, 5 = *not at all*
[a]These items were reverse coded for analysis.

Appendix 8.4
The Fiedler Group Atmosphere Scale

No. Item	Item	*M*	*SD*
1	warm – cold[a]	2.97	.86
2	interesting – boring[a]	3.81	1.04
3	accepting – rejecting[a]	3.73	.80
4	satisfying – frustrating[a]	3.06	1.08
5	enthusiastic – unenthusiastic[a]	3.37	1.15
6	productive – non-productive[a]	3.35	1.23
7	cooperative – uncooperative[a]	3.67	.96
8	supportive – hostile[a]	3.86	.78
9	successful – unsuccessful[a]	3.43	1.02

Note. Judgments were made on 5-point bipolar scales (1 = *positive rating*, 5 = *negative rating*).
[a]These items were reverse coded for analysis.

CHAPTER 9

Measuring Perceived Social Presence in DLGs

Abstract

The concept of social presence –the degree in which the illusion exists that the other in the communication appears to be a 'real' physical person– has captured the attention of educators, educational technologists, and educational researchers who deal with learning in groups through computer-supported collaborative learning environments. Social presence is important because it affects participation and social interaction, which are necessary for effective collaboration and knowledge construction. In order to study the effects of social presence empirically, a social presence measure is required. This article presents a literature overview of social presence theory and reports on the construction and validation of a self-reporting (Dutch-language) Social Presence Scale to determine the perceived social presence in distributed learning groups using computer-supported collaborative learning environments. The result is a one-dimensional scale consisting of five items with an internal consistency of .81. We used a nomological network of similar constructs for further validation. The findings suggest that the Social Presence Scale has potential to be useful as a measure for social presence.

This chapter is based on:

Kreijns, K., Kirschner, P. A., Jochems, W., & Van Buuren, H. (2004b). Measuring perceived social presence in distributed learning groups. Manuscript submitted for publication.

9.1 Introduction

Social presence, first conceptualized by social psychologists Short, Williams, and Christie (1976), has recently captured the attention of educators, educational technologists, and (distance) educational researchers as an important variable for participation and social interaction in (a)synchronous distributed learning groups (DLGs) (Saba, 1998; Garrison, 1997b; Garrison & Anderson, 2003; Gunawardena, 1995, 1997; Leh, 2001; Richardson, & Swan, 2003; Rourke & Anderson, 2002; Rourke, Anderson, Archer, & Garrison, 1999; Russo, 2002; Stacey, 2002a, 2002b; Stacey & Fountain, 2001; Shin, 2003; Swan, 2002; Tammelin, 1998; Tu, 2000a, 2001; Tu & McIsaac, 2002). We define social presence to be the degree of the psychological sensation in which the illusion exists that the other in the communication appears to be a 'real' physical person either in an immediate (i.e., real time or synchronous) or in a delayed (i.e., time-deferred or asynchronous) communication episode. We were inspired by the definition of the telepresence researchers Lombard and Ditton (1997): they define presence as "the perceptual illusion of non-mediation" (¶ Presence Explicated).

Tu (2000a), linking social learning theory to the concept of social presence, contended that "Social presence is required to enhance and foster online social interaction, which is the major vehicle of social learning" (p. 27). Consequently, if "social presence is low the foundation of social learning, social interaction, does not occur" (p.30; cf., Garramone, Harris, & Anderson, 1986). *Social interaction* is considered a necessary requirement for collaborative learning and knowledge construction (Fulford & Zhang, 1993; Gilbert & Moore, 1998; Hillman, Willis, & Gunawardena, 1994; Hiltz, 1994; Johnson & Johnson, 1994; Kearsley, 1995; Laurillard, 2002; Moore, 1993; Muirhead, 2000; Northrup, 2001; Schlegloff, 1991; Slavin, 1995; Soller, 1999; Wagner, 1994, 1997). Researchers explain its importance for a variety of reasons. Garrison (1993b) suggested interaction promotes explanation and helps to develop critical perspectives on a problem, which will lead to true meaning. Soller, Lesgold, Linton, and Goodman (1999) see social interaction as instrumental in making peer interaction more effective since students "learning effectively in groups encourage each other to ask questions, explain and justify their opinions, articulate their reasoning, and elaborate and reflect upon their knowledge" (p. 116). Johnson, Johnson, and Stanne (1985) emphasized that "the cognitive processes most necessary for deeper level understanding and the implanting of information into memory, such as elaboration and metacognition, occur only through dialogue and interaction with other people" (p. 675). All of these insights, in fact, point to a special kind of social interaction, namely that of epistemic interaction (Ohlsson, 1996) that enhances the quality of the cognitive processes and that leads to deep learning (Biggs, 1987, 1999; Newman, Johnson, Webb, & Cochrane, 1997).

Social interaction, however, is not only important for such cognitive processes, but also for socio-emotional and social processes (Gunawardena, 1995, 1997; Jacques, 1992; Kreijns, Kirschner, Jochems, 2003). These processes are related to group formation and group dynamics affecting affiliation, impression formation, developing affective relationships and building a sense of social cohesiveness and community. Only when groups have attained strong social cohesiveness, trust and belonging, and a sense of community can they effectively accomplish their learning tasks. Such groups are often referred to as communities of learning.

Since social interaction is important in both the educational dimension (emphasizing cognitive processes) and the social psychological dimension (emphasizing socio-emotional processes), a key variable such as social presence, which influences it, should be empirically studied. We agree with Saba (1998) that "the importance of social presence for mediated communication in distance education cannot be overstated" (p. 3).

This study is the third part of an experiment to develop instruments for determining how users of CSCL environments experience those environments. The first instrument (Kreijns, Kirschner, Jochems, & Van Buuren, in press) is for determining social space). The second (Kreijns, Kirschner, Jochems, & Van Buuren, 2004a) is for determining sociability.

This article first presents a literature overview of what we label as classical social presence theory oriented towards synchronous, audio or video communication. It proceeds with transforming the classical social presence concept into a new social presence theory by re-examining the factors affecting social presence and by the inclusion of (a)synchronous, text-based communication. The article continues, describing how the new social presence theory fits our framework to enhance social interaction in DLGs. This is followed by an overview of existing social presence measures, after which their weaknesses are discussed giving an argument to construct our own social presence measure. The final part describes the construction and validation of our Social Presence Scale.

9.2 Classical Social Presence Theory

Social presence theory was originally developed by Short, Williams, and Christie (1976) to explain interpersonal effects between two interlocutors in an organizational context when using telecommunication media such as telephone, audio channels, closed-circuit video channels, and face-to-face meetings. They characterized each communication medium in terms of its potential to communicate verbal and non-verbal cues conveying socio-emotional information in such a way that the other is perceived as 'physically' present. Non-verbal cues are expressed by vision (e.g., facial expression, direction of gaze, posture, gestures, eye-contact; in other words, 'body language'), audition (e.g., voice volume, inflection, soft speaking), tactile (e.g., touching, shaking hands), and olfaction (e.g., smells, body odors).

Short, Williams, & Christie (1976) define social presence as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships (…)" (p. 65) and state that social presence "varies between different media, it affects the nature of the interaction and it interacts with the purpose of the interaction to influence the medium chosen by the individual who wishes to communicate" (p.65).

9.2.1 Factors Influencing the Degree of Social Presence

Short, Williams, and Christie (1976) initially held the physical and technological characteristics of a telecommunication medium to be solely responsible for its degree of social presence. In other words, they saw social presence as an *objective* quality of the communication medium. They eventually relaxed their view to include the *subjective* qualities of the medium as a contributor to social presence. However, they still favored the objective perspective when it came to theoretically explaining the variations in the degree of social presence between different communication media. For this reason, the

kind of social presence proposed by Short, Williams, and Christie (1976) can be designated as a 'technological' social presence (Tu, 2000a).

9.2.2 The Use of Social Presence Theory

Social presence theory is often used to rank telecommunication media according their degree of social presence. This ranking in descending order is face-to-face communication, video-conferencing, and finally audio-only (e.g., the telephone). The theory also contends that communication media higher in social presence are more appropriate when interpersonally involving tasks are carried out (Rice, 1993; Steinfield, 1986). In other words, task activities needing a strong interpersonal characteristic, for example tasks that depend on developing and maintaining mutual trust such as conflict-resolution tasks or negotiation tasks require communication media that are high in social presence. This is because, according to the theory, media higher in social presence are more effective channels for trust building and, consequently, of social influence (see for social influence: Fulk, Schmitz, & Steinfield, 1990; Spears & Lea, 1992). Based upon this reasoning, the theory hypothesizes that media choice can be predicted such that "users of any given communications medium are in some sense aware of the degree of Social Presence of the medium and tend to avoid using the medium for certain types of interactions; specifically, interactions requiring a higher degree of Social Presence than they perceive the medium to have" (Short, Williams, & Christie, 1976, p. 65).

9.2.3 Social Presence and the Concepts of Intimacy and Immediacy

Short, Williams, and Christie (1976) related two other social psychological concepts to social presence, namely intimacy (Argyle & Dean, 1965) and immediacy (Wiener & Mehrabian, 1968). Both concepts were originally developed in face-to-face situations, but influenced social presence theory of communication media.

Intimacy is an equilibrium theory postulating that communicating participants will reach an optimal level of 'intimacy' in which conflicting approaches and avoidance forces are in equilibrium. Short, Williams, and Christie (1976) suggested that social presence of the communications medium should be included in the list of factors contributing to intimacy.

With respect to *immediacy*, Short, Williams, and Christie (1976) saw it as "a measure of the psychological distance which a communicator puts between himself and the object of his communication, his addressee or his communication. According to Wiener and Mehrabian, negative affect, low evaluation and non-preference for any of these things are associated with non-immediacy in communications" (p. 72). According to Gunawardena (1995): "Immediacy enhances social presence" (p. 151).

9.3 Towards a New Social Presence Theory

Classical social presence theory was developed within the confined context of synchronous communications involving face-to-face, audio, or close-circuit video telecommunication media. Therefore, from this perspective, social presence can only be perceived while participating in a real-time communication episode. Social presence theory was proposed neither for asynchronous communication nor for text-based communication media (i.e., computer-mediated communication (CMC). Despite the fact that asynchronous, text-based communication is the inherent characteristic of

CMC, social psychologists, communication researchers, and (distance) educational researchers have applied social presence theory to it. Indeed, Benschop (2004) notices that communication scientists consider e-mail to be a communication media that may also provoke social presence but he objects that e-mail just lacks the media richness and required directness of interaction to create a feeling of social presence (¶ Sociale aanwezigheid [Social presence]). Individuals, however, may *experience* the presence of the other in asynchronous communication. This *psychological* experience of the other can be designated as *psychological presence*, a substitute for the missing social presence in asynchronous communication. Psychological presence is evoked through the activation of a mental model of the other, for example, when an e-mail message written by the other is read.

This mental model is defined as the internal representation of the other that individuals construct in their minds, and its construction is affected by the individuating impressions an individual has made of the other. This mental model not only affects the perceived degree of psychological presence, but also affects the social presence in a real-time communication episode. It makes a difference if individuals already know the other in the conversation. If this is the case, then this may increase the degree of social presence (cf., Tu, 2002b).

Communication researchers, however, do not differentiate between psychological presence and social presence, because the effects of perceiving social presence or experiencing psychological presence are believed to be comparable. To be compatible with those researchers, we also use the term social presence in those cases where it, technically speaking, we would actually denote psychological presence.

9.3.1 Re-examining Factors Influencing the Degree of Social Presence

The subjective weighing of transmitted cues cannot completely explain observed differences in perceptions of social presence and online behavior. Other factors apparently affect the degree of perceived social presence.

Here, we see one group of researchers adhering to the position of what can be called 'technological determinism' and another group to the position of 'social determinism.' Depending on the position taken, different factors are in focus.

Concurrently, we also see that the same researchers have different interpretations of what social presence is and, consequently, use definitions that are in concordance with their interpretations.

9.3.1.1 *Technological Versus Social Determinism*

Social presence theory as developed by Short, Williams, and Christie (1976) is a prime example of technological determinism in that, in their view, the technology determines social presence. Contrastingly, some educational researchers (e.g., Gunawardena, 1995; Tu, 2002b) declared that the attributes of the communication media are irrelevant in the perception of social presence but social factors are.

These two extreme positions illustrate what Spears, Postmes, Wolbert, Lea, and Rogers (2000) called the 'technological versus social determinism' controversy. They pointed out that 'simple' theories over-generalize ICTs' social effects such as the tendency "to assume that ICTs' effects are due to characteristics of the technology or that these are constructed by social factors" (p.8). From their studies, they concluded that "the diversity of social effects precludes that technology is singularly good or bad, and that technology determines the social effects. Conversely, social determinism

cannot account for invariable technological effects: not every use of ICTs is as flexible as these theories claim. Moreover, social determinism often is relativistic, which restricts its power of prediction and practical use" (p.8). We support them when they advocate that "a theory of the social effects of ICT must emphasize that the use and effect of the new technologies are co-determined by technological features (anonymity, isolation, and asynchrony) and social psychological factors (identities, social relations, and social practices)" (p. 8).

9.3.1.2 *Definitions of Social Presence*

Social Presence as the Psychological Sensation of the Other as 'Physically' Real.

Gunawardena (1995) adapted the social presence definition of Short, Williams, and Christie (1976) to "the degree to which a person is perceived as a 'real person' in mediated communication" (p. 151). In her view, the development of social presence is the key to promoting collaborative learning and knowledge building and is a predictor of learner satisfaction (Gunawardena & Zittle, 1997). Gunawardena (1995) concluded from two studies on social presence in text-based computer conferences that "although CMC is described as a medium that is low in non-verbal cues and social context cues, participants in conferences create social presence by projecting their identities and building online communities" (p. 163).

Social Presence as the Psychological Sensation of Feeling Connected to the Other.

Tu (2000a, 2001, 2002a, 2002b, 2002c) uses a variety of definitions of social presence. He defined social presence to be the degree "of person-to-person awareness, which occurs in a mediated environment" (Tu, 2002b, p. 34) and as the degree "of feeling, perception and reaction of being connected on CMC to another intellectual entity" (Tu, 2002c, p. 2; cf., Tu & McIsaac, 2002).

In his view, social presence is a key variable for determining the social interaction in group learning. He (2000a, 2001, 2002a, 2002b, 2000c) identified three main variables contributing to social presence, namely:

- Social context. Social context is constructed from the users' characteristics and their perceptions of the CMC environment.
- Online communication. In his opinion, online communication relates to the attributes of the online language and its application. Tu also stress that it is important that students have basic computer literacy skills and online language skills.
- Interactivity. Tu defines interactivity as the active communication and learning activities that users engage in and the utility of the communication styles. The potential for feedback and the immediateness of responses given both affect the degree of social presence

In agreement with Witmer (1997), Tu (2002a) suggested that two (main) variables potentially could affect the degree of perceived social presence. Both variables concern the perceived privacy in CMC environments:

- System privacy. System privacy is the actual security of CMC technologies offered, including the likelihood that the CMC system will allow unknown others to read, send, or resend messages to or from someone else (including yourself).

- Feelings of privacy. This refers to the "perception of privacy psychologically, mentally, culturally, or conditionally rather than actual security" (Tu, 2002a, p. 297). The perceived degree of social presence is low in settings that are perceived to be less private.

Social Presence as the Competency to Project Oneself as 'Physically' Real.

Garrison (1997a) expanding on Gunawardena's (1995) perspective that social presence can be cultured and defined it "the degree to which participants are able to project themselves affectively within the medium" (p. 6). Garrison, Anderson, and Archer (2000) adopted this definition in their framework for analyzing critical thinking in computer conferences and redefined it as "the ability of participants in a community of inquiry to project themselves socially and emotionally, as 'real' people (i.e., their full personality), through the medium of communication being used" (p. 94). In other words, they maintain that the competency to develop social presence is social presence. They argued that it is important because it functions as "a support for cognitive presence, indirectly facilitating the process of critical thinking carried on by the community of learners (…) and is a direct contributor to the success of the educational experience" (p. 89). Cognitive presence, social presence, and teaching presence are the three corner stones of their community of inquiry (see for this community of inquiry, Archer, Garrison, Anderson, & Rourke, 2001).

Rourke, Anderson, Archer, and Garrison (1999) developed three categories of social expressions defining social presence:

- Affective responses: expressions of emotions (e.g., use of emoticons, conspicuous capitalization; see, Beals, 1991; Gunawardena & Zittle, 1997; Kuehn, 1993; Poole 2000), use of humor (e.g., irony, teasing, cajoling, sarcasm; see, Baym, 1995; Edgins & Slade, 1997; Poole, 2000), and self-disclosure (e.g., presenting details of personal life, expressing vulnerability; see, Cutler, 1995; Fåhræus, 1999; Hillman, 1999; Poole, 2000; Shamp, 1991).
- Interactive: continuing a thread, quoting from others' messages, referring explicitly to others' messages (see, Edgins & Slade, 1997), asking questions and getting feedback (see, Fåhræus, 1999), complimenting or expressing appreciation, and expressing agreement (see, Gorham & Zakahi, 1990; Walberg, 1984)
- Cohesive: vocatives (addressing participants by name; see, Edgins & Slade, 1997; Fåhræus, 1999), using inclusive pronouns (addressing the group as we, us, our group; see, Mehrabian. 1969; Gorham & Zakahi, 1990), and phatics or salutations (e.g., greetings, closures; see, Bußmann, 1998; Fåhræus, 1999).

9.4 Measuring the Perceived Social Presence

9.4.1 Existing Measures for Social Presence

Although a number of measures exists that purport to measure social presence, a closer examination reveals that each of them measure also aspects of other constructs such as social climate, social cohesiveness, social space, and sociability. Also, some measures that are intended to measure social presence are used to measure other constructs such as social environment. The next sub-sections discuss all of these measures.

9.4.1.1 *The Short, Williams, and Christie Social Presence Measure*

The dominant social presence measure adopted by researchers (e.g., Perse, Buton, Kovner, Lears, & Sen, 1992; Rice, 1992; Steinfield, 1986) is the one developed by Short, Williams, and Christie (1976) or a modified version of it. Short, Williams, and Christie (1976) used four, 7-point semantic differential scales (see for this technique, Osgood, Suci, & Tannenbaum, 1957) to measure the subjective degree of social presence: personal–impersonal, sensitive–insensitive, warm–cold, and sociable–unsociable (see also Appendix 8.1). The more personal, sensitive, warm, and sociable the medium is perceived, the higher social presence is. However, the measure is not without criticism.

Although it is the objective quality perspective upon which Short, Williams, and Christie (1976) constructed their social presence theory, it is the subjective quality perspective upon which they based their social presence measure. This raises questions as to whether the measure is appropriate for determining the degree of social presence when seen from the objective perspective (Walther, 1992). But, in the new perspective on social presence –which sees social presence as a psychological sensation– the measure *could* be valid. Yet, Bradner and Mark (2001) contended that Short, Williams, and Christie used their social presence measure to rank different media and, thus, the measure is a relative measure of social presence and not the absolute one which most researchers actually need (p. 158). Tu (2002b) argued that the four items are too general to measure the complicated issue of online social presence and that the semantic differential technique may be faulty because different respondents may ascribe different definitions and meanings to the adjectives (p. 39).

Beyond the shortcoming of the instrument itself, there are also researchers who adopted the social presence measure (or used a modified one) but used it for measuring related variables. Gunawardena (1995) extended the four scale items with 13 new scale items, resulting in a questionnaire of 17, 5-point bipolar scale items (in this article referred to as Social Presence Indicators, see Appendix 1) for soliciting the students' reactions on a range of feelings toward CMC (p. 149–150). She related the outcome to the perceived social climate (p. 162), thereby, implicitly suggesting that the instrument is measuring social climate. Similarly, Rourke and Anderson (2002) measured the social environment (social climate) of computer conferencing by using a questionnaire of six, 5-point bipolar scales items (see Appendix 1) based upon Anderson (1979), Gunawardena & Zittle (1997), and Short, Williams, & Christie (1976). Tu (1997) used a questionnaire derived from Gunawardena's (1995) Social Presence Indicators; his questionnaire consists of 15, 5-point bipolar scales (see Appendix 1), designed to solicit (Chinese) students' reactions on a range of feelings toward CMC.

9.4.1.2 *Alternative Social Presence Measures*

Alternative social presence measures have been developed by Gunawardena and Zittle (1997) and Tu (2000b). Gunawardena and Zittle (1997) developed a social presence measure consisting of 14, 5-point Likert-scale items (e.g., 'The moderators created a feeling of an online community' and 'I felt that my point of view was acknowledged by other participants in GlobalEd.' In our article, we refer to this measure as the GZ Social Presence Scale. They contend (p. 11–12) that the Social Presence Indicators measure the 'intimacy' dimension of social presence (intimacy: see Argyle & Dean,

1965) whilst, in contrast, the GZ Social Presence Scale measures the 'immediacy' dimension of it (immediacy: see Wiener & Mehrabian, 1968).

Tu (2000b) developed the Social Presence and Privacy Questionnaire (SPPQ) to assess five dimensions of social presence for respectively e-mail, bulletin board and real-time discussion:

- Social context (five items; e.g., 'Computer-Mediated Communication messages are social forms of communications')
- Online communication (five items; e.g., 'The language used to express oneself in online communicating is meaningful')
- Interactivity (four items; e.g., 'I am comfortable participating, if I am familiar with the topics')
- System privacy (seven items; e.g., 'What is the likelihood that someone else might read and/or re-post messages sent to or from you?')
- Feeling of privacy (six items; e.g., 'How SECURE/SECRET [capitals Tu] is your online participation?')

All items are 5-point Likert-scale items, except for one system privacy item.

9.4.1.3 *Measuring Social Presence through Content Analysis*

In the section "Social Presence as the Competence to Project Oneself as 'Physically' Real," the three categories system of social expressions of Rourke, Anderson, Archer, and Garrison (1999) that manifest the existence of social presence, is discussed. These social expressions form the indicators of a template that can be used in content analysis.

9.4.2 Problems with the Existing Social Presence Measures

9.4.2.1 *Equivocality of about What is Actually Measured*

As shown in the previous section, it is unclear what these instruments actually measure and whether they measure only social presence (what it should do) or other variables (what it should not do) such as social cohesiveness, social climate, social space, social environment, sociability, social communication, feelings of the learners towards CMC, privacy, degree of interpersonal interaction, and the intimacy or immediacy dimension of social presence as well. Moreover, if aspects of the other variables are measured, then it may be necessary to develop an own unequivocal social presence measure without these 'side-effects.'

Researchers themselves are the source of this problem. Rourke and Anderson (2002) are not consistent in their use of the term social climate. They also use the term 'social environment' and, when referring to the instrument for measuring 'social climate', they use the term 'social presence.' Their definition of social presence is adopted from Garrison, Anderson, and Archer (2000) and, thus, is different from the definition used by Short, Williams, and Christie (1976). In addition, they measured 'social communication' by measuring the perceived frequencies of the 15 social expressions; Rourke, Anderson, Archer, & Garrison (1999) use almost the same social expressions, but this time the expressions are used to measure 'social presence.'

Gunawardena (1995) stated that her scale items (the Social Presence Indicators) measure student perception of CMC as a social medium although she defined social presence as "the degree to which a person is perceived as a 'real person' in mediated

communication" (p. 151). Obviously, these two definitions are completely different. She also suggested that there was a relationship between social climate and social presence, yet this relationship is not clearly described. Finally, Gunawardena and Zittle (1997) stated that their social presence measure (the GZ Social Presence Scale) measures the immediacy dimension of social presence. However they also stated that the GZ Social Presence Scale measures the "Perceived sense of 'online community', the degree of social comfort with CMC" (p. 14).

9.4.2.2 *Measure Something Other that is out of the Space of Interest*

Some of the social presence measures assess things beyond the space of interest associated with the social presence construct. The GZ Social Presence Scale (Gunawardena & Zittle, 1997) includes items such as 'Discussions using the medium of CMC tend to be more impersonal than face-to-face discussions'). Agreeing or disagreeing with the statement does not say anything about the degree of social presence experienced.

9.4.2.3 *Measure Effects or Variables that Correlate with Social Presence*

A third shortcoming/problem is that effects of social presence or variables that correlate with social presence are measured and equated as being social presence rather than that social presence per se is measured. Tu's (2000b) social presence uses variables correlating with social presence. Tu himself (2002b) states that "Many different variables are cited in the literature that may contribute to the degree of social presence: recipients, topics, privacy, task, social relationship, communication styles and so forth" (p. 39). In his SPPQ, some of these variables are explicitly part of the social presence measure.

9.4.2.4 *Content Analysis is not Aggregating the Scores*

Content analysis based upon the template provided by Rourke, Anderson, Archer, and Garrison (1999) does not give a clear answer as to how to calculate scores from frequencies and how to aggregate the scores of each indicator to provide one single measure representing the degree of social presence. Firstly, the frequencies (e.g., the number of vocatives found) are not normalized which prohibits comparisons between samples (normalizing is necessary to overcome the differences in the number of messages and number of words found in different samples). Secondly, it is unclear how to weigh each indicator score (e.g., the number of vocatives can be much, much larger than the number of expressions of humor).

9.4.2.5 *Conclusion*

Existing social presence scales measure varying aspects of an amorphous set of variables, including social presence to varying degrees. This problem is confounded by the fact that not all of the scales exhibit the necessary content or construct validity nor do their authors present data (if any exists) regarding their internal reliability. This has led us to the conclusion that we need to develop an own alternative unequivocal measure for social presence. This social presence measure is introduced in the next sub-section.

9.5 An Alternative Social Presence Scale

The Social Presence Scale that we developed is a self-reporting questionnaire (in Dutch) that measures the perceived degree of social presence in a CSCL environment. The construction of the test-items was inspired by telepresence research (see, for example, Lombart and Ditton, 1997). Telepresence and social presence are similar, yet different constructs (Biocca & Levy, 1995; Biocca, 1997). Telepresence researchers are developing instruments that focus on the measurement of the degree individuals feel that they are transported from 'here to there' and are feeling that 'they are there' (which is the telepresence-effect). These instruments try to capture the 'sensation' of telepresence as a psychological phenomenon without any 'side-effects' (as is the case with many social presence measures described in the previous sections).

Questionnaires measuring virtual presence are sometimes fairly simple. For example, Towell and Towell (1997) used only a single 5-point Likert-scale item: 'I feel a sense of actually being in same room with others when I am connected to a MOO.' In the same vein, we wish to construct our social presence measure while still capturing the psychological sensation associated with social presence. Table 9.1 depicts our (refined) Social Presence Scale. The next section will explain in more detail the refinement process and the meaning of the last three columns.

Table 9.1
The Social Presence Scale

No. Item	Item	*M*	*SD*	Factor Social Presence
1	When I have real-time conversations in this CSCL environment, I have my communication partner in my mind's eye	2.15	1.17	.80
2	When I have asynchronous conversations in this CSCL environment, I also have my communication partner in my mind's eye	2.75	1.16	.70
3	When I have real-time conversations in this CSCL environment, I feel that I deal with very real persons and not with abstract anonymous persons	2.90	1.50	.79
4	When I have asynchronous conversations in this CSCL environment, I also feel that I deal with very real persons and not with abstract anonymous persons	3.56	1.21	.79
5	Real-time conversations in this CSCL environment can hardly be distinguished from face-to-face conversations	1.81	1.01	.69

Note. Judgments were made on 5-point Likert scales (1 = *not applicable at all*; 2 = *rarely applicable*; 3 = *moderately applicable*; 4 = *largely applicable*; 5 = *totally applicable*).

9.6 Method

9.6.1 Participation

Students in three distance education courses at the Open Universiteit Nederland (OUNL) participated in the study. The first course is Virtual Environmental Consultancy (VEC) of the Department of Natural Sciences, a virtual company on environmental issues integrating working and learning in an authentic context. VEC is a Virtual Company Innovation Project providing authentic environments to students to maximize competence building (Ivens, Van Dam-Mieras, Kreijns, Cörvers, &

Leinders, 2002; Westera, Sloep, & Gerrissen, 2000). Thirty-five students (25 males, 10 females) from four higher education institutions participated in VEC: the OUNL (8 males, 2 females), the University Maastricht (UM; 3 males, 6 females), the University Twente (UT; 7 males, 1 female), and the Fontys University of Professional Education (Fontys; 7 males, 1 female). OUNL- and UM students were combined and assigned to one of five groups; four groups had four participants, the remaining group had three participants. All UT students were assigned to one group of eight participants. Finally, Fontys students were assigned to one of two groups; both groups had four participants. Groups could choose a case from a pool of 13 cases (e.g., 'Criteria for sustainability in environmental planning and interventions') and had to produce an Environmental Advice Report. Students used eRoom version 5.4 (http://www.eroom.com) as their CSCL environment.

The two other courses were part of the Statistics Education Innovation Project (Van Buuren & Giesbertz, 1999) at the Department of Psychology. Thirty-eight adult undergraduates (all OUNL students, 6 male and 32 female) enrolled in the first course and were randomly assigned to one of seven groups consisting of five or six members each. Among these students, two female students were non-starters (i.e., they did not participate from the very beginning of the course). During the course, ten students (2 males, 8 females) dropped out. Consequently, group sizes were decreased; four groups ended up with three participants, one group had four participants and the remaining two groups had five participants. All groups had to study the same study-material emphasizing psychological experimentation and the use of ANOVA. Groups had to produce a prototype of a research paper. The groups made use of Studynet, the CSCL environment of the OUNL, which makes use of newsgroups for asynchronous communication and Microsoft® Netmeeting™ for synchronous communication. Use of telephone and e-mail were prohibited.

One hundred and thirteen adult undergraduates (all Dutch OUNL students, 24 male and 79 female) enrolled in the second course. Students were randomly assigned to one of eight 'slow' groups, one of eight 'fast' groups, or one of two 'free' groups (in total 18 groups). Slow and free groups had approximately twice the time allotted to fast groups to complete the course (10 months and 6 months respectively). Collaboration was compulsory for the slow and fast groups, and voluntary for the free groups. Half of the slow groups and half of the fast groups had four members; the remaining slow and fast groups had eight members. The free groups had 5 and 12 participants. Among these students, six female students were non-starters. During the course 14 students dropped out (4 males, 10 females) and 18 students moved to another group. Consequently, groups changed in composition and in group size. All groups had to study the same study-material emphasizing the use of questionnaires, moderation analysis with ANOVA, and regression methods. The groups of the second statistics course also used the Studynet CSCL environment. Here too, e-mail and telephone were prohibited.

9.6.2 Procedure

The Virtual Environmental Consultancy course lasted 14 weeks. In that period, there were three face-to-face meetings, namely a kick-off meeting, an evaluation meeting halfway through the course, and a closing meeting at the end of the course. The questionnaire containing all the scales (including the Social Presence Scale, Social Space Scale, Sociability Scale and all the other scales discussed in the next section), was

administered electronically (using Dipolar Professional Quest™ software[I], release 2.2) just after the second face-to-face meeting. From the 35 students 11 students (31.4 %) responded to the questionnaire of which 9 students (25.7 %) responded to all items. All respondents were either OUNL- or UM students. Although response was low, we had agreed with those responsible for the course that students were to be asked only once for filling in the questionnaire.

The first course from the Statistics Education Innovation Project lasted 18 weeks in which three face-to-face meetings were organized. The same electronic questionnaire was launched. From the number of students that actually participated (26 students; 38 initial students minus the number of non-starters minus the number of dropouts) 18 (69.2 %) students responded to the questionnaire. The distribution was as follows: one group had one response, three groups had two responses, one group had three responses, and two groups had four responses.

The second course from the Statistics Education Innovation Project had a variable length. Slow and free groups had ten months to complete the course while fast groups had six. At the time the questionnaire was launched, slow and free groups were still studying while the fast groups had already completed the course. From the number of students that still participated (93 students; 113 initial students minus the number of non-starters and minus the number of dropouts), 50 (53.8 %) students responded. Two students who dropped out also returned the questionnaire. The total number of respondents is, therefore, 52. In more detail: from the 29 students of the fast groups, 20 (69.0 %) students responded; from the 41 students of the slow groups, also 20 (48.8 %) students responded and one student who dropped out. From the 23 students of the free groups, 10 (43.5 %) students responded and one student who dropped out. The distribution of the responses in the fast groups is as follows: three groups had only one response, one group had two responses, two groups had three responses, one group had four responses, and one group had five responses. The distribution in the slow groups is as follows: one group had only one response, three groups had two responses, two groups had four responses, and one group had six responses. Finally, the distribution of the responses in the free groups is as follows: one group had two responses, one group had three responses, and one group had six responses.

9.6.3 Instrumentation

In our validation process, we used six measures that deal with constructs that are related to the social presence construct. These measures are:

- Social Space Scale (Kreijns, Kirschner, Jochems, Van Buuren, in press)
- Sociability Scale (Kreijns, Kirschner, Jochems, Van Buuren, 2004a)
- Social Presence Indicators (Gunawardena, 1995)
- Social Presence Scale (Gunawardena & Zittle, 1997)
- Work-Group Cohesiveness Index (Price & Mueller, 1986)
- Group Atmosphere Scale (Fiedler, 1962, 1967)

We briefly describe each of these measures in the next sub-sections.

[I] The Dipolar home site is http://www.dipolar.com.au.

9.6.3.1 *The Social Space Scale*

The (Dutch language) Social Space Scale measures the degree of the perceived quality of the social space that exists in a(n) (asynchronous) distributed learning group. Kreijns, Kirschner, Jochems, and Van Buuren (in press) define a social space to be the network of social relationships amongst the group members embedded in group structures of norms and values, rules and roles, beliefs and ideals. A social space is ′sound′ if it is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction, and a strong sense of community. We developed the Social Space Scale for isolating the social space aspects, which are implicitly measured by most existing social presence measures.

The Social Space Scale has two dimensions: Positive Group Behavior and Negative Group Behavior. Each dimension contains ten, 5-point Likert scale items. Examples of the test items are: 'Group members felt free to criticize the ideas, statements, and/or opinions of others', 'Group members gave personal information on themselves', and 'Group members grew to dislike others.' The Social Space Scale has a high internal consistency (Cronbach's alphas are .92 and .87 for the Positive Group Behavior- and Negative Group Behavior dimension respectively). We expected a moderate correlation between the aggregates scores of the items of the Positive Group Behavior dimension of the Social Space Scale and of the items of the Social Presence Scale because, based upon our theoretical discussions in the previous sections, social presence is hypothesized to affect social interaction in that it facilitates socio-emotional processes which may result in a sound social space. In contrast, it is difficult to predict the correlation between the aggregates scores of the items of the Social Presence Indicators and of the items of the Negative Group Behavior dimension of the Social Space Scale. Past research on social presence theory has suggested that CMC low in social presence may cause deindividuation and depersonalization effects, possibly leading to uninhibited behavior (Jessup, Connolly, & Tansik, 1990; Lea & Spears, 1991). Walther's (1992) social information processing (SIP) theory, on the other hand, rebuts these suggestions. We, therefore, did not predict a correlation at the moment.

9.6.3.2 *The Sociability Scale*

The (Dutch language) Sociability Scale measures the degree of perceived sociability of a CSCL environment. Kreijns, Kirschner, & Jochems (2002) define sociability as "the extent the CSCL environment is able to give rise to (…) a social space" (p. 14), that is, the extent to which a CSCL environment is able to facilitate the emergence of a social space. For the same reasons as the Social Space Scale, we developed the Sociability Scale to isolate aspects that deal with particular properties of the CSCL environment that make the environment more inviting for informal and chance social interactions. For example: in real life, a room that has no chairs and tables is probably not inviting people to stay there and converse with each other, while a room that has these 'social affordances' probably does. Some fast food restaurants are accused having such social affordances, which allow customers to sit long enough for eating their meal but hamper sitting too long and socializing.

The Sociability scale is one-dimensional and contains ten, 5-point Likert scale items. Examples of the test items are: 'This CSCL environment enables us to develop into a well performing team' and 'I feel comfortable with this CSCL environment.' Like the Social Space Scale, this Sociability Scale has a high internal validity

(Cronbach's alpha is .92). We expected a moderate correlation between the aggregates scores of the items of the Sociability Scale and that of the Social Presence Scale because sociability is concerned with aspects of person-to-person and group awareness (for awareness see, Kreijns, Kirschner, & Jochems, 2002) which directly affects the degree of social presence experienced.

9.6.3.3 *The Gunawardena Social Presence Indicators*

Gunawardena (1995) used a 17-item questionnaire composed of 5-point bipolar scale items (see Appendix 1) to assess a range of feelings students have towards CMC, which she equates to the perceived social presence. We have translated the items of this scale into Dutch for our questionnaire.

We expected (see the earlier discussion of this scale) a moderate correlation between the aggregates scores of the items of the Social Presence Indicators and of the items of our Social Presence Scale because only a part of the instrument measures social presence with the rest measuring sociability, social space, and other variables.

9.6.3.4 *The Gunawardena and Zittle Social Presence Scale*

The GZ Social Presence Scale (Gunawardena & Zittle, 1997) is an alternative scale for measuring social presence. The authors of the scale validated it using a bi-variate correlation analysis between the aggregated scores of the items of the GZ Social Presence Scale and six selected bi-polar items of the Social Presence Indicators. The GZ Social Presence Scale consists of 14, 5-point Likert-scale items (see the earlier discussion of this scale). We slightly adapted the items of the GZ Social Presence Scale to fit our particular setting and translated them into Dutch.

We expected a moderate correlation between the aggregates scores of the items of the GZ Social Presence Scale and of the items of our Social Presence Scale over a very high correlation because only a part of the scale measures social presence with the rest measuring sociability, social space, and other variables.

9.6.3.5 *The Price and Mueller Work Group Cohesion Index*

Price and Mueller (1986) developed their Work Group Cohesion Index to measure work-group cohesion in an organizational context. Work-group cohesion is "the extent to which employees have close friends in their immediate work units" (p. 252). We consider a distributed learning group to be similar to employees in their immediate work unit. The Work Group Cohesion Index consists of five, 5-point Likert scale items ('To what extent: were the other team mates friendly?' '(…) were the other team mates helpful?', '(…) did other team mates take a personal interest in you?', '(…) do you trust the other team mates?', and '(…) do you look forward to work again with the same team mates?'). The items of the measure were translated into Dutch.

We expected the correlation between the aggregated scores of the items of the Work Group Cohesion Index and of the items of our Social Presence Scale to be moderate because social presence and social cohesiveness mutually affect each other (Yoo & Alavi, 2001) but are not the same.

9.6.3.6 *Fiedler's Group Atmosphere Scale*

Fiedler (1967) developed the Group Atmosphere Scale, an 8-point scale for determining the atmosphere in a group as perceived by the group members (see Appendix

1). The items of the Group Atmosphere Scale were translated into Dutch and were modified to 5-point scales to concur with the other scales used.

Social presence affects social space and, thus, indirectly contributes to group atmosphere (social climate). Consequently, we expected a moderate correlation between the aggregated scores of the items of the Group Atmosphere Scale and the items of our Social Presence Scale. Because the Group Atmosphere Scale is very similar to the Gunawardena's Social Presence Indicators, we expected the correlation to be of the same magnitude as the correlation between the aggregated scores of the items of the Social Presence Indicators and of the items of our Social Presence Scale.

9.6.4 Refinement of the Raw Social Presence Scale

The raw Social Presence Scale initially consisted of eight items, which we eventually reduced to five items in order to derive a one-dimensional social presence measure. Firstly, two items were removed that did not accurately assess the psychological sensation associated with social presence. Factor analysis (Principal Component Analysis, no rotation) on the remaining six test items revealed two factors with one item loaded equally strong on both factors. This item was removed.

Table 9.1 depicts the refined Social Presence Scale. A second factor analysis (Principal Component Analysis, no rotation) was performed on the five test items of the refined scale to obtain the factor loadings on the first and only factor. This factor explained 57.17 per cent of the total variance.

9.7 Results

9.7.1 Internal Consistency and Validity of the Scales

Cronbach's alpha for the Social Presence Scale is .81, revealing a high internal consistency. The content validity of the scales was established via a test face-validity. The items were developed based upon a search in the literature regarding social presence, telepresence, social interaction via CMC, group development and group dynamics, trust building, and creating sense of community. The authors of this article then assessed items.

9.7.2 Pearson Bi-Variate Correlations

We applied a Pearson bi-variate correlation (2-tailed) analysis on the aggregate scores of the test items of each measure involved: Sociability Scale, Social Presence Scale,

Table 9.2
Pearson Bi-Variate Correlation Coefficients between the Social Presence Scale and the Other Scales (Text in parentheses reflects our predictions)

Measure	Sociability Scale	Social Space Scale		Social Presence Indicators	GZ Social Presence Scale	Work Group Cohesion Index	Group Atmosphere Scale
		Positive Group Behavior	Negative Group Behavior				
Social Presence Scale	.63** (moderate)	.53** (moderate)	−.10 (?)	.66** (moderate)	.62** (moderate)	.44** (moderate)	.54** (moderate)

** $p < .01$, 2-tailed.
* $p < .05$, 2-tailed.

Social Space Scale, Social Presence Indicators, GZ Social Presence Scale, Work Group Cohesion Index, and Group Atmosphere Scale. Table 9.2 depicts the correlations with respect to our Social Presence Scale. Appendix 9.2 depicts all correlations.

As can be seen from the table, the correlations vary between .44 and .66, which are at the low- and high end of the continuum that characterize moderate correlations (accounting for between 19% and 44% of the variance). The correlations between the aggregated scores of the items of the Social Presence Scale and of the items of the Work Group Cohesion Index and that of the Group Atmosphere Scale are at the low end because social presence only *indirectly* affects social cohesiveness and group atmosphere through social interaction. The correlation between the aggregated scores of the items of our Social Presence Scale and of the items of the Sociability Scale is at the high end because sociability is *directly* affecting social presence. The correlations between the aggregated scores of the items of the Social Presence Indicators and of the items of the GZ Social Presence Scale are also at the high-end because, ultimately, these measures were designed for assessing social presence in first place.

9.7.3 Factor Analysis Involving the Three Scales for Sociability, Social Presence, and Social Space

Finally, we carried out a factor analysis (Principal Component Analysis using Varimax rotation) on the ten test items of the refined Sociability Scale, the five test items of the Social Presence Scale, and the twenty test items of the Social Space Scale. We were interested in determining whether each of the measures assessed isolated phenomena, that is, sociability, social presence and social space or whether there was overlap. We therefore, restricted the extraction to only four factors because the purpose of this analysis was not to reveal new factors but rather to determine the uniqueness of the scales with respect to each other. Because the Social Space Scale has two dimensions and both the Sociability Scale and the Social Presence scale only one, the restriction was set to four. The result of the factor analysis is given in Table 9.3. From this table it can be seen that each of the three scales indeed measure isolated phenomena.

Table 9.3
Factor Analysis on the Scores of the Items of
the Sociability Scale, Social Presence Scale, and the Social Space scale

No. Item	Item	Factors			
		Sociability	Social Presence	Positive Group Behavior	Negative Group Behavior
Sociability Scale					
1	This CSCL environment enables me to easily contact my team mates	.74			
2	I do not feel lonely in this CSCL environment	.76			
3	This CSCL environment enables me to get a good impression of my team mates	.71			
4	This CSCL environment allows spontaneous informal conversations	.70			
5	This CSCL environment enables us to develop into a well performing team	.56		.45	
6	This CSCL environment enables me to develop good work relationships with my team mates	.70			
7	This CSCL environment enables me to identify myself with the team	.55		.46	

8	I feel comfortable with this CSCL environment	.73			
9	This CSCL environment allows for non task-related conversations	.68			
10	This CSCL environment enables me to make close friendships with my team mates	.69			
Social Presence Scale					
1	When I have real-time conversations in this CSCL environment, I have my communication partner in my mind's eye		.69		
2	When I have asynchronous conversations in this CSCL environment, I also have my communication partner in my mind's eye	.44	.65		
3	When I have real-time conversations in this CSCL environment, I feel that I deal with very real persons and not with abstract anonymous persons		.56		
4	When I have asynchronous conversations in this CSCL environment, I also feel that I deal with very real persons and not with abstract anonymous persons		.62		
5	Real-time conversations in this CSCL environment can hardly be distinguished from face-to-face conversations		.48		
Positive Group Behavior					
1	Group members felt free to criticize the ideas, statements, and/or opinions of others			.74	
2	We reached a good understanding on how we had to function			.76	
3	Group members ensured that we kept in touch with each other			.77	
4	We worked hard on the group assignment			.77	
5	I maintained contact with all other group members			.69	
6	Group members gave personal information on themselves	.42		.49	
7	The group conducted open and lively conversations and/or discussions			.79	
8	Group members took the initiative to get in touch with others			.80	
9	Group members spontaneously started conversations with others	.51		.53	
10	Group members asked others how the work was going			.60	
Negative Group Behavior					
11	Group members felt that they were attacked personally when their ideas, statements and/or opinions were criticized[a]				.73
12	Group members were suspicious of others[a]				.78
13	Group members grew to dislike others[a]				.66
14	I did the lion's share of the work[a]				.56
15	Group members obstructed the progress of the work[a]	.41			.58
16	Group members were unreasonable[a]				.90
17	Group members disagreed amongst each other[a]				.69
18	The group had conflicts[a]				.67
19	Group members gossiped about each other[a]				.69
20	Group members did not take others seriously[a]				.60

[a]These items were reverse coded for analysis.

9.8 Discussion and Conclusion

It is clear from the results that social presence is a unique construct and that the existing instruments for determining its degree of presence are inadequate. The results of this study, both the empirical and the nomological, unequivocally show that our instrument, if nothing else, is an important step in the right direction.

The validation of the social presence measure, however, does have some weak points. Firstly, the number of cases was 79. A general rule of the thumb is that there must be at least five to ten cases per item when performing a factor analysis. The raw Social Presence Scale initially contained eight items, implying that we needed between 40 and 80 cases to derive this measure. This condition was fulfilled. However, in the case of the factor analysis in which the three measures were involved, we actually needed between 175 and 350 cases, and this condition was not fulfilled. Secondly, three samples (VEC, Stat 1, and Stat 2) were collapsed in order to obtain the 79 cases and not one homogenous sample. Thirdly, we used the same cases for the factor analysis on the test items of the refined Sociability Scale, the Social Presence Scale, and the Social Space Scale. Due to this, the result (Table 3) might benefit from the chance characteristic of the 79 cases from which the Social Presence Scale (and the two other measures) was derived.

In other words, though the results are promising, we must stress that the findings suggest that the Social Presence Scale has potential to be useful as measures for measuring social presence. More experiments are needed for corroborating the findings in this article. In fact, we are just doing content analysis on the postings of a discussion board of the course Stat 1 using the community of inquiry model developed by Garrison, Anderson, and Archer (2000) and the template with indicators of social expressions provided by Rourke, Anderson, Archer, and Garrison (1999). Future articles will report on this issue and present results.

Appendix 9.1
Bipolar Scales

Item	(Short, Williams, & Christie, 1976)	(Steinfield, 1986)	Social Presence Indicators (Gunawardena, 1995)	Social Climate/ Social Presence (Rourke & Anderson, 2002)	(Tu, 1997)	Group Atmosphere Scale (Fiedler, 1962)
Informal – formal		√				
stimulating – dull			√		√	
personal – impersonal	√	√	√	√	√	
sociable – unsociable	√	√	√		√	
sensitive – insensitive	√		√		√	
warm – cold	√	√	√	√		√
colorful – colorless			√			
interesting – boring			√		√	√
appealing – not appealing			√			
interactive – non-interactive			√			
active – passive			√			
reliable – unreliable			√		√	
humanizing – dehumanizing			√			
immediate – non-immediate			√		√	
easy – difficult			√		√	
efficient – inefficient			√		√	
unthreatening – threatening			√		√	
helpful – hindering			√		√	
trusting – untrusting				√		
disinhibiting - inhibiting				√		
close – distant				√		
friendly – unfriendly				√		√
enjoy –					√	
stimulating – dull			√		√	
accepting – rejecting						√
satisfying – frustrating						√
enthusiastic – unenthusiastic						√
productive – non-productive						√
cooperative – uncooperative						√
supportive – hostile						√
successful – unsuccessful						√

Appendix 9.2
Pearson Bi-Variate Correlation Coefficients between the Scales
(Text in parentheses reflects our predictions)

Measure		Sociability Scale	Social Presence Scale	Social Space Scale		Social Presence Indicators	GZ Social Presence Scale	Work Group Cohesion Index
				Positive Group Behavior	Negative Group Behavior			
Social Presence Scale		.63** (moderate)						
Social Space Scale	Positive Group Behavior	.60**	.53** (moderate)					
	Negative Group Behavior	−.08	−.10 (?)	−.18				
Social Presence Indicators		.83**	.66** (moderate)	.58**	.01			
GZ Social Presence Scale		.85**	.62** (moderate)	.62**	.01	.85**		
Work Group Cohesion Index		.60**	.44** (moderate)	.70**	.28*	.59**	.66**	
Group Atmosphere Scale		.78**	.54** (moderate)	.55**	.12	.92**	.82**	.66**

** $p < .01$, 2-tailed.
* $p < .05$, 2-tailed.

CHAPTER 10

A Pilot Study: Testing the Hypotheses

Abstract

In this chapter, the results of a pilot study with asynchronous distributed learning groups utilizing a first prototype of a group awareness widget in a computer-supported collaborative learning environment are presented. This study is preliminary to a series of experiments aimed at finding evidence with respect to four hypotheses, namely that: (1) social affordance devices (e.g., group awareness widgets) positively affect to the sociability of computer-supported collaborative learning environments, (2) increased sociability increases the likelihood of the establishment of a sound social space, (3) increased sociability increases the degree of social presence, and (4) increased social presence increases the likelihood of the establishment of a sound social space. However, (1) the nature of distance education at the Open Universiteit Nederland and its typical students, (2) the characteristic of the software used, led to minimal results, which only give a first indication of the value of the chosen direction. The pilot study made clear that some of these variables are difficult to control in a field experiment, and consequently, although not preferable, laboratory experiments should be conducted first and should be followed by field experiments.

10.1 Objectives of the Pilot Study

The pilot study presented here is a first attempt to determine how the elements in the framework presented in earlier chapters –directly and indirectly– affect social interaction in CSCL environments and thus affect the creation of a social space and the establishment of a community of learning. A complete overview of the relationships can be seen in Figure 10.1. In fact, these relationships are hypothesized and need to be tested. Only the first four hypotheses are relevant for the present research:

H_1: Social affordances contribute to the degree of perceived sociability of the CSCL environment

H_2: A higher perceived sociability of the CSCL environment increases the likelihood of the establishment of a sound social space

H_3: A higher perceived sociability of the CSCL environment increases the degree of perceived social presence

H_4: A higher perceived social presence increases the likelihood of the establishment of a sound social space.

The other hypotheses fall beyond the scope of the present research, because they are not a consequence of the theoretical framework described, but are given here for reasons of completeness:

H_5: Social interaction affects the building of a mental model (individuating impressions are a dimension of the mental model; these impression are formed through social interaction, see Walther, 1992, 1993)

H_6: The mental model of the other is affecting the degree of perceived social presence (Tu, 2002b)

H_7: The application of pedagogical (collaborative) techniques will increase the degree of perceived social presence (Gunawardena, 1995)

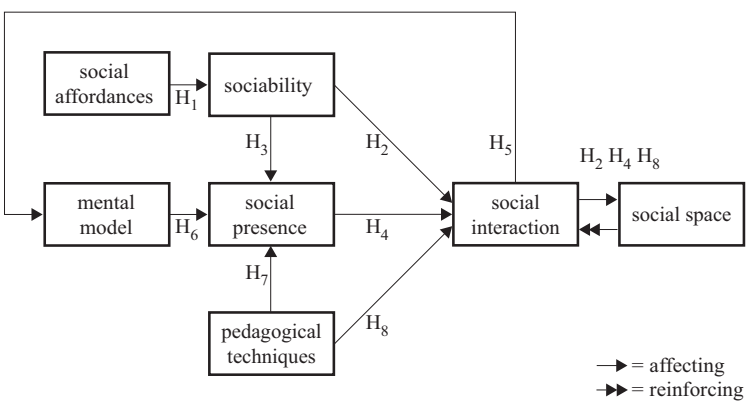


Figure 10.1 Model of Relationships between the Variables Sociability, Social Presence, Pedagogical Techniques, Social Affordances, Mental Model, Social Interaction and Social Space.
(Each Arrow Represents a Hypothesis)

H_8: The application of pedagogical (collaborative) techniques will increase the likelihood of the establishment of a sound social space (Dillenbourg, Baker, Blaye, & O'Malley, 1995; Mesh, Lew, Johnson & Johnson, 1986)

If there is evidence for the first four hypotheses, then the theoretical framework becomes a foundation framework for the design of sociable CSCL environments, and the importance of social presence for distance education is reaffirmed. Accordingly, the purpose of the present research is to test, through a series of empirical experiments, whether the four hypotheses hold. This chapter reports on a pilot study preliminary to the series of experiments. The objective of the pilot study is to gather first experiences of students regarding the use of the GAW prototype with respect to its interaction design and usability aspects (see for these issues, Section "Interaction Design" of Chapter 5). A second objective is to use the three scales developed in the present research (see Chapters 7, 8, and 9) to find first indications whether the four hypotheses will hold.

10.2 The GAW Prototype

The GAW prototype is a system consisting of a number of basic units; one of them is the GAW client (see Chapter 6). Participants have to install it on their computers. The GAW client is the most important unit because it encompasses the user interface component, which is used along with the e-mail client WebmailASP[I] and the chat client ZBIT chat[II]. The GAW prototype is used in conjunction with a CSCL environment, which is the Microsoft Sharepoint™ Team Services (SPTS) version 1.1[III]. The GAW user interface consists of a sidebar at the right side of the computer screen and two tickertapes on top of it (see Figure 6.7 of Chapter 6). The sidebar can be filled with segments, each providing group awareness information about a specific activity/engagement. The GAW prototype has defined nine types of activities/ engagements that can be detected and, thus, can be associated with group awareness information (see Table 10.1)

Table 10.1
Group Awareness Information in the GAW Prototype

	Types of group awareness information	Precise text that appears in GAW client
1	Connect and disconnect from internet	Going on- and offline (internet)
2	Opening and closing the GAW client	Starting and stopping the GAW
3	Posting a tickertape message	User (tickerbar) message
4	Posting a tickertape idea	New ideas from users
5	Browsing the course web site	Visits to course web-sites
6	Opening and closingthe e-mail client	Visit to the mail-server
7	Opening the chat-client	Visit to the chat-server
8	Posting an e-mail message	Entering a chat message
9	Posting a contribution to the discussion forum	Posting a forum message

[I] The WebmailASP home site is http://www.webmailasp.net.

[II] The ZBIT chat home site is http://zbitinc.com.

[III] The Microsoft® SPTS home site is http://www.microsoft.com/sharepoint/previous.

In this pilot study, however, it was decided that only one type of group awareness information will be provided, namely 'Connect and disconnect from internet.' The idea behind it is that this is a basic type of group awareness information and, thus, should be powerful enough in its own right for initiating communication episodes between participants (cf., MSN® Messenger, which shows similar information). The corresponding segment is depicted in Figure 10.2.

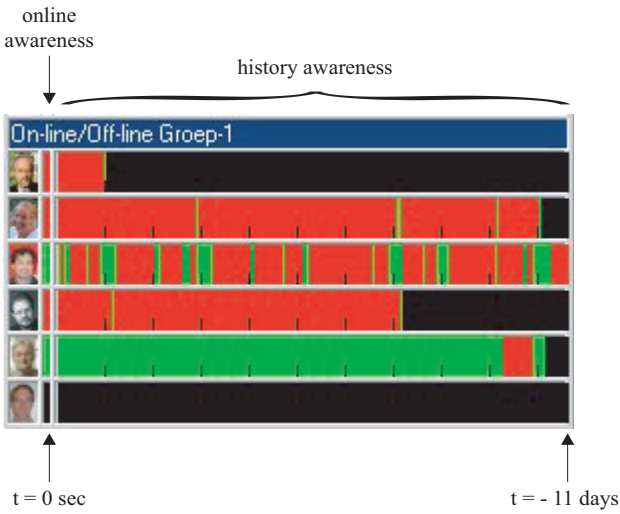


Figure 10.2 Segment Showing the Connection Times and Online Durations of the Members of this Group. The Time Unit is One Day

As can be seen from Figure 10.2, a row represents a member. Therefore, a group consisting of six members will have the segment display six rows. A row shows at the most left side a small picture of the participant. Clicking with the mouse on this picture opens a dialog box (not shown in Figure 10.2) containing the member's information and buttons for launching the e-mail or chat client. Directly at the right side of the picture, is a small rectangle that displays online awareness information. If the participant is online, then the color of this rectangle is green (white) and she or he can be contacted by real-time chat. If the participant is offline, then the color is red (grey). In that case, contact is only possible by e-mail. Black means that the participant has not installed the GAW prototype yet. The remaining part of the row displays history awareness information. A timeline is used for displaying this information.

The web-based e-mail client WebmailASP offers all basic e-mail functionalities required. For this pilot study, e-mail accounts were created for each participant, so that they could distinguish between mail for the purpose of this pilot and their other mail. The chat client ZBIT chat is a modest chat application with the possibility to create temporary rooms and the use of emoticons. ZBIT chat is a web-application too.

The use of these clients was driven by the need to log all messages. WebmailASP, for example, was modified to prevent the erasing of messages and could only retrieve messages from the created e-mail accounts. It was not possible for the participants to change their password or other system data such as the IP-address of the mail server. In

fact, if a participant opened WebmailASP, then all account data were passed automatically to the mail server so that participants did not need to bother with login procedures. If participants used their own e-mail accounts, it would not have been possible to access the messages produced in the pilot. The same considerations had led to the use of ZBIT chat. It was possible in ZBIT chat to automatically log all chat sessions on the server. In the same way as with WebmailASP, all login procedures started automatically when opening the ZBIT chat.

The logged data is used for further analysis (i.e., content analysis) at a later time (not in this chapter).

There was also a technical reason to choose for both clients. In order to generate the group awareness information, it is necessary to insert pieces of code that take care of that part in the application code.

Microsoft® SPTS is a web-based application consisting of a number of notification tools (such as announcements, event lists), productivity tools (such as contact lists, task lists) and one communication tool (discussion boards).

The choice for Microsoft® SPTS was driven by the fact that the CSCL environment should be as lean as possible with respect to social affordances as to make the contrast bigger between a CSCL environment with and without a GAW. Thus, the environment should ideally lack group awareness and possess as few communication media as possible. Microsoft® SPTS did fulfill these requirements.

10.3 Method

10.3.1 Participation

From the 129 students enrolled in the distance course *Interactive Multimedia* at the department of Informatics, 67 students (52,7 %) participated in the pilot study. From these participants, 51 (76.1%) were Dutch (42 male and 9 female) and 16 (23.9%) were Dutch speaking Belgians (12 male and 4 female). All students were distance students at the Open Universiteit Nederland following one or more courses there.

10.3.2 Treatment

Two conditions were examined in this pilot study. The first, the experimental condition, made use of the Microsoft® Sharepoint™ Team Services (SPTS) version 1.1 as CSCL environment and the GAW prototype in conjunction with the e-mail client WebmailASP and the chat client ZBIT chat. The control condition used the Microsoft® SPTS environment only. The two conditions were abbreviated as GAW condition and control condition respectively.

Participants were assigned to one of the two conditions depending on their connection to internet (Modem, ISDN, Cable, ADSL, or LAN). Those, who had a persistent connection (Cable, ADSL, or LAN), were assigned to the GAW condition with a maximum of 33 participants. The rest, together with those who had a modem or ADSL connection, were assigned to the control condition; this condition had 34 participants. Participants in each condition were further assigned to one of seven study groups. In the GAW condition, five groups had five members, and two groups had four members; in the control condition, six groups had five members and one group had four members. Belgian participants were assigned, for practical reasons, to the same groups with only one exception. Each condition had two groups with Belgian participants.

Participants in the GAW condition could download a manual for installing the GAW prototype with a description of how to use it, without revealing its real (i.e., experimental) purpose.

The course *Interactive Multimedia* is an undergraduate course[I], designed for independent study. The course encompasses two textbooks (234 and 184 pages respectively) and students have to do a practical in which they have to make a multimedia production. The text of the project description was slightly rewritten to suit collaborative learning. A paragraph was devoted to the benefits of collaborative learning as opposed to individual learning in order to motivate the students. The incentive for collaborative learning was relatively weak, relying primarily on individual accountability and not positive interdependence (see Chapter 2). It was agreed that individual accountability would be realized by grading each member as a function of the group reward and the observed individual contributions. Building a stronger incentive based on positive interdependence would have required a complete redesign of the course, which was not the intention of the course designers and instructors. The duration of the course was estimated to be 12 to 15 weeks.

Three instructors were involved in this course. The first instructor was responsible for two GAW groups and one control group located at the north-west of the Netherlands (region Amsterdam). The second instructor was responsible for only one control group located at the northeast of the Netherlands (region Zwolle) and two Belgian groups, one in the GAW condition and the other in the control condition. The remaining groups were the responsibility of the third instructor. These groups were located in the south of the Netherlands (region Rotterdam and Eindhoven). The same instructors were also responsible for students that did not participate in the pilot study. Instructors each organized a kick-off meeting, but it was up to each of them whether or not to organize additional meetings.

10.3.3 Procedure

The course started in the third week of November, 2003. An electronic questionnaire (using the Dipolar Professional Quest™ software[II], release 3.0) was administered in the second and third week of January, 2004. At that time, at least two additional face-to-face meetings were organized and a number of participants had left as non-starter (8 in the GAW condition and 14 in the control condition), dropout (4 in the GAW condition and 1 in the control condition), independent student (4 in the GAW condition and 6 in the control condition), or exemption (2 in the GAW condition and 3 in the control condition). From the remaining 15 participants in the GAW condition 8 (53.3%) responded, and from the remaining 11 participants (including 1 exemption) in the control condition 6 (54,5%) responded.

10.3.4 Instruments

A number of instruments were used for gathering data on social space, sociability, and social presence. These instruments were discussed in the chapters 7, 8, and 9.

[I] Specifics about the course can be found at http://srv-hrl-60.web.pwo.ou.nl/is-bin/INTERSHOP.enfinity/eCS/Store/nl/-/EUR/.

[II] The Dipolar home site is http://dipolar.com.au.

10.4 Results

The objective of the pilot study was to gather (1) first experiences with the GAW prototype and (2) first indications whether the four hypotheses hold.

From the 33 initial participants in the GAW condition, 21 (63,6 %) of them install the GAW prototype (see Figure 10.3). Participants did not, however, install the

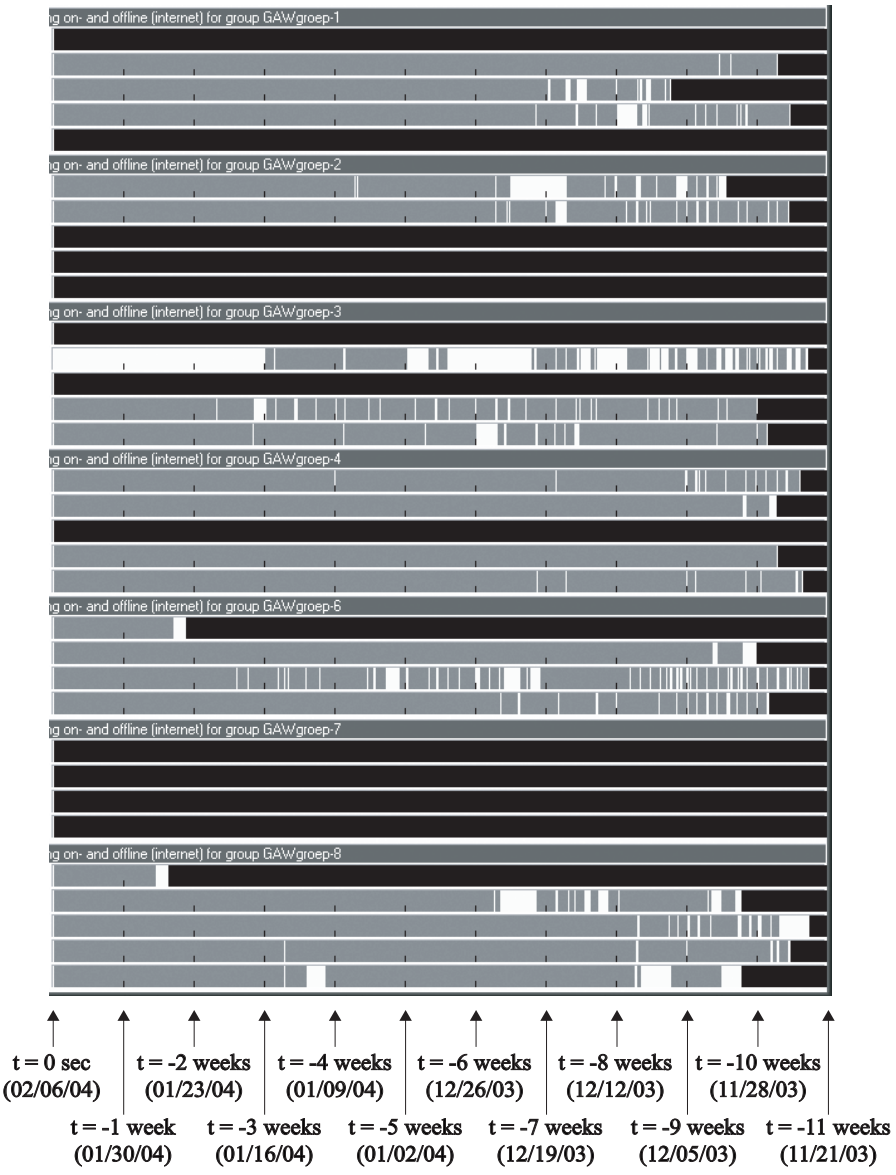


Figure 10.3 The History Awareness Information of All groups.
(Red/Grey = Offline; Green/White = Online; Black = GAW Not Installed)

GAW prototype right at the beginning of the course. Moreover, participants hardly used the GAW prototype. After installation, the pattern observed was that the majority of them started to use the GAW prototype only for 'spying', that is, to see if other group members were also online, which –of course– was rarely the case because the others spied as well. This spying involved opening the GAW prototype, quickly glancing at the awareness information, and then closing it. The general picture was that after spying a couple of times, participants stopped using the GAW prototype because 'nobody' was online. Apparently, the majority of participants did not understand that the GAW prototype should be opened for a longer time (i.e., a few minutes) to increase the likelihood to see members going online and offline.

In addition, participants had to start the GAW prototype separately from the Microsoft® SPTS environment. If this was finally started, they often forgot or did not make the effort to start the GAW prototype, because they were already busily reading the new contributions or writing new ones.

Finally, because not all members had installed the GAW prototype or they launched it very rarely, use decreased enormously. From critical mass theory, a critical number of members must use the GAW prototype if the GAW is going to be used at

Table 10.2
Social Space Scale

No. Item	Item	GAW (N=8)		control (N=6)	
		M	*SD*	*M*	*SD*
Positive Group Behavior		27.50	8.80	22.23	8.87
1	Group members felt free to criticize ideas, statements, and/or opinions of others	3.00	1.07	2.67	1.21
3	We reached a good understanding on how we had to function	3.00	.93	2.50	1.05
5	Group members ensured that we kept in touch with each other	2.88	.99	1.83	.75
7	We worked hard on the group assignment	3.13	.99	2.33	1.21
9	I maintained contact with all other group members	2.50	1.51	1.83	.98
11	Group members gave personal information on themselves	3.25	1.04	2.00	.63
13	The group conducted open and lively conversations and/or discussions	2.75	1.04	2.50	1.38
15	Group members took the initiative to get in touch with others	2.63	1.06	2.50	1.23
17	Group members spontaneously started conversations with others	2.25	1.04	2.17	.98
19	Group members asked others how the work was going	2.13	1.13	2.00	1.10
Negative Group Behavior		45.00	5.04	43.83	7.28
2	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized[a]	4.50	.76	4.67	.52
4	Group members were suspicious of others[a]	4.38	.92	4.50	1.23
6	Group members grew to dislike others[a]	4.63	.74	4.00	1.55
8	I did the lion's share of the work[a]	4.00	.76	3.33	1.86
10	Group members obstructed the progress of the work[a]	4.38	.92	4.17	1.60
12	Group members were unreasonable[a]	4.88	.35	4.67	.52
14	Group members disagreed amongst each other[a]	4.38	.92	4.83	.41
16	The group had conflicts[a]	4.63	.74	4.50	.55
18	Group members gossiped about each other[a]	4.75	.71	4.33	1.63
20	Group members did not take others seriously[a]	4.50	.93	4.83	.41

Note. For items (refined Social Space Scale) 1–12: Judgments were made on 5-point Likert scales (1 = *not applicable at all*; 2 = *rarely applicable*; 3 = *moderately applicable*; 4 = *largely applicable*; 5 = *totally applicable*). For items (refined Social Space Scale) 13–20: Judgments were made on 5-point Likert scales (1 = *very rarely or never* (on the average less than once a month), 2 = *rarely* (on the average once a month), 3 = *sometimes* (on the average a few times a month), 4 = *often* (on the average a few times a week), 5 = *always or very often* (on the average a few times a day)).

[a]These items were reverse coded for analysis.

all. Mahler and Rogers (1999) define critical mass as the minimal number of adopters of an interactive innovation for the further rate of adoption to be self-sustaining (cf., Markus, 1990). In the case of this pilot, it was clear that all members had to use the GAW prototype, for the critical number was equal to the number of members in the group, which was true in just two groups (see GAWgroep-6 and GAWgroep-8 in Figure 10.3).

Since the GAW prototype was hardly used, the number of respondents was low (14 in total), quite a number of participants left the pilot (41 of the initial 67 participants[1]), and the objectives of the pilot were not achieved. Hence, it was decided to make use of descriptive statistics only.

From this data, it can be seen that with respect to the Social Space Scale, participants in both conditions scored low to moderate on the Positive Group Behavior dimension, indicating that a sound social space did not emerge, but that the social space that did developed was adequate. The scores on the Negative Behavior Scale confirm this; these are high, meaning that negative behavior is not an issue here (see Table 10.2).

Participants in both conditions rated the software environment as low in sociability (see Table 10.3). This means that the Microsoft® SPTS environment needs to be improved (the data reflect to a much greater degree the experiences with the Microsoft® SPTS environment than with the GAW prototype, because the latter was hardly used). But, as mentioned before, this environment was specifically chosen because it met the requirement that the CSCL environment for the experiments should be as lean as possible with respect to social affordances. In that respect the

Table 10.3
Sociability Scale

No. Item	Item	GAW (N=8)		control (N=6)	
		M	*SD*	*M*	*SD*
		24.75	8.05	20.33	7.84
1	This CSCL environment enables me to easily contact my team mates	2.50	1.20	2.00	.89
2	I do not feel lonely in this CSCL environment	2.00	1.07	2.17	.98
3	This CSCL environment enables me to get a good impression of my team mates	2.50	1.20	2.00	.89
4	This CSCL environment allows spontaneous informal conversations	2.25	1.04	1.67	.82
5	This CSCL environment enables us to develop into a well performing team	2.38	1.19	2.17	.98
6	This CSCL environment enables me to develop good work relationships with my team mates	2.50	1.20	2.00	1.10
7	This CSCL environment enables me to identify myself with the team	2.38	1.07	2.00	1.10
8	I feel comfortable with this CSCL environment	3.00	1.51	2.33	1.21
9	This CSCL environment allows for non task-related conversations	3.38	1.30	2.33	.82
40	This CSCL environment enables me to make close friendships with my team mates	1.88	.99	1.67	.82

Note. Judgments were made on 5-point Likert scales (1 = *not applicable at all*; 2 = *rarely applicable*; 3 = *moderately applicable*; 4 = *largely applicable*; 5 = *totally applicable*).

[1] Prior experience with this course *Interactive Multimedia* reveals that this is apparently a normal phenomenon. Approximately 20% to 30% is finally completing the course.

Table 10.4
Social Presence Scale

No. Item	Item	GAW (N=8)		control (N=6)	
		M	*SD*	*M*	*SD*
		13.88	5.11	10.67	4.93
1	When I have real-time conversations in this CSCL environment, I have my communication partner in my mind's eye	3.12	1.36	2.00	1.27
2	When I have asynchronous conversations in this CSCL environment, I also have my communication partner in my mind's eye	2.75	1.49	2.50	1.05
3	When I have real-time conversations in this CSCL environment, I feel that I deal with very real persons and not with abstract anonymous persons	3.25	1.28	2.17	1.47
4	When I have asynchronous conversations in this CSCL environment, I also feel that I deal with very real persons and not with abstract anonymous persons	2.75	1.28	2.50	1.05
5	Real-time conversations in this CSCL environment can hardly be distinguished from face-to-face conversations	2.00	1.20	1.50	.84

Note. Judgments were made on 5-point Likert scales (1 = *not applicable at all*; 2 = *rarely applicable*; 3 = *moderately applicable*; 4 = *largely applicable*; 5 = *totally applicable*).

choice of Microsoft™ SPTS seems to be justified. The scores of the Social Presence Scale are also low to moderate (see Table 10.4).

10.5 Discussion

The pilot study showed a number of things.

Firstly, the GAW prototype was realized and functioned flawlessly during the pilot. There were no problems with 'crashes' since the start of the pilot. In other words, the GAW prototype was easy to install and was highly reliable. As soon as participants installed the GAW prototype and went online or offline, these activities could immediately be seen by the other participants (on the assumption that they installed it as well) because group awareness information was continuously updated. The e-mail client WebmailASP and the chat client ZBIT chat also functioned with high reliability, but their availability was moderate to high (occasionally, participants had problems entering the chat and connecting to the mail-server). Microsoft® SPTS was highly reliable and available, but its usefulness was, according to the participants, low because it was very slow, inconveniently arranged, and meager regarding its functionalities.

A second encouraging result is that the scores, as depicted in the tables 2, 3, and 4, show a slight difference between the groups in the GAW condition and the control condition in favor of the groups in the GAW condition (i.e., the expected direction).

Thirdly, and this is less encouraging, participants failed to really appreciate the GAW prototype. Apparently, its function was not clear to the participants; most of them used the GAW prototype only for spying (cf., waylaying in Babble, Bradner, Kellogg, & Erickson, 1999) but this turned out to be unsuccessful. Consequently, the actual use of the GAW prototype was very low and gradually ceased altogether.

Finally, in the time between the start of the course and the administration of the questionnaire, 41 participants had left the course. Two groups in the GAW condition and two groups in the control condition continued with at least three members. In addition, two dyads in the GAW condition continued with the pilot.

The fact that the GAW prototype was hardly used, quite a number of participants left the pilot, and the low number of responses to the questionnaire caused the pilot not to meet its objectives. The next sub-sections elaborate on the reasons why the participants left the pilot and will discuss the software used in greater detail.

10.5.1 Participants Leaving the Pilot

The Open Universiteit Nederland is an institution for higher distance education and its students surely have different characteristics than the students at traditional universities. They are adults ranging in age from 25 to 65 years with full-time work, who are given the freedom to study courses whenever they wish, in their own pace, and from any location. This freedom of time, pace, and place supports students with an independent learning style and is one of the reasons why people choose to study there. Rourke and Anderson (2002) found that there is a "group of students [that] may select distance education because it has traditionally allowed students to work towards their goals independently without having to interact with others" (p. 270). Therefore, putting students with an independent learning style in a collaborative learning setting might negatively influence their satisfaction and cause conflict. A respondent pointed to this by stating that the pilot has to deal with "strong individuals who were (…) asked to work in a team", and yet another stated that "it is difficult to put people who study on an individual base in groups[I]." Also, the primary concern, for the most of these students, is to get a grade (homo economicus) and some of them have a specifically scheduled period in which they take their examination (window of opportunity). This is the main reason that not all students who enrolled in the course wanted to participate. Yet, the pilot study had some participants falling in this category. Therefore, when at a certain moment they felt that working and learning in a group, the Microsoft® SPTS CSCL environment, or even the pilot was hindering them to achieve their goals, they expressed their wish to proceed individually and left the pilot. There was another reason to proceed individually, namely in the case that participants could not keep pace with the group to which they belonged.

Participants also left the pilot for other reasons related to distance education. Some of them were non-starters, others dropped out, and a few were exempted from the course. *Non-starters* are students who either enroll for a course just to acquire the course materials[II] or enroll for a course with the intention of following it but get 'frightened' when they look at the learning material. In addition, although the intentions for starting to study the learning materials are real, time and again things come in between, postponing the start of the study. In the end, these students actually do not start, and become non-starters. *Dropouts* are students that gradually discover that the learning material is more difficult than they initially thought. Also, personal circumstances may change (e.g., having a baby, moving to another town because of a job change) causing the student to quit the study. Another reason to drop out is

[I] Translated from Dutch

[II] The course material of the Open Universiteit Nederland are 'famous' for their high quality, but are not sold separately. Thus, to acquire the materials one must register for the course.

loosing interest in the subject of the course because it does not meet expectations. Finally, dropout can be explained from feelings of loneliness in a distance course (Rovai, 2001, 2002a, 2002b). *Exemptions* are participants who received a notice that they had already completed compensating courses.

Here a point of concern is expressed. The observations make clear that collaborative learning and the use of CSCL environments in distance education might be problematic, mainly because it is not aligned with the freedom to study whenever a student wishes.

10.5.2 Critique on the Software Used

Microsoft® SPTS

Participants in both conditions indicated that the Microsoft® SPTS CSCL environment has a number of flaws that make it less suitable for being a learning environment (e.g., it was not possible to attach files to messages in the discussion boards; the sign 'new' caused confusion in that this mark does not disappear after the message was read but is automatically removed after 24 hours, making participants unsure whether they had already read the message or not). The most striking point is that Microsoft® SPTS is perceived as very slow. The comments of the respondents led to the general conclusion that the environment was tolerable, but not appreciated.

Some participants in the control condition expressed feelings that indicated that the Microsoft® SPTS is, with respect to communication, a too lean environment. One group even decided to switch to Yahoo!®[I] Groups.

A technical issue is that in Belgium the internet traffic has to be secured that conveys log in data (meaning that 'https://(…)' instead of 'http://(…)' should be used) causing the Windows® environments to generate Security Alert messages when visiting other web sites outside Microsoft® SPTS[II].

WebmailASP and ZBIT Chat

Participants in the GAW condition additionally expressed that the chat client (ZBIT chat) has a problem with the logout procedure, which if it occurs, inhibits logging in next time. These participants also expressed that the e-mail client (WebmailASP) lacks the advanced features of Microsoft® Outlook/Express, leaving them very unsatisfied. Some students also experienced problems connecting to the mail-server.

Because the e-mail client and the chat client are hosted on a different computer as where Microsoft® SPTS is hosted, participants have to log in on that server too when they launched the clients. Participants found that very annoying.

GAW Prototype

Because the GAW prototype was hardly used, participants did not express feelings on it, neither for good or bad.

[I] The Yahoo!® Groups home site is http://groups.yahoo.com.

[II] Although these messages can be switched off, some participants preferred them because the messages let them know when leaving or entering a secure site.

10.6 Conclusion

The pilot study showed that the GAW prototype was realized and fully functional. However, because the GAW prototype was hardly used, quite a number of participants left the pilot, and the number of responses was low. Therefore, the pilot study cannot empirically answer the research questions, that is, present empirical indications that the four hypotheses hold. However, the pilot study makes clear that there exists a tension due to the misalignment between collaborative learning (that exhibits high coordination and time constraints, but attracts learners with a collaborative learning style) and the typical characteristic of distance education (freedom of time, pace, and place, therefore, attracting independent learners). The implications of this misalignment with respect to the introduction of collaborative learning in distance courses require further exploration. The pilot study also makes clear that if collaborative learning is applied in distance courses, the incentive of collaborative learning should be much stronger, for example, through the structuring of positive interdependence into the learning tasks. Collaborative learning based upon individual accountability alone is too weak; participants tend to wait for others to do something and, thus, do not effectively collaborate. Another point that the pilot makes clear is that the software should show high quality on every aspect of it such that it can 'compete' with commercial and other software packages. The participants in the pilot were informatics students, and they (always) knew 'better' alternatives. However, it is almost impossible that a higher education institute can compete with software giants like Microsoft® who can put many more programmers on a software development project.

The final conclusion is that the pilot study showed that a field experiment using a standard distance course yields a number of variables that are difficult to control. Although not preferable, laboratory experiments should be conducted first and only then be followed by field experiments.

CHAPTER 11

General Discussion

Abstract

This chapter summarizes the findings of the present research in four categories: literature, theory, materials, and experimental findings. The present research advances a theory on designing sociable computer supported collaborative learning environments and the relationships that exist between the support of social functionalities and learning performances, which is important for the computer supported collaborative learning community in general and the Open Universiteit Nederland in particular. However, this theory still needs validation, which is seen as an activity for future research. Such future research also encompasses new directions, including the application of the theory of affordances for learning processes and the examination of other variables, such as social navigation and social browsing which affects the sociability of a computer supported collaborative learning environment.

11.1 The Results

11.1.1 The Literature

The present research started with a literature review to identify the causes underlying the general observation that often the use of computer supported collaborative learning (CSCL) environments in asynchronous distributed learning groups (DLGs) were unsuccessful (Gregor & Cuskelly 1994; Hallet & Cummings, 1997; Heath, 1998; Hiltz, 1998; Hobaugh, 1997; Hughes & Hewson 1998; Mason, 1991; Taha & Caldwell, 1993). An analysis of the literature revealed two pitfalls and three categories of barriers in the use of CSCL environments (Chapter 2). The two pitfalls identified are:

- taking social interaction for granted, thus thinking that the interactivity provided by the CSCL environments will guarantee that social interaction will take place and
- taking group forming and group dynamics for granted and, thus, restricting social interaction to the support of cognitive processes only.

The three categories or 'rings' of barriers are:

- Ring 1: CSCL pedagogy. The fact that there is no suitable CSCL pedagogy forms the first barrier against achieving effective and efficient asynchronous DLGs. This has led many educators to apply educational techniques that are successful in face-to-face settings which, however, might not be suitable to asynchronous DLGs (Chapter 2, 3).
- Ring 2: CSCL communication media. The fact that communication media are limited in their capacity to transfer socio-emotional cues forms a second barrier, namely to the forming of groups and group dynamics (Chapter 2).
- Ring 3: CSCL environment. The CSCL environment itself is a third potential barrier. The CSCL environment may provide insufficient functionalities and may not be usable, thereby demotivate the use of it (Chapter 2, 5).

From these literature findings, it was concluded that contemporary CSCL environments are predominantly *functional*, that is, they are singularly focused on the provision of educational functionality (confirming the existence of the second pitfall). In addition, the design of these environments often fails to take interaction design and usability principles into account. If the environment lacks an attractive and usable interface, then learners will avoid using the CSCL environment.

The present research primarily focuses on the barriers in Ring 3, that is, it seeks to find theoretically based guidelines for designing *sociable* CSCL environments that are both attractive and useful. These guidelines are presented as a theoretical framework in the next sub-section. The present research also partially focused on barriers in Ring 2. Consequently, the theoretical framework also pays attention to the application of social presence theory.

11.1.2 The Theory

The present research formulated a framework upon which the design, implementation, and realization of sociable CSCL environments can be based. The theoretical framework (Chapter 4) has three interrelated foci:

- The ecological approach to social interaction (Gaver, 1996; Gibson, 1986), including the theory of affordances (Gibson, 1977) which provides a means for developing sociable CSCL environments
- The concept of sociability (Kreijns, Kirschner, & Jochems, 2002), which has been taken from theories about how public spaces can be transformed into sociable places (Whyte, 1980; Gehl, 2001). Sociability is defined here as the extent to which the CSCL environment is able to facilitate the emergence of a social space.
- The theory of social presence (Short, Williams, & Christie, 1976), which is especially important in disembodied contexts. This dissertation defines social presence as the illusion that the other in the communication is perceived as physically 'real.'

In essence, the theoretical frameworks holds that if social interaction is to be increased for group forming and group dynamics so that this may result in a sound social space, then (1) the CSCL environment should encourage it through the incorporation of social affordance devices and (2) social presence has to be created amongst the group members. Social affordance devices are (software) artefacts that create opportunities for social interaction by electronically bringing group members together and giving meaning to this gathering through the provision of group awareness (i.e., awareness about where the group members are and what they are doing) and a set of communication media. This characteristic warrants the perception-action coupling, which is one of the two defining relationships of affordances. The other is the reciprocal relationship that exists between what is offered by the artefact and the needs of the group member (Gibson, 1977). Social affordance devices contribute to the sociability of CSCL environment and, thus, may increase the likelihood that a sound social space will arise. Such social space is characterized by common goals, norms and values, trust and belonging, and a sense of community, allowing group members to make the transition from a group of individuals to a performing team.

Social presence is another factor that may increase the likelihood that a social space will emerge. The framework, however, points out that it is still unclear what exactly the determinants are that increase the degree of perceived social presence. In contrast to *classical* social presence theory (Short, Williams, & Christie), *new* social presence theory sees social presence co-determined by social factors *and* technological features (Sudweeks, McLaughlin, & Rafaeli, 1998; Spears, Postmes, Wolbert, Lea, & Rogers, 2000). The development of a solid (new) social presence theory has recently been started and is a work-in-progress (Biocca, Harms, & Burgoon, in press).

The present research clearly views the theoretical framework as complementary to the educational approaches that also try to stimulate social interaction. Although the social interaction is oriented towards learning tasks, Mesh, Lew, Johnson, and Johnson (1986) and Dillenbourg, Baker, Blaye, and O'Malley (1995) found that it has also a social psychological dimension.

11.1.3 The Material

The application of the theoretical framework resulted in the design, implementation, and realization of a first GAW prototype (Chapter 5 and Chapter 6). Three basic units –GAW client, GAW relay server, and GAW server– form the building blocks of the GAW prototype:

The GAW client's main component is the user interface. This component features:

- a sidebar for containing segments displaying graphically different kinds of group awareness information, and
- two tickertapes. One tickertape is directly accessible for posting messages; the other is meant for displaying notification messages.

The user interface component is loosely coupled with the web-based e-mail client ZIT chat and WebmailASP. These clients are accessible through the member's information dialog box. This dialog box is invoked from the tickertapes and from the segments. The user interface is the only component that group members see.

The GAW relay server's only function is to pass notifications generated by event notification generators to the GAW server. These event notification generators are small devices that are inserted at code level into the software of the applications.

The GAW server has two main components:

- an event notification server using the open source SIENA event server for distributing events as notifications across the internet, and
- a global repository using the MySQL open source application for storing the notifications, account information, and system information.

The GAW prototype must be regarded as providing a minimum of social functionality that is adequate for generating effects that can be measured in the experiments.

11.1.4 The Experiments

11.1.4.1 *The Measurement Instruments*

Measurements instruments were developed for measuring social space, sociability, and social presence. The findings suggest that the Social Space Scale, Sociability Scale, and the Social Presence Scale have potential as measures for the respective variables.

The Social Space Scale

Social space is defined as the human network of social relationships amongst the group members, which are embedded in group structures of norms and values, rules and roles, beliefs and ideals (see "The Sociability of CSCL Environments" in Chapter 4). The Social Space Scale measures two dimensions of social space, namely Positive Group Behavior and Negative Group Behavior, each encompassing ten, 5-point Likert scale items. Positive group behavior exists when group members help each other, reveal personal information on themselves, feel free to criticize others without harming them, and so forth. Negative group behavior exists when group members dislike each other, are suspicious of other group members, are unreasonable, and so forth.

The Social Space Scale is a two-part measurement instrument. The first part (items 1–12) assesses the applicability of feelings of group members regarding their own or other member's behavior in the CSCL environment. The second part (items 13–20) assesses perceived frequencies of social behavior in the CSCL environment. The

internal consistency was .81 for the total scale, .92 for the Positive Group Behavior dimension and .87 for the Negative Group Behavior dimension. A nomological network was used for further validation. Appendix 11.1 in this chapter depicts the Social Space Scale as questionnaire.

The Sociability Scale

Sociability is defined as the extent to which the CSCL environment is able to facilitate the emergence of a social space (see "The Sociability of CSCL Environments" in Chapter 4). The Sociability Scale consists of ten, 5-point Likert scale items, is one dimensional, and its internal consistency is .92. A nomological network was used for further validation. Appendix 11.2 depicts the Sociability Scale as Questionnaire.

The Social Presence Scale

Social presence is defined as the degree of the psychological sensation in which the illusion exists that the other in the communication appears to be a 'real' physical person either in an immediate (i.e., real time or synchronous) or in a delayed (i.e., time-deferred or asynchronous) communication episode (see "Introduction" in Chapter 8). The Social Space Scale consists of five, 5-point Likert scale items, is one dimensional, and its internal consistency is .81. As was the case for the other two measures, a nomological network of similar constructs was used for further validation.

11.1.4.2 *Pilot Study*

A pilot study was conducted as a preliminary to a series of experiments. In this pilot study, participants in the experimental condition had access to the GAW prototype, the e-mail client WebmailASP, and the chat-client ZBIT chat whereas participants in the control condition did not have these applications. In both conditions the Microsoft® SPTS was used as CSCL environment.

One objective of the pilot study was to gather first experiences and thoughts of students regarding the use of the GAW prototype. Another objective was to use the three scales (Social Space Scale, Sociability Scale, and Social Presence Scale) to find indications in favor of the four hypotheses (and if so, this would have to be empirically reaffirmed by the next experiments):

H_1: Social affordances contribute to the degree of perceived sociability of the CSCL environment

H_2: A higher perceived sociability of the CSCL environment increases the likelihood of the establishment of a sound social space

H_3: A higher perceived sociability of the CSCL environment increases the degree of perceived social presence

H_4: A higher perceived social presence increases the likelihood of the establishment of a sound social space.

Observations

The following observations were made. Firstly, although the GAW prototype functioned flawlessly during the pilot, the GAW prototype was hardly used because (1) participants did not fully understand its function and used it as a tool for spying, but since this turned out to be unsuccessful, its use decreased; (2) after starting Microsoft®

SPTS, participants often began to work in this environment at once and forgot or did not make the effort to start the GAW prototype too; and (3), critical mass of use was not achieved in the groups because not all members of the group used the GAW prototype.

Secondly, quite a number of participants left the pilot because (1) they proceded individually (either (a) because these participants had a strong independent learning style and found group learning obstructive and, therefore, were granted to continue on an individual base or (b) because they could not keep pace with the group), (2) were non-starters (these participants never started with the course), (3) were dropouts (these participants discovered at some point during the course that they could not keep up because either (a) the course material was too difficult or (b) because of personal circumstances), or they were exempted from the course (as they had already completed compensating courses).

Mainly, because the number of responses was low, the pilot study cannot present empirical indications that the four hypotheses hold. However, the pilot study did show the tension between collaborative learning (exhibiting high coordination and time constraints, thus attracting learners with a collaborative learning style) and the typical characteristics of distance education (freedom of time, pace, and place, therefore, attracting independent learners). The pilot study also made clear that if collaborative learning is applied in distance courses, the incentive of collaborative learning should be much stronger, for example, through the structuring of positive interdependence into the learning tasks. Finally, the pilot did make clear that participants (informatics students) were critical of the software used, often because they knew or were used to 'better' alternatives. Therefore, anything less than those alternatives made some of them dissatisfied with the software used in the pilot. This particularly refers to the Microsoft® SPTS (participants of in both conditions) and WebmailASP application (participants in the GAW condition). Participants did not complain about the GAW client (i.e., its user interface), but this is merely because the GAW prototype was hardly used.

Conclusions

The pilot study did not give the results for which it was designed. Clearly, the observations showed that a field experiment using a regular distance course has its drawbacks. Alternative ways for performing field experiments should be explored in future research including laboratory experiments.

11.2 Limitations in the Present Research

11.2.1 The First GAW Prototype

The GAW prototype was developed based upon the aforementioned theoretical framework. However, it remains a *first prototype*, it is, therefore, rudimentary in architecture, and its user interface lacks certain interaction design and usability aspects. The short time schedule (approximately five months) for designing, implementing, realizing, and testing the GAW prototype from scratch has led to drastic decisions in each phase of its development which in some cases have led to a tension between what was possible otherwise and what should have be realized according to the guidelines of the framework. This tension is particularly salient in the user interface component of

the GAW client. Although the participants of the pilot study did not complain about the user interface, it does need a number of improvements.

Due to the short period of time, the current choices of notification types (see Table 6.2 in Chapter 6) are probably not optimal. The question arises whether other choices of notification types –and, thus, corresponding kinds of group awareness information– would improve the overall picture developed by group members of the behavior of other group members. In addition, the number of notification types may have been too conservative or too large.

Usually, software projects like this one take much longer than the approximately five months time that was allotted to it (due to budgetary and practical constraints). Another two months were needed to integrate the e-mail client WebmailASP and the chat client ZBITchat into the GAW prototype and the Microsoft® SPTS.

Lastly, the limited time for testing the GAW prototype prevented a thorough test.

11.2.2 The Measurement Instruments

The validation of the three instruments has some weak points. In the first place, the number of cases was 79 (Chapter 7, 8, and 9). A general rule of the thumb for factor analysis is that there must be at least five (Gorsuch, 1983) to ten (Nunnally, 1978) cases per item. The raw Social Space Scale contained 44 initial test items, meaning that actually between 220 and 440 cases would be needed. Secondly, the research used three samples that were collapsed to obtain the 79 cases. Finally, the same cases –used for the factor analysis for deriving the three instruments– were reused for the factor analysis on the test items of the refined Sociability Scale, the Social Presence Scale, and the Social Space Scale. This implies that the result (Table 9.3, Chapter 9) might have benefited of the chance characteristic of the 79 cases from which the scales were derived. Taken together, these weak points show that the findings in this dissertation suggest that the instruments are potentially useful as measures for the respective variables, but they do need further validation.

11.2.3 Experiments

The present research has performed a pilot study to obtain first experiences with the GAW prototype and for finding indications whether the four hypotheses hold. However, due to reasons explicated in the previous section about the pilot study, the results aimed at were not obtained.

11.3 The Relevancy

11.3.1 For the CSCL Community at Large

As pointed out in Chapter 2, a number of problems (pitfalls and barriers) plague the CSCL community when deploying CSCL environments in asynchronous DLGs. The present research provides a theoretical framework aimed at overcoming the barriers in the second and third ring (for the educational approaches aimed at overcoming the barriers in the first ring, see Chapter 3) by stressing the need for sociable CSCL environments. The framework has its roots in ecological psychology, the theory of affordances, and social presence theory. Consequently, the framework has three interrelated foci, namely the ecological approach to social interaction, the concept of sociability, and the concept of social presence (see Chapter 4).

The framework was used in two ways. Firstly, it was used to derive theoretically based guidelines for designing and implementing social affordance devices, in particular group awareness widgets. These guidelines encompass both utility aspects as well as interaction design/usability aspects (see Chapter 5). Such guidelines can be of great help to the designers and researchers of CSCL environments who all too often use trial-and-error methods or other ad-hoc methodologies when designing CSCL environments.

Secondly, it was used to develop three instruments –the Social Space Scale, the Sociability Scale, and the Social Presence Scale– for measuring social space, sociability, and social presence respectively. These instruments are important for designers of CSCL environments because they provide a means for assessing the quality of the sociable CSCL environments that are designed, implemented, and realized based on the guidelines presented here.

11.3.2 For Distance Education

As a distance education institution, the Open Universiteit Nederland is continuously investigating ways to innovate its education to suit its geographically dispersed student population (i.e., distance education students). This innovation in education also encompasses the transition from individual learning to collaborative learning within asynchronous DLGs. Within that context, the Open Universiteit Nederland has begun to use CSCL environments that embrace the newly offered opportunities brought about by ICT and the internet. The present research can help in achieving its goals.

However, the present research has also revealed a number of concerns that may have consequences regarding the introduction of collaborative learning in distance education. Firstly, the pilot study has shown that the misalignment between collaborative learning (requiring coordination, exhibiting time constraints, and is attracting learners with a collaborative learning style) and the typical characteristic of distance education (encompassing freedom of time, pace, and place, and is attracting learners with an independent learning style), creates tension. The implications of this tension require further exploration. Secondly, distance education shows much higher dropout rates than face-to-face learning (Astleitner, 1999). Non-starters and dropouts are a serious threat to collaborative learning. In the pilot study it did not only break groups down but it also left those members behind who were dependent on them. The problem of non-starters and dropouts has to be examined more closely in a separate study. Thirdly, there is also tension between the lack of a solid CSCL pedagogy (see Chapter 2) and the desire to use collaborative learning in distance courses. Therefore, if collaborative learning is applied in distance courses, care must be taken that at least the incentive of collaborative learning is structured within the learning tasks, for example, through the application of positive interdependence and individual accountability (see Chapter 3). A weak incentive on collaboration does not work as the pilot study has shown. Fourthly, if distance courses incorporate collaborative learning, then this dissertation strongly suggests utilizing sociable CSCL environments. Yet, these environments are not available off-the-shelf. One solution is the augmentation of an existing CSCL environment with social affordance devices (as was done in the pilot study). However, the social affordance devices themselves have to be developed implying that a software development project has to be initiated. The pilot study has shown that (informatics) students do not accept software that is of less quality than they are used to. This creates the problem of developing high quality social affordance

devices (in terms of interaction design and usability), while there is at the same time insufficient capacity (in terms of human resources and budgetary) to accomplish this.

11.4 Future Reseach

The present research is a first step in the conceptualization and theorization of how to design and implement sociable CSCL environments that meet the socio-emotional needs of asynchronous DLGs. As can be concluded from this dissertation, theorizing about sociable CSCL environments taps into quite a number of research domains, such as:

- Education technology (i.e., collaborative learning in small groups)
- CSCL
- Social psychology (i.e., small group processes and the effects of tele-communication media on group processes and learning)
- Organizational behavior (i.e., working and learning in distributed teams)
- Communication media theories, especially social presence theory
- Computer science
- Interaction design and HCI
- CSCW (i.e., regarding the application of awareness information in working groups)
- Communities of learners and communities of practice

Each of these domains requires further examination as to its meaning when designing sociable CSCL environments. A few suggestions are made for topics on a research agenda, not necessarily restricting the agenda to social aspects. The suggestions deal with empirical studies, improving the GAW prototype, and expanding the research foci.

11.4.1 Empirical Studies

The theoretical framework presented in Chapter 4 and 5 offers a principled approach for designing and implementing sociable CSCL environments. It also drives the empirical work to be done, namely the design of experimental settings for generating useful data for analysis. The pilot study shows that future research must include empirical results from both laboratory and field experiments. As the pilot study in Chapter 10 has shown, a large number of variables are difficult to control in field experiments using regular distance courses and students of the Open Universiteit Nederland. Laboratory experiments seem appropriate for gathering preliminary information on the effects social affordance devices such as GAWs have on social space, sociability, and social presence. The experiments will also have to include validation on the participating students.

Ultimately, the focus of the empirical studies should include learning effects, as this is why sociable CSCL environments are designed. The hypothesis is that sociable CSCL environments will increase the learning performance of the group and of the individual in terms of understanding the learning material and retention of what is learned. Sociable CSCL environments are also hypothesized to increase the learner's motivation and to reduce dropout. This means that field experiments in more restricted settings are needed.

11.4.2 Improving the GAW Prototype

Future research should be carried out to improve the GAW prototype and to test alternative prototypes that are based upon the same theoretical underpinnings. With respect to the first GAW prototype, improvements are necessary with respect to:

- Architectural Design. The current architecture of the GAW infrastructure is based upon an event notification system (SIENA) and a relational database system (MySQL). While SIENA and MySQL are satisfactory choices, alternatives should be investigated that are simpler to implement. One such alternative is not to use an event notification server, but rather base the handling of notifications on a transaction-oriented model that is common when using databases.
- The data modeling must be redesigned. The organization of the tables, the selection of fields and the selections of primary keys lack flexibility for extension.
- Functionality. The functionality of the GAW is restricted to only a few types of notifications. A more grounded usability approach should be undertaken to reveal the types of notification learners want to have at their disposal.
- Reliability. Reliability should be increased. The GAW client sometimes 'hangs,' meaning that the computer has to be restarted for opening the GAW prototype. There were no problems with regard to the reliability and availability of the GAW server and the GAW relay server.
- Interaction design and usability. From the pilot study, it is clear that learners want a 'professional' application that can compete with applications that they know such as Microsoft® MSN® Messenger,[I] Microsoft® Outlook®[II], and Yahoo!®[III] Groups.

In addition, it is the intension once a satisfactory prototype is available, to publish it as an open source application. As stated before, the capacity is insufficient for developing these kinds of applications at a level that can compete with other high quality (commercial) applications. Open source offers an escape to this problem and has the advantage that other researchers will have access to a GAW for usage in their own research.

11.4.3 Expanding the Research Foci

11.4.3.1 *Expanding the Theoretical Framework: Educational Affordances*

Future research should expand the theoretical framework presented in Chapter 4 to include the educational functionality. This means that the ecological approach to social interaction and the theory of affordances must also be applied to support educational processes in the CSCL environment (see Figure 11.1). Kirschner (2002) already suggested expanding the framework by defining educational affordances. Such educational affordances may help find a solid CSCL pedagogy, which is highly needed as the pilot study has shown.

[I] The Microsoft® MSN® Messenger home site is http://messenger.msn.com.

[II] The Microsoft® Outlook® home site is http://www.microsoft.com/outlook.

[III] The Yahoo!® Groups home site is http://groups.yahoo.com.

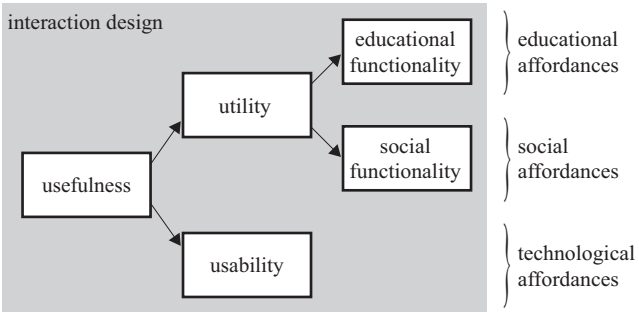


Figure 11.1 Educational, Social, and Technological Affordances

Other educational researchers have also proposed to use the theory of affordances for learning processes. Laurillard, Stratfold, Luckin, Plowman, and Taylor (2000) acknowledge that Gibson (1986) offers a valuable concept for describing educational interactions. Just as a door with a flat plate affords pushing and a door with a handle also affords pulling, so does a large lecture affords listening and a small group affords preparing to speak. Pea (1993) sees the concept of *affordance* as being critical in building a science of distributed intelligence and in a more flexible design orientation to the practice of education. Fisher and Mandl (2002) study the effects of shared external representation tools on knowledge convergence in a CSCL setting. Inspired by Gibson's (1986) ecological psychology, they state that constraints-and-affordance approaches emphasize that external representations help information processing because these approaches either reduce possible degrees of freedom in the learners' activities or initiate activities by providing a salient structure. Barab and Plucker (2002) argue that ability and talent is in the relationships that exist between learner and environment and ground their ecological description of ability and talent on Gibson's (1986) theory of ecological theory of psychology. Vaccare (1997) sees the shared graphics space (e.g., an electronic whiteboard) as an affordance "that helps to make activities possible but not inevitable" (p. 16). Dillenbourg (2000) discusses virtual learning environments from the perspective of affordances. He discusses four types of affordances: social interaction, access to information, the integration of technology, and collaborative learning. Salomon (1998) states that affordances offered by technology –hence he calls them technology affordances[I]– enable the social construction of knowledge and at the same time offer new opportunities for learning. In the same spirit as Dillenbourg (2000) and Salomon (1998), Wallace (2002) discusses technology affordances[II] for learning and teaching. He points out that technology for science education can afford opportunities for students to engage in meaningful learning and for supporting teaching.

[I] Salomons technology affordances are not to be confused with the technological affordances described in this dissertation. Salomons technology affordances are at the utility level, while the technological affordances in this dissertations (following Gaver, 1991, and Norman, 1990, 1999) are at the usability level. Therefore, the use of educational affordances would be a more appropriate term for the case of Salomon.

[II] See the footnote above.

All these researchers show that the application of the theory of affordances in education can be fruitful. Perhaps, the application of educational affordances in CSCL may help in defining a suitable CSCL pedagogy.

11.4.3.2 *Examining other Variables Affecting Sociability: Social Navigation and Social Browsing*

Two other variables are contributing to sociability, namely, social browsing and social navigation. Although very interesting, these variables are beyond the scope of the present research but should be explored in future research. Figure 11.2 depicts the relationships between the variables social affordances, social navigation, social browsing and sociability.

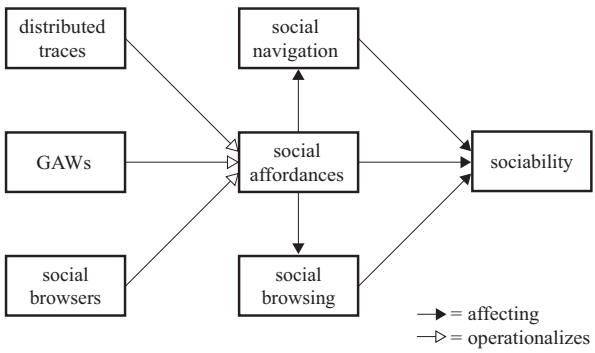


Figure 11.2 Relationships between the various variables

Social Browsing

Root (1988) first used the term social browsing and defined it as the "dynamic process of informal, in-person, mobility-based social interaction (…) a fundamental mechanism for developing and maintaining social relationships in the workplace" (p. 27).

Social browsing requires dedicated social affordance devices called social browsers. In contrast to GAWs, social browsers do not present awareness information about activities around some commonality (dynamic information). Instead, they present collections –directories or white pages– of people around some commonality (static information). In CHIplace People Browser[I] (Lee & Girgensohn, 2002), collections of people are based on the roles they performed. Other forms of social browsing can be found by instant messaging systems like Microsoft® MSN® Messenger, which uses white pages to find other people that share same interest areas.

Social Navigation

Dourish and Chalmers (1994) applied the concept of social navigation to the domain of CSCW and define it as "moving 'towards' a cluster of other people, or selecting objects because others have been examining them" (p. 1). In other words, people or objects leave traces that can be exploited for finding and gathering information. Social

[I] The CHIplace People Browser home site is http://chiplace.fxpal.com/people/browser.jsp.

navigation as a concept is further developed by Wexelblat (1998, 1999; see also Munro, Höök, & Benyon, 1999; Kreijns, 2000).

The idea of social navigation is often found in *recommender systems* such as the one found by amazon.com[I]. If a customer looks for a book and eventually finds it, amazon.com also lists a number of potentially interesting books under the heading "Customers who bought this book also bought:" and –more importantly– the comments of other customers under the heading "Our Customers' Advice." In addition, the customer can also comment on the book after reading it. As can be seen, social navigation can be an important concept to access distributed knowledge in a group of people.

Robins (2001) have explored the application of social navigation in CSCL environments. She suggested that (social) affordances affect social navigation. By understanding "the social behavior afforded by persistent structures [in a collaborative virtual environment], designers of virtual 'places' might be better able to generate and support social navigation in on-line communities" (Robins, 2002, ¶ Structural Support for Social Navigation).

If a CSCL environment supports social navigation, then it is likely that this increases its sociability because social navigation is concerned with people in the environment (e.g., accessible through GAWs) or with the traces left by people in the environment. It is important to notice that traces in the CSCL environment are distributed all around this environment and, hence, are coupled with the specific places where they originated. Consequently, these distributed traces can only be encountered while browsing the CSCL environment, that is, when one is going from one place to another. In contrast, the traces that build up history awareness in a GAW are coupled with the members of a group: by inspecting the GAW's history one becomes aware of all the activities of its members without browsing the CSCL environment.

11.5 In Closing

If there is anything that the present research should make clear, then it is that educators, educational technologist, and educational researchers who are concerned with (higher) distance education and e-learning should not focus solely on the support of cognitive and meta-cognitive processes at a distance, but also on the support of socio-emotional processes that are fundamental for asynchronous distributed learning groups whose members probably will never meet physically but still have a need to affiliate and to establish relationships. A new generation of CSCL environments is needed for this purpose, which includes the support of social functionalities that current environments lack. Hence, the present research designates the environments as sociable CSCL environments. However, their design and implementation should not be left to educational researchers alone, but should also include people with other expertises such as interaction designers, usability engineers, social psychologists, computer experts, software engineers, organizational behavior scientists, CMC researchers, CSCW researchers, and most importantly the learners themselves because they are the ones who are going to use the CSCL environment. Only then, it is assured that CSCL environments are realized that are beneficial for creating a sense of community and ultimately, for collaborative learning.

[I] The amazone.com home site is http://www.amazon.com.

Appendix 11.1
The Social Space Scale as Questionnaire

No. Item	Item	not applicable at all	rarely applicable	moderately applicable	largely applicable	totally applicable
1	Group members felt free to criticize ideas, statements, and/or opinions of others	○	○	○	○	○
2	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized	○	○	○	○	○
3	We reached a good understanding on how we had to function	○	○	○	○	○
4	Group members were suspicious of others	○	○	○	○	○
5	Group members ensured that we kept in touch with each other	○	○	○	○	○
6	Group members grew to dislike others	○	○	○	○	○
7	We worked hard on the group assignment	○	○	○	○	○
8	I did the lion's share of the work	○	○	○	○	○
9	I maintained contact with all other group members	○	○	○	○	○
10	Group members obstructed the progress of the work	○	○	○	○	○
11	Group members gave personal information on themselves	○	○	○	○	○
12	Group members were unreasonable	○	○	○	○	○
		very rarely or never	rarely	sometimes	often	always or very often
13	The group conducted open and lively conversations and/or discussions	○	○	○	○	○
14	Group members disagreed amongst each other	○	○	○	○	○
15	Group members took the initiative to get in touch with others	○	○	○	○	○
16	The group had conflicts	○	○	○	○	○
17	Group members spontaneously started conversations with others	○	○	○	○	○
18	Group members gossiped about each other	○	○	○	○	○
19	Group members asked others how the work was going	○	○	○	○	○
20	Group members did not take others seriously	○	○	○	○	○

Note.
Very rarely or never = on the average less than once a month
Rarely = on the average once a month
Sometimes = on the average a few times a month
Often = on the average a few times a week
Always or very often = on the average a few times a day

Appendix 11.2
The Sociability Scale as Questionnaire

No. Item	Item	not applicable at all	rarely applicable	moderately applicable	largely applicable	totally applicable
1	This CSCL environment enables me to easily contact my team mates	○	○	○	○	○
2	I do not feel lonely in this CSCL environment	○	○	○	○	○
3	This CSCL environment enables me to get a good impression of my team mates	○	○	○	○	○
4	This CSCL environment allows spontaneous informal conversations	○	○	○	○	○
5	This CSCL environment enables us to develop into a well performing team	○	○	○	○	○
6	This CSCL environment enables me to develop good work relationships with my team mates	○	○	○	○	○
7	This CSCL environment enables me to identify myself with the team	○	○	○	○	○
8	I feel comfortable with this CSCL environment	○	○	○	○	○
9	This CSCL environment allows for non task-related conversations	○	○	○	○	○
10	This CSCL environment enables me to make close friendships with my team mates	○	○	○	○	○

Appendix 11.3
The Social Presence Scale

No. Item	Item	not applicable at all	rarely applicable	moderately applicable	largely applicable	totally applicable
1	When I have real-time conversations in this CSCL environment, I have my communication partner in my mind's eye	○	○	○	○	○
2	When I have asynchronous conversations in this CSCL environment, I also have my communication partner in my mind's eye	○	○	○	○	○
3	When I have real-time conversations in this CSCL environment, I feel that I deal with very real persons and not with abstract anonymous persons	○	○	○	○	○
4	When I have asynchronous conversations in this CSCL environment, I also feel that I deal with very real persons and not with abstract anonymous persons	○	○	○	○	○
5	Real-time conversations in this CSCL environment can hardly be distinguished from face-to-face conversations	○	○	○	○	○

Summary

Problem Description: No Social Interaction

Most computer-supported collaborative learning (CSCL) environments are often purely *functional*, that is, they solely display educational functionalities. This is not surprising because their design is entirely based on educational grounds, driven by educators, educational technologists and educational researchers. Unfortunately, these functional CSCL environments are not always fulfilling their objectives, namely enabling collaborative learning (Gregor & Cuskelly, 1993; Hallet & Cummings, 1997; Heath, 1998; Hobaugh, 1997; Hughes & Hewson, 1998; Mason, 1991; Taha & Caldwell, 1993). What is missing is social interaction, which is seen as a key element in collaborative learning (Hitz, 1994; Kearsley, 1995; Muirhead, 2000; Laurillard, 1993; Moore, 1993; Vygotski, 1978; Wagner, 1997). In addition, social interaction is also a key element in socio-emotional processes underlying group formation and group dynamics. The current literature suggest, that developing relationships, trust and belonging, social cohesiveness and a sense of community (characterizing a sound social space) is reducing drop-out, facilitating learning behavior, and increasing motivation and learning performance (Brandon & Hollingshead, 1996; Gunawardena, 1995; Harasim, 1991; Henri, 1992; Jacques, 1992; Jehng, 1998; Rourke & Anderson, 2002; Rovai, 2001; Smith & Kollock, 1998; Von Krogh, Nonaka, & Ichijo, 2000; Wegerif, 1998).

Problem Analysis: Pitfalls and Barriers to Social Interaction

Chapter 2 describes a literature study discussing two pitfalls (Kreijns, Kirschner, & Jochems, 2003a) and a number of barriers (Kreijns & Kirschner, 2004) causing the lack of social interaction in asynchronous distributed learning groups (DLGs). It is, therefore, important that the pitfalls are avoided and the barriers overcome to increase the likelihood that social interaction will emerge.

The two pitfalls are: (1) taking social interaction for granted and (2) taking group forming and group dynamics for granted. Many educators making the transition from contiguous learning groups to asynchronous DLGs, believe that the implications of this transition is not that far-reaching, that is, they think that all processes associated with contiguous learning groups easily translate to DLGs, including the pedagogy, social interaction, and group dynamics, as long as the CSCL environment provides the necessary communication tools. However, the utilization of CSCL environments raises a number of barriers non-existent in the face-to-face setting or exacerbates barriers that were less prominent there (Kreijns & Kirschner, 2004).

The barriers are organized into three 'rings' and range from Ring 1—encompassing barriers due to the non-existence of a suitable CSCL pedagogy (Brandon and Hollingshead, 1999; Van Merriënboer, 2002), to Ring 2— encompassing barriers due to media effects 'negatively' influencing impression formation, the establishment of

interpersonal relationships and a sense of community (Daft & Lengel, 1986; Short, Williams, & Christie, 1976), and Ring 3—encompassing barriers due to unsuitable CSCL environments that are short on utility, interaction design, and usability. Indeed, a few researchers recognize that current CSCL environments lack social functionalities (Bly, Harrison, Irvin, 1992; Donath, 1997; Sproull & Faraj, 1997) and possibly an attractive interface and good usability, which are demotivating group members for using them.

Problem Solution to Ring 1: The Pedagogical Approaches

Chapter 3 discusses the approaches educationalists use for coping with the lack of a suitable CSCL pedagogic. These approaches are based on classroom collaborative learning. Collaborative learning encourages active learning and leads to critical thinking (Bullen, 1998; Garrison, Anderson, & Archer, 2001; Newman, Johnson, Webb, & Cochrane, 1997; Norris & Ennis, 1989), shared understanding (Clark & Brennan, 1991; Mulder, Swaak & Kessels, 2002), knowledge construction (Littleton & Häkkinen, 1999; Salomon & Perkins, 1998; Veldhuis-Diermanse, 2002), deeper level learning (Biggs, 1987, 1999; Newman, Johnson, Webb, & Cochrane, 1997), and long term retention (Johnson, Johnson, & Stanne, 1985; Newman, Johnson, Webb, & Cochrane, 1997). Collaborative learning is most effective when it is embedded in authentic contexts (Brown, Collins, & Deguid, 1989; Jonassen, 1991b) and ill-structured domains (Spiro, Coulsin, Feltovich, & Anderson, 1988) thereby serving competency-based learning (Kirschner, Vilsteren, Hummel, & Wigman, 1997; Van Merriënboer, 1999). In addition, if epistemic interaction (Ohlsson, 1996) exists in collaborative learning then this will add to its effectiveness. Collaborative learning can be activated in two ways: using (1) the direct approach or (2) the conceptual approach. The direct approach involves the use of a specific collaborative technique to structure a specific learning task. Examples of such techniques are Student Teams-Achievement Divisions (Slavin, 1994), Jigsaw and Jigsaw II (Aronson, Blaney, Stephan, Silkes, & Snapp, 1978; Slavin, 1978, 1990), Structured Academic Controversy (Johnson & Johnson, 1994b, 1995), and Reciprocal teaching (Palincsar & Brown, 1984, 1986). The conceptual approach holds that a set of conditions is used to enforce collaboration. Johnson and Johnson (1989, 1994a) suggest the following five conditions: positive interdependence, individual accountability, promotive interaction, interpersonal and small group skills, and group processing. The use of these techniques will eliminate negative effects, which may exist when collaborative learning is not enforced. Negative effects are free riding (Kerr, 1983; Kerr & Bruun, 1983), social loafing (Comer, 1995; Kerr & Bruun, 1981), sucker effect (Kerr, 1983; Kerr & Bruun, 1983), and rich-get-richer effect (Cohen & Lotan, 1997; Cohen, Lotan, Scarloss, & Arellano, 1999).

Problem Solution to Ring 2 and 3: The Ecological Approach

Chapter 4 presents an alternative way for fostering and enhancing social interaction in distributed learning groups, which is the focus of the present research. It is directed towards the design and implementation of *sociable* CSCL environments and as such concerned explicitly with the barriers in the third ring. However, as sociable CSCL environments will also affect the barriers in the second ring, this research will occasionally, and implicitly, address the barriers in the second ring as well.

Sociable CSCL environments exhibit social functionalities and are hypothesized to increase the likelihood that a sound social space will emerge. The present research proposes a theoretical framework upon which the design of these sociable CSCL environments can be based. This framework has three foci:

- The ecological approach to social interaction centered on the concept of social affordances (Gaver, 1996, Gibson, 1977, 1986; Kreijns, Kirschner, & Jochems, 2002),
- The concept of the sociability of CSCL environments (Kreijns, Kirschner, & Jochems, 2002), and
- Social presence theory (Gunawardena, 1995; Short, Williams, & Christie, 1976; Tammelin, 1998; Tu, 2000a, 2002c; Tu & McIsaac, 2002).

Focus 1: The Ecological Approach to Social Interaction

Using an ecological approach to social interaction (Gaver, 1996) means that the impetus is put on the environmental characteristics of the CSCL environment for encouraging social interaction. The particularly environmental characteristics that encourage social interaction are social affordances, which are defined as the properties of a CSCL environment that act as social-contextual facilitators relevant for the learner's social interactions. Social affordances should increase the number of impromptu or chance encounters, stimulate informal conversations, and present awareness of the past (history awareness) in order to bridge the time gaps that are imposed by working asynchronously. This approach increases the likelihood that more conversations are taking place conveying socio-emotional content.

Proximity is an important dimension of social affordances, offering a means for achieving the aims mentioned above. Two kinds of proximity are distinguished: proximity of place (i.e., spatial proximity) and proximity of time (i.e., temporal proximity). Creating spatial proximity amongst group members is seen as a solution for stimulating impromptu encounters and informal communication (Festinger, Schachter, & Back, 1950; Isaacs, Tang, & Morris, 1996; Kiesler & Cummings, 2002; Kraut, Egido, & Gallegher, 1990; Walther, 2002; Wellman, 1992; Wellman & Wortley, 1990; Whittaker, Frohlich, & Daly-Jones, 1994). If group members are leaving traces or footprints during their activities then these traces will inform members that were in temporal proximity of each other. Such traces help to bridge the time gap because they may function as anchor points to get in contact with the other (assuming the trace contains information about her or him).

Focus 2: The Sociability of CSCL environments

CSCL environments differ in their ability to facilitate the emergence of a social space: the human network of social relationships amongst group members embedded in norms and values, rules and roles, beliefs and ideals. Sociability is defined as the extent to which a CSCL environment is able to give rise to a social space. It is hypothesized that social affordances increase the sociability of CSCL environments.

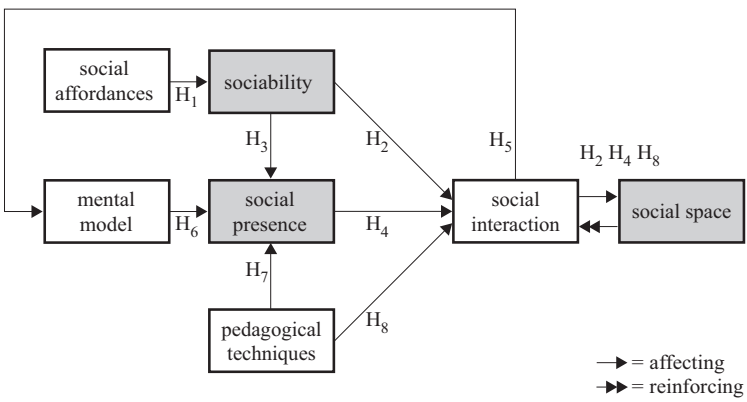
Focus 3: Social Presence Theory

The present research defines social presence as the degree of the psychological sensation in which the illusion exists that the other in the communication appears to be a 'real' physical person either in an immediate (i.e., real-time or synchronous) or in

a delayed (i.e., time-deferred or asynchronous) communication episode. Social presence affects the degree of social interaction taking place in CSCL environments (Gunawardena, 1995; Tammelin, 1998; Tu, 2000a). For this reason, it is important to determine the variables that contribute to an increase of social presence. One of these variables is the mental model, which is defined as the internal representation that learners construct of the other and which is used while interacting with the other. Social affordances are affecting social presence because they provide group awareness on the others along with a set of communication media.

Hypotheses

The framework suggests a number of hypotheses (Chapter 1 and 10), depicted in the



Model of Relationships between the Variables Sociability, Social Presence, Pedagogical Techniques, Social Affordances, Mental Model, Social Interaction and Social Space.
(Each Arrow Represents a Hypothesis; Variables in the Grey Rectangles are those for Which an Instrument is Developed)

figure below.

Only the first four hypotheses (H_1, H_2, H_3, and H_4) are relevant for the present research:

H_1: Social affordances contribute to the degree of perceived sociability of the CSCL environment

H_2: A higher perceived sociability of the CSCL environment increases the likelihood of the establishment of a sound social space

H_3: A higher perceived sociability of the CSCL environment increases the degree of perceived social presence

H_4: A higher perceived social presence increases the likelihood of the establishment of a sound social space.

Testing the first four hypotheses implies that a real social affordance device (i.e., a device exhibiting social affordances) has to be designed, implemented, and realized. In

addition, instruments are needed for measuring the variables social space, sociability, and social presence.

A Social Affordance Device

Design and Implementation

Chapter 5 discusses the design and implementation of social affordance devices. If proximity is an important dimension of social affordances then an operationalization of a social affordance device must take proximity as a point of departure. Group awareness fulfills this requirement because it provides tele-proximity (i.e., virtual spatial proximity). Group awareness is awareness of the whereabouts of the members of the group (i.e., where they are and what they are doing); it is an awareness that is artificially created with the aid of computers and networks (Borning & Travers, 1991; Dourish & Bellotti, 1992; Dourish & Bly, 1992; Gajewska, Manasse, & Redell, 1995). Social affordance devices exploiting group awareness are designated as group awareness widgets (GAWs). In an electronic CSCL environment, a GAW is a piece of software.

While group awareness is addressing spatial proximity, history awareness is addressing temporal proximity. History awareness is the structured collection of traces created by all the group members. History awareness is not only providing insight in when and how long group members have been engaged in a particularly activity, it also provides insight in their overall behavior patterns (e.g., the degree of participation of each group member is easily inferred).

GAWs are tightly coupled with a set of communication media in order to warrant the perception-action coupling, that is, as soon as a group member becomes 'visible' a communication episode can be started at once, providing that there exists an immediate need for spontaneous communication. Perception-action coupling is one of the two relationships of social affordances; the other is the reciprocal relation between the CSCL environment and the group members using it, that is, there is a match between what the CSCL environment offers and what the group members need in terms of social issues.

Chapter 5 points out that a GAW should also meet the criteria of usability (dealing with issues such as easy-to-learn and easy-to-use) and interaction design (dealing with aesthetics, that is, how to make the GAW an attractive device). It is recognized that issues dealing with aesthetics are difficult to define because they refer to subjective qualities. In contrast, usability can be determined empirically.

Realization

Chapter 6 presents the realization of a first prototype of the GAW, which is based on a client-server architecture and consists of three basic units: a GAW client, a GAW relay server, and a GAW server. The client-server architecture uses an event notification server for distributing events as notifications –conveying the awareness information– across the internet to the group members. An event is a representation of something that has happened at a specific moment in terms of a description of what has happened, but which has no duration (Rosenblum & Wolf, 1997), for example, the act of logging on to a computer. A notification is a formal description of an event in terms of a list of named attributes of simple data types such as strings and integers (Fitzpatrick, Kaplan, Mansfield, Arnold, & Segall, 2002). A global repository is used

for storing the notifications. The GAW server consists of components realizing these two functions using the SIENA event service (Carzinga, Rosenblum, & Wolf, 1998, 2001) and the MySQL server software for setting up the database system. Distributing events is one thing, the other is the generation of the events. Therefore, code implementing event notification generators have to be inserted at strategic locations in the source code of the applications used by the group members. Notifications generated by these event notification generators are then passed to the GAW relay server residing on the same computer on which the user applications reside. The GAW relay server's only function is to pass these notifications on to the GAW server. The GAW client installed on the group member's computer provides the user interface. The GAW user interface consists of a sidebar and two tickertapes. The sidebar contains a number of segments that graphically display the different kinds of group awareness information along with the corresponding history awareness information. One tickertape along the top of the screen is used for displaying messages posted by group members, the other, located directly under the first, is used for displaying notification messages. The user interface component is loosely coupled with a web-based e-mail (the WebmailASP application is used) and chat client (the ZBITchat client is used).

The GAW prototype has to be used in conjunction with a CSCL environment. The Microsoft® Sharepoint™ Team Services application is used as such an environment. The GAW prototype and Microsoft® Sharepoint™ Team Services form an 'instrument' that can be used in experiments investigating social affordances.

The Social Space Scale

Chapter 7 describes the construction and validation of the (Dutch language) Social Space Scale. The Social Space Scale is a 20 item self-reporting measure in two parts for assessing the perceived quality of the social space that exists in distributed learning groups. The first part (items 1–12) assesses the students' feelings regarding their own behavior or the other group members' behavior in the group. The second part (items 13–20) assesses perceived frequency of specific group members' behaviors in the group. The Social Space Scale has two dimensions: the Positive Group Behavior and the Negative Group Behavior dimension. Each dimension consists of ten items (odd items belong to the Positive Group Behavior dimension, even items to the Negative Group Behavior dimension). Positive group behavior exists when group members help each other, reveal personal information on themselves, feel free to criticize others without harming them, and so forth. Negative group behavior exists when group members dislike each other, are suspicious of other group members, are unreasonable, and so forth.

The internal consistency was .81 for the total scale, .92 for the Positive Group Behavior dimension and .87 for the Negative Group Behavior dimension. A nomological network was used for further validation. The findings suggest that the Social Space Scale has the potential to be useful as a measure for social space.

The Sociability Scale

Chapter 8 describes the construction and validation of the (Dutch language) Sociability Scale for determining the perceived degree of sociability of CSCL environments. The Sociability Scale consists of ten items and is one-dimensional. Sociability exists if the CSCL environment is inviting informal, casual conversations

and is permitting chance encounters to happen, thereby enhancing the likelihood that a sound social space will emerge.

The internal consistency of the Sociability Scale is .92. A nomological network was used for further validation. The results of the explorative study are highly promising and show that the sociability scale has the potential to be useful as a measure for sociability.

The Social Presence Scale

Chapter 9 deals with the construction and preliminary validation of a five item self-reporting (Dutch language) Social Presence Scale.

The internal consistency of the Social Presence Scale is .81. A nomological network of similar and related constructs was used for further validation. Like the Social Space Scale and the Sociability Scale, this Social Presence Scale has the potential to be used as a measure for assessing the perceived social presence in distributed learning groups.

Pilot Study

Chapter 10 reports on a pilot study which is preliminary to a series of experiments. In this pilot study, participants in the experimental condition had access to the GAW prototype, the e-mail client WebmailASP, and the chat-client ZBIT chat whereas participants in the control condition did not have these applications. In both conditions, the Microsoft® Sharepoint™ Team Services was used as CSCL environment. The pilot study's two objectives were: (1) to gather first experiences with the GAW prototype and (2) to gather first indications whether the four hypotheses hold or not.

However, (1) the nature of distance education at the Open Universiteit Nederland –characterized by freedom of time, pace, and place– and its typical students, and (2) the characteristics of the software used, led to minimal results, which only gave a first indication of the value of the chosen direction.

With respect to the typical students of the Open Universiteit Nederland: quite a number of participants left the pilot because of reasons (they did not start with the course, dropped out, proceeded individually, or were exempted from the course).

With respect to the software used: all three applications Microsoft® Sharepoint™ Team Services, WebmailASP, and ZBITchat showed some flaws that decreased their usability. The GAW prototype was hardly used because participants did not fully understand its function and used it as a tool for spying (i.e., quickly glancing to see if other group members were also online), but since this often turned out to be unsuccessful, its use decreased. In addition, after starting Microsoft® Sharepoint™ Team Services, participants would begin to work in this environment at once and either forgot or did not make the effort to start the GAW prototype too. Finally, critical mass of use was not achieved in the groups because not all members of the group used the GAW prototype.

Mainly, because the number of responses was low, the pilot study cannot present empirical indications that the four hypotheses hold. However, the pilot study did make clear that some of the variables are difficult to control in a field experiment. Consequently, laboratory experiments should be conducted first and should be followed by field experiments.

In Closing

Chapter 11 provides a general discussion in four main sub-sections: the results, the limitations of the present research, its relevancy for distance education and in particular for the Open Universiteit Nederland, and future research.

With respect to the results: a literature study was conducted to answer the question why social interaction is often absent in distributed learning groups using CSCL environments. This study revealed that there are two pitfalls and a number of barriers. In order to find a solution for encouraging social interaction, a framework was presented advocating designing and implementing sociable CSCL environments. In order to test the four hypotheses, a group awareness widget was realized and three scales developed (the Social Space Scale, the Sociability Scale, and the Social Presence Scale). The pilot study, however, was unsuccessful.

With respect to the limitations of the present research: it is pointed out that, due to limited time and budgets, the GAW used in the pilot study was just a rudimentary first prototype, which probably did not completely satisfy the usability criteria and was certainly not meeting the interaction design criteria. In addition, the scales developed should be used with some reservations due to (1) the small sample size relatively to the number of items in the raw scales, (2) the collapsing of five smaller samples in order to obtain one larger sample, and (3) the repeatedly use of the same data set. Nevertheless, the scales are potentially useful for assessing the corresponding constructs (i.e., social space, sociability, and social presence). Finally, the hypotheses could not be tested whether they held or not because the pilot delivered insufficient results.

With respect to the relevancy of the study: the present research did advance the theory about encouraging social interaction in distributed learning groups. Besides, three scales were provided to the CSCL community for use in the community's own research. The present research also showed that distance education institutions, such as the Open Universiteit Nederland, should be cautious when introducing collaborative learning in their curricula; they should take into account the typical distance students who exhibit higher rates of non-starting and dropout. In addition, they should be aware of the tension created by the misalignment between collaborative learning (requiring coordination and exhibiting time constraints, and attracting learners with a collaborative learning style) and the typical characteristic of distance education (encompassing freedom of time, pace, and place and, therefore, attracting learners with an independent learning style).

With respect to future research: it is suggested to expand the concept of affordances to include educational affordances (Kirschner, 2002). In addition, the potential of alternative social affordance devices based upon social navigation (Dourish & Chalmers, 1994; Munro, Höök, & Benyon, 1999; Wexelblat, 1998, 1999) and social browsing (Lee & Girgensohn, 2002; Root, 1988) should be probed.

But, most importantly, the present research points out that the design and implementation of future sociable CSCL environments should be accomplished in multidisciplinary teams and not be left to educators only.

Samenvatting

Probleembeschrijving: geen sociale interactie

De meeste computerondersteunde omgevingen voor samenwerkend leren (Engels: computer-supported collaborative learning environments, hier afgekort als CSCL-omgevingen) zijn vaak puur *functioneel*, dat wil zeggen, zij tonen uitsluitend onderwijskundige functionaliteiten. Dit is niet verbazingwekkend, omdat hun ontwerp volledig is gebaseerd op onderwijskundige principes, gestuurd door onderwijskundigen, onderwijstechnologen en onderwijsonderzoekers. Jammer genoeg beantwoorden deze functionele CSCL-omgevingen niet altijd aan hun doel, namelijk het tot stand brengen van samenwerkend leren (Gregor & Cuskelly, 1993; Hallet & Cummings, 1997; Heath, 1998; Hobaugh, 1997; Hughes & Hewson, 1998; Mason, 1991; Taha & Caldwell, 1993). Wat ontbreekt is sociale interactie, wat als een belangrijk element in samenwerkend leren wordt gezien (Hitz, 1994; Kearsley, 1995; Muirhead, 2000; Laurillard, 1993; Moore, 1993; Vygotski, 1978; Wagner, 1997). Daarnaast is sociale interactie ook een belangrijk element in sociaal-emotionele processen die aan groepsvorming en groepsdynamica ten grondslag liggen. De huidige literatuur suggereert dat het ontwikkelen van sociale relaties, vertrouwen, het gevoel ergens bij te horen, sociale cohesie en een gemeenschapsgevoel (gekarakteriseerd als gezonde sociale ruimte) uitval van studenten vermindert, het leergedrag faciliteert en de motivatie en leerprestaties verhoogt (Brandon & Hollingshead, 1996; Gunawardena, 1995; Harasim, 1991; Henri, 1992; Jacques, 1992; Jehng, 1998; Rourke & Anderson, 2002; Rovai, 2001; Smith & Kollock, 1998; Von Krogh, Nonaka, & Ichijo, 2000; Wegerif, 1998).

Probleemanalyse: valkuilen en barrières voor sociale interactie

Hoofdstuk 2 beschrijft een literatuurstudie waarbij twee valkuilen (Kreijns, Kirschner, & Jochems, 2003a) en een aantal barrières (Kreijns & Kirschner, 2004) worden besproken die het gebrek aan sociale interactie in asynchrone gedistribueerde leergroepen (Engels: distributed learning groups, hier afgekort als DLGs) veroorzaken. Het is daarom belangrijk dat de valkuilen worden vermeden en de barrières overbrugd zodat de kans dat sociale interactie zal plaatshebben, wordt vergroot. De twee valkuilen zijn: (1) het als vanzelfsprekend aannemen dat sociale interactie zal plaatshebben en (2) het als vanzelfsprekend aannemen dat groepsvorming en groepsdynamica zullen plaatshebben. Vele onderwijskundigen die de overgang maken van face-to-face leergroepen naar asynchrone DLGs, denken dat de implicaties van deze overgang niet echt zo ver reiken. Zij denken daarom dat alle processen die in face-to-face leergroepen worden aangetroffen, met inbegrip van de didactiek, sociale interactie en groepsdynamica, zich eenvoudig laten vertalen naar DLGs zolang de CSCL-omgeving de noodzakelijke communicatiemiddelen verstrekt. Nochtans, het gebruik van CSCL-omgevingen creëert een aantal barrières die niet in face-to-face situaties bestaan, óf verergert een

aantal barrières die daar latent aanwezig waren (Kreijns & Kirschner, 2004). De barrières worden ingedeeld in drie 'ringen', lopende van Ring 1— omvattende de barrières die het gevolg zijn van het niet bestaan van een geschikte CSCL-didactiek (Brandon en Hollingshead, 1999; Van Merriënboer, 2002), naar Ring 2— omvattende de barrières die het gevolg zijn van mediaeffecten die een 'negatieve' invloed hebben op indrukvorming van de ander, de totstandbrenging van interpersoonlijke verhoudingen en een gemeenschapsgevoel (Daft & Lengel, 1986; Short, Williams & Christie, 1976), en naar Ring 3— omvattende de barrières die het gevolg zijn van ongeschikte CSCL-omgevingen met gebreken ten aanzien van functionaliteiten, interactieontwerp en gebruiksgemak. Een klein aantal onderzoekers erkent dat huidige CSCL-omgevingen sociale functionaliteit ontberen (Bly, Harrison, Irvin, 1992; Donath, 1997; Sproull & Faraj, 1997) en mogelijkerwijs ook een aantrekkelijke interface en goed gebruiksgemak, hetgeen demotiverend werkt op het gebruik ervan door groepsleden.

Probleemoplossing voor Ring 1: de didactische benadering

Hoofdstuk 3 bespreekt de benadering die onderwijskundigen gebruiken om het hoofd te bieden aan het gebrek aan een geschikte CSCL-didactiek. Deze benaderingen zijn gebaseerd op samenwerkend leren in de klas. Samenwerkend leren bevordert actief leren en leidt tot kritisch denken (Bullen, 1998; Garrison, Anderson & Archer, 2001; Newman, Johnson, Webb & Cochrane, 1997; Norris & Ennis, 1989), wederzijds begrip (Clark & Brennan, 1991; Mulder, Swaak & Kessels, 2002), kennisconstructie (Littleton & Häkkinen, 1999; Salomon & Perkins, 1998; Veldhuis-Diermanse, 2002), dieper leren (Biggs, 1987, 1999; Newman, Johnson, Webb & Cochrane, 1997), en retentie op lange termijn (Johnson, Johnson & Stanne 1985; Newman, Johnson, Webb & Cochrane, 1997). Samenwerkend leren is het meest efficiënt wanneer het is ingebed in authentieke contexten (Brown, Collins & Deguid, 1989; Jonassen, 1991b) en slechtgestructureerde domeinen (Spiro, Coulsin, Feltovich & Anderson, 1988) die ondersteunend zijn voor competentiegericht onderwijs (Kirschner, Vilsteren, Hummel & Wigman, 1997; Van Merriënboer, 1999). Bovendien, wanneer epistemische interactie (Ohlsson, 1996) aanwezig is in samenwerkend leren, dan zal dit aan de doeltreffendheid ervan bijdragen. Het samenwerkend leren kan op twee manieren worden geactiveerd: (1) via de directe benadering of (2) via de conceptuele benadering. De directe benadering impliceert het gebruik van een specifieke collaboratieve techniek om een specifieke leertaak te structureren. Voorbeelden van dergelijke technieken zijn: student teams-achievement divisions (Slavin, 1994), jigsaw en jigsaw II (Aronson, Blaney, Stephan, Silkes & Snapp, 1978; Slavin, 1978, 1990), structured academic controversy (Johnson & Johnson, 1994b, 1995) en reciprocal teaching (Palincsar & Brown, 1984, 1986). De conceptuele benadering stelt een reeks voorwaarden voor om samenwerking af te dwingen. Johnson en Johnson (1989, 1994a) noemen de volgende vijf voorwaarden: positieve interafhankelijkheid, individuele verantwoordelijkheid, ondersteunende interactie, interpersoonlijke en groepsvaardigheden, en groepsverwerking. Het gebruik van deze technieken zal de negatieve gevolgen (deze kunnen bestaan wanneer het samenwerkend leren niet wordt afgedwongen) elimineren. Voorbeelden van negatieve gevolgen zijn meeliften (Engels: free riding) (Kerr, 1983; Kerr & Bruun, 1983), social loafing (Comer, 1995; Kerr & Bruun, 1981), uitzuigeffect (Engels: sucker effect) (Kerr, 1983; Kerr & Bruun, 1983) en rijken-

worden-rijker-effect (Engels: rich-get-richer effect) (Cohen & Lotan 1997; Cohen, Lotan, Scarloss & Arellano, 1999).

Probleemoplossing voor Ringen 2 en 3: de ecologische benadering

Hoofdstuk 4 stelt een alternatieve benadering voor om sociale interactie in gedistribueerde leergroepen te bevorderen en te verbeteren; deze benadering vormt tevens de focus van het huidige onderzoek. Het onderzoek is gericht op het ontwerpen en implementeren van *sociabele* CSCL-omgevingen en heeft als zodanig betrekking op de barrières van de derde ring. Echter, sociabele CSCL-omgevingen zullen ook de barrières in de tweede ring beïnvloeden. Daarom richt het onderzoek zich nu en dan, en impliciet, op de barrières van de tweede ring.

Sociabele CSCL-omgevingen hebben sociale functionaliteiten en worden verondersteld de kans te verhogen dat een gezonde sociale ruimte zal ontstaan. Het huidige onderzoek stelt een theoretisch raamwerk voor waarop het ontwerp van sociabele CSCL-omgevingen kan worden gebaseerd. Dit raamwerk heeft drie aandachtsgebieden:

- De ecologische benadering tot sociale interactie gericht op het concept van sociale affordances[I] (Gaver, 1996, Gibson, 1977, 1986; Kreijns, Kirschner & Jochems, 2002)
- Het concept van de sociabiliteit van CSCL-omgevingen (Kreijns, Kirschner & Jochems, 2002)
- De theorie van sociale aanwezigheid (Gunawardena, 1995; Short, Williams & Christie, 1976; Tammelin, 1998; Tu, 2000a, 2002c; Tu & McIsaac, 2002).

Aandachtsgebied 1: de ecologische benadering tot sociale interactie

Het aanhangen van de ecologische benadering tot sociale interactie (Gaver, 1996) betekent dat de nadruk gelegd is op de omgevingskenmerken van de CSCL-omgeving om sociale interactie aan te moedigen. Die bepaalde omgevingskenmerken die sociale interactie aanmoedigen, worden aangeduid als sociale affordances die gedefinieerd worden als: de eigenschappen van een CSCL-omgeving die dienst doen als sociaal-contextuele facilitators relevant voor de sociale interactie van de lerende. Sociale affordances worden verondersteld het aantal 'toevallige' ontmoetingen te verhogen, informele gesprekken te bevorderen en het tijdgat te overbruggen dat als gevolg van het asynchroon werken en leren is ontstaan, middels het presenteren van awareness[II]-informatie over het verleden (d.w.z. geschiedenisawareness). Deze benadering vergroot de kans dat meer gesprekken zullen plaatsvinden die sociaal-emotionele inhoud bevatten.

Nabijheid is een belangrijke dimensie van sociale affordances, die als een middel kan dienen om de vermelde doelstellingen te bereiken. Twee typen nabijheid worden onderscheiden: nabijheid van plaats (d.w.z. ruimtelijke nabijheid) en nabijheid van tijd (d.w.z. temporele nabijheid). Het creëren van ruimtelijke nabijheid onder groepsleden wordt gezien als oplossing voor het bevorderen van toevallige ontmoetingen en informele communicatie (Festinger, Schachter & Back 1950; Isaacs, Tang & Morris,

[I] Voor het woord 'affordance' is helaas nog geen gepaste vertaling in het Nederlands.

[II] Voor het woord 'awareness' is ook nog geen gepaste vertaling in het Nederlands. Onder awareness wordt verstaan de door observatie of op andere wijze verkregen (visuele) informatie over iets, waardoor men op een hogere bewustzijnsniveau kennis heeft.

1996; Kiesler & Cummings, 2002; Kraut, Egido & Gallegher, 1990; Walther, 2002; Wellman, 1992; Wellman & Wortley, 1990; Whittaker, Frohlich & Daly-Jones, 1994). Als de groepsleden tijdens hun activiteiten sporen (of voetafdrukken) achterlaten, dan helpen deze sporen het tijdgat te overbruggen, omdat zij als ankerpunten kunnen dienen om in contact met anderen te komen (aannemende dat het spoor informatie over die anderen bevat).

Aandachtsgebied 2: de sociabiliteit van CSCL-omgevingen

CSCL-omgevingen verschillen in hun capaciteit om het tot stand komen van een sociale ruimte te faciliteren. De sociale ruimte is het menselijk netwerk van sociale relaties tussen de groepsleden ingebed in normen en waarden, regels en rollen, overtuigingen en idealen. Sociabiliteit wordt gedefinieerd als de mate waarin een CSCL-omgeving aanleiding geeft tot het creëren van een sociale ruimte. Een hypothese hierbij is dat sociale affordances de sociabiliteit van CSCL-omgevingen vergroten.

Aandachtsgebied 3: de theorie van sociale aanwezigheid

Het huidige onderzoek definieert sociale aanwezigheid als de mate van de psychologische sensatie die bestaat in de illusie dat de ander in de communicatie een 'echte', fysieke persoon is en of dit nu een directe (d.w.z. real-time of synchrone) of een vertraagde (d.w.z. tijd-uitgestelde of asynchrone) communicatie-episode betreft. Sociale aanwezigheid beïnvloedt de mate van sociale interactie die in CSCL-omgevingen plaatsvindt (Gunawardena, 1995; Tammelin, 1998; Tu, 2000a). Daarom is het belangrijk om die variabelen te bepalen die tot een vergroting van sociale aanwezigheid bijdragen. Een van die variabelen is het mentaal model. Dat mentaal model wordt gedefinieerd als de door de lerende geconstrueerde interne representatie van de ander dat gebruikt wordt tijdens de interactie met die andere persoon. Sociale affordances beïnvloeden sociale aanwezigheid omdat zij awareness over de groep verschaffen tezamen met communicatiemedia.

Hypothesen

Het raamwerk veronderstelt een aantal hypothesen (Hoofdstuk 1 en 10), die in de figuur te zien zijn.

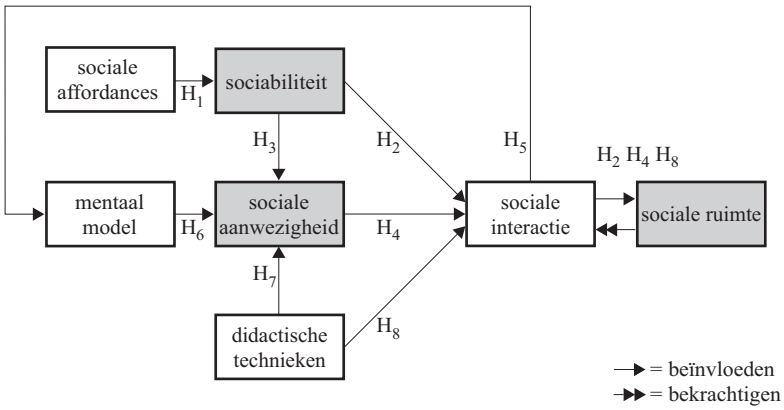
Slechts de eerste vier hypothesen (H_1, H_2, H_3 en H_4) zijn relevant voor het huidige onderzoek:

H_1: Sociale affordances dragen bij aan de mate van gepercipieerde sociabiliteit van de CSCL-omgeving

H_2: Een hogere gepercipieerde sociabiliteit van de CSCL-omgeving vergroot de kans dat een gezonde sociale ruimte tot stand komt

H_3: Een hogere gepercipieerde sociabiliteit van de CSCL-omgeving vergroot de mate van gepercipieerde sociale aanwezigheid

H_4: Een hogere gepercipieerde sociale aanwezigheid vergroot de kans dat een gezonde sociale ruimte tot stand komt.



Model van relaties tussen de variabelen sociabiliteit, sociale aanwezigheid, didactische technieken, sociale affordances, mentaal model, sociale interactie en sociale ruimte.
(Elke pijl vertegenwoordigt een hypothese; variabelen in de grijze rechthoeken zijn die waarvoor een meetinstrument is ontwikkeld)

Het testen van de eerste vier hypothesen impliceert dat een echt sociale-affordance-instrument (d.w.z. een instrument dat sociale affordances ten toon spreid) moet worden ontworpen, geïmplementeerd en gerealiseerd. Daarnaast zijn instrumenten nodig voor het meten van de variabelen sociale ruimte, sociabiliteit en sociale aanwezigheid.

Een sociale-affordance-instrument

Ontwerp en implementatie

Hoofdstuk 5 bespreekt het ontwerp en de implementatie van sociale-affordance-instrumenten. Als nabijheid een belangrijke dimensie van sociale affordances is, dan moet de operationalisatie van een sociaal instrument nabijheid als uitgangspunt nemen. Groepawareness voldoet aan deze vereiste, omdat het tele-nabijheid bewerkstelligt (d.w.z. virtuele ruimtelijke nabijheid). Groepawareness is awareness met betrekking tot de verblijfplaatsen van de leden van de groep (d.w.z. waar zij zijn en wat zij doen); het is awareness die kunstmatig wordt gecreëerd met de hulp van computers en netwerken (Borning & Travers, 1991; Dourish & Bellotti, 1992; Dourish & Bly, 1992; Gajewska, Manasse & Redell, 1995). De sociale-affordance-instrumenten die groepawareness benutten, worden aangeduid als groepawareness-apparaatje (Engels: group awareness widgets, hier afgekort met GAWs). In een elektronische CSCL-omgeving is een GAW een stuk software.

Terwijl groepawareness zich richt tot ruimtelijke nabijheid, richt zich geschiedenis-awareness tot temporele awareness. Geschiedenisawareness is de gestructureerde verzameling sporen die door alle groepsleden zijn gecreëerd. Geschiedenisawareness geeft niet alleen inzicht in wanneer en hoe lang groepsleden met een bepaalde activiteit bezig zijn geweest, maar ook in hun algemene gedragspatronen (bijvoorbeeld de mate van participatie binnen de groep kan eenvoudig worden afgeleid).

GAWs worden strak aan communicatiemedia gekoppeld om de perceptie-actiekoppeling te kunnen waarborgen waardoor, zodra een groepslid 'zichtbaar' wordt, meteen

een communicatie-episode kan worden gestart, op voorwaarde dat er een onmiddellijke behoefte aan spontane comunicatie bestaat. De perceptie-actiekoppeling is één van de twee relaties van sociale affordances; de andere is de reciproke relatie die bestaat tussen de CSCL-omgeving en de groepsleden die daarvan gebruikmaken, dat wil zeggen, er bestaat een overeenstemming tussen dat wat de CSCL-omgeving biedt en dat wat de groepsleden nodig hebben in termen van sociale kwesties.

Hoofdstuk 5 wijst erop dat een GAW ook aan de criteria van gebruiksgemak (waaronder zaken als 'gemakkelijk te leren' en 'gemakkelijk te gebruiken' vallen) en interactieontwerp (die betrekking hebben tot esthetica, met andere woorden, hoe van de GAW een aantrekkelijk apparaat te maken valt) zou moeten voldoen. In het algemeen wordt erkend dat zaken die betrekking hebben op esthetica, moeilijk zijn te bepalen, omdat zij naar subjectieve kwaliteiten verwijzen. In tegenstelling daarmee kan gebruiksgemak empirisch worden bepaald.

Realisatie

Hoofdstuk 6 presenteert de realisatie van een eerste prototype van de GAW dat gebaseerd is op een client-server-architectuur en dat uit drie basiseenheden bestaat: een GAW-cliënt, een GAW-relaisserver, en een GAW-server. De client-server-architectuur gebruikt een 'gebeurtenis-bericht'-server voor het distribueren van gebeurtenissen als berichten –die de awarenessinformatie bevatten– over internet naar de groepsleden. Een gebeurtenis is een representatie van iets dat op een specifiek ogenblik plaats heeft gehad, uitgedrukt in termen van een beschrijving over het gebeurde, maar wat geen duur heeft (Rosenblum & Wolf, 1997), bijvoorbeeld het inloggen op een computer. Een bericht is een formele beschrijving van een gebeurtenis, uitgedrukt in termen van een lijst van benoemde attributen van enkelvoudige datatypen zoals *string* en *integer* (Fitzpatrick, Kaplan, Mansfield, Arnold & Segall, 2002). Een globale bewaarplaats wordt gebruikt voor het opslaan van de berichten. De GAW-server bestaat uit componenten die deze twee functies realiseert, daarbij gebruikmakend van de SIENA-gebeurtenisservice (Carzinga, Rosenblum & Wolf, 1998, 2001) en van de MySQL-serversoftware voor het opzetten van het gegevensbestandssysteem. Het distribueren van de gebeurtenissen is één ding, het andere is het genereren van de gebeurtenissen. Daarom moet code die de 'gebeurtenis-bericht'-generatoren implementeren op strategische locaties, in de broncode van die applicaties worden opgenomen die door de groepsleden worden gebruikt. Berichten geproduceerd door deze 'gebeurtenis-bericht'-generatoren worden verstuurd naar de GAW-relaisserver die aanwezig is op dezelfde computer als waarop de toepassingen zijn geïnstalleerd. De enige functie van de GAW-relaisserver is slechts het doorgeven van de berichten naar de GAW-server. De GAW-cliënt omvat de gebruikersinterface en is geïnstalleerd op de computer van het groepslid. De gebruikersinterface van de GAW bestaat uit een sidebar en twee tickertapes. De sidebar bevat een aantal segmenten die grafisch de verschillende typen groep awarenessinformatie tonen tezamen met de daarbij horende geschiedenis-awareness. De tickertape langs de bovenkant van het scherm wordt gebruikt voor het tonen van gebruikesrsberichten, de andere, die direct onder de eerste tickertape is geplaatst, wordt gebruikt voor het tonen van systeemberichten. De gebruikersinterface is zwak met een webgebaseerde e-mail-cliënt (WebmailASP wordt gebruikt) en een chat-cliënt (de toepassing ZBITchat wordt gebruikt) gekoppeld.

Het GAW-prototype moet tezamen met een CSCL-omgeving worden gebruikt. Hiervoor is Microsoft® Sharepoint™ Teamservices gebruikt. Het GAW-prototype en

Microsoft® Sharepoint™ Teamservices vormen een 'instrument' dat in experimenten kan worden gebruikt waarmee de effecten van sociale affordances worden onderzocht.

De sociale-ruimteschaal

Hoofdstuk 7 beschrijft de constructie en validatie van de sociale-ruimteschaal. De sociale-ruimteschaal is een zelfrapporterend meetinstrument met 20 items om de gepercipieerde kwaliteit te bepalen van de sociale ruimte die in gedistribueerde leergroepen aanwezig is, en bestaat uit twee delen. Het eerste deel (de items 1–12) beoordeelt het gevoel die studenten hebben betreffende hun eigen gedrag of het gedrag van andere groepsleden binnen de groep. Het tweede deel (de items 13-20) beoordeelt de gepercipieerde frequentie van het optreden van specifiek gedrag van groepsleden binnen de groep. De sociale-ruimteschaal heeft twee dimensies: de positieve en de negatieve groepsgedragdimensie. Elke dimensie bestaat uit tien items (de oneven items behoren tot de positieve groepsgedragdimensie, de even items tot de negatieve groepsgedragdimensie). Positief groepsgedrag bestaat wanneer groepsleden elkaar helpen en ondersteunen, persoonlijke informatie over zichzelf vrijgeven, zich vrij voelen om anderen te bekritiseren zonder de anderen te beschadigen en dergelijke. Negatief groepsgedrag bestaat wanneer groepsleden een afkeer van elkaar hebben, wantrouwend zijn ten opzichte van de andere groepsleden, onredelijk zijn en dergelijke.

De interne consistentie was .81 voor de totale schaal, .92 voor de positieve groepsgedragdimensie en .87 voor de negatieve groepsgedragdimensie. Een nomologisch netwerk werd gebruikt voor verdere validatie. De bevindingen suggereren dat de sociale-ruimteschaal potentieel een zinvol meetinstrument is om de sociale ruimte binnen groepen te bepalen.

De sociabiliteitschaal

Hoofdstuk 8 beschrijft de constructie en validatie van de sociabiliteitschaal voor het bepalen van de gepercipieerde mate van sociabiliteit van de CSCL-omgeving. De sociabiliteitschaal bestaat uit tien items en is eendimensionaal. Sociabiliteit bestaat wanneer de CSCL-omgeving uitnodigend is tot het voeren van informele, terloopse gesprekken en waar 'toevallige' ontmoetingen mogelijk zijn, waardoor de kans vergroot wordt dat een gezonde sociale ruimte tot stand komt.

De interne consistentie van de sociabiliteitschaal .92. Een nomologisch netwerk werd gebruikt voor verdere validatie. De resultaten van de exploratieve studie zijn veelbelovend en tonen aan dat de sociabiliteitschaal potentieel een zinvol meetinstrument is om de sociabiliteit te bepalen.

De sociale-aanwezigheidschaal

Hoofdstuk 9 beschrijft de constructie en validatie van een zelfrapporterende sociale-aanwezigheidschaal met vijf items.

De interne consistentie van de sociale-aanwezigheidschaal is .81. Een nomologisch netwerk van gelijkaardige en verwante concepten werd gebruikt voor verdere validatie. Evenals de sociale-ruimteschaal en de sociabiliteitschaal, heeft de sociale-aanwezigheidschaal de potentie om als instrument te worden toegepast om de gepercipieerde sociale aanwezigheid in DLGs te meten.

De pilotstudie

Hoofdstuk 10 rapporteert over een pilotstudie die vooraf aan een reeks experimenten is geplaatst. Participanten in deze pilotstudie hadden in de experimentele conditie de beschikking over het GAW-prototype, de e-mail-cliënt WebmailASP en chat-cliënt ZBIT, terwijl participanten in de controleconditie niet over deze toepassingen konden beschikken. In beide condities werd Microsoft® Sharepoint™ Team Services gebruikt als CSCL-omgeving. De twee doelstellingen van de pilot studie waren: (1) eerste ervaringen verzamelen over het GAW-prototype en (2) eerste aanwijzingen verzamelen of de vier hypothesen bevestigd kunnen worden.

Echter, (1) de aard van het afstandsonderwijs bij de Open Universiteit Nederland –die door vrijheid van tijd, tempo en plaats wordt gekenmerkt– en haar typische studentenpopulatie en (2) de aard van de gebruikte software hebben tot minimale resultaten geleid die slechts een voorzichtige eerste aanwijzing gaven over de richting van de gekozen relaties zoals geformuleerd in de hypothesen.

Met betrekking tot de typische studentenpopulatie van Open Universiteit Nederland: vrij veel participanten verlieten de pilot om uitlopende redenen (zij startten niet met de cursus, vielen uit, gingen op individuele basis verder, of waren vrijgesteld van de cursus).

Met betrekking tot de gebruikte software: alle drie toepassingen Microsoft® Sharepoint™ Team Services, WebmailASP en ZBITchat toonden enkele gebreken die het gebruiksgemak ervan verminderde. Het GAW-prototype werd nauwelijks gebruikt omdat de participanten de functie ervan niet hadden begrepen en zij het slechts als middel gebruikten om te 'spioneren'. Spioneren is het snel even kijken of medegroepsleden ook online zijn. Aangezien dit zelden het geval was, verminderde het gebruik van het GAW-prototype. Ook gebeurde het vaak dat, nadat Microsoft® Sharepoint™ Team Services was gestart, de participanten er onmiddellijk in begonnen te werken en daarbij vergaten om ook het GAW-prototype te starten. Tenslotte werd de kritieke gebruikersmassa niet bereikt, omdat niet alle groepsleden het GAW-prototype gebruikten.

Voornamelijk omdat het aantal reacties op de vragenlijst te laag was, kunnen er geen uitspraken gedaan worden of de vier hypothesen wel of niet standhouden. De pilot maakte echter wel duidelijk dat sommige variabelen moeilijk te controleren zijn in een veldexperiment. Dientengevolge zullen eerst laboratoriumexperimenten uitgevoerd moeten worden vóór de veldexperimenten.

Ten slotte

Hoofdstuk 11 is de algemene discussie met betrekking tot de resultaten, de beperkingen van het huidige onderzoek, de relevantie ervan voor afstandsonderwijs en voor de Open Universiteit Nederland in het bijzonder en voor toekomstig onderzoek.

Met betrekking tot de resultaten: een literatuurstudie werd uitgevoerd om de vraag te kunnen beantwoorden waarom sociale interactie in DLGs die van CSCL-omgevingen gebruikmaken, vaak afwezig is. Deze studie gaf aan dat er twee valkuilen zijn en een aantal barrières. Om een oplossing te vinden voor het aanmoedigen van sociale interactie, is een raamwerk opgesteld dat het ontwerpen van sociabele CSCL-omgevingen promoot. Om de vier hypothesen te testen, is een groepawarenessapparaatje (GAW) gerealiseerd en zijn er drie schalen ontwikkeld (de sociale-ruimteschaal, de sociabiliteitschaal en de sociale-aanwezigheidschaal). De pilot echter, was niet succesvol verlopen.

Met betrekking tot de beperkingen van het huidige onderzoek: er wordt op gewezen dat wegens beperkte tijd en budget, de GAW in de pilot enkel een rudimentair eerste prototype is die waarschijnlijk niet aan de criteria van gebruiksvriendelijkheid voldoet en zeker niet aan de criteria ten aanzien van interactieontwerp. Daarnaast moeten de ontwikkelde schalen met enige reserves worden gebruikt vanwege: (1) een kleine steekproefgrootte (relatief ten opzicht van het aantal testitems in de ruwe schalen), (2) het bijeenvoegen van vijf kleinere steekproeven teneinde één grotere steekproef te verkrijgen, en (3) het herhaaldelijk gebruik van dezelfde dataverzameling. Niettemin, de schalen hebben potentie om de overeenkomstige variabelen te meten (d.w.z. sociale ruimte, sociabiliteit en sociale aanwezigheid). Tot slot, de hypothesen konden noch bevestigd noch ontkracht worden aangezien de pilot onvoldoende resultaten leverde.

Met betrekking tot de relevantie van het onderzoek: het huidige onderzoek heeft bijgedragen aan de theorievorming over het aanmoedigen van sociale interactie in gedistribueerde leergroepen. Daarnaast zijn drie schalen ter beschikking gesteld aan de CSCL-gemeenschap voor gebruik in eigen onderzoek. Het huidige onderzoek toont ook aan dat instellingen van afstandsonderwijs, zoals de Open Universiteit Nederland, voorzichtig moeten zijn wanneer zij samenwerkend leren in hun curricula introduceren; zij dienen rekening te houden met de typische afstandsstudenten die vaak hogere frequenties van non-startgedrag en uitval tonen. Ook moeten zij zich van de spanning bewust zijn die het gevolg is van de conflicterende verhouding tussen samenwerkend leren (wat coördinatie- en tijdbeperkingen kent, maar studenten met een samenwerkende leerstijl aantrekt) en de aard van afstandsonderwijs (wat vrijheid van tijd, tempo en plaats omvat en daardoor juist studenten met een onafhankelijke leerstijl aantrekt).

Met betrekking tot toekomstig onderzoek: er wordt voorgesteld om het concept affordances uit te breiden met onderwijskundige affordances (Kirschner, 2002). Daarnaast zou de potentie van alternatieve sociale-affordancesinstrumenten, die gebaseerd zijn op sociale navigatie (Engels: social navigation) (Dourish & Chalmers, 1994; Munro, Höök & Benyon, 1999; Wexelblat, 1998, 1999) en sociaal bladeren (Engels: social browsing) (Lee & Girgensohn, 2002; Root, 1988), uitgeprobeerd moeten worden.

Het huidige onderzoek wijst erop dat het allerbelangrijkste is dat het ontwerp en de implementatie van toekomstige CSCL-omgevingen in multidisciplinaire teams moet gebeuren en niet slechts overgelaten moet worden aan onderwijskundigen alleen.

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Curriculum Vitae

Karel Kreijns werd geboren op 18 Februari 1957 te Surabaya, Indonesië. Na eerst vijf jaren in Paramaribo, Suriname, als kind gewoond te hebben, kwam hij in 1964 naar Nederland.

In 1975 behaalde hij het Atheneum-B diploma aan het Sintermeerten-college te Heerlen. Daarna studeerde hij tussen 1975 en 1982 Elektrotechniek met als afstudeerrichting Regeltechniek aan de Technische Hogeschool Eindhoven (thans Technische Universiteit Eindhoven).

Ter vervulling van zijn dienstplicht was hij tussen 1983 en 1984 als ROAG (reserveofficier academisch gevormd) werkzaam bij het TNO/LEOK (laboratorium voor elektronische ontwikkelingen voor de krijgsmacht) alwaar hij betrokken was bij de implementatie van een real-time besturingssysteem voor de Motorola 68000-familie van micro-processoren. Vervolgens was hij tussen 1984 en 1987 werkzaam bij de afdeling R&D (Research and Development) van het kopieerbedrijf Océ van de Grinten. Daar heeft hij zich eerst als regeltechnicus beziggehouden met de ontwikkeling van een digitale moterregeling voor gebruik in de documentfeeder, dan als programmeur mede een besturingssysteem helpen ontwikkelen voor de Intel 8088-microprocessor in assembleertaal, en tenslotte was hij als projectleider betrokken bij het ontwikkelen van een besturing voor een hoog volume kopieerapparaat waarbij hij gebruikmaakte van de door hem geïntroduceerde Yourdon (Ward-Mellor) software ontwikkelingsmethodiek.

Vanaf mei 1987 was hij werkzaam bij de produktgroep Technische Wetenschappen (thans faculteit Informatica) bij de Open Universiteit Nederland. Daar was hij als cursusteamleider tot de zomer 2004 verantwoordelijk geweest voor het maken van cursussen op het gebied van digitale systemen, computerhardwarearchitectuur en besturingssystemen. Tussen 1998 en 2001 was hij ook betrokken bij het project Virtueel Bedrijf, voornamelijk eerst als medewerker voor de ICT-ondersteuning van virtuele bedrijven, maar later ook (voor enkele maanden) voor de ontwikkeling ervan.

Eind 1999 is hij gestart met een promotieonderzoek op het gebied van de sociale aspecten van samenwerkende leergroepen, waarbij de vraag centraal stond in hoeverre elektronische leeromgevingen zelf ondersteuning kunnen bieden ten aanzien van die sociale aspecten. Dit promotieonderzoek stond sinds Oktober 2000 onder auspiciën van het OTEC (onderwijstechnologisch expertisecentrum).

Vanaf Maart 2004 is hij verbonden aan het Ruud de Moorcentrum dat een taakstelling heeft ten aanzien van het lerarentekortprobleem. Hij is daar betrokken bij de projecten e-didactiek en praktijkgemeenschap.

Publications

Journals

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