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Determining Sociability, Social Space, and Social Presence in (A)synchronous Collaborative Groups

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ABSTRACT

The effectiveness of group learning in asynchronous distributed learning groups depends on the social interaction that takes place. This social interaction affects both cognitive and socio-emotional processes that take place during learning, group forming, establishment of group structures, and group dynamics. Though now known to be important, this aspect is often ignored, denied or forgotten by educators and researchers who tend to concentrate on cognitive processes and on-task contexts. This "one-sided" educational focus largely determines the set of requirements in the design of computer-supported collaborative learning (CSCL) environments resulting in functional CSCL environments. In contrast, our research is aimed at the design and implementation of sociable CSCL environments which may increase the likelihood that a sound social space will emerge. We use a theoretical framework that is based upon an ecological approach to social interaction, centering on the concept of social affordances, the concept of the sociability of CSCL environments, and social presence theory. The hypothesis is that the higher the sociability, the more likely that social interaction will take place or will increase, and the more likely that this will result in an emerging sound social space. In the present research, the variables of interest are sociability, social space, and social presence. This study deals with the construction and validation of three instruments to determine sociability, social space, and social presence in (a)synchronous collaborating groups. The findings suggest that the instruments have potential to be useful as measures for the respective variables. However, it must be realized that these measures are "first steps."

INTRODUCTION

CONTEMPORARY computer-supported collaborative learning (CSCL) environments offer two distinct complements to traditional education. First, CSCL environments allow learners to be geographically and temporally distributed, allowing the formation of distributed learning groups consisting of members originating from different countries, which in today's society is seen as an important issue. Second, CSCL environments also have the potential to support current insights in teaching and learning that rely on social interaction between group members. These aspects have convinced many educators to believe that CSCL environments are the promising next generation of educational tools.

However, despite this promise, literature reports inconclusive findings. In addition to the positive

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findings, mixed and negative findings[5] are reported regarding the learning process itself,[1–4] and regarding the group forming and group dynamics.[6–9] These disappointing results can be traced down to the impediment of social interaction and of the group dynamics in (a)synchronous distributed learning groups which are usually taken for granted by teachers, instructors, (distance) educators, and researchers.[10] Kreijns et al.[11] state that the computer-mediated communication (CMC) subsystems embedded in the CSCL environments raise barriers that—when not recognized—will impede social interaction both for cognitive processes and for socio-emotional processes underlying the group dynamics. These barriers are:

1. There is no suitable CSCL pedagogy. Brandon and Hollingshead[12] point 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).
2. CMC-typed media is text-based leaving out the non-verbal (visual and audio) and back-channeling cues which hampers impression formation and, thus, forming of groups and group dynamics,[13–15] the coordination of conversations and task accomplishment,[16] and grounding.[17]
3. CSCL environments may not meet the criteria of interaction design[18] and usability.[19]

Consequently, if the barriers are not overcome, the effectiveness of group learning may decrease. Recently, a number of educational researchers have recognized that the effectiveness of a (a)synchronous distributed group for collaborative learning largely depends on whether a sound social space has emerged indicating the establishment of a community of learning. In a sound social space, open dialogue and social interaction are possible, enabling cognitive processes such as elaborating, questioning, and defining to take place, all of which are necessary for the social construction of knowledge and competence building.[5,20,21] Inherent to many (a)synchronous distributed learning groups—especially those consisting of learners from different countries—is that they contain members with different cultural backgrounds who do not know each other. The group as a whole has no history and it is very unlikely that group members will ever meet each other face-to-face. Group forming and group dynamics have yet to take place.

However, contemporary CSCL environments are predominantly *functional* CSCL environments because their design is guided by pure educational constraints without paying any attention to the social (psychological) aspects of collaborating through CMC. Cutler[22] 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).

This paper starts with presenting a theoretical framework aimed at the design of *sociable* CSCL environments eliciting three key variables: sociability, social presence, and social space. We proceed by presenting three instruments for measuring the respective variables and discuss their validation in the methods section. Finally, we present conclusions and future work.

Theoretical framework

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 encompassing:

1. The ecological approach to social interaction[23–25]
2. The concept of the sociability of CSCL environments[26]
3. Social presence theory[5,13,27–30]

Ecological approach to social interaction: social affordances

The ecological approach to social interaction uses the concept of social affordances as its central theme. Social affordances are the "properties of a CSCL environment that act as social-contextual facilitators relevant for the learner's social interactions".[26] This definition emphasizes the unique relationship between the CSCL environment and the learners with respect to social interaction as does the definition of Bradner, Kellog, and Ericson[31] namely, 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." Social affordances can be realized by independent devices (as suggested by the Bradner, Kellog, and Ericson definition) augmenting the CSCL environment; hence these devices are designated social affordances devices. A typical example of a social affordances device in real-life settings is the coffee machine around which people may gather and have informal conversations about anything

from task-related problems, last night's football game, or information about oneself (self-disclosure). Thus, these conversations contain fragments of task-oriented as well as socio-emotional content. Here, we see the social dynamics in action.

Proximity is an important dimension of social affordances. In our research we have operationalized social affordances devices by grounding them on the concept of tele-proximity,[32] that is, proximity that is artificially created with the aid of computers and networks with the goal of the creation of group awareness: up-to-the-minute knowledge about the others in their activities whether on-task or off-task.[33] Social affordance devices based upon mechanisms for group awareness and tightly coupled with a set of communication media are called group awareness widgets (GAWs), tools aimed at increasing impromptu encounters (rather than planned encounters) and increasing informal communication (rather than formal communication) both in on-task and off-task settings. GAWs are complementary to workspace awareness widgets[34] that provide awareness about the on-task activities of the other while performing a specific task; for example, the positions of the cursors of all the others in a shared editor application. 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. Xerox PARC and EuroPARC researchers use media spaces.[35] 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. Our implementation of a GAW displays group awareness information graphically together with history information along a time-axis, thereby providing history. Other implementations of mechanisms for group awareness information may include abstract video images[36] or sound.[37]

The set of communication media may include asynchronous as well as synchronous media. Generally, a default set of CMC typed media is used: chat, computer conferencing, and e-mail. It may, however, be questioned whether such a set is optimal.[11] Gay and Lettini[38] suggest that the set should have a "sufficient" variety of communication media. Research is needed to determine the right set of communication media in group awareness widgets.

The sociability of CSCL environments

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 et al.[26] define sociability "to be the extent 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. the learners/group members) and their activities (i.e., the learning tasks) are needed to recognize and exploit this sociability potential of the CSCL environment. We hypothesize that the greater the sociability of an environment, the more likely 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 effective 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 among the group members.

Social presence theory

Short et al.[13] 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." Social presence is thus the degree of illusion that the other in the communication appears to be a "real" physical person. Social presence affects the degree of social interaction taking place in CSCL environments.[5,27–30] Tu,[28] linking social learning theory with social presence theory, concluded that "Social presence is required to enhance and foster online social interaction, which is the major vehicle of social learning," and "if social presence is low, the foundation of social learning, social interaction, does not occur." Garrison[39] contends that social presence is an important concept for understanding the social context and for creating a social climate in computer conferences.

Relationships between sociability, social presence, and social space

Our framework suggests a number of relationships between the variables sociability, social

presence, social space, and social interaction. These relationships are subsumed in a model of relationships, as seen in Figure 1. Because the framework emphasizes the promotion of social interaction in the social (psychological) dimension, it complements 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 that are determined by the pedagogical techniques) are all equally important.

Our research encompasses the following hypotheses implicated by our framework and (partly) depicted in the model:

H1: Social affordance devices contribute to the degree of perceived sociability of CSCL environments.
H2: CSCL environments higher in perceived sociability will increase the likelihood of the establishment of a sound social space.
H3: CSCL environments higher in perceived sociability will increase the degree of perceived social presence.
H4: A higher perceived social presence will increase the likelihood of the establishment of a sound social space.

A discussion of the model and testing the hypotheses is, however, beyond the scope of this paper.

Instruments for sociability, social presence, and social space

Existing instruments. A number of existing instruments purport to measure social climate/social presence. Rourke and Anderson[40] measure the social climate of computer conferencing by using six, 5-point bipolar (semantic differential) scale items: personal–impersonal, warm–cold, trusting–untrusting, disinhibiting–inhibiting, close–distant, and friendly–unfriendly. These bipolar scale items are commonly used to measure the degree of social presence. Short, Williams, and Christie[13] used four, 7-point bipolar scale items: personal–impersonal, sociable–unsociable, sensitive–insensitive, and warm–cold, for measuring social presence. These four scale items were, and still are, the dominant social presence measure for many researchers. Gunawardena[5] extended these four scale items with 13 new scale items, resulting in a questionnaire of 17, 5-point bipolar scale items. She uses 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[41] 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 on-line community" and "I felt that my point of view was acknowledged by other participants in GlobalEd"; GlobalEd is a listserv based discussion board). They contend that the Social Presence Indicators measure the "intimacy" dimension[43] of social presence,[42] whilst, in contrast, the Social Presence Scale measures the "immediacy" dimension. Tu[44] developed a measure that assesses five dimensions of so-

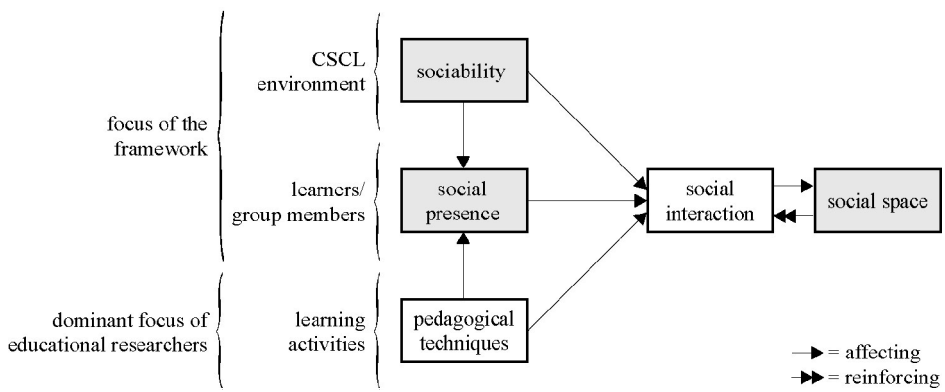

FIG. 1. Model of relationships between the variables sociability, social presence, pedagogical techniques, social interaction, and social space. Variables in the gray rectangles are those for which an instrument is developed.

cial presence: 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?"), and feelings of privacy (six items; e.g., "How SECURE/SECRET is your online participation?") for e-mail, bulletin board and real-time discussion respectively. All items are 5-point Likert-scale items, except for one system privacy item.

From this discussion we conclude that it is unclear what all these instruments are actually measuring since they show overlap in test items or test items are not within the space of interest associated with the construct (Gunawardena and Zittle's Social Presence Scale include 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 toward CMC, and/or the intimacy or immediacy dimension of social presence.

The authors themselves also add to the confusion. Rourke and Anderson[40] 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 than that of Short et al.[13] Gunawardena[5] stated that the 17, 5-point bipolar scale items (the Social Presence Indicators) measures the students' 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). 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[41] 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, privacy, social context, and the effects of using certain pedagogical techniques. Moreover, not all the measurements 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 measures for sociability, social presence, and sociability. These measures are presented in the next sub-sections.

The Sociability Scale is a self-reporting questionnaire in Dutch for measuring the perceived sociability of a CSCL environment. The construction of the test items of Sociability Scale is based upon group awareness, communication, and potential for facilitating the creating a community of learning. Consequently, the Sociability Scale is composed of test items addressing these elements. Table 1 depicts the (refined) sociability scale. The methods section will explain in more detail the refinement process and the meaning of the last three columns.

The Social Presence Scale. Like the Sociability Scale, the Social Presence Scale 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 is inspired by telepresence research. According to Sheridan,[45] telepresence means that the operator receives sufficient information about the teleoperator and the task environment displayed in a sufficiently natural way, that the operator feels physically present at the remote site. This definition reflects the original purpose of telepresence research, namely that of a teleoperation in (e.g., hazardous) physical environments. Today, telepresence research also encompasses virtual presence research: the experience of being in a computer generated environment. These environments can be text-based like MOOs and MUDs or graphical 3D environments. Questionnaires measuring virtual presence are sometimes fairly simple. For example, Towell and Towell[46] use 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 have developed a social presence scale. Table 2 depicts the (refined) Social Presence Scale. Details about the refinement process are discussed in the methods section.

The Social Space Scale The Social Space Scale is a self-reporting two-part measure in Dutch for assessing the perceived quality of social space in

TABLE 1. THE SOCIABILITY SCALE

No. item	*Item*	*M*	*SD*	*Factor sociability*
Q1	This CSCL environment enables me to easily contact my team mates	3.29	1.03	0.77
Q2	I do not feel lonely in this CSCL environment	2.90	1.18	0.69
Q3	This CSCL environment enables me to get a good impression of my team mates	2.58	0.98	0.80
Q4	This CSCL environment allows spontaneous informal conversations	2.75	1.14	0.68
Q5	This CSCL environment enables us to develop into a well performing team	2.76	1.05	0.80
Q6	This CSCL environment enables me to develop good work relationships with my team mates	3.19	1.05	0.84
Q7	This CSCL environment enables me to identify myself with the team	2.96	1.07	0.79
Q8	I feel comfortable with this CSCL environment	3.44	1.06	0.83
Q9	This CSCL environment allows for non task-related conversations	3.61	0.99	0.69
Q10	This CSCL environment enables me to make close friendships with my team mates	2.49	1.13	0.73

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

TABLE 2. THE SOCIAL PRESENCE SCALE

No. item	*Item*	*M*	*SD*	*Factor social presence*
Q1	When I have real-time conversations in this CSCL environment, I have my communication partner in my mind's eye	2.15	1.17	0.80
Q2	When I have asynchronous conversations in this CSCL environment, I also have my communication partner in my mind's eye	2.75	1.16	0.70
Q3	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	0.79
Q4	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	0.79
Q5	Real-time conversations in this CSCL environment can hardly be distinguished from face-to-face conversations	1.81	1.01	0.69

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

distributed learning groups. The construction of the test items of Social Space Scale is based upon literature on collaborative learning with respect to psychological health and well being in the group,[47] and on social psychology (e.g., effects of trust, making friends). The first part (Q1–Q12) assesses the applicability of feelings regarding their own or a group members' behavior in the CSCL environment. The second part (Q13–Q20) assesses perceived frequencies of social behavior in the CSCL (Table 3).

MATERIALS AND METHODS

Participation

Data was collected from students in three distance education courses at the Open Universiteit Nederland (OUNL). The first "course" is the Virtual Environmental Consultancy (VEC) of the Department of Natural Sciences (n = 35, 25 males, 10 females from four higher education institutions). Students were assigned to one of eight groups.

TABLE 3. THE SOCIAL SPACE SCALE

No. item	*Item*	*M*	*SD*	*Factors*	
				Positive group behavior	*Negative group behavior*
Q1	Group members felt free to criticize the ideas, statements, and/or opinions of others	3.29	1.03	0.69	
Q2	We reached a good understanding on how we had to function	2.44	1.32	0.75	
Q3	Group members ensured that we kept in touch with each other	3.10	1.11	0.79	
Q4	We worked hard on the group assignment	2.90	1.30	0.76	
Q5	I maintained contact with all other group members	2.78	1.31	0.76	
Q6	Group members gave personal information on themselves	2.82	1.07	0.62	
Q7	The group conducted open and lively conversations and/or discussions	2.59	1.15	0.85	
Q8	Group members took the initiative to get in touch with others	2.84	1.11	0.87	
Q9	Group members spontaneously started conversations with others	2.66	1.10	0.72	
Q10	Group members asked others how the work was going	3.15	1.12	0.70	
Q11	Group members felt that they were attacked personally when their ideas, statements and/or opinions were criticized[a]	3.99	0.94		0.74
Q12	Group members were suspicious of others[a]	4.37	0.72		0.79
Q13	Group members grew to dislike others[a]	4.22	1.09		0.66
Q14	I did the lion's share of the work[a]	4.00	0.97		0.57
Q15	Group members obstructed the progress of the work[a]	3.94	1.09		0.60
Q16	Group members were unreasonable[a]	4.37	0.89		0.90
Q17	Group members disagreed amongst each other[a]	4.47	0.81		0.69
Q18	The group had conflicts[a]	4.49	0.85		0.66
Q19	Group members gossiped about each other[a]	4.72	0.70		0.68
Q20	Group members did not take others seriously[a]	4.72	0.58		0.60

[a]These items were reverse coded for analysis.

For items (refined Social Space Scale) Q1–Q12: Judgments were made on five-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) Q13–Q20: Judgements were made on five-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).

Group size was between three and eight members. Groups could choose a case from a pool of 13 cases (e.g., "Criteria for sustainability in spatial interventions") and had to produce an Environmental Advice Report. Students used eRoom version 5.4 (www.eroom.com) as their CSCL environment.

The two other courses were taken from the Statistics Education Innovation Project[48] at the Department of Psychology. Thirty-eight adult undergraduates (all Dutch OUNL students, 6 males and 32 females) 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, the group sizes changed because two female students were non-starters and during the course ten students (2 males, 8 females) dropped out. All 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 occurred through newsgroups, and real-time communication via Microsoft Netmeeting. Telephone and e-mail use were prohibited.

One hundred and thirteen adult undergraduates (all Dutch OUNL students, 34 males and 79 females) 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 than fast groups to complete the course. 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, 14 students (4 males, 10 females) dropped out and 18 students moved to another group. In addition, one slow group discontinued and one free group was formed. All groups had to study the same material emphasizing the use of questionnaires, moderation analysis with ANOVA, and regression methods. The groups of the second statistical course used the Studynet CSCL environment as well. Here, too, e-mail and telephone use were prohibited.

Procedure

VEC 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, release 2.2, www.dipolar.com.au) just after the second face-to-face meeting. From the total of 35 students only 11 students (31.4%) responded to the questionnaire from which 9 students (25.7%) responded to all items. All respondents were merely from two higher education institutions. Stat 1 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 less two non-starters and less 10 drop-outs), 18 (69.2%) students responded to the questionnaire. Stat 2 had a variable length. Slow and free groups had ten months to complete the course while fast groups had six. At the time of the data collection, slow and free groups were still studying while the fast groups have completed the course. From the number of students that actually participated (93 students; 113 initial students less six non-starters and less 14 drop-outs), 50 (53.8%) students responded. Two students who dropped-out also returned the questionnaire. The total number of respondents is, therefore, 52.

Instruments

In order to validate the Sociability Scale, the Social Presence Scale, and the Social Space Scale, four measures dealing with constructs related to sociability, social presence, and social space—or to aspects of them—were selected as reference measures:

1. Social Presence Indicators[5]
2. Social Presence Scale[41]
3. Work-Group Cohesiveness Index[49]
4. Group Atmosphere Scale[50, 51]

For validation we used Campbell and Fiske's[52] criterion that related constructs in a nomological network[53] should exhibit moderate to high correlations, but not too high since extreme correlation could be interpreted as equivalency.

The Gunawardena Social Presence Indicators. Gunawardena[5] used a questionnaire of 17, 5-point bipolar scale items to assess a range of feelings students have toward CMC: 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, and helpful–hindering. In this paper, we refer to these bipolar scale items as the Social Presence Indicators. In our study, we have translated these items into Dutch.

We believe the test items of the Social Presence Indicators measure, amongst other things, many of the sociability aspects of CSCL environments (see, for instance, the item "sociable–unsociable"), less of the social presence aspects, and even lesser on the social space aspects. We therefore expect a high correlation between this measure and the Sociability Scale, a moderate correlation with the Social Presence Scale, and a low to moderate correlation with the Social Space Scale with respect to the Positive Group Behavior dimension.

It is difficult to pronounce upon 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 in social presence are on group behavior in the negative dimension. On the one hand, 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.[54,55] On the other hand, Walther's[15] social information processing (SIP) theory rebuts these suggestions. Therefore, we leave this correlation aside for the moment.

The Gunawardena and Zittle Social Presence Scale. The Gunawardena and Zittle[41] Social Presence Scale (from here on referred to as the GZ Social Presence Scale for avoiding confusion with our Social Presence Scale) is, according to Gunawardena and Zittle, an alternative scale for measuring social presence which can be used interchangeably with the Social Presence Indicators. The GZ Social Presence Scale consists of 14, 5-point Likert-scale items. In our study, we did not consider items 9, 10, and 11, because these test-items ask to compare CMC with respectively face-to-face, audio teleconference, and video teleconference with regard to the impersonality of discussions. We also slightly adapted the GZ Social Presence Scale to better fit our particular setting and translated it into Dutch.

Based on the test-items of the GZ Social Presence Scale, we believe that, like the Social Presence Indicators, this scale measures many of the sociability aspects and less of the social presence and social space aspects. We expect the magnitudes of the correlations between this scale and our scales to be approximately of the same magnitudes as the correlations between the Social Presence Indicators and our scales. With respect to the correlation between the GZ 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. Thus, we here also leave this correlation for the moment aside.

The Price and Mueller Work Group Cohesion Index. Price and Mueller[49] 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: "To what extent were the other team mates friendly?," "To what extent were the other team mates helpful?," "To what extent did the other team mates take a personal interest in you?," "To what extent did you trust the other team mates?," and "To what extent do you look forward to working again with the same team mates?" All items were translated into Dutch.

Sociability is affecting social space, and an attribute of social space is social cohesiveness. Therefore, we expect a moderate correlation between the Work Group Cohesion Index and the Sociability Scale. Since social cohesiveness is an attribute of social space, 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 develop. One reason could be negative behavior in the group, for example, trust is violated by group members. 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. The correlation between the Work Group Cohesion Index and the Social Presence Scale is expected to be moderate, because social presence and social cohesiveness mutually affect each other.[56]

Fiedler's Group Atmosphere Scale. Fiedler[51] developed the Group Atmosphere Scale, which made use nine 8-point bipolar scale items for assessing the atmosphere in a group as perceived by the group: warm–cold, interesting–boring, accepting– rejecting, satisfying–frustrating, enthusiastic– unenthusiastic, productive–non-productive, cooperative–uncooperative, supportive–hostile, and successful–unsuccessful. Instead of using 8-point scales we used 5-point

scales to concur with the other scales used. All items were translated into Dutch.

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 is contributing 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 and we therefore expect a (very) low correlation between the Group Atmosphere scale and the Social Space Scale in the Negative Group Behavior dimension. Sociability, as well as social presence, affects social space and thus indirectly contributes to group atmosphere. Consequently, we expect moderate correlations between the Group Atmosphere Scale and the two scales for sociability and social presence.

However, the Group Atmosphere Scale is very similar to the Social Presence Indicators; therefore, we actually expect the correlations to be somewhat higher, but lower than the magnitudes of the correlations between the Social Presence Indicators and each of our scales.

Our expectations with regard to the correlations between the scales involved are summarized in Table 4.

Refinement of the scales

The process of refining the raw Sociability Scale, Social Presence Scale, and Social Space Scale evolved in two phases. In the first phase we applied a factor analysis (Principal Component Analysis, no rotation) on the scores of all 174 test items of the questionnaire. Except for the raw scales, the questionnaire also contained, amongst others, the Social Presence Indicators, the GZ Social Presence Scale, the Work Group Cohesion Index, and the Group Atmosphere Scale. The total sample was 79 students, which is low considering a total of 174 items on the questionnaire. This means that results should be interpreted with some reservation.

The analysis revealed 37 components possessing eigenvalues of 1.0 or greater (Kaiser-Gutman Rule). However, according to Hofstee[57] the criterion of 1.0 is too liberal and argued that only components possessing eigenvalues of 4.0 should be considered (pp. 126–127). That latter criterion revealed six components. A scree test[58] revealed a clear break after the third component. We therefore concluded that there are at least three factors.

The actual refinement process happens in the second phase in a number of steps; that number may differ per scale. The following subsections discuss the refinement process for each scale.

Refining the raw 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[19] 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 Catell[58]). The step was also used to remove the few test items that did not load higher than 0.40 (see for this criterion, Stevens[59]) 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 ex-

TABLE 4. SUMMARY OF THE EXPECTED CORRELATIONS BETWEEN THE SCALES

			Social space scale	
Measure	*Sociability scale*	*Social presence scale*	*Positive group behavior*	*Negative group behavior*
Social presence indicators	High	Moderate	Low/moderate	?
GZ social presence scale	High	Moderate	Low/moderate	?
Work group cohesion index	Moderate	Moderate	High	Very low/low
Group atmosphere scale	Moderate/high	Moderate	Low/moderate	Very low/low

plained total variance (removed zero items, we already had 10 items).

The resulting refined Sociability Scale is depicted in Table 1. The last three 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% of the total variance.

Refining the raw Social Presence Scale

The raw Social Presence Scale initially consisted of eight initial test items which we reduced to five items. Our objective was to derive a one-dimensional measure (the screeplot[58] suggested this dimensionality). Two items were removed that did not directly assess the feeling of the "transportation of the communication partner from there to here" (see Lombard and Ditton[60]). Factor analysis (Principal Component Analysis, no rotation) on the remaining six test items revealed two factors, one item loaded equally strong on both factors; this item was removed.

Table 3 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. The factor explained 57.17% of the total variance.

Refining the raw Social Space Scale

The raw Social Space Scale contained 44 initial test items and was refined in the following four steps. In the first step, a factor analysis (Principal Component Analysis, Varimax rotation) was performed on these test items and all other items of the questionnaire encompassing all the other scales. The majority of initial test items of the raw Social Space Scale loaded higher than 0.40[59] exclusively on factor two or three. This means that the social space construct is not one-dimensional but two-dimensional. These two factors are interpreted as Positive Group Behavior (factor two) and Negative Group Behavior (factor three) and can be considered as dimensions of the social space construct. In this step, test items were also removed whose load on the two factors were less than 0.40 (five items), or that did load higher on the other factors than on the two factors (two items). The second step was a careful semantic examination on the items. Test 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 test items not associated with positive or negative group behavior (four items), or almost semantically identical to another item within the raw Social Space Scale (one item). The fourth and final step was aimed to balance the items in the dimensions Positive Group Behavior and Negative Group Behavior with no more than ten items in each dimension (removed one item). The refined Social Space Scale is depicted in Table 3. With respect to the loadings, a new factor analysis (Principal Component Analysis using Varimax rotation) was performed on the final 20 test items thereby focusing on a two factor solution. Both factors show strong loadings. The two factor solution explained 54.59% of the total variance (the first factor explained 30.14% and the second factor 24.45%).

RESULTS

Internal consistency and validity of the scales

Cronbach's alphas for the Sociability Scale and the Social Presence Scale are, respectively, 0.92 and 0.81, revealing a high internal consistency for both scales. Cronbach's alpha for the Social Space Scale is 0.91; Cronbach's alphas for the factors representing the Positive Group Behavior dimension and the Negative Group Behavior dimension are, respectively, 0.92 and 0.87. These values show that the Social Space Scale has a high internal consistency as well.

The content validity of the scales 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. Items were then assessed by the authors of this paper.

Pearson bi-variate correlations

First we applied a Pearson bi-variate correlation (2-tailed) analysis on the aggregate scores of the test items of the different scales involving Sociability Scale, Social Presence Scale, and Social Space Scale on the one-hand, and each of the measures of Social Presence Indicators, GZ Social Presence Scale, Work Group Cohesion Index, and Group Atmosphere Scale on the other hand. Table 5 depicts the correlations.

As can be seen, correlations are as expected with respect to both the strength and the direction (Table 4). The correlations between the Social Presence Indicators and the Negative Group Behavior

TABLE 5. PEARSON'S BIVARIATE CORRELATION COEFFICIENTS BETWEEN THE DIFFERENT SCALES

			Social space scale	
Measure	*Sociability scale*	*Social presence scale*	*Positive group behavior*	*Negative group behavior*
Social presence indicators	0.83**	0.66**	0.58**	0.01
GZ social presence scale	0.85**	0.62**	0.62**	0.01
Work group cohesion index	0.60**	0.44**	0.70**	0.28
Group atmosphere scale	0.78**	0.54**	0.55**	0.12

**$p < 0.01$, two-tailed.
*$p < 0.05$, two-tailed.

dimension of the Social Space Scale and between the GZ Social Presence Scale and the Negative Group Behavior dimension of the Social Space Scale appear to be respectively .02 and .06. This means that there is no relationship between the corresponding variables. The correlations show that the Sociability Scale, Social Presence Scale, and the Social Space Scale are indeed measuring phenomena that are related to sociability, social presence, social space, group cohesiveness and group atmosphere.

We also applied Pearson's bivariate correlation (2-tailed) analysis on the aggregate scores of the test items of the Sociability Scale, Social Presence Scale, and Social Space Scale (Table 6), and of the test items of the measures Social Presence Indicators, GZ Social Presence Scale, Work Group Cohesion Index, and Group Atmosphere Scale (Table 7).

Factor analysis involving the three scales for sociability, social presence, and social space

Finally, we applied 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 restricted the extraction to only four 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 and the Social Presence scale have only one, the restriction was set to four. The result of this analysis is given in Table 8. From this table, it can be seen that each of the three scales indeed measure a separate phenomenon.

TABLE 6. PEARSON'S BIVARIATE CORRELATION COEFFICIENTS BETWEEN SOCIABILITY SCALE, SOCIAL PRESENCE SCALE, AND SOCIAL SPACE SCALE

				Social space scale	
Measure		*Sociability scale*	*Social presence scale*	*Positive group behavior*	*Negative group behavior*
Sociability scale					
Social presence scale		0.63**			
Social Space Scale	positive group Behavior	0.60**	0.53**		
	behavior				
	negative group behavior	−0.08	−0.10	−0.18	

**$p < 0.01$, two-tailed.

TABLE 7. PEARSON'S BIVARIATE CORRELATION COEFFICIENTS BETWEEN THE MEASURES SOCIAL PRESENCE INDICATORS, GZ SOCIAL PRESENCE SCALE, WORK GROUP COHESION INDEX, AND GROUP ATMOSPHERE SCALE

Measure	*Social presence indicators*	*GZ social presence scale*	*Work group cohesion index*	*Group atmosphere scale*
Social presence indicators				
GZ social presence scale	0.85**			
Work group cohesion index	0.59**	0.66**		
Group atmosphere scale	0.92**	0.82**	0.66**	

**$p < 0.01$, two-tailed.

TABLE 8. FACTOR ANALYSIS ON THE SCORES OF THE ITEMS OF THE SOCIABILITY SCALE, SOCIAL PRESENCE SCALE, AND THE SOCIAL SPACE SCALE

			Factors			
Measure	*No. item*	*Item*	*Sociability*	*Social presence*	*Positive group behavior*	*Negative group behavior*
Sociability scale	Q1	This CSCL environment enables me to easily contact my team mates	0.74			
	Q2	I do not feel lonely in this CSCL environment	0.76			
	Q3	This CSCL environment enables me to get a good impression of my team mates	0.71			
	Q4	This CSCL environment allows spontaneous informal conversations	0.70			
	Q5	This CSCL environment enables us to develop into a well performing team	0.56		0.45	
	Q6	This CSCL environment enables me to develop good work relationships with my team mates	0.70			
	Q7	This CSCL environment enables me to identify myself with the team	0.55		0.46	
	Q8	I feel comfortable with this CSCL environment	0.73			
	Q9	This CSCL environment allows for non task-related conversations	0.68			
	Q10	This CSCL environment enables me to make close friendships with my team mates	0.69			
Social presence scale	Q1	When I have real-time conversations in this CSCL environment, I have my communication partner in my mind's eye		0.69		

continued

TABLE 8. CONTINUED

Measure	No. item	Item	Factors			
			Sociability	Social presence	Positive group behavior	Negative group behavior
	Q2	When I have asynchronous conversations in this CSCL environment, I also have my communication partner in my mind's eye	0.44	0.65		
	Q3	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		0.56		
	Q4	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		0.62		
	Q5	Real-time conversations in this CSCL environment can hardly be distinguished from face-to-face conversations		0.48		
Positive group behavior	Q1	Group members felt free to criticize the ideas, statements, and/or opinions of others			0.74	
	Q2	We reached a good understanding on how we had to function			0.76	
	Q3	Group members ensured that we kept in touch with each other			0.77	
	Q4	We worked hard on the group assignment			0.77	
	Q5	I maintained contact with all other group members			0.69	
	Q6	Group members gave personal information on themselves	0.42		0.49	
	Q7	The group conducted open and lively conversations and/or discussions			0.79	
	Q8	Group members took the initiative to get in touch with others			0.80	
	Q9	Group members spontaneously started conversations with others	0.51		0.53	
	Q10	Group members asked others how the work was going			0.60	
Negative group behavior	Q11	Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized[a]				0.73
	Q12	Group members were suspicious of others[a]				0.78

TABLE 8. CONTINUED

Measure	No. item	Item	Factors			
			Sociability	Social presence	Positive group behavior	Negative group behavior
	Q13	Group members grew to dislike others[a]				0.66
	Q14	I did the lion's share of the work[a]				0.56
	Q15	Group members obstructed the progress of the work[a]	0.41			0.58
	Q16	Group members were unreasonable[a]				0.90
	Q17	Group members disagreed amongst each other[a]				0.69
	Q18	The group had conflicts[a]				0.67
	Q19	Group members gossiped about each other[a]				0.69
	Q20	Group members did not take others seriously[a]				0.60

[a]These items were reverse coded for analysis.

DISCUSSION

The validation of the three instruments have some weak points that limit the study. First, the number of cases was 79. A general rule of the thumb is that there must be at least 10 cases per item. The raw Social Space Scale contained the most initial test items, namely 44 items, meaning that we actually needed 440 cases to derive this measure. Second, there were three samples (VEC, Stat 1, and Stat 2) that have been collapsed in order to obtain the 79 cases. We agree the samples have different characteristics (e.g., time aspects, CSCL environments, task type) which mean that they actually can not be collapsed into one big sample. Third, 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. This implicates that the result (Table 8) might take advantage of the chance characteristic of the 79 cases from which these scales were derived. Fourth, some items do load more than 0.40 on the other factors.

Taking these weak points together, we must stress that the findings in this paper only suggest that the instruments have potential to be useful as measures for the respective variables.

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 to 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 instruments that measure a variety of variables. This paper presents three of these instruments: a Sociability Scale, a Social Presence scale, and a Social Space Scale. However, it must be realized that these measures are preliminary "first steps." More experiments are needed for corroborating the findings in this paper. 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[61] and related instruments for assessing teaching presence,

cognitive presence, and in particular social presence (see Rourke et al.[62]). 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.

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REFERENCES

1. Gregor, S.D., & Cuskelly, E.F. (1994). Computer mediated communication in distance education. *Journal of Computer Assisted Learning* 10:168–181.
2. Hallet, K., & Cummings, J. (1997). The virtual classroom as authentic experience: Collaborative, problem-based learning in a WWW environment. In: *Proceedings of the annual conference on distance teaching and learning: competition-connection-collaboration.* Madison, WI: University of Wisconsin–Madison, pp. 103–107.
3. Heath, E.F. (1998). Two cheers and a pint of worry: an on-line course in political and social philosophy. *Journal of Asynchronous Learning Networks* 2:15–33.
4. Mason, R. (1991). Analyzing computer conferencing interactions. *International Journal of Adult Education and Training* 2:161–173.
5. Gunawardena, C.N. (1995). Social presence theory and implications for interaction and collaborative learning in computer conferences. *International Journal of Educational Telecommunications* 1:147–166.
6. Hiltz, S.R. (1998). Collaborative learning in asynchronous learning networks: building learning communities. Presented at the WEB98, Orlando, Florida. Available: http://eies.njit.edu/~hiltz/collaborative learning_in_asynch.htm.
7. Hobaugh, C.F. (1997). Interactive strategies for collaborative learning. In: *Proceedings of the annual conference on distance teaching and learning: competition-connection-collaboration.* Madison, WI: University of Wisconsin–Madison, pp. 121–125.
8. Hughes, C., & Hewson, L. (1998). Online interactions: developing a neglected aspect of the virtual classroom. *Educational Technology* 38:48–55.
9. Taha, L.H., & Caldwell, B.S. (1993). Social isolation and intergration in electronic environments. *Behaviour & Information Technology* 12:276–283.
10. 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* 19:335–353.
11. Kreijns, K., Kirschner, P.A., & Jochems, W. (2003). Supporting social interaction for group dynamics through social affordances in CSCL: Group awareness widgets. Presented at the 10th Biennial European Conference for Research on Learning and Instruction (EARLI), Padova, Italy.
12. Brandon, D.P., & Hollingshead, A.B. (1999). Collaborative learning and computer-supported groups. *Communication Education* 18:109–126.
13. Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications.* London: John Wiley & Sons.
14. Wallace, P. (1999). *The psychology of the internet.* Cambridge, United Kingdom: Cambridge University Press.
15. Walther, J.B. (1992). Interpersonal effects in computer-mediated interaction: a relation perspective. *Communication Research* 19:52–90.
16. Whittaker, S., & O'Conail, B. (1997). The role of vision in face-to-face and mediated communication. In: K.E. Finn, A.J. Sellen, & S.B. Wilbur (eds.), *Video-mediated communication.* Mahwah, NJ: Lawrence Erlbaum, pp. 23–49.
17. Clark, H.H., & Brennan, S.E. (1991). Grounding in communication. In: L.B. Resnick, J.M. Levine, & S.D. Teasley (eds.), *Perspectives on socially shared cognition.* Washington, DC: American Psychological Association, pp. 127–149.
18. Alben, L. (1997). At the heart of interaction design. *Design Management Journal* 8:9–26.
19. Shneiderman, B. (1998). *Designing the user interface: strategies for effective human–computer interaction,* 3rd ed. New York: Addison-Wesley.
20. Rourke, L. (2000). Operationalizing social interaction in computer conferencing. In: *Proceedings of the 16th annual conference of the Canadian Association for Distance Education.* Quebec City, Canada.
21. Wegerif, R. (1998). The social dimension of asynchronous learning networks. *Journal of Asynchronous Learning Networks* 2:34–49.
22. Cutler, R.H. (1996). Technologies, relations, and selves. In: L. Strate, R. Jacobson, & S.B. Gibson (eds.), *Communication and cyberspace: social interaction in an electronic environment.* Cresskill, NJ: Hampton Press, pp. 317–333.
23. Gaver, W.W. (1996). Situating action II: affordances for interaction: the social is material for design. *Ecological Psychology* 8:111–129.
24. Gibson, J.J. (1977). The theory of affordances. In: R. Shaw & J. Bransford (eds.), *Perceiving, acting, and knowing*. Hillsdale, NJ: Erlbaum, pp. 67–82.
25. Gibson, J.J. (1986). *The ecological approach to visual perception.* Hillsdale, NJ: Lawrence Erlbaum.
26. Kreijns, K., Kirschner, P.A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Journal of Education Technology & Society* 5:8–22.

27. Tammelin, M. (1998). From telepresence to social presence: the role of presence in a network-based learning environment. In: S. Tella (ed.), *Aspects of media education. Volume 8. Strategic imperatives in the information age*. Helsinki, Finland: Media Education Centre, University of Helsinki, Media Education Publications, pp. 219–231.
28. Tu, C.H. (2000). On-line learning migration: from social learning theory to social presence theory in a CMC environment. *Journal of Network and Computer Applications* 23:27–37.
29. Tu, C,H. (2002). The impacts of text-based CMC on online social presence. *The Journal of Interactive Online Learning* 1:1–24.
30. Tu, C.H., & Isaacs, M. (2002). An examination of social presence to increase interaction in online classes. *American Journal of Distance Education* 16:131–150.
31. Bradner, E., Kellogg, W., & Erickson, T. (1999). The adoption and use of "Babble": a field study of chat in the workplace. In: S. Bødker, M. Kyng, & K. Schmidt (eds.), *Proceedings of the 6th [European conference on computer-supported cooperative work*. Dordrecht, The Netherlands: Kluwer Academic Press, pp. 139–158.
32. Tang, J.C., & Rua, M. (1994). Montage: providing teleproximity for distributed groups. In: B. Adelson, S. Dumais, & J.S. Olson (eds.), *Conference proceedings on human factors in computing systems: celebrating interdependence*. New York: ACM Press, pp. 17–43.
33. Borning, A., & Travers, M. (1991). Two approaches to casual interaction over computer and video networks. In: S.P. Robertson, G.M. Olson, & J.S. Olson (eds.), *Conference proceedings on human factors in computing systems: reaching through technology*. New York: ACM Press, pp. 13–19.
34. Gutwin, C., Roseman, M., & Greenberg, S. (1996). A usability study of awareness widgets in a shared workspace groupware system. In: M.J. Tauber, V. Belotti, R. Jeffries, et al. (eds.), *Conference proceeding on human factors in computing systems: common ground*. New York: ACM Press, pp. 258–268.
35. Bly, S.A., Harrison, S.R., & Irwin, S. (1993). Media spaces: bringing people together in a video, audio, and computing environment. *Communications of the ACM* 36:28–47.
36. Pedersen, E.R., & Sokoler, T. (1997). AROMA: abstract representation of presence supporting mutual awareness. In: S. Pemberton (ed.), *Conference proceedings on human factors in computing systems: looking to the future*. New York: ACM Press, pp. 51–58.
37. Ackerman, M.S., Starr, B., Hindus, D., et al. (1997). Hanging on the "wire": a field study of an audio-only media space. *ACM Transactions on Computer–Human Interaction* 4:39–66.
38. Gay, G., & Lentini, M. (1995). Use of collaborative resources in a networked collaborative design environment. *Journal of Computer Mediated Communication* [On-line]. Available: www.ascusc.org/jcmc/vol1/issue1/IMG_JCMC/ResourceUse.html.
39. Garrison, R.D. (1997). Computer conferences: the post-industrial age of distance education. *Open Learning* 12:3–11.
40. Rourke, L., & Anderson, T. (2002). Exploring social communication in asynchronous, text-based computer conferencing. *Journal of Interactive Learning Research* 13:259–275.
41. Gunawardena, C.N., & Zittle, F. (1997). Social presence as a predictor of satisfaction within a computer mediated conferencing environment. *American Journal of Distance Education* 11:8–25.
42. Argyle, M., & Dean, J. (1965). Eye contact, distance and affiliation. *Sociometry* 28:289–304.
43. Wiener, M., & Mehrabian, A. (1968). *Language within language: immediacy, a channel in verbal communication*. New York: Appleton-Century-Crofts.
44. Tu, C.H. (2002). The measurement of social presence in an online learning environment. *International Journal on E-learning* April-June:34–45.
45. Sheridan, T.B. (1992) Musings on telepresence and virtual presence. *Presence: Teleoperators and Virtual Environments* 1:120–126.
46. Towell, J., & Towell, E. (1997). Presence in text-based networked virtual environments or "MUDS." *Presence: Teleoperators and Virtual Environments* 6:590–595.
47. Johnson, D.W., & Johnson, R.T. (1994). *Learning together and alone: cooperative, competitive, and individualistic learning*, 4th ed. Needham Heights, MA: Allyn & Bacon.
48. Van Buuren, H., & Giesbertz, W. (1999). Naar een virtueel onderzoekcentrum: innovatie van het onderwijs in methoden en technieken van onderzoek [Towards a virtual research center: innovation of research methods and statistics education]. In: K. Schlusmans, R. Slotman, C. Nagtegaal, et al. (eds.), *Competentiegerichte leeromgevingen*. Utrecht, The Netherlands: Lemma, pp. 137–150.
49. Price, J.L., & Mueller, C.W. (1986). *Handbook of organizational measurement*. Marshfield, MA: Pitman Publishing Inc.
50. Fiedler, F.E. (1962). Leader attitudes, group climate, and group creativity. *Journal of Abnormal and Social Psychology* 65:308–318.
51. Fiedler, F.E. (1967). *A theory of leadership effectiveness*. New York: McGraw-Hill.
52. Cambell, D.T., & Fiske, D.W. (1959). Convergent and discriminant validation by the multi-trait-multimethod matrix. *Psychological Bulletin* 56:81–105.
53. Cronbach, L.J., & Meehl, P.E. (1955). Construct validity in psychological tests. *Psychological Bulletin* 52:281–302.
54. Connolly, T., Jessup, L.M., & Valacich, J.S. (1990). Effects of anonymity and evaluative tone on idea generation in computer-mediated groups. *Management Science* 36:97–120.
55. Lea, M., & Spears, R. (1991). Computer mediated communication, de-individuation and group decision making. *International Journal of Man-Machine Studies* 31:283–301.

56. Yoo, Y., & Alavi, M. (2001). Media and group cohesion: Relative influences on social presence, task participation, and group cohesiveness, *MIS Quarterly* 25:371–390.
57. Hofstee, W.K.B. (1999). *Principes van beoordeling: methodiek en ethiek van selectie, examinering en evaluatie [Principles of assessment: methods and ethics of selections, testing and evaluation].* Lisse, The Netherlands: Swets & Zeitlinger BV.
58. Cattell, R.B. (1966). The scree test for number of factors. *Multivariate Behavioral Research* 1:245–276.
59. Stevens, J.P. (1992). *Applied multivariate statistics for the social sciences*, 2nd ed. Hillsdale, NJ: Lawrence Erlbaum.
60. Lombart, M., & Ditton, T. (1997). At the heart of it all: the concept of presence. *Journal of Computer-Mediated Communication* [On-line]. Available: www.ascusc.org/-jcmc/vol3/issue2/lombard.html.
61. Garrison, D.R., Anderson, T., & Archer, W. (2000). Critical thinking in a text-based environment: computer conferencing in higher education. *Internet and Higher Education* 11:1–14.
62. Rourke, L., Anderson, T., Garrison, D.R., et al. (1999). Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education* 14:50–71.

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