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Measuring perceived quality of social space in distributed learning groups

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Abstract

Distributed learning in groups is usually supported by computer-supported collaborative learning environments. 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 10 items. 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 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.
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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; Wagner, 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 'conditio 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). 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 Fig. 1 (Kreijns, Kirschner, & Jochems, 2003). This is in line with Hare and Davis, 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 Fig. 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
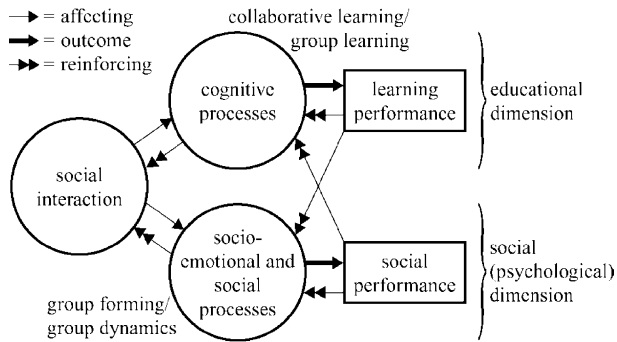
Fig. 1. The Two Dimensions of Social Interaction.

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, 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 tasks contexts. In fact, by doing so, these educators take – consciously or unconsciously – group dynamics for granted (Kreijns et al., 2003). 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, in press; Kreijns, Kirschner, & Jochems, 2002).

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/social presence (Gunawardena, 1995; Gunawardena & Zittle, 1997; Rourke & Anderson, 2002; Short, Williams, & Christie, 1976; Tammelin, 1998;

Tu, 2000, 2002; Tu & Isaacs, 2002). Social presence is the degree of illusion that the other in the communication appears to be a 'real' physical person. Close study to 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 et al., 2002), and the effects of using certain pedagogical techniques in varying degrees (see for an overview of these pedagogical techniques, Kreijns et al., 2003). None of them, however, measured what we consider to be social space. For this reason, we have developed and validated our own measurement instrument: the Social Space Scale.

2. Existing instruments

A number of existing instruments purport to measure social climate/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 et al. (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, 4-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 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/or 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 than that of Short et al. (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 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 social space measure. The (refined) Social Space Scale is discussed in the next section.

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 group and consists of two parts. The first part assesses the students' feelings regarding their own behavior and/or the other 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 1. The four last columns show statistical data discussed in Section 5.

4. Method

4.1. Participation

Data was collected from a total of 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

Table 1
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

Note: For items (refined Social Space Scale) Q1–Q12: 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) Q13–Q20: Judgements 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 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 10 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 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.

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, release 2.2: see 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 nine 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 two non-starters and less 10 drop-outs), 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 drop-outs), 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.

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:
1. Social Presence Indicators (Gunawardena, 1995)
2. Social Presence Scale (Gunawardena & Zittle, 1997)
3. Work-Group Cohesiveness Index (Price & Mueller, 1986)
4. Group Atmosphere Scale (Fiedler, 1962; Fiedler, 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.

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 the social presence aspects, and even lesser on the social space aspects. 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 CMC low in social presence may cause de-individuation and depersonalization effects, possibly leading to uninhibited behavior (Jessup, Connolly, & Tansik, 1990). On the other hand, Walther's (1992) social information processing (SIP) theory rebuts these suggestions. Therefore, we leave this correlation for the moment aside. In our study we have translated the items of the Social Presence Indicators into Dutch.

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 bivariate 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 can 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, is here applicable. Thus, we here also leave this correlation for the moment aside. We slightly adapted their Social Presence Scale to fit our particular setting and then translated it into Dutch.

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, 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. Here too, all items were translated into Dutch.

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 1). Although Fiedler's Group Atmosphere Scale is used for leaders in contiguous groups, we use this scale for distributed learning groups where each 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.

4.4. Construction, dimension, and refinement of the Raw Social Space Scale

4.4.1. 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 about 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 will also remove those items that are psychometrically 'rejected'. The advantage of such a method is that we could postpone the decision of which items to include in the final Social Space Scale up to the moment that we would have gained a clearer picture of the meaning of the various items.

4.5. 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 a total of 174 items of the questionnaire. This means that results should be interpreted with some reservation.

The factor analysis was used to:
1. reject the preposition of one-dimensionality of the social space construct
2. determine interpretable factors, and
3. help select items of the raw Social Space Scale that can 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 argued that only components possessing eigenvalues of 4.0 should be considered (p. 126–127). That latter criterion revealed six components. A scree test (Catell, 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 0.40 (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 1).

4.6. 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 who's load on component two or three were less than 40 (5 items), or that did load higher on the other components than on component two or three (2 items). The second step was a careful semantic examination on 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 were almost (semantically) identical to another item *within* the raw Social Space Scale (1 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 10 items in each dimension (removed 1 item).

The items removed in the second and third step were those items that we consider 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 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 show strong loadings. The two factor solution explained 54.59% of the total variance (the first component explained 30.14% and the second 24.45%).

5. Results

5.1. 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 0.81 (Social Space Scale), 0.92 (factor representing the Positive Group Behavior-dimension), and 0.87 (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.

5.2. Pearson bi-variate correlations

We applied a Pearson bi-variate correlation (two-tailed) analysis on the aggregate scores of the items of the Social Space Scale and the other measures (see Table 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.

5.3. 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 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.

Table 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	−0.18	–				
Social Presence Indicators	0.58**	0.01	–			
Social Presence Scale	0.62**	0.01	0.85**	–		
Work Group Cohesion Index	0.70**	0.28*	0.59**	0.66**	–	
Group Atmosphere Scale	0.55**	0.12	0.92**	0.82**	0.66**	–

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

We argued that the Social Presence Indicators and the Social Presence Scale both measure some aspects of social space. We, thus, expect 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 is expected to be low. Except for the Social Presence Scale, we expect that items (again, those items that measure particular aspects of social space) of the Social Presence Indicators may also load on the Negative Group Behavior-dimension because the bi-polar items are also capable of assessing negative experiences. Items of the Social Presence Scale only assesses positive experiences, with the exception of items 1, 9, 10, and 11 (see Table 3); the items 9, 10, and 11 are not considered in this study.

We have stated that a sound social space is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction and a strong sense of community. Thus, group cohesiveness is an attribute of, but not the same as social space. Consequently, the Social Space Scale that we have developed includes, amongst other things, items that (indirectly) address group cohesiveness. If a separate measure is used that assesses group cohesiveness such as the Work Group Cohesion Index, we expect that all its items will load higher than 0.40 on the same factor that represents the Positive Group Behavior-dimension of social space (i.e., by definition all items are measuring the social cohesiveness aspect of social space). We do not expect items to load higher than 0.40 on the factor representing the Negative Group Behavior-dimension of social space because the items of the Work Group Cohesion Index do not assess negative experiences.

With respect to the Group Atmosphere Scale, we have 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 do not expect items to load more than 0.40 on both factors of social space. The results are depicted in Table 3; only items with factor loading of 0.40 and higher are shown.

All items associated with the Positive Group Behavior-dimension are salient on the same factor, as is 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) are 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 0.40 on the factor representing the Negative Group Behavior-dimension of social space is due to the fact that only the Social Presence Indicators is capable assessing negative experiences (as far the items assess the aspect of social space) and to the fact that negative experiences were not collected.

Table 3
Factor analysis on the scores of the items of the social space scale and each of the other scales

No. Item	Item	Factor Analysis 1 Social Space Scale and Social Presence Indicators			Factor Analysis 2 Social Space Scale and Social Presence Scale			Factor Analysis 3 Social Space Scale and Work Group Cohesion Index		Factor Analysis 4 Social Space Scale and Group Atmo- sphere Scale		
		Factor 1	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2 Negative Group Behavior	Factor 1	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		0.69		0.76			0.65			0.72	
3	We reached a good understanding on how we had to function		0.76		0.77			0.70			0.79	
5	Group members en- sured that we kept in touch with each other		0.76		0.74			0.78			0.75	
7	We worked hard on the group assignment		0.74		0.76			0.71			0.77	
9	I maintained contact with all other group members		0.73		0.74			0.71			0.71	
11	Group members gave personal information on themselves		0.54		0.49			0.63			0.49	

Table 3 (continued)

No. Item	Item	Factor Analysis 1 Social Space Scale and Social Presence Indicators			Factor Analysis 2 Social Space Scale and Social Presence Scale			Factor Analysis 3 Social Space Scale and Work Group Cohesion Index		Factor Analysis 4 Social Space Scale and Group Atmosphere Scale		
		Factor 1	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2 Negative Group Behavior	Factor 1	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior
13	The group conducted open and lively conversations and/or discussions		0.84		0.81			0.82			0.81	
15	Group members took the initiative to get in touch with others		0.83		0.76			0.85			0.82	
17	Group members spontaneously started conversations with others		0.67		0.53	0.48		0.72			0.63	
19	Group members asked others how the work was going		0.64		0.60			0.73			0.58	
	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]			0.72			0.73		0.76			0.73

4	Group members were suspicious of others[a]	0.79	0.78	0.81	0.80
6	Group members grew to dislike others[a]	0.64	0.65	0.62	0.64
8	I did the lion's share of the work[a]	0.57	0.56	0.61	0.58
10	Group members obstructed the progress of the work[a]	0.57	0.57	0.61	0.58
12	Group members were unreasonable[a]	0.89	0.90	0.88	0.90
14	Group members disagreed amongst each other[a]	0.69	0.71	0.71	0.70
16	The group had conflicts[a]	0.66	0.68	0.65	0.68
18	Group members gossiped about each other[a]	0.68	0.70	0.65	0.66
20	Group members did not take others seriously[a]	0.60	0.61	0.57	0.60

Social Presence Indicators

1	Stimulating–dull[a]	0.85	
2	Personal–impersonal[a]	0.71	
3	Sociable–unsociable[a]	0.61	0.47
4	Sensitive–insensitive[a]	0.67	
5	Warm–cold[a]	0.65	0.42
6	Colorful–colorless[a]	0.62	0.41
7	Interesting–boring[a]	0.80	
8	Appealing–not appealing[a]	0.87	

Table 3 (*continued*)

No. Item	Item	Factor Analysis 1 Social Space Scale and Social Presence Indicators			Factor Analysis 2 Social Space Scale and Social Presence Scale			Factor Analysis 3 Social Space Scale and Work Group Cohesion Index		Factor Analysis 4 Social Space Scale and Group Atmosphere Scale		
		Factor 1	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2 Negative Group Behavior	Factor 1	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior
9	Interactive–non-interactive[a]	0.67	0.48									
10	Active–passive[a]		0.64									
11	Reliable–unreliable[a]	0.47										
12	Humanizing–dehumanizing[a]	0.76										
13	Immediate–non-immediate[a]	0.62										
14	Easy–difficult[a]	0.49		0.45								
15	Efficient–inefficient[a]	0.73										
16	Unthreatening–threatening[a]											
17	Helpful–hindering[a]	0.79										
Social Presence Scale (adapted)												
1	Messages in the CSCL environment were impersonal[a]					0.62						
2	The CSCL environment is a an excellent medium for social interaction					0.74						
3	I felt comfortable conversing through this text-based CSCL environment					0.87						

4	I felt comfortable introducing myself in the CSCL environment		0.80
5	The introduction(s) enabled me to form a sense of on-line community in which I was part of		0.75
6	I felt comfortable participating in discussions in the CSCL environment	.43	0.63
7	The moderators created a feeling of an on-line community		0.60
8	The moderators facilitated discussions in the CSCL environment		0.49
9	Discussions in CSCL environments tend to be more impersonal than face-to-face discussions[a,b]		
10	Discussions in CSCL environments are more impersonal than audio teleconference discussions[a,b]		
11	Discussions in CSCL environments are more impersonal than video teleconference discussions[a,b]		

Table 3 (continued)

No. Item	Item	Factor Analysis 1 Social Space Scale and Social Presence Indicators			Factor Analysis 2 Social Space Scale and Social Presence Scale			Factor Analysis 3 Social Space Scale and Work Group Cohesion Index		Factor Analysis 4 Social Space Scale and Group Atmosphere Scale		
		Factor 1	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2	Factor 3 Negative Group Behavior	Factor 1 Positive Group Behavior	Factor 2 Negative Group Behavior	Factor 1	Factor 2 Positive Group Behavior	Factor 3 Negative Group Behavior
12	I felt comfortable interacting with other participants in the CSCL environment					0.70						
13	I felt that my point of view was acknowledge by other participants in the CSCL environment				0.61	0.46						
14	I was able to form distinct individual impressions of some participants even though we communicated only via this text-based CSCL environment					0.54						
Work Group Cohesion Index												
1	To what extent were the other team mates friendly?[a]							0.63				
2	To what extent were the other team mates helpful?[a]							0.78				

3	To what extent took the other team mates a personal interest in you?[a]	0.73		
4	To what extent did you trust the other team mates?[a]	0.60	0.53	
5	To what extent do you look forward to work again with the same team mates?[a]	0.73		
Group Atmosphere scale				
1	Warm–cold[a]			0.65
2	Interesting–boring[a]			0.77
3	Accepting–rejecting[a]			0.73
4	Satisfying–frustrating[a]			0.80
5	Enthusiastic–unenthusiastic[a]			0.88
6	Productive–nonproductive[a]			0.85
7	Cooperative–uncooperative[a]			0.71
8	Supportive–hostile[a]			0.80
9	Successful–unsuccessful[a]			0.80

[a] These items were reverse coded for analysis.

[b] These items were not considered in this study.

6. Discussion of possible limits

The validation of the Social Space Scale has 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 five (Gorsuch, 1983) to 10 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.

Second, 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.

Third, 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 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 3) might take advantage of the chance characteristic of the 79 cases from which the Social Space Scale was derived.

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

7. 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 CSCL environments.

In order to examine socially enhanced environments there is also a need for an instrument that measured 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 needed for corroborating the findings thus far. In fact, we 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 et al. (2000) and related instruments for assessing teaching presence, cognitive presence and in particular social presence (see, Rourke, Anderson, Garrison, & Archer, 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.

Appendix 1. Three social presence scales and the group atmosphere scale

Item	Social Presence Indicators (Gunawardena, 1995)	Social Presence (Short et al., 1976)	Social Climate/ Social Presence (Rourke & Anderson, 2002)	Group Atmo- sphere 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	●			

Appendix 1 (*continued*)

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			●

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