Gender: An influence factor in the collaborative work process in computer-mediated communication

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ABSTRACT
Several studies indicate gender differences in the use of computers and in the areas of collaborative work. This paper presents the design of a software tool that allow us to capture information concerned with the group work and evaluate whether gender is a factor which influences the collaborative work process in computer-mediated interactions. We present an exploratory study of 10 groups of various gender compositions that used the software tool "Chase the Cheese." The findings indicate that groups with women as the minority had a low index of collaboration compared to homogeneous groups and groups with women as the majority.

Keywords
Collaborative Systems, CSCW, Work Group, gender.

INTRODUCTION
There are a number of studies indicating gender differences in the use of computers. Males tend to be more interested in computers than females and that males use computers more than females at a younger age (Adam & Bruce, 1993). Other studies indicate that a preference for computer use, or lack of it, stems from socialization which takes place outside of schools (Kirk, 1992; Yelloushan, 1989). For instance, parents are more likely to buy a computer and video games for their sons than for their daughters (Levin & Gordan, 1989). Several studies also note that sex differences in computer use are engendered by the mass media which tend to advertise computer use essentially as a male activity (DiMona & Herndon, 1994; Forsyth & Lancy, 1989; Sanders, 1985). Finally, in computer-based group activities, females had lower results when working with males even though the same females had no disadvantage in similar tasks when working individually or in same-gender groups (Underwood, McCaffey, and Underwood, 1990).

Taking into account whether gender is an influence factor in the collaborative work process, we propose a set of indicators and an exploratory experiment with a software tool designed to gather information that permit us to measure the quality of cooperation process. In section 2, we present some of the recent literature in the area. In section 3, we describe the cooperation indicators as well as a method that permit us to evaluate some key points identified in the phases of collaborative learning. Section 4 describes the instrument (software) we used. Section 5 describes the experiment design. In section 6, we present the results. In Section 7 we present some conclusions and proposals for future work.

LITERATURE REVIEW
There are several recent studies that explore gender differences in computer-mediated interaction. Underwood (Underwood et al., 1990) examined interaction styles in mixed- and single-gender pairs during a computer-based English course. This study was designed to measure the interactional effects on learning taking place in the zone of proximal development during computer-based communicative activities. Students had three sessions: (1) an individual CAI session, (2) a cooperative CAI session, and (3) another individual CAI session. The effect of cooperative work was measured by comparing the results of session 3 with those of session 1. The results indicated that both types of single-gender pairs improved individual performance in session 3, but mixed-gender pairs did not show any improvement of individual abilities. The author explained the flat performance of the mixed-gender groups by stating that partners had difficulty cooperating and that females tended to be dominated by their male partners who competed for keyboard control.

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Siann and MacLeod (1986) observed that in computer-based group activities, females had lower outcomes when working with males even though the same females had no disadvantage in similar tasks when working individually or in same-gender groups. Other studies indicated that when educators give equal attention to males and females, no gender differences are reported (Felder, Felder, Mauney, Hamrin, & Dietz, 1994). Felder et al. observed that gender differences are important in some social contexts but not in others and the social climate is different when either males or females comprise a large majority in a class. From the studies we briefly reviewed, we can conclude that gender differences is an important factor in a collaborative activity. In our work we are interested to look how those differences affect the collaborative learning.

COOPERATION INDICATORS

In order to analyze whether gender is an influence factor within a collaborative group activity, we propose a set of indicators and an experiment with a tool instrumented to gather information that permit us to measure the quality of cooperation process in some groups. We define five indicators in order to evaluate the *cooperation degree* in the group interaction (Guerrero, Alarcon, Collazos, Pino, & Fuller, 2000). The selection was based on the structure of Cooperative Learning proposed by Johnson and Johnson described by Adams and Hamm (1995). These indicators are based on the following activities: use of collaborative strategies, intra-group cooperation, checking the success criteria, monitoring and the ability of providing help. Subsequently, we established the Index of Cooperation (IC) as the average of these five indicators. This index allows us to evaluate the work process of the groups. Next, we present the definition given by Johnson and Johnson (1975) for each one of these activities and a description of the criteria to define each indicator.

- *Application of collaborative strategies*: Create a product related to a goal system where rewards are based on individual and group results. Apply strategies like positive interdependence of the goal, motivation of the peers, and support of learning. These aspects can be identified using a semantic analysis of the messages (see below for a description of semantic analysis).

- *Intra-Group Cooperation:* Define the collaboration strategies that are going to be used by the members of the group. If each group member is able to understand how his/her task is related with the global team goals, then every one can anticipate their actions, requiring less coordination efforts. These aspects can be identified using a semantic analysis of the messages.

- *Test the success criteria*: The success criteria are based in terms of guidelines, limits, and roles. The success criteria must be defined at the beginning of the activity and must be reviewed during the activity to check if the common goal is being reached. After the activity, it is important to check if the common goal was reached. In some activities these success criteria can depend of the time or score reached. It is possible to know if any group checked or not these criteria; in positive cases, its possible to determine how much emphasis was put into the criteria.

- *Provide help:* Provide assistance when someone asks for it. It is provided to the whole group by the facilitator or peers. These can be checked using a semantic analysis of the messages.

- *Monitor:* Monitor the students, for example, verify that the desired behavior is fulfilled. Also, this behavior can be checked using a semantic analysis of the messages.

THE SOFTWARE TOOL AND COLLABORATION INSTRUMENT

"Chase the Cheese" is a group game, implemented in a software tool that allows us to capture group information that occurs within a cooperative work interaction. The game is a distributed and synchronic application (Guerrero et al., 2000). The game is a labyrinth divided into four quadrants. To win the game, the group (four players) must lead the mouse to its cheese. It is the common goal and to achieve it, every group member must fulfill a partial goal that is accomplished when every one of him or her "solve" their own quadrant. Each player has two predefined roles: coordinator (only one per quadrant and randomly assigned) or collaborator (the three remaining). Also, each player is identified by a pseudonym. A coordinator must take decisions concerned to the movement of the mouse. The collaborators must support the coordinator to ensure that her/his decisions are accurate. In each quadrant there are

two types of obstacles through where the mouse cannot pass: general obstacles or grids and colored obstacles. Though every player can see grids, colored obstacles can only be seen by the player who has that assigned color.

In order to communicate, each player has a dialogue box from which s/he can send messages for each of the others explicitly (one at a time). Also, each player can only see messages the other players send to him or her in an individual mailbox, one for each player. The application records every message sent by any member of the group. This information is used in order to make a determination of the level of collaboration in the group.

Because each player has a partial view of the game obstacles, to solve the problem they have to interact closely with their group peers. Due to this necessity, the game presents a strict positive interdependence of goals. If the group is able to solve the game, we can say that their members have built a shared understanding of the problem (Dillenbourg, Baker, Blake, & O'Malley, 1995).

EXPERIMENTAL DESIGN

In order to describe the experimental design, we are going to describe the software tool, the methodology and the participants.

Methodology

The experiment has four phases. In the first phase the group receives a brief description of the software tool, in the second phase, group members are assigned to network workstations in separate rooms (synchronous distributed interaction). All the communication is mediated by computer. During the third phase, the group tries to solve the labyrinth. Finally, the fourth phase corresponds to the gathering and analysis of data recorded in the tool logs. The members of the group do not know that they being "recorded". In order to maintain the privacy of the members of the group, the users choose an "alias" that reflects their gender.

Sample

There were 11 groups from a variety of backgrounds in the current study:

- A group of randomly selected people who had never met (group 3). Three men and 1 women.
- A group of friends that has worked in groups many times before and have a good personal relationship (group 4). Three women and 1 men.
- A group of post-graduate students from the course "Collaborative Systems" at the Pontificia Universidad Católica de Chile, with some experience on collaborative work techniques (group 0). Three men and 1 women.
- Four groups of high school students from Cumbres de Santiago with an average age of 15 years old. Two of these were randomly selected (group 1 and 2) and the remaining ones were friends (group 5 and 6). All men.
- Four groups of post-graduate students, from the Universidad de Chile. (Groups 7,8,9,10). All women.

RESULTS

We define the IC as the average result of the previous identified indicators: IC= I1 + I2 + I3 +I4 +I5. Table 1 shows the results obtained by the groups.

Table 1. Results of the Cooperation Indicators

Groups	I1	I2	I3	I4	I5	IC
0	1.00	0.60	0.20	1.00	0.60	0.68
1	0.00	0.60	0.20	0.60	0.20	0.32
2	1.00	1.00	0.20	1.00	0.20	0.68
3	0.00	0.20	0.40	0.20	0.20	*0.20*
4	1.00	1.00	0.80	0.40	0.60	0.84
5	1.00	1.00	1.00	1.00	0.60	*0.92*
6	1.00	1.00	1.00	1.00	0.20	0.84
7	1.00	1.00	0.00	1.00	1.00	0.80
8	0.00	1.00	0.00	1.00	1.00	0.60
9	0.00	1.00	0.00	1.00	1.00	0.60
10	1.00	1.00	0.00	1.00	1.00	0.80

The group which has the best IC was the Group 5 with **IC = 0.92**, this group is composed of all men. The group which has the worst IC was the Group 3 with **IC = 0.20**, this group is composed of three men and 1 women.

For this paper, we are primarily interested in analyzing the results of the groups where women are minority or majority. Table 2 presents the results obtained by the groups organized according to the composition of every group. Gray cells represent the groups where men are majority and white cells those where women are majority.

Table 2. Results of the Cooperation Indicators according group composition.

Groups	I1	I2	I3	I4	I5	IC
0	1.00	0.60	0.20	1.00	0.60	0.68
1	0.00	0.60	0.20	0.60	0.20	0.32
2	1.00	1.00	0.20	1.00	0.20	0.68
3	0.00	0.20	0.40	0.20	0.20	*0.20*
5	1.00	1.00	1.00	1.00	0.60	*0.92*
6	1.00	1.00	1.00	1.00	0.20	0.84
4	1.00	1.00	0.80	0.40	0.60	0.84
7	1.00	1.00	0.00	1.00	1.00	0.80
8	0.00	1.00	0.00	1.00	1.00	0.60
9	0.00	1.00	0.00	1.00	1.00	0.60
10	1.00	1.00	0.00	1.00	1.00	0.80

Averaging the results by gender composition, we have the next table.

Table 3. Average results of the Cooperation Indicators according group composition.

Groups	I1	I2	I3	I4	I5	IC
All Men (1,2,5,6)	0.75	0.9	0.6	0.9	0.3	0.69
All Women (7,8,9,10)	0.5	1.0	0.0	1.0	1	0.70
Majority Women (4)	1.0	1.0	0.8	0.4	0.6	0.84
Minority Women (3)	0.5	0.4	0.3	0.6	0.4	0.44

As we can see in the Table 3, the groups where women were majority had a relatively high index of collaboration ($\underline{M}$ = .84), whereas the groups where women were minority had a relatively low index of collaboration ($\underline{M}$ = .44). Figure 1 presents this data graphically. These results shows that gender may be an important factor which influences the collaboration process within a group.

CONCLUSIONS AND FUTURE WORK

Gender difference is a factor, which appears to influence the process of a collaborative activity within a group. The exploratory experiment that we developed shows us that collaborations varied according to the gender composition of the pair in initial experiences in a new domain with specific types of tasks. These findings may indicate that computer-mediated communication may be subject to gender biases just as face-to-face communication is. Thus, it will be important to discover why the "neutrality" of computer-mediation communication still leads to difficulties in the interaction and collaboration process. In the current study, it may be because the "aliases" identified the gender of the participants, which resulted in stereotypic male/female interaction. Future research is needed to explore these findings. Additionally, a larger experimental (i.e., more groups) is needed to corroborate the initial findings of the current study.

One practical suggestion can be gleaned from the current findings. Groups containing all men, two women and one or two men, or all women are likely to result in high levels of collaboration. However, groups with one woman and two or three men should be avoided if collaboration is a critical requirement. Alternatively, we should also suggest that individuals should be trained to avoid the pitfalls of stereotypic interaction in these types of groups.

In summary, the current study provides some initial results about the effect of imbalanced gender composition in computer-mediated groups. The software tool described in this paper is a useful tool for measuring the level of collaboration in these types of groups. Our future research will seek to corroborate the current findings with a formal experimental design that also investigates the influence of individual characteristics on the collaboration process.

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