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Augmenting Group Presence: A Study with Activity Feedback

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Abstract

The study aims at investigating the effects of feedback intervention on group presence, and to measure these effects with both behavioral and self-reported data. Participants played 4 sessions of an online treasure hunting in one of three different conditions: in the first two conditions they received a visual feedback about their activity in the prior game session ('centrality' or 'reciprocity'), while in the third condition no feedback about prior activity was provided. Results highlighted stable behavioral modifications in the two feedback conditions, in terms of the general number of messages exchanged, even though participants did not declare different levels of social presence and group awareness in the post-study questionnaire, and believed that the feedback had a low effectiveness.

Keywords--- **Social Network Analysis, Feedback, Social Presence, Multiplayer game, Centrality, Reciprocity, Augmented Communication**

1. Introduction

In some situations, well exemplified by on-line communities, the awareness of other people who relate to us and have an impact on our social environment is diminished by the lack of information on the general activity that is being developed. Differently from a 'one-to-one' kind of social presence where people want to be aware of another actor present in their environment, or need access to his/her detailed on-going behavior in order to achieve a smooth coordination, what is missing in this case is a higher yet general level of social presence, having the whole group of interdependent connected people as the object and allowing to appreciate the overall pattern of their activity.

The basic question is, thence, "how can we increase this kind of social presence"? One possibility is to convey information of this collective activity, implementing it in the mediated environment as a cue available for the users to check.

In this paper, we will consider the use of Social Network Analysis indices as cues of the collective activity, and test their effectiveness in terms of the ability to affect the way in which the users interact. These cues will not make direct suggestions as to the way in which action has to be performed, but will display certain dimensions of interaction that are not immediately present to the users in a large group. As such, they will serve as reminders of the existence of these dimensions, projecting the individual move on a larger scenario.

This modified activity will be taken as a form of increased social presence: relying on an action-based definition of presence according to which being present to oneself and the other means to do something in a place [1] , then design their interactions accordingly with the feedback received represents an enhancement of social presence. More classic forms of social presence will also be checked, by administering a questionnaire at the end of the experiment, and the results discussed.

While the first part of this article is devoted to an introduction of Social Network Analysis and feedback interventions in social interactions, the second section presents the study hypothesis, experimental setting and design. Then, section three will discuss the main results in terms of behavioral changes as well as questionnaires' outcome consequent to feedback interventions.

1.1. Social Networks

Intuitively "Social network" can be a synonym for "group" (for further consideration on the differences between groups and social networks, see [2]); it is an approach to social aggregates, seen as composed by people carrying on activities (thereby, actors) within a certain social context (meaning a context comprising other people); such a network is defined by the connections established among actors [3] .

An interest in extracting specific properties of a social network and expressing them in a measurable index has emerged since the early thirties [4] , in a scientific branch

known as "Social Network Analysis" (SNA) [3] [5] . Despite the most common way of representing these properties may seem to be a Network Representations using graph, which represent a possibility to graphically represent the network structure using nodes and lines connecting them, this option is just one among several others: the social dimensions emerged from the data extracted (see, for instance, the "popularity display" of Technorati [6]) can be represented in an indefinite number of ways, with the information about group structure and individual properties remaining embedded in the value of the index and possibly in some properties of the representation [7] . Therefore they can have several potentialities to serve as a source of feedback provided to on-line groups, also considering the possibility to apply algorithms to automatically collected data on the users' mediated behavior.

1.2. Augmented Interactions: Social Feedback in Mediated Communication

Previous literature has shown how feedback can increase people motivation and performance, as suggested by several theoretical models as Control Theory [8] , Goal-Setting Theory [9] and Social Learning Theory[10] .

The next session will present an overview of studies using social feedback in the specific context of mediated communication.

1.2.1. Social Feedback in Mediated Communication In the field of computer-mediated communication the effects of Feedback Intervention on different dimensions of group-mediated activity are various and complex. DiMicco, Hollenbach, Pandolfo, and Bender[11] , used a shared display during a decision-making task to illustrate the users' participation rates, indicating over-participators and under-participators. Participation rate and the process of information sharing changed in a direction connected with the evaluation implicit in the feedback. Exploiting feedback based on explicit evaluations of users' behaviours, Zumbach, Schönemann, and Reimann [12] proposed a problem-solving task supported by an html-based collaborative system. A trained human observer detected every episode of collaboration and displayed a reinforcement message on the participants' monitors. The highest amount of collaborative events was detected in the condition with distributed resources and with feedback.

Morris [13] introduced a Social Network display, in order to increase elderly people self-awareness and confidence in the possibility of improving their social life by controlling their own social activity. After using the display, participants were reported to be more socially active: they were able to drew attention to the part of the network with fewer contacts and to increase and improve their relationships with them. All these studies converge on the result that feedback presentation can induce a change in those aspects of the performance covered by the feedback. In addition, feedback accuracy [11] and complexity [14] affect its persuasiveness.

Classic psychological studies offer some specific recommendations on how an efficient feedback should be built. Kluger and DeNisi [15] , working on an extensive meta-analysis of 131 papers, found that a feedback works by drawing user's attention to one of three levels: task-motivation, task-learning and meta-task (self). When both goal and feedback are clear, optimal usage of a feedback occurs when the processing remains on the task-motivation level, with the user trying to find a way to fill the standard-feedback gap.

In case of collaborative tasks, feedback at the group level (i.e. team performance) rather than feedback centered on individual level (i.e. single members performance) may help provide this kind of information that increases the overall performance, since the individual contributions would become more precise and appropriate to the actual status of the activity.

Other aspects that need to be considered to build efficient feedback have been discussed by Ilgen, Fisher, and Taylor, who underlined the role of credibility, frequency and sign [16] . They also stressed how a computer-generated feedback is perceived as more accurate and can improve performance, as suggested by similar studies [17] .

Time provision is another critical aspect to be addressed. If Ilgen and coll. [16] reported that feedback works when close to the task it is meant to affect, and associated to a memory of the original task, Kerr, Messe, Park, and Sambolec [18] and Murrel [19] found that feedback do not need to be provided immediately after the performance, but instead when the subsequent activity needs it.

1.2.2. Social Network Analysis indices Network representations have been proved to increase awareness of social connectedness and to improve the abilities to manage social relations [12] . More generally, SNA can provide valuable tools to describe, evaluate, and visualize the quantity and quality of social relations, and for this reason it has been applied, for instance, to the analysis of chat [20] , blogs [21] or email [22] . In fact, it has several advantages and characteristics:

- it is a well-known and consolidated framework for describing different social phenomena;
- it can provide brief information about a specific social dimension;
- data for index computation can be easily gathered considering the communicational events among members of the group (the use of this kind of data has sometimes been referred as Dynamic Network Analysis [23]);
- data refer to the form and structure of the interaction, not to the content.

In the study described here, two specific dimensions of interaction were considered, namely centrality and reciprocity, based on the number and direction of messages sent during chat communication.

Centrality is one of the fundamental structural attributes of a social network. Probably the most intuitive index of centrality is degree centrality. In graph terms, the degree of a node is

simply the number of other points adjacent to it. Socially, it represents the number of interactions developed between an individual and the other members of the group. Freeman [24] reports that "centrality in terms of degree are responding to the visibility or the potential for activity in communication" (p. 219).

The second dimension, reciprocity, considers the direction of the relation when ties between actors are bi-directional [25] , and refers to the mutuality of the choice of directing a communicative event to somebody. It is calculated as the ratio between the number of reciprocated links and the number of the overall links each participant received or sent [26] . Reciprocity values go from 0 (every link is asymmetrical) to 1 (every link is symmetrical).

Coherently with the definition provided by Kluger and DeNisi[15] , our feedback intervention is intended as a series of actions producing an information, provided intentionally by an external agent (i.e. different from the one performing the activity) and not spontaneously available as the product of the ongoing task.

Our specific case departs from Kluger and DeNisi's framework in that:

- the feedback focuses on group processes instead of group performance (i.e. feedback may focus on social activities performed during the ongoing task, rather than results);
- a computer can be considered as the 'external agent' which provides the feedback, with the final goals of implementing an automatic feedback provision system.

In particular, our attempt is to verify any change in behaviors and social presence due to the provision of feedback based on the on-going communication activity, captured through SN indices of centrality and reciprocity.

2. Hypotheses

The hypotheses of our study can be summarized as follows:

[H1] *Social feedback influences user's behavior in the group task.* Feedback presentation is able to produce a change in user's behavior, especially on those dimensions that are directly addressed by the feedback[11] . In our specific case, and based on previous results [27] , we expect that feedback based on the number or symmetry of message exchanges modify players' communicative behavior in the direction of intensifying the general flow of exchanged messages.

[H2] *Any change in the group activity produced by the feedback is stable over the duration of the activity*. Kluger and DeNisi reported an increase in the feedback effectiveness as a consequence of feedback frequency [15] and no effect for task novelty. Likewise, we would like to observe if the two SNA types of feedback considered here keep on being effective during a prolonged activity, past a first experience of the feedback where novelty can play a major role in making them effective, and if the effect maintains the same direction throughout the activity.

[H3] *Feedback is able to modify self-reported group experience.* Social Network Displays have been considered as tools for augmenting awareness of the social context [11] [12] . We would like to investigate whether players' activity after feedback presentation is accompanied by an awareness of this activity. This is checked by investigating the way in which several aspects of the experience are recounted and assessed through classic self-reported measures of group awareness, presence, social presence.

3. Research setting

In order to test the hypotheses, a collaborative task in a mediated environment had to be set up. An on-line multiplayer game was devised, by using an open source, cooperative multiplayer graphical RPG called 'Crossfire' [28] .Two main reasons guided our decision to rely on a game environment: first of all, due to our interest on the long-term feedback effects, the entertaining aspects of a game should motivate participants to carry on the experiment to its end; secondly, the increasing general interest in games make them a feasible scenario for feedback applications. Consequently, the exploitation of a game allowed us to study feedback intervention in an ecologic as well as controlled environment.

Figure 1 Crossfire client and Skype window displayed on the monitor during one game session

The game was structured as a treasure hunt: participants were instructed that their team goal was to find several special objects hidden in the game environment using an assigned avatar in a limited amount of time (twenty minutes); information about the location of treasures were provided through signs located in the different cities constituting the environment. Using a bird-view perspective, each participant had access to a view of his/her avatar as well as other participants' avatars wandering in the nearby. Avatars could move according to commands performed through the directional arrows on the keyboard and one key for performing

actions (pick up objects, read signs). To identify visible avatars participants used the right key of the mouse. The environment was appropriate to stimulate communication among players: each player could only have a limited access to the virtual world at any given moment, so information needed to be exchanged in order for the team to effectively cover the whole virtual world and share cues and updates. This communication happened via textual chats through the Skype® system [30] (see Figure 1). Since our interest was in dyadic communication exchanges, then only one-to-one textual chats were allowed.

3.1. Experimental design

Participants were 120 students of the University of Padova, who volunteered to participate (age: M=23.66 SD=4.13). Participants were as much as possible randomly assigned to different teams, after considering their availability (the experiment took about three hours, so we had to consider commitment constraints for each participant when composing groups). Each team included 10 participants. Twelve teams were distributed in three different experimental conditions: groups in the first condition received a feedback displaying the centrality value, groups belonging to the second condition received a feedback on reciprocity, groups in the third condition received no feedback. Feedback was provided at the beginning of each game session, starting from the second session. Feedback conditions varied between subjects; 4 teams (40 participants) belonged to each condition. Participants were instructed that their only aim was to find as more special hidden objects (i.e. goblets) as possible, using whatever kind of strategy they preferred.

Members of a team met for 4 sessions in a raw, in the same day; the geography of the virtual world changed in each session. Participants met in the same computer room (see Figure 2); then, after a brief preparatory phase where they signed the informed consent, logged in the Skype® system and read game instructions, they began the first session of the game. Each session lasted 20 minutes, with an interval of 25 minutes between them. At the beginning of the second, third and fourth session, before they started the game, participants in the feedback condition were shown information on their communication activity in the previous session. The feedback was displayed on the participants' monitor as long as they wanted. After feedback presentation, subjects were requested to close the feedback window, because another session was starting. Feedback was just a representation of their communication activity, and they were also told that they could simply ignore it, if not interested in it.

At the end of the fourth experimental session, participants were asked to fill in a questionnaire about presence and feedback.

Figure 2 Participants sat in the same room, but were not allowed to speak. Three experimenters checked the correct development of each game session

3.1.1. Feedback design Participants communicated via dyadic textual chats during each game session. Centrality values were built based on the messages exchanged between pairs of team members: if at least one message was exchanged between two participants, then a link among them was built. The higher the number of links connecting each team member to the other ones, the higher his/her centrality score. A network representation was used to visualize the centrality values of all team-members: having a higher centrality score corresponded to being a node with a more a central position in the visualization, a larger dimension (see Figure 3) and a darker tone of green. In Figure 3, for instance, Antonella is the most central participant.

Reciprocity values were based on "thread starting requests" (TSR), namely on messages that could develop into a longer thread of messages. They could be sent from one team member to another in order to start an exchange afresh, or could resume an already open chat that had some periods of inactivity. If a participant sent a message like that to another, then s/he showed the willingness to communicate with the receiver. Therefore, if both people on a chat had sent at least one TSR during a game session, then the attempts at communicating were even between them; alternatively, the initiative to communicate belonged to one of them, and the other was mostly passive to this respect. Reciprocity values for each participant were 1 if, considering every other player with whom s/he had communicated, attempts to communicate were made by both of them; reciprocity values for each participant were 0 if, considering ever other player with whom s/he had communicated, the initiative to communicate belonged only to one of them. The representation consisted in a graduated scale where two hands were joined (if reciprocity value was 1) or were separated (the degree of separation is maximum when reciprocity is 0) (Figure 4). This representation stems from the idea that reciprocity is directly connected to cooperation, [30] which is easily associated to two shaking hands.

All feedback visualizations were accompanied by a brief description.

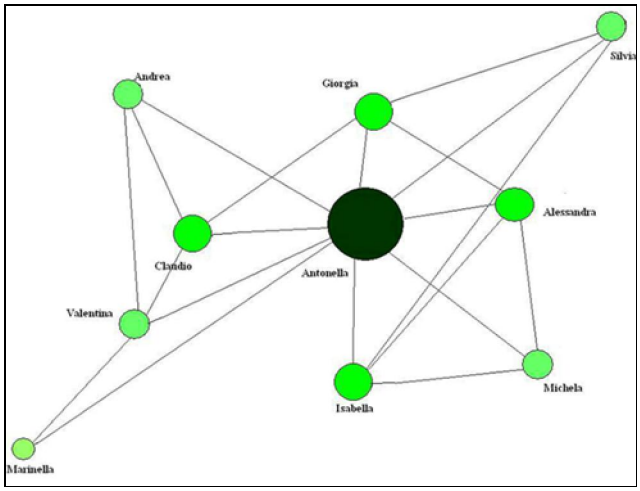

Figure 3 An example of the centrality feedback visualization

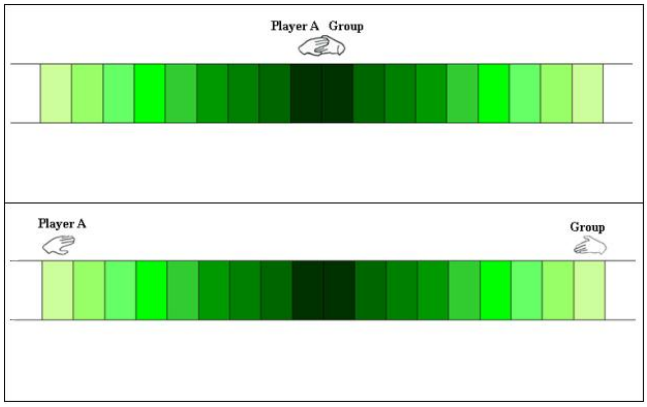

Figure 4 Two examples of reciprocity-based feedback

3.1.2. Questionnaire The aim of the questionnaire was to investigate the:

- *social presence*, feeling the presence of others in the same virtual environment;
- *group awareness*, feeling of being part of a team and knowledge of relevant team status;
- *efficacy, perception and effectiveness of the feedback.*

The questionnaire was divided into two parts: the first part comprised items about social presence and group awareness, and was administered to all participants; the second part related to feedback, and was administered only to participants belonging to Feedback condition. Most items were taken from well-known questionnaires according to the scheme illustrated in Table 1. In particular, as reported in Table 1, we referred to Schroeder, Steed, Axelsson, Heldal, Abelin, and Wideström [31] , Biocca and Harms' "Networked Mind Questionnaire" [32] , an adaptation of Cross, Borgatti, and Parker [33] and Di Micco, Pandolfo, and Bender[34] . Participants were asked to respond on 5-points scales. The direction of the scales was balanced (in half of the items rates increased from left to right, while in the other half they increased from right to left).

4. Results

4.1. Activity measures

A two-way ANOVA for mixed design on the number of messages exchanged considering the within-factor "number of sessions" (4 levels) and the between-factor "experimental condition" (centrality feedback, reciprocity feedback and no feedback) (see Table 2 for mean and standard deviations) was performed. A main significant effect of the within-factor "number of sessions" [F(3,27)=4,172, p=.015, η_p^2=.317] and of the between-factor "experimental condition" [F(2,97)=8.407, p<.001, η_p^2=.651] were found. The interaction of these two factors was also significant [F(6.227)=5.479, p=.001, η_p^2=.534].

1	Have you experienced to be in the same game environment of your team-mates?	[[31]
2	Did you expect to meet your team-mates while you were exploring the environment?	[31]
3	Did you feel that you and your team-mates were collaborating to fulfil the same aim?	[31]
4	Did you feel as a member of the team?	[32]
5	Did you feel that your team-mates were depending on your actions?	[32]
6	I was aware of what was happening in the team.	[32]
7	My principal occupation was to find goblets.	
8	I contacted people I knew	[33]
9	I knew who was the person who had more information in my team	[33]
10	I tried to contact the biggest number of team-mates	
11	I knew who was available for helping me	[33]
12	I responded to my team-mates only if I knew the answer	[33]
13	I find the feedback useful	[34]

14	I think that feedback about my situation was accurate	[34]
15	I think that feedback about team situation was accurate	[34]
16	I think feedback gave me information I could not have had otherwise	[34]
17	I have noticed that feedback influenced the team	[34]
18	I thought about feedback during the game	
19	I noticed that feedback influenced my behavior.	[34]
20	I would have liked to have a constantly available and updated feedback	

Table 1 Items used in the questionnaire; in the column on the right, the source from where the item was adapted is reported (missing sources are items proposed by the authors)

A 'simple effects' analysis showed that in session 1 there was no significant difference in the number of exchanged messages among the groups in the three different conditions [F(2,36)=0.23, p>.05]. In the other three sessions, significant differences were found (respectively, F(2,36)=7.50 for the second session, F(2,36)=8.42 for the third session, F(2,36)=6.23 for the fourth session, with $F_{critic} \approx 3{,}27$, $\alpha=.05$). This means that differences between conditions cannot be attributed to the starting values of the teams belonging to the different conditions.

The "Between Simple Comparisons" have shown differences between the centrality feedback condition and the control condition in session 2 [F(1,36)=184.7], in session 3 [F(1,36)=201.34], in session 4 [F(1,36)=199.92], reciprocity feedback condition and control condition in session 2 [F(1,36)=175.3], in session 3 [F(1,36)=202.76], in session 4 [F(1,36)=61.53], centrality feedback condition and reciprocity feedback condition in session 4 [F(1,36)=39.63]. Other "Between Simple Comparisons" were not statistically significant for $\alpha=.05$ [$F_{critic}(1,36) \approx 4.17$]. This confirms the significance of the differences illustrated in Figure 5, where the two conditions with feedback seem to register an increase in the number of messages starting from the second session, with respect to the control condition. Furthermore, in the forth session also the two feedback conditions differ.

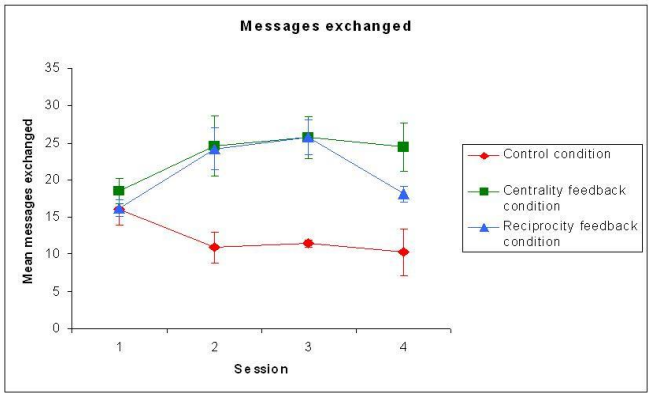

Figure 5 The variation of the mean number of messages exchanged during the four sessions grouped by experimental condition

Going deeper into what happens within each condition across time, the "Within Simple Comparisons" showed significative difference in centrality feedback condition between session 1 and session 2 [F(1,27)=7.01], between session 1 and session 3 [F(1,27)=9.98], between session 1 and session 4 [F(1,27)=12.42], in reciprocity feedback condition between session 1 and session 2 [F(1,27)=17.73], between session 1 and session 3 [F(1,27)=4.20], between session 2 and session 4 [F(1,27)=7.19], between session 3 and session 4 [F(1,27)=11.35]. Other "Within Simple Comparisons" were not statistically significant for $\alpha=.05$ [Fcritic(1,27) ≈4.23]. This analysis confirms that the effect of the centrality feedback on the exchange of messages is more stable over time, increasing after the first feedback provision and then maintaining this increased level; the reciprocity feedback tended to decrease its effect after a certain number of sessions, equaling the initial level at the last session. Finally, there was no significant difference across time in the control group, showing that the communication increase was not a natural consequence of meeting several times with the same teammates.

4.2 Self-reported measures

Let's consider now the effect on participants' self-reported measures collected at the end of the forth session. We'll first describe the items administered to all participants (items 1 to 12), and then the items on feedback, which were only administered to participants in the centrality and reciprocity conditions (items 13 to 20). Figure 6 shows the mean values and bar errors for all items in each condition.

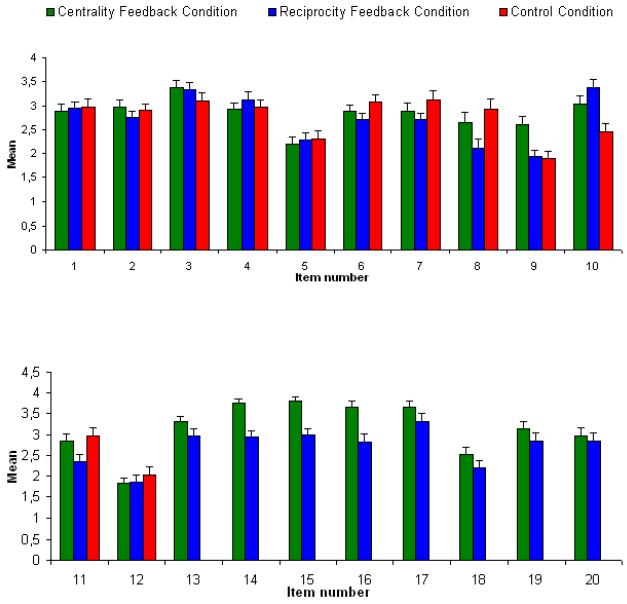

Figure 6 Means and error bars of items for each condition

A one-way MANOVA found no significant differences between conditions in items 1, 2, 3, 4, 5, 6, the items more linked to the *sense of presence* and to *the sense of being part of a team*.

Items 7 to 12 concern the players' *behavioral strategies* during the game. For items 7, describing the general goal of the activity ("My principal occupation was to find goblets."), and item 12, describing the reason to reply to a message ("I responded to my team-mates only if I knew the answer"), we did not find any significant difference between the three experimental conditions. Differences were found in items 8 [$F(2, 118) = 4.33$, $p = .02$], 9 [$F(2, 118) = 6.20$, $p < .001$], 10 [$F(2, 118) = 6.87$, $p < .001$] and 11 [$F(2, 118) = 4.25$, $p = .02$]. Table 3 shows mean and standard deviation values for these latter items.

In particular, a Scheffè test executed on Item 8 ("I contacted people I knew") showed a significant difference in the feedback conditions ($p = .017$), meaning that participants in these conditions were less dependent on prior acquaintances (being students in the same university, some participants already knew each other) when deciding whom to contact to exchange information on the game.

A Sheffè test executed on item 9 ("I knew who was the person who had more information in my team") showed a higher value for Centrality Condition. The difference was significant both between Centrality and Reciprocity conditions groups ($p = .013$) and Centrality and Control Conditions groups ($p = .010$). This result was expected, because Centrality feedback visually emphasized the actor who had more exchanges in the group.

A Sheffè test executed on item 10 ("I tried to contact as many people as I could") showed a difference only between reciprocity and control conditions ($p = .017$), while the difference between Centrality Condition and Control Condition was not significant ($p = .075$). This seems to suggest that this aspect of the communication strategy was affected by the reciprocity feedback only.

	Condition	Mean	Std. Deviation	N
item1	Centrality	2,8750	,93883	40
	Reciprocity	2,9500	,81492	40
	Control	2,9750	1,09749	40
	Total	2,9333	,95031	120
item2	Centrality	2,9750	,94699	40
	Reciprocity	2,7500	,83972	40
	Control	2,9000	,90014	40
	Total	2,8750	,89407	120
item3	Centrality	3,3750	1,00480	40
	Reciprocity	3,3250	,97106	40
	Control	3,1000	1,05733	40
	Total	3,2667	1,01031	120
item4	Centrality	2,9250	,85896	40
	Reciprocity	3,1250	1,01748	40
	Control	2,9750	,91952	40
	Total	3,0083	,93031	120
item5	Centrality	2,2000	,93918	40
	Reciprocity	2,2750	,96044	40
	Control	2,3000	1,06699	40
	Total	2,2583	,98301	120
item6	Centrality	2,8750	,79057	40
	Reciprocity	2,7000	,91147	40
	Control	3,0750	,97106	40
	Total	2,8833	,89989	120
item7	Centrality	2,8750	1,09046	40
	Reciprocity	2,7000	,91147	40
	Control	3,1250	1,15886	40
	Total	2,9000	1,06432	120
item8	Centrality	2,6500	1,29199	40
	Reciprocity	2,1000	1,29694	40
	Control	2,9250	1,30850	40
	Total	2,5583	1,33345	120
item9	Centrality	2,6000	1,10477	40
	Reciprocity	1,9250	,94428	40
	Control	1,9000	,95542	40
	Total	2,1417	1,04757	120
item10	Centrality	3,0250	1,12061	40
	Reciprocity	3,3750	1,12518	40
	Control	2,4500	1,15359	40
	Total	2,9500	1,18712	120
item11	Centrality	2,8500	1,05125	40
	Reciprocity	2,3500	1,05125	40
	Control	2,9750	1,14326	40
	Total	2,7250	1,10737	120
item12	Centrality	1,8250	,87376	40
	Reciprocity	1,8500	1,16685	40
	Control	2,0250	1,25038	40
	Total	1,9000	1,10309	120

Table 3 Means and standard deviations of items in the first part of the questionnaire

A Sheffè test executed on item 11 ("I knew who was ready to help me") showed that significantly lower values were obtained with the Reciprocity Feedback and the Control Condition ($p = .022$). This result can be explained by the fact that reciprocity feedback did not display others' scores on this dimension and, consequently, it was not possible for the players to know who reciprocated most; instead people generically tried to include as many people as possible in their communicative network, as suggested by the results in item 10.

The second part of the questionnaire was administered only to the 80 participants in the two feedback conditions, since it focused on feedback perception.

Items 13 to 16 investigated the *perceived usefulness and accuracy of the feedback*. Significant differences were found in items 14 [$F(1,78) = 19.31$, $p < .001$], 15 [$F(1,78) = 19.87$, $p < .001$] and 16 [$F(1,78) = 10.51$, $p = .002$]. Means and standard deviations for every item of this questionnaire are reported in Table 4. While both types of feedback were rated as partially useful (see mean values for item 13), the accuracy and information rarity were rated higher in the centrality feedback. It is not clear if this is due to the fact that it reported all participants' values or if it was perceived as more connected to the task.

Items 17 to 19 investigated the players' *awareness of the feedback effect*. The mean values for each item were not different in the two conditions and were moderately positive regarding a general awareness of the feedback effect on the group, but generally low in the other items, showing that players reported to have not thought about the feedback during the game and to have not noticed behavioral changes due to the feedback, even though the feedback intervention did affect participants' communication. Finally, item 20 showed that the pace of feedback provision (between tasks, but not constantly updated within each task) was satisfying to participants, who were neutral in their answers to the question "I would have liked to have a constantly available and updated feedback".

	Condition	Mean	Std. Deviation	N
item13	Centrality	3,3250	,69384	40
	Reciprocity	2,9750	1,04973	40
	Total	3,1500	,90148	80
item14	Centrality	3,7500	,66986	40
	Reciprocity	2,9500	,95943	40
	Total	3,3500	,91541	80
item15	Centrality	3,8000	,64847	40
	Reciprocity	3,0000	,90582	40
	Total	3,4000	,88016	80
item16	Centrality	3,6500	1,00128	40
	Reciprocity	2,8250	1,27877	40
	Total	3,2375	1,21430	80
item17	Centrality	3,6500	,94868	40
	Reciprocity	3,3250	1,11832	40
	Total	3,4875	1,04329	80
item18	Centrality	2,5250	1,01242	40
	Reciprocity	2,2000	1,15913	40
	Total	2,3625	1,09364	80
item19	Centrality	3,1500	1,05125	40
	Reciprocity	2,8500	1,27199	40
	Total	3,0000	1,16923	80
item20	Centrality	2,9750	1,14326	40
	Reciprocity	2,8500	1,21000	40
	Total	2,9125	1,17132	80

Table 4 Means and standard deviations of items in the second part of the questionnaire

In synthesis, participants could report a difference in the feedback conditions when asked about their specific communication strategy, or their awareness of specific information, but not about their general sense of presence, group belongingness or feedback effectiveness. Also, the centrality feedback was rated more positively than the reciprocity feedback.

Conclusions

This study focused on group presence and its possible augmentation. It investigated whether making available to group members more information about the group communication activity would result in individuals using this information to orient their own activity accordingly. This modified activity would reflect participants' 'knowledge' of the state of the activity within the group as a whole.

The results of this study clearly showed that the provision of information about how team members communicate among them increases the communicative behavior accordingly. This result aligns with previous researches in the feedback area, which specified that feedback based on a certain dimension (in our case, the exchange of messages) influences that same dimension [11] Therefore, we could conclude that it is not just information about the results reached that powerfully influences individual behaviors, as was shown by other studies, but it is also knowledge about the activity of the group, provided by the SNA indices used here that induces behavioral changes .

Although the type of information provided by the two feedback was able to increase communication flow, on the long period this effect differed according to the kind of feedback provided. In particular, we found that information about the presence of interactions with other members (referred to as "centrality" feedback) fostered an increase in communication and that this higher levels remained stable till the forth session. On the contrary, information on the mutuality of initiative of communication (referred to as "reciprocity" feedback), increased the number of messages exchanged at the beginning, but did not maintain these higher levels over a prolonged period of time, till the forth session.

This difference could be due to the different perceived accuracy of the feedback, resulted from the questionnaires: centrality based feedback was found to mirror what was going on in the group better than the reciprocity feedback. The accuracy of the feedback, therefore, seems to have a determinant role in its efficacy, further confirming previous results by [15] [16] , and extending them to mediated environments.

Once verified that making visible the nature of the group' activity produced behavioral changes, we wanted to understand if these changes were also evident to the participants themselves. Again, the participants' perception of their behavioral modifications varied in the two feedback conditions: participants in the centrality condition referred to be more

aware of whom had more information and of whom was available for help. Most generally, however, self-reported measures were not able to detect an increase in presence, in being part of a team and in the awareness of the feedback effectiveness, while they detected awareness of specific communication strategies (trying to contact as many people as possible, etc). These results highlight a gap between the sense of presence measured by self-reported techniques such as the questionnaire, and presence in the groups as is detected by recording the actions performed [1] . Individuals change their behavior when presented with information on the activity in the group, and then their way of being present there, but were not aware of the role of the feedback in orienting their actions. These results encourage further explorations in the use of feedback to augment the presence in a social aggregate whose size could otherwise hamper the individuals' ability to grasp the general sense of a common, interlaced activity, and then threaten the ability to tailor the actions to the group state. They also suggest that this feedback may operate at a level that is not immediately appraised by the individual, and that can escape some data collection techniques: an increased awareness of the social environment in which people are participating can occur at the practical level but not emerge from self-reported measures. Further investigation on both aspects is needed.

Results from questionnaires have also provided some hints on the application of feedback to current technologies. Participants belonging to groups which received feedback declared to have contacted people independently from their previous familiarity with them. This result could be very promising, since feedback could be exploited as a tool for building communities, because of its power to enhance interactions even among people working together (as often happens in dislocated collaborative activities).

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