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INTERLOCUTION SCENARIOS FOR PROBLEM SOLVING IN AN EDUCATIONAL MUD ENVIRONMENT

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ABSTRACT

This paper presents an analysis of computer mediated collaboration on a problem-solving task in a virtual world. The theoretical framework of this research combines research in Computer Mediated Communication with a social psychology theory of conflict. An experiment was conducted involving university students performing a problem solving task with a peer in an Educational MUD. Each performance was guided by a predefined script, designed based on the 'common speech' concepts. All the performances were analyzed in terms of identity perception, conflict perception and cooperation. By looking at the relationship among the CMC environment features, the social influence activated on this environment, the conflict elaboration, and the problem solving strategies, a distinctive 'interlocution scenario' emerged. The results are discussed using contributions from the two theoretical approaches embraced.

Key Words: problem solving, computer mediated communication, social comparison, MUDs

Introduction

The current discussion about opportunities and dangers of human experience patterned on computer screen models (Turkle 1995) has relevant theoretic and practical implications. Modifications resulting from the exposition to new communication technologies can be analyzed through multi-disciplinary approaches.

This paper presents an analysis of computer-mediated collaboration on a problem-solving task in a virtual world. A definition of technology as 'cultural artifact' is used, and as such its cognitive, psychological and social effects are explored (Mantovani 1996). The CMC environment used is an educational Multi-Users Domain (MUD) (Curtis 1992) where a problem-solving task has been implemented: a mystery game to be solved by two partners interacting at a distance. MUDs allow performing such a task because synchronous communication takes place while partners communicate and jointly use virtual objects they are provided with or that are present in the virtual enviroment (a set of hotel rooms, implemented within the MUD).

Theoretical framework

The theoretical framework of the present research is multi-disciplinary: we integrate views on problem solving strategies from both Computer Mediated Communication (CMC) and a social psychological theory, called Conflict Elaboration Theory (CET). We briefly discuss each of these areas below.

Computer Mediated Communication (CMC)

CMC research consists in a number of studies focused on the topic of human interaction through media and sharing the idea of communication as social construction of meanings and symbols. The most recent developments of this stream of research consider outdated the proposal maintained by some researchers (Sproull and Kiesler 1991), that technology features strongly determine goals, interaction style, users' relationships established during the mediated communicationas well as the conflict dynamic. Interactions in a computer-mediated environment do not take place in a sort of 'social vacuum.' Human presence seems to be sensed through symbolic processes (Spears & Lea 1992). In this respect, the 'situated action' model is particularly useful because it refuses any formal pattern of action (Suchman 1987). Actors choose aspects of the situations that are more relevant to their goals (Mantovani 1996), and the process of selecting the aspects runs parallel to the process of interpretating them. Situations are constructed actively and they are the results of several social processes. Based on these assumptions, computer mediated interactions are organized around rules determined by the continuously changing specific context. The social context is seen as an important factor that gives rise to the salient identity; and computer mediation can be considered as a tool that can be used every time in a different way.

According to these assertions, it can be stated that each social interaction is different from others, even when mediated by the same media. Different styles of communication, interaction, and problem solving strategies can be fostered. In fact, media ability to support a social function does not depend completely on its technical features but on the meaning given to the media. This meaning is socially constructed as function of a complex system composed by the specificity of participant goals, the environmental features, the cultural, and social context.

The Conflict Elaboration Theory (CET)

CET considers cognitive conflict as a powerful strategy to influence the others' opinions and ideas (Butera & Pérez 1995). Its dynamics depend on both: (1) the type of task performed, (2) characteristics of the sources of influence. In a problem-solving task the solution is never known *a priori,* thus uncertainty is generated. While trying to reduce the uncertainty, targets of influence take in consideration the source's information and, indirectly, build a relationship with him/her. By analyzing interactions built between partners the cognitive strategies used to solve a problem can be extrapolated. For example, social comparison makes salient the source's **competence** in the task and the **threat power** on the target identity (Maggi, Butera & Mugny 1996). The dynamic used to manage a conflict will impact the social strategies used, the type of relationship engaged with the partner as well as the cognitive strategies used to seek the solution to the task.

To understand the types of conflict elaboration studied by this theory, source and target features need to be taken in consideration. The source can vary from high to low competence and can either represent or not represent a threat to the target. Target can also be of high or low competence. Combining those dimensions eight different types of conflict elaboration are yeld (Mugny & Butera 1997) (see table no. 1).

	High Competent Source		**Low Competent Source**	
	Threatening	**Not Threatening**	**Threatening**	**Not Threatening**
High competent target	(1) Conflict of Competencies	(3) Informational Interdependence	(5) No Conflict Perceived	(7) No Conflict Perceived
Low competent target	(2) Informational Constrain	(4)Informational Dependence	(6) Negative Interdependence	(8) Conflict of Incompetence

Table no. 1 - Conflicts dynamics depending on source's and target's competence, and identity threat perception.

In this model the identity protection seems to be in competition with the cognitive processes used to elaborate the conflict: the higher is the people's effort to protect their own image from a threatening source, the less engaging is the cognitive process used in elaborating the conflict.

By integrating CMC and CET theories, three dimensions appear to be relevant in analysing human interaction: a) how subjects perceive both their own **identity** and that of their partners; b) **conflict relevance** as a factor able to clarify and drag in the foreground interaction processes; c) **relationship** established between partners. Those theoretical issues will be used to set our data analysis system.

Research design

The research design is inspired by the *social influence* paradigm where a source of influence tries to modify the target position about the solution to a shared problem through a cognitive conflict. The interaction between source and target is guided by a fixed 'interlocution structure' built upon the theoretical suggestions coming from the 'strong interactionism' perspective (Jacques 1991). Our methodology tries to combine the need to isolate and to observe variables from a quantitative standpoint, with the wish for an ecological framed pattern of research such as conversation in virtual reality. The 'interlocution scenario' concept fosters the feeling of a natural interaction, preserving a perception of an interaction between real interlocutors, acting in a realist style.

We used a Multi-User Domain (MUD) (Curtis 1992) environment as the setting for this research. In particular, we used tecfamoo (www.tecfamoo.unige.ch), a gathering place for educational technology researchers at the University of Geneva and their colleagues. MOOs (MUDs with Object-Oriented programmability, Curtis 1993) are virtual "environments" on the network where multiple users can connect to a central server and interact with each other and the environment. This environment contains *rooms*, which represent the local view of the users, and *objects* (including avatars for the users), which can be in rooms. All objects can be given descriptions and augmented with other actions that can be performed on them. Users can navigate from room to room, talking with other users, and viewing and "manipulating" objects.

The sample

Twenty-five subjects were recruited through a 'Call for Subjects' posted in several MUDs and on MUD mailing lists. The task was presented as a fun game aimed at showing talent in solving a murder mystery, by discovering crucial details, and working on a difficult problem with a partner detective. Subjects interested in performing the task were invited to contact the researcher via electronic mail.

The subjects' age was between 19 and 30 years old, with the highest percentage between 20 and 23 (48%). Ten of them were women and fifteen men. All subjects were university students and all of them had some basic MUD knowledge. All the assignments and the arrangements were conducted through the Internet and none of the participants ever met face-to-face. Subjects connected from different countries and they were of different nationalities and they all used English to communicate.

The task

The setting for the task was finding a solution to a murder mystery. The setting was a small mountain ski lodge, implemented as a set of 13 interconnecting rooms in the MOO. Clues were present in the form of MOO objects that could be found and inspected, and also 11 'robots' were implemented, who served as suspects and witnesses, with the abilities to answer a few relevant questions, such as what they were doing around the time of the murder and how they knew the victim. Participants were assigned special MOO textual avatars, named Sherlock and Hercule. Each detective was also provided with a "detective notebook", that stored answers from suspects and could be reviewed by the detectives. The task was used previously for experiments with grounding and multiple media (Dillenbourg, Traum & Schneider 1996, Dillenbourg and Traum 1999). The task was a difficult one, with only 2/3 of the pairs arriving at the correct solution. For the current experiments, a subject played one detective, while the partner was played by a confederate – following a pre-specified protocol. The subject meets his/her partner only in the virtual environment and a limited time (one hour) was allotted to solve the problem. This task entails an uncertainty about the right solution that forces subjects to evaluate partners' information and characteristics (Butera & Mugny 1995).

The procedure

Each subject who answered the 'Call for subjects' was given a day and time to meet the partner and to perform the task. Before connecting to the virtual lodge, subjects were supplied via the web with a map of the lodge and a list of MOO commands available during the experiment. The subjects' real names were never used and the connection was enabled through a special login (Sherlock) and a personal password. Each subject connected to the game was matched to a partner (Hercule) introduced as another subject recruited through standard procedure, but who was actually the first author of this paper acting as a confederate. This double role was possible thanks to a MOO client that allowed multiple windows on the same computer, each corresponding to a different connection. In our study, the researcher had two windows on the screen: one to perform the task as confederate, and the other to act as researcher equipped by special options such as controlling passwords, monitoring subjects' performance, recording and printing all the interactions. The same confederate interacted with all subjects and always followed the

same pre-defined script which was composed by several phases, each of them aimed at provoking the events included in the experimental 'interlocution scenario.'

The experimental "Interlocution scenarios"

The concept of 'interlocution scenario' combines pragmatic linguistics with social psychology. It is based on the 'common speech' perspective (Mininni 2000) where personal identification is always related to the interlocutors' features and to the aim of interaction. This approach forces the researchers to take into account both conversational style and goals of each interlocutor and to consider each interaction in its uniqueness.

Our experimental interlocution scenario was designed as a loose script. The common structure made each single "interlocution scenario" comparable. In all the scenarios, three 'dramatis personae' were acting: (1) Kalimero = the researcher chairing the section; (2) Sherlock = the subject; (3) Hercule = the subject's partner , who was actually the researcher playing the role of the confederate.

The interlocution structure was composed of several phases:

* An Instruction Phase. Kalimero welcomes the subject (Sherlock) and a few seconds later activates the confederate's connection as Hercule. During this phase the researcher gives all the instructions to perfom the task.

* Three Interaction Phases guided by the confederate, who asks a question about the initiative to be taken '*So, what's the plan?*', two navigation questions '*Do we want to go/do it together or do we want to split?*' '*Who goes/does it first?*', and an implicit request for information sharing '*What do we do with the notebooks?*'

* Three Free Interaction Phases during which Hercule simply reciprocates the subject's conversational mode: she answers Sherlock's requests, asks questions, gives comments and inferences whenever the subject does the same, and remains silent when Sherlock does not talk.

* A Conflict Phase activated by Kalimero before the third and last Guided Interaction Phase by asking Sherlock his/her first guess and informing him/her that Hercule had a different guess.

* A Debriefing Phase during which Kalimero asks the partners to report the final solution/s. Hercule remains silent waiting for Sherlock to take the turn and to phrase his/her solution.

* A General Information Phase. Kalimero administers a questionnaire at the end of each interaction to the subject. The questionnaire contains two questions about their own and the partner's competence. A seven-point scale, from 1 (not at all) to 7 (very much), is available for each answer.

The questionnaire gives information about how subjects' and partner's identity is perceived. If the subjects assess themselves and their partner competence at the same level, it can be assumed that no identity defense is activated, thus the social comparison can be considered as non-threatening. Conversely, if subjects assess the competencies at different levels, it can be inferred that the social comparison is perceived as threatening. In this case, it can be deduced that subjects are either trying to threaten their partner or to defend their identity from a threatening partner.

Data recording

All the interactions were automatically recorded and printed out in html format that contains the conversational contributions of each 'dramatis personae' and the following context indicators: (1) Time: how long after the start did the action take place; (2) Place: where did the action take place; (3) Who: the name of who was writing or acting; (4) Action: the type of action (e.g., talk, movement, examination of clues); (5) Arguments: for talk – who was the recipient, or objects, such as source and goal, for movement; (6) Said Text: the statement produced and actually received; (7) Typed Command: the actual typing done by the participant – including also mistakes that do not result in a MOO command or communication taking place.

Data analysis system

Printed protocols of the interactions recorded were analyzed through an analysis system organized along three levels: a) a higher theoretical level composed of the three dimensions pointed out from the theoretical discussion, b) an intermediate level composed of the observed variables and their categories, c) a lower empirical level that refers to the empirical events recorded in the protocol.

This data analysis system is described in detail in Ligorio (1999) and here is given an overview in Table no. 2.

Theoretical level		
1. Identity perception	2. Conflict perception	3. Co-operation
Observed Variables and values		
1.1 Self competence 1.2 Partner competence (low, medium, or high)	2.1 Conflict management (independent or dependent) 2.2 Solution strategy (same or different solution)	3.1 Information sharing (low or high) 3.2 Navigation (individual or team) 3.3 Cognitive planning (separate, parallel, or joint) 3.4 Relationship (leader, negotiative, or verification)
Empirical Events		
For both 1.1 and 1.2: Questionnaire	2.1: Conflict Phase 2.2: Conflict + Free Interaction + Debriefing Phase	3.1: Guided Interaction Phases 3.2 Guided Interaction Phases 3.3: Entire protocol 3.4: Entire protocol

Table no. 2 - Data analysis system

Results

The frequency and percentage distribution of the categories let us assert that:

- subjects tend to assess both their own and their partner competence as medium or high (low for only 28% of self and partner competence);
- in most of the cases the relationship established with the partner is of the negotiation type (64%);
- there is a strong tendency to navigate as a team (88%);
- subjects frequently collaborate with their partner (72%);
- during the Conflict Phase, partners' opinion is sought and a divergent guess by partner is taken into account (64%);
- solutions are built through individual and parallel hypotheses that are very often shared with the partner (60%);
- the final solutions tend to be rather different when compared with the first guesses stated during the Conflict Phase (68%).

In order to identify a typical 'interlocution scenario' the Chi^2 test is applied crossing all the variables.

Variables	Chi^2 results
Relationship by Cognitive planning	$\underline{X^2}$ (4) = 12.3; $\underline{p.}$ <.05
Navigation by Cognitive planning	$\underline{X^2}$ (2) = 9; $\underline{p.}$ <.05
Navigation by Relationship	$\underline{X^2}$ (2) = 8; $\underline{p.}$ <.05

Table no. 3 - Significant correlation

Table no. 3 depicts three significant relations between the following variables:

- between the Relationship established by the partners and the Cognitive Planning used to construct the solution;
- between the Navigation style and the Cognitive Planning;
- between the Navigation and the partners Relationship.

When a Negotiation relationship takes place, the Cognitive planning used tends to be Parallel. The Team Navigation is coupled with Parallel planning and Negotiation relationship. Relationship between partners, Navigation style, and Cognitive planning are strongly related to each other and this relation can be considered as the basis for a distinctive interlocution scenario in a MUD while two partners are engaged in solving a problem.

The Distinctive 'Interlocution Scenario'

From the results collected we can assert that the distinctive MUD 'interlocutor scenario' has the following characteristics:

1. *Mutual Evaluation:* subject's and partner's competence are both positively assessed although other variables are not connected to this results. The equal assessment suggests the idea that subjects are not defending their identities, thus the social comparison is not threatening and it takes place between two competent partners;
2. *Collaboration*: subjects seek a collaborative relationship with their partner, they prefer to navigate as a team, and the possibility to share information again fosters a non-threatening partner perception;
3. *Co-construction* : final solutions are built by involving the partner in parallel cognitive planning that doesn't merely adopt the partner's first guess. The new final solutions stated at the debriefing allow us to infer that integration and constructivist cognitive processes are activated.
4. *Positive dependency*: the conflict phase is managed by taking the partner's ideas seriously into account.

Conclusions

The results obtained in this study indicate that in general subjects positively perceive their own identity and appreciate partner's competence and availability to co-operate. The tendency to assess the competences at the high and intermediate levels appears despite the performance quality: only the 44% of the subjects reach the right solution. This result could be a consequence of the specific computer mediated context and of the way subjects interpreted it. The assignment given to the researcher may be influenced by the synchronicity of communication, the avatar assigned, and other technical cues such MUD commands made available just for this task, e.g., those related to the use of the virtual notebook. All of these facts may lead the subjects to joint participation, information and inferences sharing, negotiation of ideas, and hypothesis construction based on confirmations and invalidation. A partner so massively involved in the performance has to carry a valuable contribution. Besides, the positive assessment about the partner contribution could be influenced by the lack of feedback about the solution: subjects are not informed whether they correctly solved the mystery. This point of view seems to favor the context driven approach (Lea & Spears 1991) and shows the influence of the nature of the assignments on shaping the interactions style.

Using the CET perspective, the features of the typical interlocution scenario can be used to select a conflict dynamic. Looking at Table 1, the interlocution scenario can be placed in the cell containing:

a non-threatening social comparison, since both self and partner competence are positively assessed,

- a reciprocal high competency that leads to a non-competitive relationship between the two partners. This generates a fairly strong tendency toward negotiating the final solutions that are often reached by integrating the two points of view in such a way that new solutions are generated.

Conflicts seem to be solved through the 'informational interdependence', the dynamic marked in Table 1, cell number 3. But the interdependence experienced by the subjects in this study takes place at a more complex level than just informational. The data analysis system used to categorize our protocols allows exploring cognitive and social variables. The correlation found among the co-operation variables entitles us to re-define the interdependence established between subjects and partners as "socio-cognitive." In fact, the equally positive assessment of both self and partner competence can be considered as a consequence of having little or no threat coming from the social comparison. Since the partner is not perceived as a threat, subjects do not feel the need to defend their identity. The lack of identity defense could also be related to the typical nature of identities in the virtual space (Mantovani 1996, Talamo & Ligorio in press): strategic, fragmented, flexible, constructible and re-constructible at any time. According to the mechanism pointed out by CET, the cognitive effort not needed for the defense mechanism can be used instead in conflict elaboration, the solution strategies, and in establishing a relationship between the partners. Therefore, the social strategies and the cognitive effort invested in performing the task and elaborating the conflict represent the additional value of the 'informational interdependence' dynamic found in this study.

We would like to conclude this paper by remarking that using two theoretical contributions, adequately selected, helped us reach a deeper analysis of the data collected. A complex situation, such as solving a difficult problem in a MUD environment, could be analyzed by choosing the correct perspective depending on the specific result under analysis. Moreover, the combination of two theoretical contributions can lead to reciprocal advances and enrichments.

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