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# Perturbed Communication in a Virtual Environment to Train Medical Team Leaders

Lauriane HUGUET <sup>a,b,1</sup>, Domitile LOURDEAUX <sup>a</sup>, Nicolas SABOURET <sup>b</sup> and Marie-Hélène FERRER <sup>c</sup>

<sup>a</sup>*Sorbonne universités, Université de technologie de Compiègne, CNRS, Heudiasyc UMR 7253, France*

<sup>b</sup>*LIMSI, CNRS, Univ. Paris-Sud, Université Paris-Saclay, F-91405 Orsay*

<sup>c</sup>*French Armed Forces Biomedical Research Institute – IRBA, France*

**Abstract.** The VICTEAMS project aims at designing a virtual environment for training medical team leaders to non-technical skills. The virtual environment is populated with autonomous virtual agents who are able to make mistakes (in action or communication) in order to train rescue team leaders and to make them adaptive with all kinds of situations or teams.

**Keywords.** Virtual environment, medical team, non-technical skills, verbal communication

## 1. Introduction and Context of the Research

Health care delivery in military conflict, in peacekeeping missions or in the aftermath of disaster, implies high stress environments with danger exposures, life-threatening events and high levels of work demand. Crisis and emergency risk communication remains a real challenge in these situations [9]. The rapid response of emergency medical teams has an important role to play in preventing serious adverse events [12] but this need for rapid actions can also increase stress level. Elevated stress levels can reduce performance on tasks that require divided attention, working memory, retrieval of information from memory and decision making.

During critical events, medical errors can be related to human or system factors, including ineffective team leadership, non-standardized team communication, a lack of global situation awareness, poor use of resources and inappropriate triage and prioritization [10]. Team training optimize the non-technical skills [10] and team feedback influence behaviour and changing practices [11]. The VICTEAMS (Virtual Characters for Team Training: Emotional, Adaptive, Motivated and Social) project aims at building a virtual environment for training non-technical skills of rescue team leaders. In this interactive learning environment, which is a work in progress, virtual characters play the role of the team members and interact with each other in a natural manner.

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<sup>1</sup>Corresponding Author: Hugué Lauriane, Heudiasyc; E-mail: lauriane.huguet@hds.utc.fr

Virtual Reality provides compelling, engaging learning experiences that have been shown to reduce training time and increase training persistence.

In opposition to existing systems [6,7,8], our idea by proposing virtual characters with varied behaviours, is not to train a team of technical experts but an expert and adaptable team. The parameters influencing collective decision aspects can then be controlled by a pedagogical director to tailor collective behaviours according to the dynamic profile of the learner. In the VICTEAMS project, we have to face the challenge of interpersonal verbal exchanges in the virtual environment and with the learner who uses the interface. In this article, we focus on communications and how aspects of autonomous characters can adapt and create consistent and relevant communications (*i.e.* ideal or erroneous communications).

The following section describes the technical setup and the communication architecture.

## 2. Technical Setup

The VICTEAMS platform is based on multi-agent system (MAS): each team member is represented by an autonomous agent that makes decision based on local information and communicates with other agents to synchronise. This MAS is coupled with the virtual environment in which the scene is played, so that the team leader - the only human interacting with autonomous agents in the scene - is immersed in the simulation.

### 2.1. Virtual Environment

The virtual environment reproduces a Field Hospital, located in a tent, with regular/standard medical material in cupboards. The victims are already placed on beds and the medical staff is scattered in the room, taking care of the victims. The profiles of the victims and medical staff can be changed by the trainer between training sessions to optimize adaptive skills of the learner. Figure 1 gives an overview of this virtual environment.



**Figure 1.** The Virtual Field Hospital - designed by Reviatech

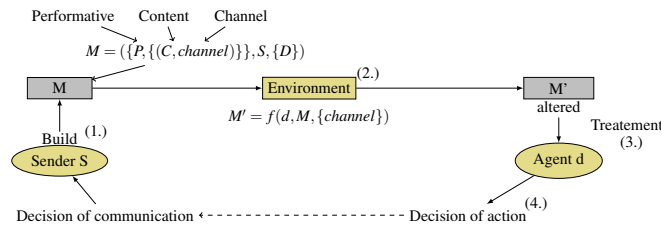
The team leader can interact and move in the room like in a first-person game using a joy pad. A wheel is used to displays the different communication options if the user is facing a character, or actions if the player is facing objects.

In this paper, we focus on the communication between the team members: [4] has proven that it is a very important skill for teamwork.

## 2.2. Communication

Research in MAS and Artificial Intelligence (AI) has proposed several models for communication. The FIPA-ACL model [3], is now widely used for agent coordination. One important property of AI model is that the illocutionary act (what is said in the message) is equal to the perlocutionary act (what is understood by the receiver), which ensures a correct and reliable global behaviour in the MAS. The originality of our research is to consider situations in which agents do not understand each other correctly, because of the stressful condition of their activity.

We have designed a new communication architecture to reproduce communication errors in an agent team. This model is based on both field observation (conducted by ergonomist) and on psychological study about stress, behaviour, critical situation, leadership and teamwork [5,2].



**Figure 2.** Overview of the communication model

This model, presented on figure 2, relies on two major ideas:

First, to support misinterpretation, and based on the idea proposed by [1,2], each message is composed of several (*Performative, Content*) couples – instead of one in classical agent communication languages:

Message = ( $\{ \text{Meaning} \}$ , Sender,  $\{ \text{Addressees} \}$ ), where  
Meaning = (Performative,  $\{ (\text{content}, \text{channel}) \}$ ).

When the receiver intercepts the message, he might not select the initial meaning.

Second, communication errors can appear *at four different stages* of the process. Each of the 4 stages of message transport correspond to different processing functions. While we cannot present all of them here, we can briefly show the difficulty they arise:

1. The alternative meanings have to be built automatically, based on a domain ontology and expert rules for message transformation.
2. The message has to be send to all agents within range of the sender, and altered differently for each agents, depending on the state of the channel between receiver and sender.
3. Agents can ignore a message or ask for a clearer one, depending on their stress and the degree of alteration of the message. We use the following polynomial to compute the probability that a message is accepted:  
 $0.625s^2 - 1.55d + 0.125s + 0.95d + 0.04$ , where  $s$  is the receiver's stress level (between 0 and 1) and  $d$  is the message alteration.
4. The receiver must correct the message using its domain ontology and its current task model. This part is still worked on.

This communication model has been implemented and a preliminary experiment has been conducted to evaluate the impact on the agent's behaviour. Another experiment with the complete simulator is to be conducted soon.

### 3. Summary and Future Work

The VICTEAMS project's system is a virtual environment for training non-technical skills, based on multi-agent systems. Our work focused on the communication in the team, which is a very important skill for teamwork [4]. Our next steps are to evaluate this communication mechanism in the complete simulation, and especially the impact of the communication behaviour on the team leader's non-technical skills training. We also want to integrate collective tasks in our systems, by developing a decision model for collective behaviour and teamwork supporting erroneous communications and partial knowledge of the situation by each agent.

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