Evaluation of Conversational Agents: Mariá and ET*

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Abstract: This paper describes ET and Mariá, two conversational agents with different characteristics. Mariá presents a more realistic character; however she is not an interactive agent, since she only provides short movies with predefined questions and animations. ET is an interactive agent, which can recognize keywords (in Portuguese) and visual react emotionally and textually. We describe the development of those agents as well as results obtained with interaction with subjects. We also present details about MECA, the system we developed to Model Embodied Conversational Agents. Our contribution is the comparison, from the educational point of view, of learning aspects in subjects which interact with two communicative agents. Results show that interactivity has great impact in people learning process.
Key words: Conversational agents, interaction, recognize keywords and visual react emotionally and textually.

Resumen: Este artículo describe ET y Mariá, dos agentes conversacionales con diferentes características. Mariá presenta un carácter más realista, sin embargo no es un agente interactivo ya que sólo proporciona videos cortos con animaciones y preguntas predefinidas. ET es un agente interactivo que puede reconocer palabras clave (en Portugués) y reaccionar emocional y textualmente de forma visual. Aquí describimos el desarrollo de estos agentes y los resultados obtenidos al interactuar con sujetos. También presentamos algunos detalles sobre MECA (Model Embodied Conversational Agents), sistema que hemos desarrollado para modelar estos agentes conversacionales. Nuestra contribución es la comparación, desde el punto de vista educativo, de los aspectos de aprendizaje en sujetos que interactúan con dos agentes comunicativos. Los resultados muestran que la interactividad tiene un gran impacto sobre el proceso de aprendizaje humano.
Key words: Agentes conversacionales, interacción, reconocimiento de palabras clave y reacción emocional y textual de forma visual.

1. Introduction

From imaginary friends to the most advanced artificial intelligence robots, the idea of representing the human behavior means to realize a paradigm of rational and irrational attitude. Indeed, it is comparable to a speaker in front of an audience, where sometimes certain ideas can be transmitted

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through single body postures with no need of words. The Embodied Conversational Agent (ECA) (Cassel, 2000) is a specific type of synthetic autonomous agent that aims to establish friendly dialogues with the user, enough to be utilized as system interfaces, entertainment applications or computer aided professional and teaching tools.

This paper presents Mariá and ET, two different conversational agents (see figures 1 and 2). Mariá is a more realistic character in the visual point of view; however, she is not interactive since she is presented through the exhibition of short movies (see figure 3).

Figure 1. Snapshot of Mariá

On the other hand, ET is a very simple character, it is not human, but it provides interaction with the users. Besides, ET changes humor as a function of the established user–dialogue. MECA System (Schlemmer, Garrido and Musse, 2005) was used to develop ET and is also described in this paper.

Figure 2. Snapshot of ET

The methodology used for this analysis consists in a qualitative evaluation performed by fifty (50) students (Human Sciences courses) during a dialogue established between them and the conversational agents. For Mariá, the experience was a visit to its

website; for ET, students executed MECA and interacted with the agent. By means of a questionnaire students described their sensorial perceptions, representations, psychological relationships (established with agents) and some information about esthetic and cultural traces.
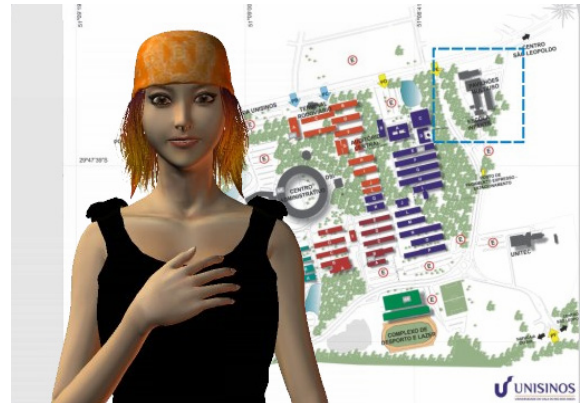

Figure 3. Mariá shows the location of a future student dormitory at University

This paper presents some discussion and the results obtained within this experience. In next section we describe further details about perception and learning process referred to our work.

2. State of the Art: Communicative Virtual Agents

Since Maes (1994) the Interface Agents are figures that collaborate with users in the same work environment. According to Ball et al. (1997), the evolution in the virtual scene start an important and necessary relation in this cooperation characterized through human images. Some authors like Klesen (2005), Hayes–Roth and Doyle (1998) and Biswas et al. (2005) wrote about this issue.

Nowadays, many virtual agents (chatterbots) interact with humans (users) in the internet through natural language communication mechanisms promoting a more real and direct approch and therefore more specific. Some well known agents are ALICE (Wallace, 2006), ELIZA (Weizembaum, 1966), Sete Zoom (SeteZoom, 2006) and Cybelle (Agentland, 2006). Besides, the Microsoft animated agents (MSAgent 2006) are ready components that contain programmable sources easy to create agent

applications to the agent, Reategui and Moraes (2006).

Gebhard et al. (2004) emphasize the relevance of the interaction (conversation) between animated agents and users; they highligthed the new possibilities of conveying information to the users by working on beliefs and mainly developing and showing emotions. Actually, it means the interaction, and therefore the communication, as an effective way to develop the approaching between real and virtual worlds.

3. Learning Process

Piaget deals with perception providing two divisions: *perception theory* –which establishes a probabilistic model of how perception works from encouraging elements; and the *theory about perceptio,* –which is an overview of perception and its development, basically its relationship with intelligence.

For Piaget, knowledge is not a copy of the reality, so he does not base the origin of the intelligence just on perception, which breaks with empiricist tradition *"Intelligence comes from action in its whole insofar as changes objects and the real, and ... knowledge ... is basically an active and operant assimilation"* (Piaget & Inhelder, 1993, p. 30). The authors state that in addition to feelings and reason in mental life, action significance should not be overlooked: *"perception actually is a particular instance of sensorial and motor activities"* (p. 30), closely related with the subject's activity, so it is not a simple portrait of the subject because it is intelligence–driven, i.e. *"perceptive activities develop with age until they can adapt to guidelines which intelligence in its operant progress"* (p. 40). Content and development of an idea do not originate from perception, as empiricism tells us, nor do they necessarily follow it. Its structuring occurs with nonperceptive contents, but coming from action or operations. *"The development for an idea could not dispense with these nonperceptive elements, once perception only provides ... snapshots of this or that standpoint, which is the subject's one in a given moment, while the idea implies coordination of all standpoints and understanding the changes leading from one standpoint to another one"* (p. 42). This coordination presupposes a subject's activity is not

originated from perceptive information, but perception itself is guided by it.

Piaget tells us that representation is an extended perception he understands as from feelings coming from the subject–environment interaction to conscious constructs these subjects product from their experiences, memories and mental schemes. Thus perception is not a set of feelings, but a composition of feelings that needs subject's action on the object, which responds to the subject. Every perception and representation implies an abstraction, which may occur in different levels, i.e., it may come from empirical abstraction processes or reflective abstraction processes. For Piaget (1995) in Schlemmer (2002), every new piece of knowledge implies abstraction. Abstracting in the wide sense is differing, separating a trace, means isolating any traces because of others. Abstraction may be empirical or reflective.

The *empirical abstraction* is purely descriptive, it refers to what is immediately testified, is everything the subject takes out straightly from what is observable. However, it is important to remember that for Piaget a subject needs to have incorporating tools, so that he/she may abstract the object's qualities with meaning for him/her. The subject needs to make connections, and these come out from sensorial and motor or conceptual schemes the subject had previously constructed and which are not object–given. These schemes are necessary for the empirical abstraction, but the latter does not refer to the former but rather looks for the content (external information) framed in shapes (that will enable capturing the content) through the schemes. *"From particular concepts (which are the product of previous–leveled reflexive abstractions), and by an empirical abstraction process, particular qualities on which new concepts are constructed to be straightly applied to a particular master of reality, are identified"* (Piaget & Garcia, 1987, 192–3).

The *reflecting abstraction* rests on coordinating actions or operations (so, on the subject's activity). Whenever the object is modified by the subject's actions and informed by qualities from his/her coordination, the subject conducts a "pseudo–empirical" abstraction. This needs to have the object as a support, and relationships are given from actions

on the object, i.e. it is all the subject takes out from the non–observable, showing something that would not exist before performing the action. In other words, qualities do not exist in objects, but the subject invents the relationship and inserts it in the objects. Even if the quality is observable at present, as in the empirical abstraction, the subject's testifying is produced by coordinating his actions. So it is a particular case of reflective abstraction. Thus, when the result of a reflective abstraction becomes conscious (i.e. there is conscience taking of the novel reasoning tools used), regardless of its level, we have *"reflected"* abstraction. The reflected abstraction rests on the subject's cognitive activities and ways (action schemes or coordination, operations, etc.), where he/she takes out something for other situations (new adaptations, problems, etc.). In other words, the reflected abstraction is the result of a reflecting abstraction in which the subject takes conscience of the relationships he/she conducted; so there are reflections of reflections. In this case, the reflection is this conscience taking and a formalizing possibility.

In the reflective abstraction, reflectiveness and reflection are present. They are inseparable, complementary aspects; they are always together and appear in almost all stages of human development. Reflectiveness is the projecting (like in a projector) what was taken out from a lower level onto an upper level (e.g. from action to representation). Reflection is cognitive reconstructing or reorganizing what was transferred, enabling informing the knowledge taken out. *"…It is necessary to specify that this abstraction does not confine to a set of hierarchical levels whose formation would be strange: it fabricates them by way of interactions for conversion and reflection…"* (Piaget, 1985, p. 39 in Schlemmer, 2002, p. 55).

When we speak of perception and representation, we always talk about its relationship with the subject who perceives and represents, and who Maturana and Varela call observer (not in the sense that someone who observes a phenomenon from outside, but rather an active observer). In these theorists' conception every explanation is conducted by a phenomenon observer, so that all that is said is told by an observer, and the differentiating operation is a basic cognitive one we conduct as an observer. The act of describing a phenomenon, that is, representing it, creates a novel phenomenological field. These authors call on us to

consider Knowledge as an action, and they say that

> *"From the perspective of the descriptive meta–field, a distinction between a unit characterization and an observer's knowledge that allows him/her to describe it in its context must be clear. Actually, knowledge always implies a concrete or conceptual action in some field, and recognizing this knowledge always implies an observer contemplating a meta–field."* (Maturana, 1980, p. 22).

Every unity or system has an *organization* that is a set of relationships necessarily present in the system and shaping its existence. But the set of effective relationships among components in a concrete machine in a given space are its *structure*.

Every living organism is disturbed (not shaped) by its environment, and these affections are read and follow some internal balance mechanism. These internal changes are the cornerstone. *Disturbance* does not specify the agent; does not take into account the effects on the unity structure; is not an integral part in shaping the unity, although it may be connected to it. Disturbance may occur in numerous ways.

> *"In interactions between living beings and the environment in the structural congruence, environment disturbance does not shape what happens to the living being; on the contrary, the living being's structure that will shape what will happen with it. …In this sense we referred to the fact that changes coming from interaction between living beings and their environment are caused by disturbing agents, but shaped by the disturbed system's structure."* (Maturana, 1992, p.96).

Every organism's existence begins as a cell, which has particular initial structures, and this initial structure comes from phylogeny's history. To continue the body's historicity, let's construct another story through our life experiences in the society where we live. The human body has the same organization as that of living beings, but, with a different structure, it owns singularity insofar as it interacts with their surroundings. The history of changes in an organism in interaction with the environment, that is, ontogeny is called structural course.

> *"In this, the occurring structural changes are contingents with environment interactions. They are not shaped by the environment*

circumstances, but rather with them because environment only unleashes structural changes in the living being. And vice–versa: the environment changes in a contingent way by interactions with the organism."

(Maturana, 2001, p.82).

Formed by a molecular dynamics, the body organizes and reorganizes itself according to what the environment stirs it to do, according to people and society we live with, and the body is also a disturbing agent, changing them. This circularity between body and world also widens our understanding of cognition by way of perception studies. Maturana and Varela (1997) consider the nervous system a closed circuit[1], i.e. working as a closed network of changeable relationships of activity. Thus, the organism and nervous system are in different fields interacting through sensorial and effector elements. And as the organism interacts with environment through structural coupling, the nervous system creates sensorial and effector correlations giving rise to the behavior. Thus we see how the interaction between organism, environment and culture occurs, which makes us note that, while the organism is autonomous, it keeps dependence on the surroundings.

Maturana and Varela tell us that the nervous system and brain do not work as a computer because the nervous system does not "collect" information from the environment and "deals with" it, and there is no representation of the outside world in animal's or man's brain. But the nervous system is an operationally closed system, structurally shaped, with no input and output, that is, it works as an autonomous system. So, results from the system operations are its very operations. "*Whenever it tries to search the root of a perception it faces something like 'a perception of a perception of a perception'...*" (Varela, 1989, p. 29). So perception is a balance system the nervous system uses during an interaction.

In this perspective, Maturana and Varela (1997) disagree from what is normally proclaimed by Neurophysiology and Psychology grounded on classical assumptions on the fact that perception

phenomenon is implied as a capturing operation in an external reality by a process of receiving reality information. For these authors, learning is changing that occurs in the set of possible states in the nervous system. Thus learning is not a process of accumulating environment representations, but rather a continuing process of structural change an organism may undergo because of its autopoiesis conservation.

When Maturana and Varela (1997) critique representation as accountable for the cognitive phenomenon, they want to substitute for the input–output notion, which describes the organism as a processing of information, which is the basis for the mainstream thought. In support of this, they propose, by the historical reciprocity, a new definition to show interaction between an autonomous system and its environment, calling it enation[2].

Enation displaces the role of representation by observing that knowledge is incorporated, that is, it refers to the fact that we are bodies, with a host of sensorial–motor possibilities, immersed in multiple contexts. Enation emphasizes on knowledge existential dimension, coming out from corporeity. Cognition depends on experience occurring in the corporal action. This action is linked with sensorial–motor capacities involved in the biopsychocultural context. The word means that sensorial–motor processes, perception and action are basically inseparable from cognition.

In this investigation, some subjects, during the interaction with ET and Mariá, perceive and represent this interaction through processes of empirical abstraction that consist in an abstraction merely descriptive, referring at an immediate establishment; it is all information the subject could extract directly from the observation. However, it is relevant to remind that, according to Piaget, in order to abstract the properties of an object, the subject needs (firstly) instruments of assimilation; it really means to have "a meaning" for him/her. The subject needs to establish relations and theses come from sensorial–motor or conceptual schemes constructed before the abstraction and are not given by object. In next section, we discuss the methodology and some results obtained in this work.

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[1] *For the nervous system working, when it is considered closed, there is no inside or outside, only its own correlations, which are in constant change, are kept (Maturana e Varela, 2001).*

[2] *This word (Maturana e Varela, 1997) is a neologism used to bring up, causing to emerge.*

4. Experimental Results

Here we show the questions mentioned to subjects in order to verify their empirical abstraction during the experiment:

1. Representation of the physical environment;
2. Physical representation of the agents ET and Mariá;
3. Changes in the physical representation of the ET and Mariá;
4. Description of elements (in general) which called more attention;
5. Description of elements (in general) which called less attention;
6. Suggestions to ET and Mariá.

During the interaction with ET and Mariá, some subjects perceive and represent them from processes of reflexive abstraction (Piaget, 1995), which support actions and operations coordination, i.e. the subject activity. Always when an object is modified by subject actions, it is enriched by the properties extracted from his/her coordination. In other words, the process of reflexive abstraction happens when the subject extracts data which are not explicit in the object. Consequently, after subject's action the object informs, describes information which does not exist before the subject's action. It was evidenced in the following users' questions:

1. Feelings about the interaction with the agents;
2. Relations established with the agents;
3. Questions of memories, experiences, interest;
4. Differences perceived between human–human conversations and human–ECA conversations
5. How subjects' ideas concerning ECAs could be used in educational processes to contribute to the learning.

4.1. Conversational Agent – Mariá

Analyzing answers subjects gave to questions concerning the interaction with the conversational agent Mariá, we have found that some subjects perceive and represent this interaction from empirical abstraction processes (purely descriptive, referring to

immediate testifying; –all the subject takes out straightly from the observable).

It was evinced in relation to issues concerning:

- Representation of the "physical" environment.
  (– She is in a very colorful environment with varied images.)

- Mariá's physical representation.
  (– She is pretty, and young and funny looking.)

- Changes in Mariá's physical representation.
  (– Maybe her hair color; – I would change her hair color into black; – I would change her breasts; – Her hair; – maybe her voice; – Nothing.)

- Elements that most attracted attention.
  (– Mariá's presentation, her photo session, and places where she "traveled"; – Colors used in the page and for Mariá; – Everything in her attracted my attention; – The way she speaks is great!; – The environment and where you find her is very colorful, shots are wonderful, at last the whole scenery was nicely worked; – The possibility to see and hear what people speak; – Mariá's photos are very nice; – I liked her set of photos, she is much in nature; – What most attracted my attention were her photos in the beautiful landscape.)

- Elements that least attracted attention.
  (– Photos where Mariá stood very far away; – I like all of them; – None of them because as I said before I found all of them interesting; – All elements attracted my attention because is something very nice; – I found not at all; – Photos where she's alone; – I like all of them, but I think there could be more; – The very Mariá that looks like a dummy; – I could not speak with Mariá.)

When interacting with conversational agent Mariá, other subjects perceive and represent that interaction from reflective abstraction processes (which rest on action or operation coordination, therefore, the subject's activity).

It was evinced in relation to issues concerning:

- Representation of the "physical" environment.
  (– The physical environment is well established because it allows one to quickly navigate through the environmen; – Very strange, it looks like she is looking at me and knows who I am; – Interesting it

seems that she's really talking to whomever connects with her. It's a very up–to–date environment.)

- Mariá's physical representation.
(– Physically, Mariá was well constructed; – Her physical representation is that of a perfect woman; – Very interesting, because she's got all qualities of a beautiful intelligent woman; – Sensual; – Very interesting the way Weber speaks; – She looks like a doll. She's got too a perfect body, in the beauty patterns cultured by media, which is too logic. If she was a black woman, or with somewhat less "curves", she would look like more real. Her hair is beautiful, her clothes are beautiful, but all in that standard of most futile girls. I think she should avoid these received beauty patterns… She's a modern girl in a poster girl style with a slim body.)

- Changes in Mariá's physical representation.
(– None, she's very real!; – I would change her face, I think it's somewhat artificial, she looks like a doll, she's Barbie–like. I would make her black or a little fat. Most people find boring seeing these girls and dolls that look like a Barbie.)

- How did you feel your interaction with Mariá, what relationships did you establish?
(– Curious; – It was interesting and different to interact, a novel way to work; – I didn't speak with her, only she interacted with me, in this talk I found her gesture very natural, she's very communicative; – A real friendship; – I liked it… she's nice, she's friendly; – Very good, it's novel for me and I liked it; – I'm satisfied and surprised because I had never seen someone speaking with me on the screen. She looks like a teenager. She seems to be enchanted with the world; – There was no interaction!!! The only thing that happened was her talking, conveying information she wanted to convey, and me to receive. She didn't know what I wanted to know, only what she wanted to convey; – I found it a little strange because she seems very artificial concerning other people and even the physical environment. I had a relation of playfulness, where we can imagine and create on this character; – I still find it a little strange to interact with the machine.)

- Elements that most attracted attention.
(– I found her physical environment very interesting, the way she communicates is also very

expressive and her physical appearance also attracts attention because she has a wonderful body. The fusion between reality and fiction, the environment esthetic quality; – What attracted my attention was seeing that this playfulness is present for adults to interact with conversational agents in a completely virtual world. I hadn't ever imagined that at college there was such a kind of communication. The introduction, whereby Mariá interacts with the surfer; – The possibilities for interaction by way of technology.)

- Elements that least attracted attention.
(– I'd like to further interact with the character.– I enjoyed this experience because for me it was novel, I was afraid in the beginning; – We cannot be talking to her, so I wonder if we only listen to and see, is it really an interaction? For I believe that, for an interaction, both parties should be communicating.)

- Has Maria aroused any interest?

- Differences you see in interaction among humans and between humans and conversational agents.

- Suggestions you would give to Maria.

- How do you believe conversational agents could be used in educational processes to contribute to the learning?

4.2. Conversational Agent – ET

Analyzing the answers subjects gave to questions concerning perception and representation when interacting with the conversational agent MECA, we have found that some subjects perceive and represent this interaction from empirical abstraction processes (purely descriptive, referring to immediate testifying; –all the subjects take out straightly from the observable)

It was evinced in relation to issues concerning:

- Representation of the "physical" environment.
(– black screen with a colored cube; – quite colored; – only him and the cube; – it could be further colored.)

- The ET's "physical" representation
(– very ugly, he keeps jumping up and down; – doesn't speak; – jumps all the time.)

- Changes in the ET's physical representation
  (– making him to speak; – I would change his hands; – eyes and head; – I would make his eyes smaller, I would wear him with another dress; – I would wear him with another dress and a cap; – I would make him a little taller; – the clothes.)

- Changes in physical representation.
  (– Instead of the cube I would place a skateboard, a wall in the background with graffiti about ETs.)

- Elements that most attracted attention.
  (– don't change the square; – colored cube; – he may move all the time; – the cube beside the conversational agent, the way the cube is moving attracted my attention; – the ET; – his movements, because he doesn't stop;– the ET's eyes and colors.)

- Elements that least attracted attention.
  (– Except the ET, the environment is not attractive; – the screen and clothes color; – physical environment and where he was; – the cube beside the ET; – the drawing beside the ET; – the background environment where he was.)

- Suggestions for the ET.
  (– don't move so much. He should be better worn, is unfashionable, doesn't need to be in the latest fashion, but short, tennis shoe, T–shirt and cap would be nice; – I would suggest them to change his environment, leave the that place, I find him as he's locked; – having a funnier face; – 0 improve his looking.)

Other subjects when in interaction with conversational agent MECA perceive and represent that interaction from reflective abstraction processes, –which rests on action or operation coordination, therefore, the subject's activity.

It was evinced in relation to issues concerning:

- Representation of the "physical" environment.
  (– environment as boring, little attractive; – somewhat confusing; – very ugly; – I didn't like it; – I enjoyed that I could move it and make it stop of jumping; – somewhat strange, morbid; – mysterious and funny; – graceless, ugly; – something very different, there's interactivity; – spatial.)

- The ET's "physical" representation.

(– seems to be crazy; – unquiet; – physically he represents the probable figure of an ET; – nice, unquiet; – could be improved, more handsome; – very ugly; – somewhat hostile, but I like him rather than Mariá; – he's different, doesn't follow that standard model of beauty, he's nice; – very similar to those TV ETs, of the films, kind; – he's handsome, but suspicious– looking; – I found him funny; – he's like an actual ET; – he's very ugly, his appearance must be improved; – presentable.)

- Changes in the ET's physical representation.
  (– a friendlier look; – somewhat more intelligent, more smiling.)

- Changes in the environment physical representation.
  (– I would change its environment.)

- How did you feel your interaction with the ET, what relationships did you establish?
  (– anger, he was provoking me all the time, it was a relation of encouragement I responded all the time, many things he didn't understand, he's boring; – he didn't allow any kind of interaction because he didn't understand what I asked him; – I didn't like him because he didn't answer my questions; – somewhat confusing, for sometimes he answered that he could not understand; – I felt powerless because he doesn't follow our language, even if you speak in good Portuguese he insists on failing to understand; – I liked him, he's limited, doesn't answer all questions, but he disputes, even though he can't understand our answers; – I felt awkward, I could not speak with him, but when he understood my name, it was nice; – it was nice but we didn't have a good conversation, because he couldn't answer my questions, he only wanted to talk about the library; – I had to stop and think how to make the correct question, so that he could answer; – I didn't like him very much, because questions he can't understand. It even becomes funny as we tried and tried…, I made all kinds of questions to see if he would answer any one. I felt awkward as I couldn't interact with him in the beginning; – he still has some limitations, as he can't understand questions. Relation? I got angry, because I found him boring; – I don't feel comfortable yet.)

- Elements that most attracted attention.

(– possibility to interact; – he looks like as being mocking at me, all the time jumping up and down, turning somersaults, he's childish; – ET's bad humor and arrogance, he annoyed by the fact that he didn't wanna communicate; – he only answers to what he's interested in and this causes anger, because I'd like to talk with him; – I liked him because he's somewhat insolent, I think his interaction attracts attention, it's not that perfect educated scheme, I like him; – he can talk with us, although I felt stupid as I couldn't have a dialog with him.)

- Elements that least attracted attention.
(– He really looks like an ET, face and all; – none; – I'd like him to talk with us really; – I liked everything, I found him nice and I think he's still in construction; – every element attracted attention.)

- What was significant for you in your talk with the ET?
(– There was few time, it was just a talk to know, and knowing him was significant; – when I called him stupid, he said he had liked it, he would rather be called stupid than by my name; – there was no talk, I even tried to communicate with him but he couldn't understand the language I was using; – most significant was when he recognized me; – some answers he gave; – significant was the fact that there was no talk, all can say is that he can't speak our language, so there was no communication; – he's quite old–fashioned. Very limited, he can only answer some questions; – he was ready to help me; – I noted he likes to tell the right thing, we have to know how to say things correctly so that he can understand us; – it was a funny activity, with no great compromise; – talk is boring because he can't understand anything; – I felt angry because he asked many times the same thing.)

- Has the ET aroused any interest?
(– Sure, but he couldn't understand what I was saying; – what does he do, what he was designed to for our learning?; – none, because there was no interaction; – no; – sure, to deal with his system, putting in more information with new ideas; – all he aroused in me was anxiety, anger, for he didn't wanna be my friend; – I'd like to talk with him but I think I will have wait 'til he learns to speak Portuguese, so that I don't get angry with him; – I'd like to have further explored his help; – I'd like to

know more about him, how he was created and why does he have these physical features; – interest in getting to make him to answer at least one question; – he's something that is interactive, because he aroused many feelings.)

- Differences you see in interaction among humans and between humans and conversational agents.
(– it was distressing that he couldn't understand what I was saying; – this conversational agent is very boring and hostile; – even moody, people communicate; – humans interact with one another agents communicate; – humans interact with one another, but agents communicate when we enter their environment; – among humans there is communication, even when we don't understand the other's language; – in a way we try to communicate, and among virtual agents there is no communication, because if he says he doesn't understand, there is no dialog; – there is much limitation in interaction with conversational agents, with some of them, there's no interaction. They're programmed to do particular things, while humans are always innovating and updated; – humans create dialogs with humans, and humans have a programmed dialog with agents, because the agent understood only what he was programmed to answer; – In human interactions, I see that even when the subject fails to express well we can give him an answer, but with the conversational agents it's more limited. They often upset the dialog (interaction); – among people the share of knowledge is mutual; – humans communicate, and among conversational agents there is not such an interaction with humans; – here there was interaction, because the conversational agent aroused in me some singular questions concerning feelings.)

- Suggestions you would give to the ET.
(– learning to speak Portuguese; – being friendly, answering all our questions, for us to improve our interaction; – he could talk, recognize the Portuguese language and be friendlier and more responsive; – he could answer the questions made; – being friendlier and more handsome; – opening up his possibilities of answers, taking into consideration the various ways of questioning; – he could be designed to answer at least some of our questions; – improving his limitations concerning language, because he's too boring in this way.)

Eliane Schlemmer, Susane Garrido, Soraia Raupp Musse

- How do you believe conversational agents could be used in educational processes to contribute to the learning?

(– I believe the greatest contribution is in terms of interaction, in which the student is no longer a receiver and plays an important role in the process; – in an interactive way: we with the machine, and it with us; – there's no way to work with ET, because he does not recognizes even the language we speak; – I think the way it was created will be a success for learning, because it's an inventive way to teach, and everything that is novel is worth delving into; – if there were sites for classes with virtual teachers for students across the ages; – always interacting with learners, so that these may make and answer questions; – so that they [conversational agents] interact with subjects, helping in significant learning; – providing for teacher and student with novel ideas to construct fresh information; – working with children's motor coordination, conversational agents are interesting because they rouse people's curiosity and interest; – because there'll be a way to interact, a way to share, in spite of the difficulty to talk with the agent; – This conversational agent can help in the process of learning, because it's interactive and funny and so kids will enjoy using it as a tool for helping in learning. Because it's something that attracts attention of humans and arouses feelings concerning the ET.)

The most important differentiation found in this investigation, if we compare both ECAs, consists in the communication attributes. Concerning ET, even if he is much less realistic than Mariá, the communication attribute composed of immediate interaction using written language, expressions changing and humor fluctuation result in a better interaction with the subject. On the other hand, Mariá does not present this attribute, and consequently does not reflect the interaction aspects if compared with ET. Considering perception and representation, aspects of communication and language reflected intensively in the cognitive construction of the subjects, altering these same subjects in different ways.

Most people who interacted with ET could abstract in a reflexive way. The opposite happened with Mariá. It means that even though Mariá is visually much more realistic than ET, the perception and

communication process established during the interactions with ET (figure 4) were much more efficient in the process of mental representation. The subjects' considerations about Mariá describe much more the physical context of the agent. Consequently, people preferred to interact to ET than to Mariá.

Figure 4. Snapshots of Mariá

5. Mariá as a tool in the Learning Virtual Environment; – AVA– UNISINOS

AVA–UNISINOS[3] was developed from a Conversational Teaching Project–PPC[4] with the philosophical institutional assumption, Christian Socialist Humanism, expressed in the Ignatian pedagogy, the interactionist constructivist systemic conception as an epistemological assumption, and dialogicity, interdisciplinarity and transdisciplinarity as teaching assumptions.

This environment allows for creating communities and micro– communities, subsystems which are interconnected and interdependent, making up systems in which the whole is larger that the parts

[3] AVA is free for educational institutions. It has accepted around 172 download orders from public, private and non-governmental elementary schools, high schools and institutions of higher education in Brazil and abroad. At present, it has 12,000 users, 150 active communities and 80 teacher educators in the University. In the scientific production, it has given rise to 3 researches, 3 doctoral theses, 1 master's dissertation, 2 book chapters, 3 graduate course conclusion works, more than 50 articles in journals and (national and international) events; and many lectures. AVA allows English, Spanish and Portuguese interaction.

[4] See Schlemmer (2002)

which knowledge is seen as an integrated whole, and the key traces come from relationships and interactions among the parties making up a net. Communities are made up by shared interests, and the subject is central to the learning process in interaction with knowledge objects and the other subjects.

AVA's interface was constructed to allow for Mutual Interaction[5] and is constituted by different elements, such as: Tutorial, Information, Services (agenda, virtualteca, glossary, FAQ, contact, quantitative report, qualitative report), Communication (mural, forum, mail, chat), Collective Webfolio (orientation, assessment, challenges, cases, problems, projects, workshops, files), and Individual Webfolio (diaries, files).

Based on the above assumptions, AVA's design provides and encourages development of methodologies aiming at constructing nets of living and solidarity establishment. They are novel ways of

living together in symbolic, functional and cognitive dimensions maintained by autonomy and cooperation relationships. So we believe that possibilities found at AVA may encourage a rethinking of current teaching practices and development of inventive teaching practices. Among them we can cite the methodology of Learning Projects and Identification and Resolution of Process–Oriented Problems.

Late in 2004 we have forwarded at UNIVERSAL/CNPq a research project consisting of integrating the Conversational Agent Mariá into the Learning Virtual Environment–AVA-UNISINOS (http://www.unisinos.br/ava), most specifically in the context of the Environment Tutorial. This project was approved, and Mariá was adapted to guide AVA-UNISINOS users trough some tools with the greatest number of usage doubts and problems. The aim was to investigate, from the above theoretical reference, how perception and representation occurred in the AVA subjects' interaction with Maria.
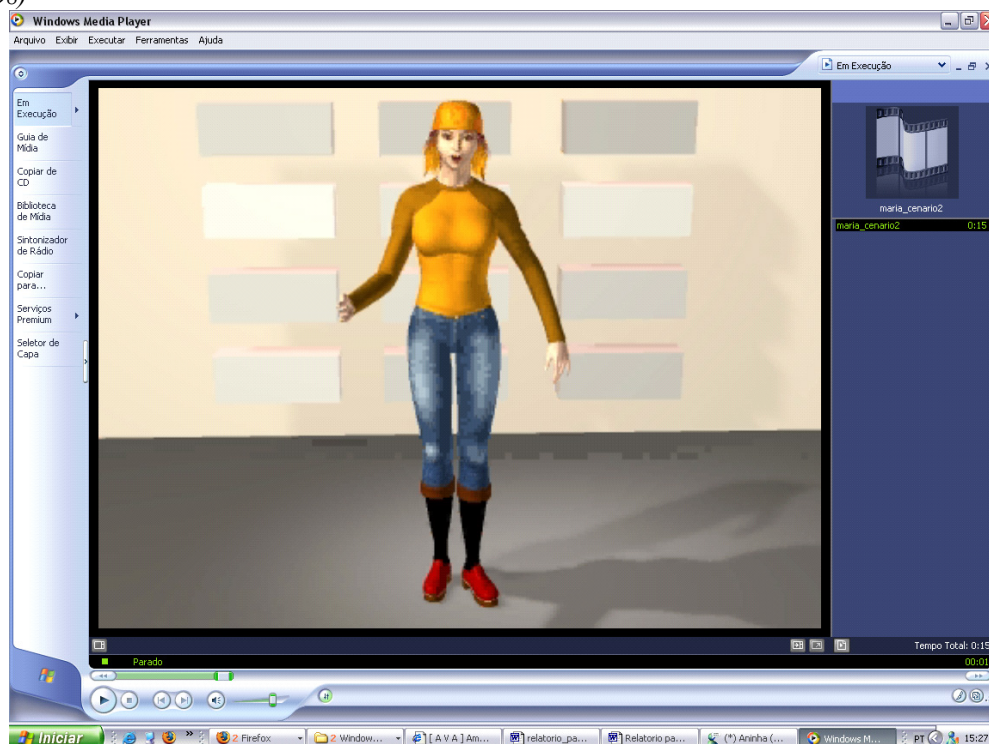
[5] *See Primo (1998)*

Figure 5. Original Video of conversational agent Mariá, by the Cromos laboratory team

Conversational agent Mariá is graphically represented as "a graduate student", "digital virtual colleague", who acts through Web application. It was designed in

the Strategical Planning field (2003 PLANEST) by an interdisciplinary team initially aiming at interacting with the academic community about changes in the

campus physical structure, which would be implemented first in a digital virtual way.

Now Mariá is used in different contexts, particularly in research. For this, some aspects, such as visual appearance, character's traces, her personality parameters, etc., have been carefully defined. However, new possibilities have been discerned, particularly concerning her usage in teaching and learning processes. At present, our interest is to integrate her into AVA-UNISINOS, using her to introduce the environment, providing information about it for the user and guiding him/her in the use of specific tools, to expand significantly the existing tutorial and, basically, to investigate what this kind of interaction, which is not only textual and "impersonal", may represent in terms of learning in using the environment.

Figure 6. Video produced to integrate Maria into AVA–UNISINOS

Mariá's integration process into AVA-UNISINOS started late in 2005 and involved the Research Group and AVA-UNISINOS technological development team (figure 6). One of the first decisions was to select the level and place for Mariá's "presence" in the environment. In this stage a chart for the interaction between research subjects (students/users) and the agent was made. Later, a set of sentences Mariá would use to cater for the user needs was organized, using as a reference the tutorial and most frequent doubts in using AVA–UNISINOS. The next stage was the development of the face and phonetic animation using keyframes. In every keyframe, the

3D model face is changed to represent a particular phoneme from the desired speech. The software is inserted in the keyframes creating animation that will represent a facial movement corresponding to a speech, and simultaneously the audio was recorded. Using the editing software, we have integrated the audio into animations, creating final videos that were inserted in AVA-UNISINOS. We have used graphical shaping software (Maya) and sound and video edition (Adobe Premier) (figure 5, 7, 8).

This research has involved around 50 graduate students from teaching courses, and currently is in the stage of analysis of data collected by means of questionnaires and signing in diaries.
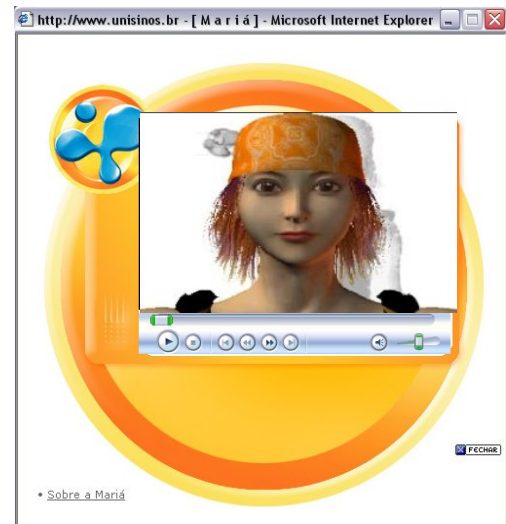

Figure 7. Mariá video played when user asks for help

5. Discussion and Future Work

First interesting consideration in this work was the people abstraction related to each one of agents. First of all, major part of subjects who interacted with ET could abstract in a reflexive way. The opposite happened with Mariá, even if it is much more realistic than ET, in the visual point of view. Also, the perception and communication process established during the interactions with ET were much more efficient in the process of mental representation than with Mariá. Consequently, people preferred to interact to ET than to Mariá.

We conclude that a realistic visual aspect without an efficient interaction does not seem to be a good

strategy to present a kind of information that users should create by means of representations and reflexive abstraction.

As future works, we intend to test more ECAs and ask for more subjects to be investigated in order to enlarge our sample and improve our conclusions. Also, we are interested in using other interactive platforms as discussed by Garrido (2003, 2004) and Schlemmer (2002).
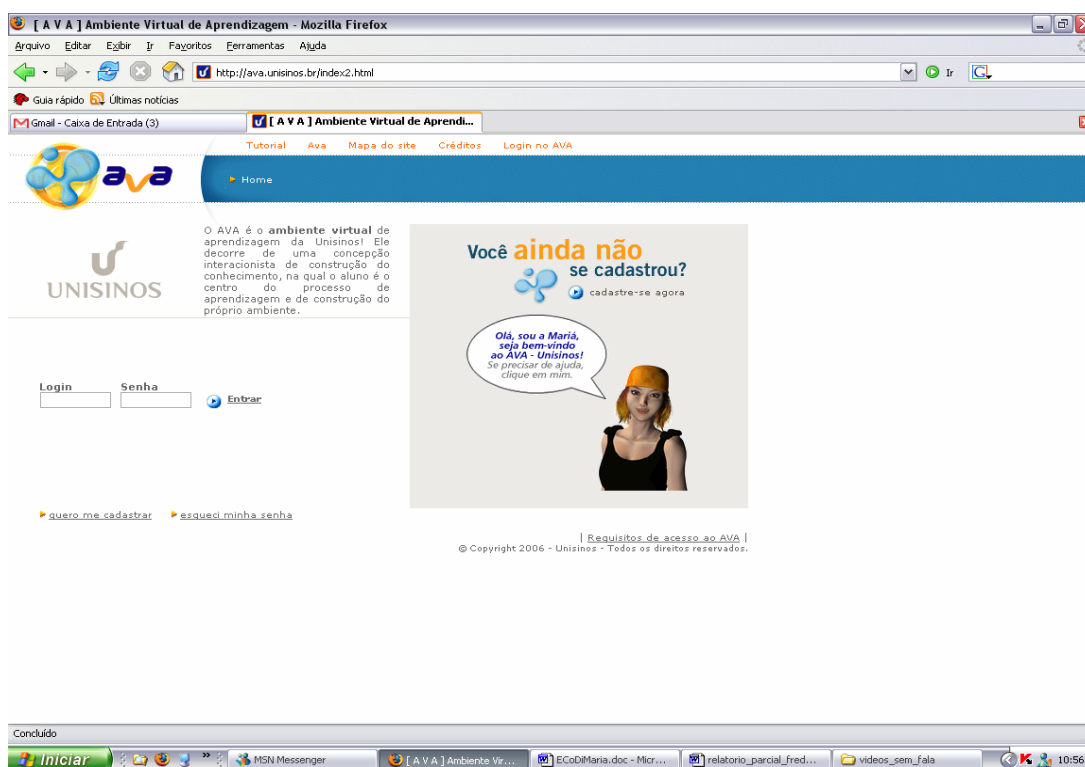

Figure 8. AVA–UNISINOS login screen image

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