Modeling the Learner Preferences for Embodied Agents: Experimenting with the Control of Humor.

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Summary
This research presents a model and an experiment on the integration of personality preferences in support systems for learning. We will present briefly the context of the research on the access to learner and group models, than the theoretical background on personalization of interface and more specifically of the functions of humor in general and how it can be used to integrate affective dimensions in tutoring interaction. This research stems partly from the Reeves and Nass [1] postulate that people will react the same way to a computer mediated interaction, then they do to a real interaction, and thus that their reaction to an humoristic tutor would be generally more positive than to the non-humoristic tutor: the tutor attracts more attention, the perceived usability, social presence and personalization are improved. We will present the design and experimentation of an open model support system, where feedback is given to learners on their progression, but also where preferences for support may be defined. It was experimented under two conditions "with" and "without humor" and qualitative attitudes measures where taken. Though results are only preliminary, this study of the impact of humor suggests various considerations on how personality aspects can be integrated and their impact studied in ITS systems.

Keywords: Personalization, embodied agents, humor, evaluation, distance education.

Context of the research
This research stems from a preoccupation for interface and communication design in ITS especially in the context of distance education, in very open domains of learning. To design appropriate interaction in the context of learning it is necessary to have access to rich tasks and learners models. Thus the majority of ITS models depend on a highly detailed representation of the domain to be learned, where knowledge can be tested at micro level and inference can be made amongst knowledge elements. It is then possible to design natural language understanding, specific explanations or deitic demonstration for a given problem or scene layout. Our challenge was to generalize the principles of support, to make them accessible when the models of the domains are more shallow; when the programming of support has to be done by a professor with no special training. In such context, evaluations cannot be as detailed and more self assessment is necessary to access the learner's model.

The support functions were to be part of a course editor. Principles that could be applied to extract constraints in tasks and to give advice; to present demonstration and suggest content element using a generic editor. In order to enrich the contextual model and also the means of support, we developed a dynamic and adaptive interface in which we experimented various dimensions of personalized support.

ExploraGraph a dynamic interface to support the task and learner models.
The ExploraGraph© Navigator (figure 1) was designed to facilitate the visualization of learning structures, that present task scenarios, knowledge or document structure. A conceptual model, with typed nodes and typed links, is used to simulate the relationships between the elements and organize the global representation to serve as a front to

the course content. The graphs follow a physical model, where links express semantical relations among elements, and which reacts with zoom and fish eye effects when they are explored by the learner (see previous description [2-4]).

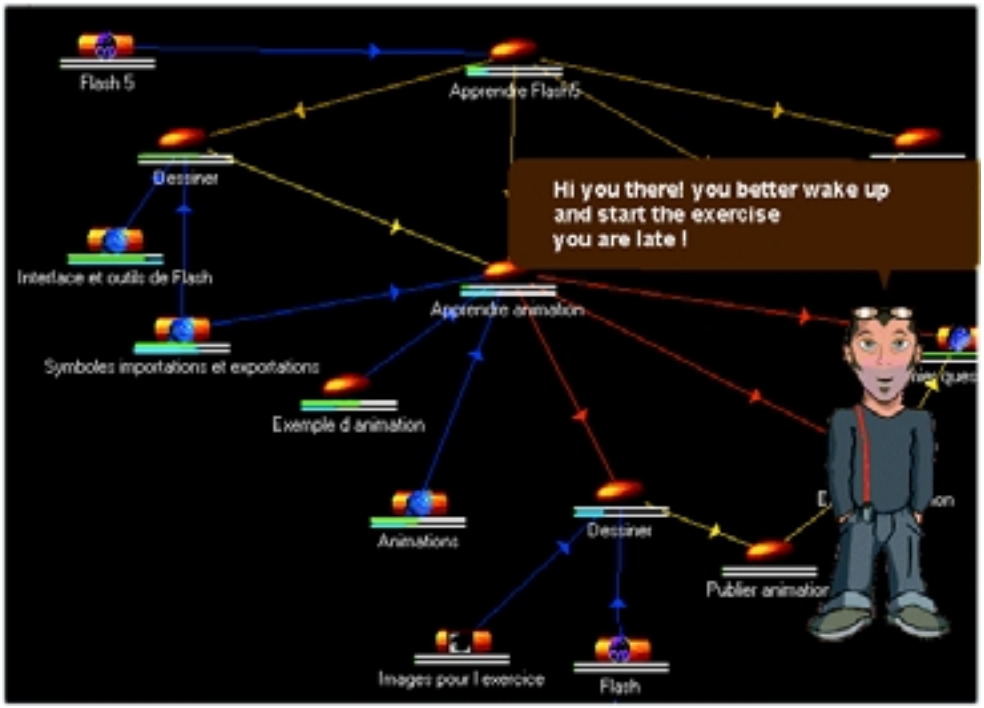

Figure 1 - ExploraGraph© Navigator, showing the graphical structure of activities with individual and group completion levels and the Hacker MsAgent contextual help.

As in other kinds of maps, adaptive annotations were used to give the learners feedback on their progression in the content, how often nodes have been visited. They can also edit their learner model by editing the degree of "completion" for each node displayed in graphs. The learner's model is thus presented as an overlay on the task's model, in structures of activities or concepts, giving feedback to what as been explored (visited), and what the learner consider as being finished. The hierarchy amongst nodes makes it possible to de propagate, both exploration and completion levels in the learner model .

Individual learner models are kept both locally and on a database server, so the learner may access his profile from different computers (e.g. home or university). It is thus possible to compile group models so a feedback can be given on the activity of the class. Feedback on the group of learners [5] can also be used to motivate the learner as a passive feedback or to support more active type of feedback (e.g. " All the others have finished"). Isolation is a problem in distant learning and graphs can become a transparent way to provide learners with information on what is happening to the group. Thus, learners can also display the levels of "visit" and "completion" of fellow learners. The postulate was that this visibility and easy access to learner models and group models would encourage learners to update them, thus improving the information the ITS system was using.

In ExploraGraph©, since graphs are dynamically generated, further adaptive functions may be added, so graphs are contextually arranged in order to cue the learner toward more relevant areas, using zoom functions (this corresponds to Brusilovsky's [6] principle of maps adaptation). Other support functions are included in the environment, like MsAgents avatar animations or messages, control of the environment when the learner specify intentions. Microsoft Agents were introduced in the environment partly "to fulfill the need for social context" when no other learner is on-line, but also to serve as the interface to the advisory system. They are driven by the rule-based support system as defined in the database.

We evaluated a first version of the system with 9 learners over a 6-weeks course. We used observation, trace analysis and questionnaires to evaluate the usability of different modalities of help in the environment [7]. We found, as expected, that the pacing of the help was critical, that physical (force feedback) guidance seemed to provide better retention, and that prolonged support improved motivation.

Comments (video taped observation, focus group and open questionnaires) showed a lot of variation in the preferences of learners for support: modality, animation of graphs, agents, timing and other personality aspects of support. It appeared important to introduce more parameters in the learner model linked to his preferences for support. It was important to investigate the attitudes toward various personalization factors, that could be taken into account while defining the rules. Those personalization factors should eventually appears as ways for the learner to control his environment (adaptation) or eventually for the system to adjust to the learner's reactions (adaptive). We are planning to give the learner the possibility to choose from various coaches, with different personalities, to ask more or less support and finally to choose whether he want humor or not. We wanted to experiment and evaluate the impact of those personalization factors separately. We describe here an experiment on the attitudes toward **humor** used by embodied agents in pedagogical interaction. This was a controlled experiment were humor was either present or not present, we wanted to investigate how learners reacted and whether that could be an interesting variable to include in an ITS.

Embodied agent and the personalization of support

Embodied agents are a seen as an interesting paradigm in AIED to support learning, because they offer a better integration between personalization and the spatial context of explanation [8-11]. As the term "embodied" suggest, they are more expressive and thus appear to be more effective to simulate real tutorial interactions. Embodied agents can be used to attract attention, guide and demonstrate using deitic gestures, suggest emotional context using the expression of emotion.

Studies were made on the integration of affective dimensions in embodied agents. As Elliott, Rickel, & Lester [12] suggest, the affective dimensions are important, because they make the coach appear to care about the learner, to be with him, and because it may communicate enthousiasm about the task. Okonkwo and Vassileva [13] also studied the impact of having coaches express emotions while giving advices. They found that non-verbal expression of emotions did not influence performance but had a positive effect on the perception of the help. But it is difficult to make an agent to be emotionally appropriate in his interaction. To do so the system's model should be more elaborate to better sense the learner emotional state, and to better react to it, both at the content and emotional level, "bridging between sensory input and action generation" [14]. As Cassel and Thórisson [15] have found it is not as much emotions per se, as the envelope role of non-verbal expressions that accompany dialogue, that are important to give a lifelike impression and to ensure fluidity in interaction.

But emotion is but one aspect of embodied agents. As André et al. [16] affirmed "the next major step in the evolution of interfaces is very likely to focus on highly personalized interfaces". So the new undergoing challenge in interface design in general and in ITS is to try to enrich the support model with more human like dimensions, incorporating aspects of personality, affective and social dimensions. But the integration of personalized embodied agents poses the problem of the investigation, the simulation and the evaluation of complex dimensions of affective and personality aspects of learning. Inside the ITS, the personalization of support appears to be an enrichment of the communication model, that uses the specifications of the context of the activity of the learner, but more importantly his learning model and preferences, to intervene or shape the communication model.

The integration of personalized support in education appears more and more essential on a pedagogical point of view, but also to make supportive agents more believable and trustable. As André [8]explains:

> "A growing number of research projects in academia and industry have recently started to develop lifelike agents as a new metaphor for highly personalised human-machine communication. A strong argument in favour of using such characters in the interface is the fact that they make human-computer interaction more enjoyable and allow for communication styles common in human-human dialogue". She presents the *Presence* system which "uses affect to enhance the believability of a virtual character, and produce a more natural conversational manner".

In this context we thought that **humor** could be an interesting dimension to integrate [17], first because of its potential for creating more personalized embodied agents, displaying emotions and social personalities depending on the context. Just as the simulation of affective reactions might make embodied agents more believable, we postulated that humor might add to the impression of intelligence and complicity of supportive agents and should make them more acceptable to humans. Humor could be an efficient communication strategy used to attract attention, diminish stress or stimulate affective and motivational reactions of learners. But humor is highly tinted with personality aspects and thus is difficult to integrate in a learning environment.

In fact, the development of personalization dimensions asks for new methodologies of research and evaluation in AIED. Should the ontology be defined theoretically and its usefulness assessed empirically ? Should it be extracted from the observation of interaction in comparison to pretest or posttest of psychological dimensions ?

Experimenting with the control of humor.

The perception and impact of humor in communication.
Humor is similar to a game, it is possible only when the participants are capable of a certain degree of **meta-communication**, stating that "this is a game". As Eco [18] describes it breaks the links between signs and signification, introducing an incongruity between them and thus a second level meaning. This signification game mixes the expectations of the receiver, which experience first an interrogation and then **surprise** when he is confronted with the unexpected meaning.

Humor has been said to increase the perceived **social presence** in a medium. According to Lombard and Ditton [19, p. 9]

> "The presence is [20] the perceptual illusion of non-mediation […] occurs when a person fails to perceive or acknowledge the existence of a media during a technologically mediated experience". The definition suggests that this illusive experience is at the perceptual, cognitive and emotional level of the user interaction. According to them the media is not only perceived as transparent but it naturally suggests the possibility to support and simulate "real" social interactions.

According to Short et al. [21] a high degree of social presence is important for specific types of interactions, for example persuasion and problem solving are difficult when the level of social presence is low. In a context where a learner has difficulties, and where the advisory system tries to influence him or to stimulate his motivation, social presence might be especially critical. ¨For Biocca [22] the perceived "social presence" is linked to the perception of intelligence and of intention expressed through the mediation of the artefact.

Theories on humor may be grouped under three dimensions: the superiority theory (humor presumes and places the receptor into an inferior position), the relaxation theory, the incongruity theory. Those dimensions of humor may each be used for a specific purpose in the context of tele-learning:

- to exert authority to bring students into a different behavior;
- to unleash tensions associated with learning or with the tutoring interaction;
- to destabilize students and provoke new understanding.

But humor is accompanied by a high level of **noise** in the interaction. The intent meaning might be unclear, the underlying model of social interaction might be inappropriate to the context, or to the learner personality. Humor is highly cultural, and its meaning is negotiated as the interaction evolve between participants. If humor is to be used, some coherent common codes must be developed between the system and users; some means of communication must be designed so users may understand, learn and adjust the models that lay behind the system; and so the system can be influenced by the reaction and preferences users have for humor. It is important to diminish distance and noise in the supportive interaction. So the messages the system is giving are understood and efficient in promoting understanding and efficient learning on the part of the participant.

Possible impact of using humor in an ITS

What could be the impact of using humor in ITS ? Research on embodied agents and research on humor suggest that humor might make embodied agents more believable; that it may make the computer look more intelligent, since it would seems as though he not only communicate, but also metacommunicate about the situation. Humor might help alleviate tensions associated with the interaction with a computer, with the isolation and stress of distance education. Finally, in a way, the noise in communication associated with humor might be a way to hide or dilute inappropriate interventions of the ITS.

Methodology and hypothesis

What could be the impact of humor and how is it possible to experiment using it in the context of ITS ? As Reeves and Nass [1] proposed, it is possible to experiment interaction with computers the same way we are evaluating real interactions, in this case having a condition "with" and a condition "without humor", and comparing impact on the usability and attitudes toward the system. But if we generalize the objectives of the system which were to integrate personalization of the interaction in the system; it is important to integrate personalization parameters of the support system, which could affect the support system, and eventually be controlled either with direct adaptation by the learner (I want more humor) or by adaptive adjustment by the system (He does seem to like humor). Though the system was designed so the learner could control it using the control panel, in the context of this research the conditions were fixed by the experimental set up, ie the learner could not change them.

As a first step we transformed the ExploraGraph rule editor so it would be possible to define rules "with" or "without humor". We experimented the system in the context of a course on learning the Flash software with undergraduate students at University of Montreal. The experiment was reduced to a three hours period, where the students were to explore the content, do some exercises and then pass a small test. Support rules were designed both with and without humor, using the different dimensions of humor – incongruity, superiority, relaxing, etc. The design was a split group experiment, where half of the subjects had first a version with humor and then without, and the other half started without humor and then with humor; the switch was time based and blinded to them. Twelve subjects participated in the experiment but only eight filled both questionnaires and were kept for the analysis.

Two questionnaires (after each experimental period) and interviews were used to collect data on attitudes of learners. As suggested by research on humor, the hypothesis were that humor would bring a more favorable evaluation of the support system, having more "social presence"; that agents would be perceived as more sensible, intelligent, more credible.

Results

Though we cannot use the results to confirm our hypothesis, because of the limited number of subjects and the short duration of the experiment. But they can serve as indication not only of the possible impact of humor on ITS, but also on the complexity of its interweaving with personality and context.

In general the learners had difficulty getting to know and use the ExploraGraph environment in such a short period. They found the graphs very different from what they are accustomed to, like regular hierarchical hypertext pages. In fact even with simple hypertext course, we had found that students suffered from the "lost in hypertext" syndrome and that they lack directions on how to organize their learning activity [7, 23]. In a previous experiment ExploraGraph had been used for 6 weeks, and it had taken some time, before learners got accustomed to it, to understand the semantic of the links and to organize their activity using it. Also in this experiment, the students had to pass a test at the end, and this might have influenced their evaluation of the environment and of the agents' support.

In general the evaluation of the agents was better for the humorous version and the appreciation of the agents was lower for the second evaluation (see Table 2). In fact, the difference between the first and the second evaluation was more important when the learners passed from an humorous to an non humorous condition (3.9 to 3.3 vs 3.6 to 3.5).

Table 1

Mean attitudes and standard deviation toward the agents in the support system for conditions with or without humor (scale 1 to 6), for the two groups at the first and second evaluations.

	First evaluation		Second evaluation			
	Group	Mean	Group	Mean	Mean	SD
Humor	G_1	3.9	G_2	3.5	3.7	0.99
No Humor	G_2	3.6	G_1	3.3	3.45	1.08
Mean		3.75		3.4		
SD		1.03		1.03		

Figure 2 presents the agglomeration of results to the questionnaires grouped by category according to the hypothesis. In general the attitudes toward the agent were more positive, when the condition was "with humor": the agent was found to be more funny, more clear, more intelligent; it was found to attract more attention, to be more relaxing. As for attributes associated with the "social presence" dimension, the humorous agent was found more friendly, sensible, expressive, and social; though he was found less personal (but the meaning of this question might not have been understood clearly (more personality vs more personalized to learner).

On the contrary, the humorous version of the agent was found not to be as good a support to motivation, orientation and learning. This might be due first to the stress associated with the test at the end of the experimentation. It might also be due to the very short experience with the course and the agent - only three hours, which limited the number of possible support interventions. It would be interesting to see if the attitudes would be the same for a course lasting many weeks, when the isolation and motivation might become a problem.

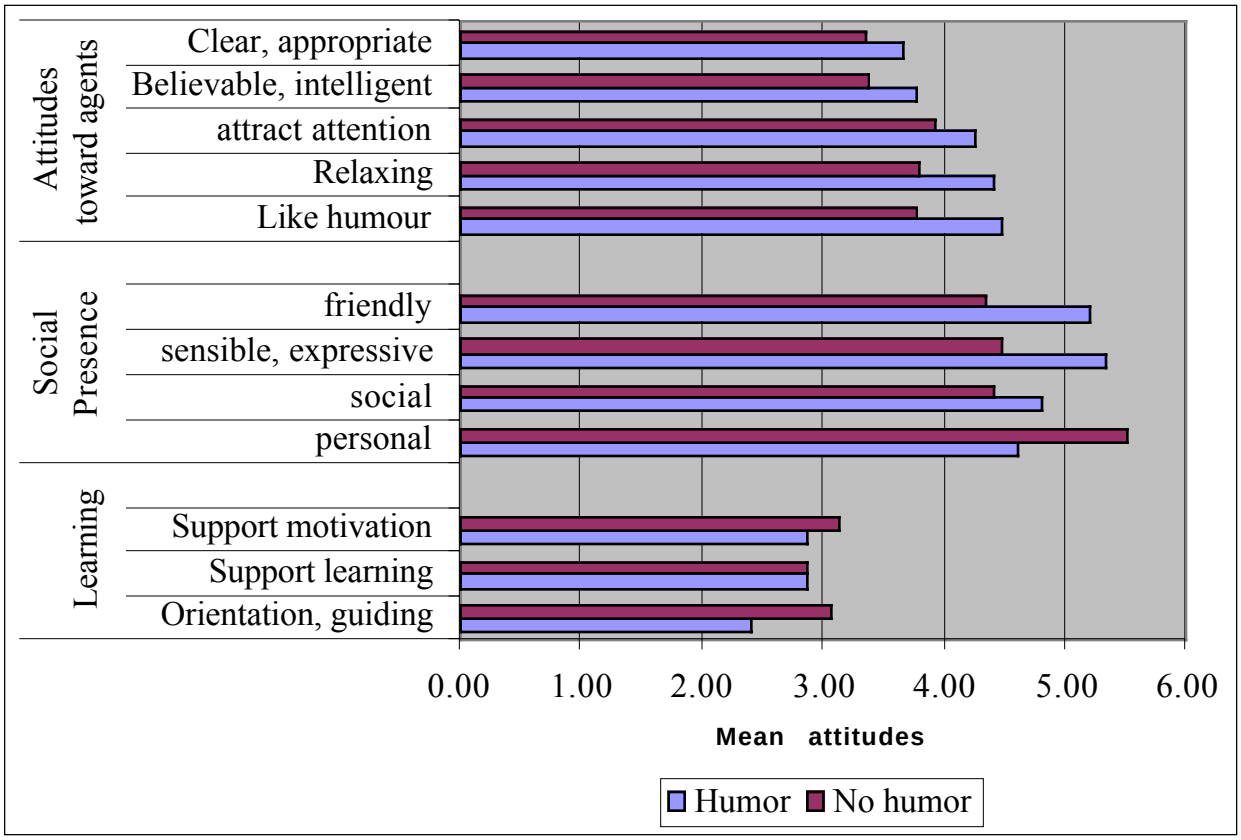

Figure 2 – Mean attitudes toward the agent and the help provided in the ITS for conditions with or without humor on a scale from 0 to 6.

Discussion

In general results and interviews showed that the appreciation of humor was much dependent on context: How difficult is the course and the learning environment? Whether there is an evaluation at stake. Specific situations where the agent interventions where out of place. While some students liked the agent, other expressed reserves on his personality, they did not like some of his remarks which they found inappropriate. The agent, the "Hacker", had been designed to address "resistant" students [24]; his humor was found by some students to be aggressive (using a superiority strategy, the agent was teasing the student), his relaxing and incongruous behavior was also found misplaced, by some students since there was an evaluation and the students were stressed. Some students expressed the need to stop the agent at one point or they wished they could have chosen another one, when proposed so at the interview. So, even though the theory and general empirical results suggest humorous agents might preferred to non-humorous one, in some conditions and for some students they were found disturbing. In general students wished they could have more control on supportive interventions.

Another interesting result, was that humorous interventions were perceived as less supportive for the task, orientation and motivation. Even though this might be linked to the very short experiment, it might be important when adjusting the degree of humor to take into consideration both task and personality factors. May be keep humor for when a task has just been completed (reinforcement) or no task is urgent (beginning of the course).

This experiment on humor is part of a more general research, where students will eventually be able to choose the personality of the supportive agent. Not only would they be able to choose humor or not, more or less support, but they will be able to choose amongst a set of coaches with different personalities. Following Martinez [24] research on learning styles, we will offer them four archetypal coaches designed to match the four kinds of learners – *transforming or intentional, performing*, *conforming*, and *resistant*. She describes how individuals follow a

complex mix of beliefs, desires, emotions, intentional effort, and cognitive and social styles to learn, which must be taken into account by the supportive environment. In fact learning styles and humor theories suggest ontologies for preferences, which may be included in general rules of support systems. For example for *intentional* or *resistan*t learner, incongruity type of humor might be more appropriate; for *performing* learner superiority type of humor might be more supportive. So the apparent personality of the coach can be used to represent a style of support – timing, parameters of the situation where help will be offered, content of the advices. We had designed four coaches for the different type of learners, but only one the Hacker was used in the context of this research. Eventually with multiple coaches, we will experiment the differential models of personalities of help in relation to style of learners, in order to measure the spontaneous use of the coaches, and their impact on attitudes toward help (perception and reaction to help).

Conclusion

Even though research on embodied agents with models of affective reactions are interesting, few evaluations have been made of their acceptance by learners in real educational context. More so, it appears interesting to study how we can design general models to use them in context where the knowledge of the domain is limited to interdependencies in tasks or concepts, like what is described by Paquette & Tchounikine. [25]. In this direction, the ExploraGraph system was built to externalize the structure of the task and the learner and group models and to facilitate its access to learners. In it, support rules may be designed to use adaptive interface and MsAgent animations and advices. Parameters were added in the support system to take into account preferences of the learners (humor, chosen coaches, level of support). We have used it to make this control experiment on the attitudes toward humor in embodied agents.

Though with only a limited number of subjects, we found that attitudes toward agents displaying humor was generally more positive, that it makes them appear more intelligent, sensible, believable, that their social presence is higher. We also found that embodied agents with humor were more distracting and not perceived as being as good support for learning. As Eco[18] suggests, the learner must look twice to understand the second level in humorous intervention. This appears to attract his attention, but also to distract him from what he is doing. The learners reacted negatively to such disturbance.

Learners comments suggested that their affective reaction is highly dependent on their personality and that of the agent. More research is needed to describe in more details how humor and personality could be linked to define situations and actions to support learners based on cognitive or learning styles [24]. It is also important to analyze and model the control and reaction of learners to the help provided and to compare this to their attitudes toward help and the justification they see for preferring one coach over the other. An environment where the learner could control the degree and style of coaching would be interesting to study, but it must rely on strong and generic theoretical models of coaching, linking the diagnosis of situations and the types of support actions, to generic models of tasks as in ExploraGraph [2].

It would be interesting to do observation and to ask learners to characterize the personalities of the coaches and their interventions to precisely understand the reaction of learners to different personalities, and types of humor in agents. We may also find gender-based differences in the use and control of the support system as in Okonkwo and Vassileva [13]. But letting the learner adjust the support preferences is not enough, since even though it is important to let the learner control his environment; it might be a tedious task for him. So we intend to integrate in the environment adaptive features taking into account reactions to support (agent is stopped, advice are not followed). So general rules could be adjusted to students in general and to a specific learner using learning mechanisms.

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