Social and visual style in virtual pedagogical agents

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Social and Visual Style in Virtual Pedagogical Agents

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ABSTRACT
The paper addresses aspects of virtual pedagogical agents' visual style (realism – iconization) in relation to their social style (task oriented – relation oriented). Two studies are presented that investigate which visual and social styles users prefer and how they articulate their preferences. The first study involved 42 university students; the second study involved 90 elementary school children. Special emphasis was put upon two hypotheses, grounded in cognitive theory: (i) iconized visualization may be better suited for representing a relation oriented, subjective agent – and therefore preferred by users who prefer a relation oriented agent; (ii) realistic visualization may be better suited for representing a task oriented, objective agent – and therefore preferred by users who prefer a task oriented agent.

The results of the two studies provide some support to these hypotheses. Cognitive theories are exploited to interpret the results, and possible design considerations are discussed.

Keywords
Agent, pedagogical agent, visual style interface, social style interface, pedagogical role, individual cognitive differences, motivation, human-computer interaction, user studies.

1. INTRODUCTION
An aspect that has been surprisingly little researched regarding virtual pedagogical agents is their visual appearance in terms of facial shape, body and costume, visual style, etc. Yet, the evidence that many basic patterns from human-human interaction recur in human-computer interaction [12] gives us reason to address visual rendering issues in research on animated agents. It is well established within social psychology that aspects of visual appearance have considerable impact on how people access other people. We are profoundly affected — in terms of behavioral responses as well as beliefs and attitudes — by others' body shape, facial looks and clothing. Furthermore, research supports the notion that "first impressions are lasting", i.e. impressions of someone's personality based on physical appearance, not only persist but also deepen over time [8]. This principle is likely to hold for animated agents as well (cf. [6]).

One implication of this line of reasoning is that if visual appearance of animated agents is ignored, rather than being carefully considered and articulated in research and development, agents may fall short of motivating and engaging users. The survey presented in the article *Design of Animated Pedagogical Agents – a Look at their Look* [5] shows how visual rendering issues have been neglected in research on animated pedagogical agents. The main thesis of the paper is that users' visuo-aesthetic experience of animated pedagogical agents is too important to be disregarded, with respect to the goals to motivate and engage.

The present paper addresses the issue of visual style (realism – iconization) in relation to the notion of an agent's social style (task oriented – relation oriented). In what follows, we introduce the topic and present two empirical studies.

2. VISUAL AND SOCIAL STYLE
2.1 Visual Style: Iconicity vs. Realism
Virtual pedagogical agents can be visualized in a number of ways. In the present paper, we investigate two different visual styles: realistic and iconic. Here *realistic* signifies a rather realistic 3D-rendering compared to *iconic*, which signifies a somewhat simplified character of the type to be found in Marvel Comics, for example. Various theoreticians have presented ideas on realistic versus iconic agents with respect to user involvement. Welch et al. [13] argue that pictorial realism increases involvement and the sense of presence in a digital environment and even is a condition for human cooperation with an animated agent.

Moving to another domain, McCloud in his seminal book *Understanding Comics* [10] argues to the contrary that audience involvement is increased by iconization. The underlying mechanism consists of the image and concept of *oneself* being highly iconic. When people interact they usually see the features of the other in vivid detail, but we also sustain a constant awareness of our own faces, and this mental image is highly iconic. Therefore, subjective identification and social affinity with an iconic character requires less effort compared to a realistic character, the latter taking the role of an object (another person).

All in all, we find diverging claims regarding realism versus iconicity with respect to the ability to involve and engage, even if there is not much of an explicit discussion. At the same time, we have the impression that there is a non-reflected assumption within the domain of virtual pedagogical agents that a visually realistic agent is an obvious goal to strive for. In any case, there is a need for systematic studies.

2.2 Social Style: Task Oriented vs. Relation Oriented
2.2.1 The Social Computer
As Reeves and Nass have demonstrated [12], people respond to computers in social ways and apply behavioral patterns of politeness, flattering, etc. These effects become even stronger when the

computer artifact is an anthropomorphic character, i.e. a character with humanlike shape and other humanlike properties.

Several researchers emphasize that a close emulation of the features that are present in human-human face-to-face communication is crucial in order to obtain positive results with pedagogical agents, as such emulation contributes to smoother communication and makes the interaction more stimulating, motivating or engaging (e.g. [4]; [9]).

2.2.2 Different communication styles

Yet human beings do not all interact and communicate in the same manner, and we can speak of different communicative styles (e.g. [11]). The communicative style dimension addressed in this work is that of (1) *a strictly task oriented communicative style* versus (2) *a combined task and relation oriented communicative style*. Given a pedagogical context, the two styles can briefly be exemplified as follows: (1) a coach (instructor, teacher, learning companion, etc.) who is strictly task oriented, sticks closely to the task, provides information in a succinct and objective way and focuses on factuality, and (2) a coach (instructor, teacher, learning companion, etc.) who is relation oriented (as well as task oriented) will, apart from contributing to the solving of the learning task, also work on developing of a social relationship with the learner; personalizing the task, being more subjective, and focusing less strictly on the task in the dialogue. The next section describes features of relation oriented communication in more detail.

2.2.3 Relation Oriented Communication

In human beings there are many features that contribute to relation oriented communication. A variety of non-verbal behavior is involved, such as forward lean, body and facial orientation, smiling, nodding, gaze and gesturing (cf. [2]). On the verbal side, the dialogue does not only regard the task at hand; it may contain small-talk, conversational storytelling, getting-acquainted-talk, joke-telling, sharing of personal experiences, preferences and opinions. Certain voice features are also often present such as greater warmth and expressiveness, reinforcing interjections such as "mm-hmmm" and more variation in pitch, amplitude, duration and tempo [2].

2.2.4 Implementations

Two of the most interesting implementations involving the features mentioned are the agents REA [2] and Laura [2]. Whereas REA has the role of a real estate agent who interviews potential home buyers and shows them around houses, Laura has a more direct pedagogical role as coach or advisor for individuals who want to increase their physical activity.

Both REA and Laura have been evaluated by users in two different scenarios, one with a task oriented communicative style and one with a task *and* relation oriented communicative style[1].

Baylor and Kim [1] have worked with a similar pair of communicative styles in a more prototypical pedagogical context. Their task oriented *Expert agent* speaks in a formal and professional manner with authoritative speech and provides accurate information in a succinct way. The animation is limited to deictic gestures. There is little expressivity and the agent shows no affect. The task and relation oriented *Mentor agent* works collaboratively with the learner. The goal is to demonstrate competence to the learner while simultaneously developing a social relationship to motivate the learner. Gestures incorporate both deictic and emotional expressions, and the agent shows various affects such as confusion, approval, excitement and pleasure. Sometimes the agent uses colloquial expressions, e.g. "What's your gut feeling?"[2] [1].

For a forthcoming study that we are currently planning, our goal is to implement as many as possible of the features described above in the design of a task oriented versus a task *and* relation oriented pedagogical agent. Dialogue aspects such as small-talk versus no small-talk, conversational storytelling and getting-acquainted-talk versus no such features, sharing of personal experiences and opinions versus no such features, and some of the vocalic behavior described above, will have first priority.

In our two studies reported on in this paper, the users, after having chosen their instructor/learning companion with respect to visual representation, encounter only *description*s of the two kinds of communicative styles, and are asked which one they would prefer: an instructor/a learning companion that is strictly task oriented and whose talk only relates to the task, or an instructor/a learning companion who apart from talking about the task, engages the user during pauses in small-talk, supplies personal information, and relates personal experiences and interests.

3. THE ISSUES

3.1 Study Motivations

Underlying the two studies presented in this paper as well as the forthcoming study is a desire to learn more about user/learner preferences regarding visual and social style and to learn more about possible reasons for the preferences.

As Mc Cloud suggests (see subsection 2.1), identification, social affinity and the formation of relationships require less effort with an iconic agent than with a realistic agent. From this line of argument, we formed a hypothesis that a preference for a more subjective and relation oriented character will correlate with a preference for a more iconic character, and that a preference for a more objective and task oriented character will correlate with a preference for a more realistic character.

In the second study, we also included the variable of *pedagogical role*, hypothesizing that learner preferences regarding visual and social style would differ with the pedagogical roles of the agent (*instructor* vs. *learning companion*).

3.2 Study Questions

The following issues were addressed in the two studies:

(1) If a learning environment provides a set of animated pedagogical agents, with different degrees of realism – iconicity, to chose from: (1a) What do learners chose? (1b) How do learners articulate the motives for their choice?

[1] Termed "task condition" versus "social condition" in REA, and "non-relational" versus "relational" condition in Laura.

[2] There is also a third agent, the *Motivator agent*, who could be said to be *only* relation oriented.

(2) (2a) Do learners prefer (i) a task oriented pedagogical agent that "keeps to the learning task" in an objective manner or (ii) a task and relation oriented pedagogical agent that apart from being task oriented "socializes" with the learner in various ways? (2b) How do learners articulate their preference?

(3) Can any relationships be found between the results in (1) and (2) above? In particular, is there any support for the hypothesis that iconized visualization in agents is better suited for representing a relation oriented agent and that realistic visualization in agents is better suited for representing a task oriented agent?

In addition, in the second study:

(4) Does the role of the agent (instructor vs. learning companion) affect the learner's choice with respect to visual style (realism – iconicity) and/or social style (task oriented – relation oriented)?[3]

4. FIRST STUDY

The material consisted of three different Lo-Fi paper sheet prototypes, picturing four sequential steps of an imaginary pedagogical multimedia program. Each sheet presented one out of three pedagogical agents (differing in degrees of realism – iconicity) assisting in the solving of a brain puzzle quiz (Figure 1 below).

Participants were 42 university students, 23 women and 19 men, 19-25 years old. All had some familiarity with virtual pedagogical agents[4]. After a brief introduction, the participant was asked to imagine an e-learning environment dealing with the basics of neuroscience, and was shown an example task. The participant was then told that the environment also supplied a virtual coach that gave feedback and problem solving advice, whereupon the three Lo-Fi sheets were placed in a circle (varying the positions between participants). The participant was now asked: "If you were going to work with this learning environment, which of the three characters would you prefer as your virtual coach?". Next, the participant was asked: "Which agent would you prefer least?" After this, the participant was requested to motivate the choices.

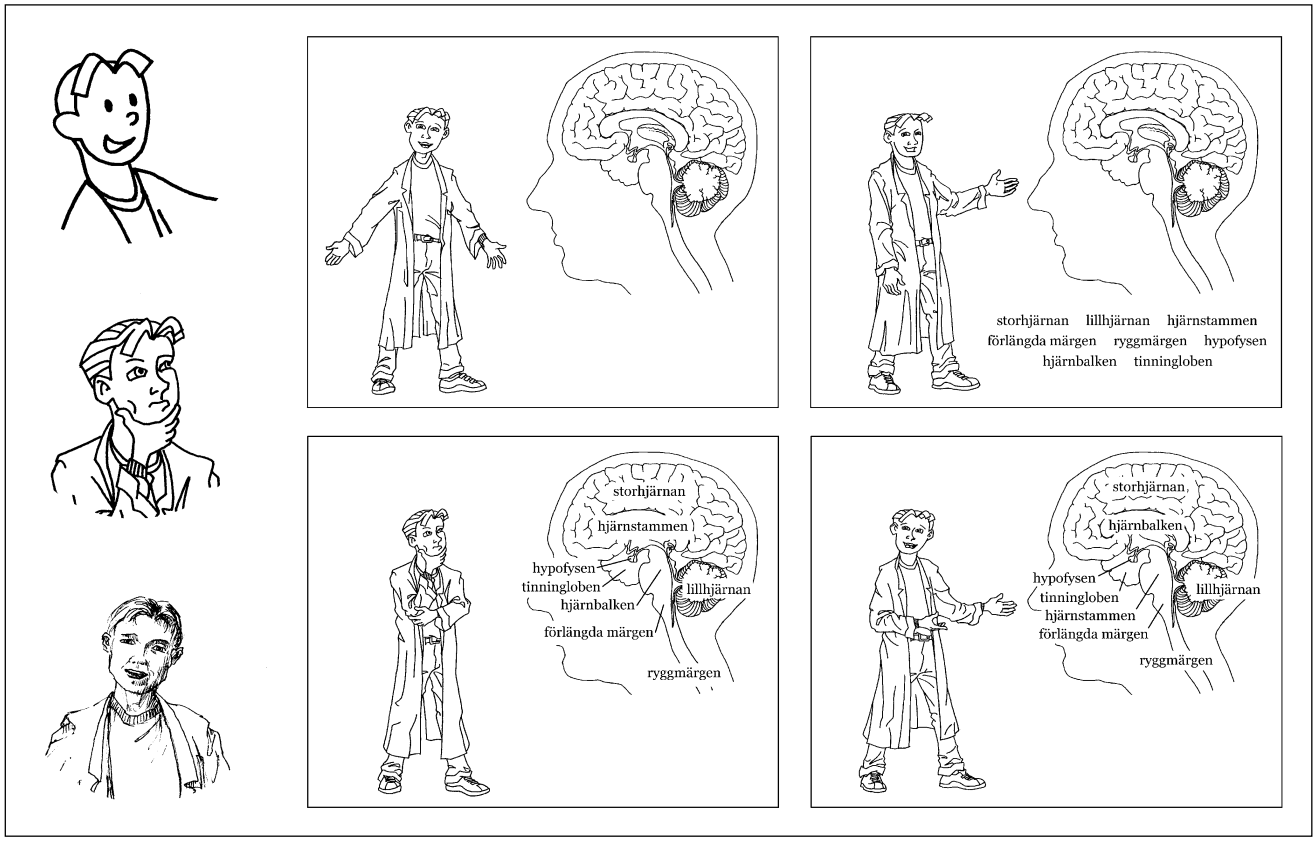

Figure 1. To the left are the three different agents (differing in degree of realism – iconicity) used in study 1, and to the right is an example of one of the three Lo-Fi scenarios (with the middle form agent) used in the study.

[3] Results relating to this issue will be reported elsewhere, as well as results regarding the relationship between learning styles and preferences as to social and visual style in agents.

[4] The familiarity ranged from "being familiar with the MS Office paper clip" to "knowing a variety of play-and-learn-programs for children" to "having used several animated agent products, in database programs, simulation programs for education, etc.".

After that, one of the experimental leaders verbally presented two scenarios: (i) one with a coach that focuses on the tasks and (ii) one with a coach with a richer and more complex social personality that, apart from advising and guiding, displays personal and social features. Finally, the participant completed a learning style inventory.

4.1 Results

4.1.1 Visual Style Preferences

Ten participants chose the most realistically drawn agent, 13 choose the middle form and 19 chose the most iconic. Female participants tended to a higher, but not significantly higher, degree than male participants to choose the most iconic agent.

Participants' views on the advantages and disadvantages with realistic and iconic agents diverged. The most frequent theme was that of *serious-childish*, where the realistic agent was preferred as more serious and the iconized agent rejected as childish and not serious enough. Another frequent theme was that of *distraction*, used both in arguments *for* the iconized or middle form agent (seen as not so distracting), and in arguments *against* the realistic agent (seen as too distracting).

4.1.2 Social Style Preferences

The distribution of choices with respect to social style in agents was as follows: 12 (63%) of the men and 14 (61%) of the women chose relation oriented style; 7 (37%) of the men and 9 (39%) of the women chose task oriented style.

Recurring arguments for choices are summarized in Table 1.

Table 1. Social style arguments (translated from Swedish).

Social Style	Arguments (No. of arguments in parentheses)
For task oriented / (Against relation oriented)	*It may disturb the learning* (11) "The agent should focus on my learning, everything else will disturb me."; "It ought to stick to the subject matter and not talk of anything that does not have to do with the learning process."
	It is not a human being (3) "I am not interested in getting to know an agent, it *is* no human being."; "They are not living creatures; there should not be much about them."
	Not appreciating this kind of social relation (3) "I prefer my real friends."; "It would feel awkward. I don't like the idea of a virtual human."
For relation oriented / (Against task oriented)	*More confidence inspiring* (6) "It would be more convincing."; "You feel more confidence in the agent and learn better."
	More fun and pleasant (3) "It would have been great fun if it worked well.", "It would be a stimulus, like having someone who cheers you up when it's dull – the point in animation is to go one step further."
	More personal is better (2) "You learn better when it is more personal."; "It would be interesting; I'm always curious about humans' inner lives."

In summary, participants' views diverged on whether a relation oriented character is a good idea or not. The *distraction* theme that appeared regarding realistic visual style, also turned up with respect to relation oriented social style. The most frequent argument against a relation oriented agent was that it may disturb and distract from learning. Two other frequent and related themes regarded "agents being artificial agents and not humans" and "social relations with such an agent being weird or inferior". The most frequently presented arguments in favor of a social agent were that it "increases confidence" and that it "makes it more fun".

4.1.3 Visual and Social Style Preferences Together

Merging the results the following can be observed (see Figure 2): Among those who preferred a relation oriented agent, there was a significant tendency to choose an iconic agent ($\chi^2(2) = 6.50$; $p = 0.04$) – whereas no significant tendency in agent choice could be seen among those who preferred a task oriented agent ($\chi^2(2) = 1.46$; $p = 0.48$).

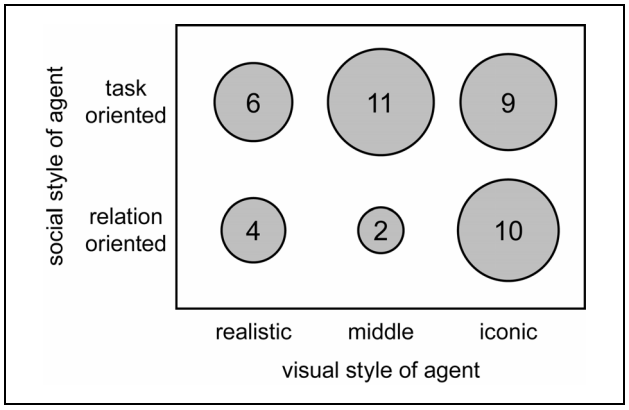

Figure 2. Distribution of chosen agents in relation to visual and social style (χ^2[total distr.] = 4.56; p = 0.10).

5. SECOND STUDY

The second study pursued the issues of the first one. The two studies differed however in the following respects: (i) implementation: two versions of a computer-based pedagogical multimedia dummy in the second study vs. a Lo-Fi paper prototype in the first (Figure 3); (ii) age of participants: school children in the second study vs. university students in the first; (iii) learning subject: geography/social science in the second study vs. neuroscience in the first; (iv) number of agents: four different agents in two degrees of iconization in the second study vs. one agent in three degrees of iconization in the first; (v) addressing new issues on pedagogical role in the second study.

The difference (iv) was motivated by our desire to study agent choices where the iconicity-realism dimension was not too obvious. With the three agents in the first study, the iconicity-realism dimension was quite obvious to the participants. This probably affected the cognitive processes in choosing and analysing one's choice. With the eight agents used in Study 2, the dimension was concealed to a larger extent.

5.1 Method

5.1.1 Participants

Ninety students, 48 girls and 42 boys (age 12-16), from 9 different school classes in Swedish elementary schools, participated in the study.

5.1.2 Materials

Two dummy versions of a scenario-based multimedia program for elementary school were developed for the study. In both versions, the student is to take the role of a journalist at a magazine, being sent to European countries to do article research. In the *Instructor Version* the student is guided by a virtual instructor and in the *Companion Version* accompanied by a virtual companion. Both dummies, created in Macromedia Director, include (i) an introduction where the program and a first mission is presented, and (ii) a module where the student is invited to choose an instructor or companion agent from the set of eight different animated agents.

The presentation of the first mission includes illustrations from Istanbul and traditional Turkish music. A male speaker voice tells about the mission and presents the student with his or her role as a journalist. In the *Instructor Version*, the student is, furthermore, told that there is a chief editor in London who will be his or her instructor. The chief editor will formulate the missions, orient the journalist (the student) and provide necessary information at critical stages. The journalist (the student) is to report back to the chief editor who will evaluate the reports and tell what is well done and what needed more work. In the *Companion Version* the student is, instead, told that there will be a companion journalist with whom s/he will conduct the missions. The student is also told that it is important to cooperate with the companion who, on the one hand, is not completely reliable when it comes to knowledge but, on the other hand, has some of the keys necessary to complete the missions.

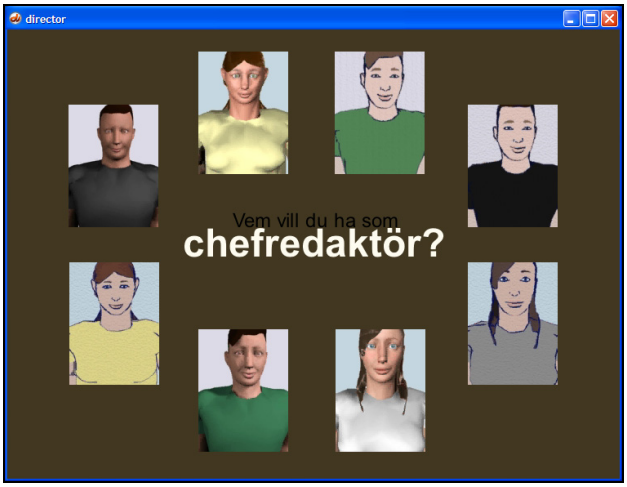

Figure 3. Example screen dump of the agents used in study 2.

Upon completion of the introduction it is time to choose an agent (instructor or companion). In both versions the same eight animated agents, four iconized and four realistic, were simultaneously placed in an oval on the screen (Figure 3). The placement of the agents was randomized before the session and stored in a table accessible to the program.

The eight agents were developed out of four basic figures (two male and two female) in *3D Studio Max 5*, and their faces were created with the plug-in module *FacialStudio*. Each of the four basic figures was then rendered in one realistic version (a 3D-figure created with the 3D Studio Max 5's default renderer) and one iconized version (an illustration rendering created in the *finalToon* rendering system). The eight agents had similar skin and hair color. Their facial forms were as similar as possible, given an ambition that they should look like four different individuals. Age related features were held constant. Body shape and eye color on the male agents were identical. The female agents had small differences in body shape; all had middle long hair and the same eye color. Clothing was simple and discrete in all agents. The underlying design rationale was to make the agents as neutral as possible with respect to visual stereotypes (attractiveness stereotypes, personality stereotypes, gender stereotypes, etc.) in order to minimize such influences on the agent choice (see [5]). The animation of the agents was parsimonious and included no sudden movements that would be likely to attract attention. The movement patterns were similar between agents but with a displacement so that movements from different agents would not coincide. Each animation lasted five seconds but was repeated in a loop so that the agents seemed to move continuously. The agents did not speak themselves, but the presentation was accompanied by a speaker voice (introducing the mission) and background music.

5.1.3 Procedure

1. The three experimental leaders[5] introduced themselves to the class as researchers from the university, investigating educational media for the future. Students were told they would be welcome to participate in a study. It was emphasized that the purpose was to listen to students' opinions on future educational media – full anonymity was ensured. The students were instructed to come, one at a time, to a small room behind the classroom, and in most cases, all students in the class participated.

2. Each participant was randomly assigned to one of four conditions: (i) companion version; realistic intro; (ii) companion version; iconic intro; (iii) instructor version; realistic intro; (iv) instructor version; iconic intro. There were 22-23 participants in each condition. After welcoming a participant and asking what grade s/he was in, s/he was asked to sit down at the computer, press start and follow the instructions.

3. The chosen agent was enlarged and centered on the screen, and the other agent animations disappeared.

4. The participant was asked the open-ended question: "Why did you choose the instructor/companion you did?"

5. Upon answering, an experimental leader reversed the program to bring forth all eight agents again. The participant was then asked whether there was any figure that s/he would definitely not have chosen as instructor/companion. The participant was

[5] One operated the program and assisted the student; one observed choices and took notes; one conducted the interviews.

then asked what s/he thought to be the important differences, if any, between the figures.

6. Next, one of the experimental leaders presented two scenarios: (i) one with an instructor/companion that focused on the mission and stuck to this (task oriented agent), and (ii) one with an instructor/companion that was more social and, apart from working on the tasks, also supplied information about him or herself in the pauses, telling about former missions, family, friends, interests, and so on (relation oriented agent).[6] Participants were then asked which of the two agents they would prefer, whereupon they were asked to motivate their choice.
7. Finally, two learning style inventories were completed.

The total time for a session was on the average eight minutes. After completion, the participant was offered refreshments, was debriefed and thanked for valuable help.

5.2 Results

5.2.1 Measures

For each participant the program logged: the condition (i) - (iv) (see section 5); the positions of the agents; the time it took for the participant to choose an agent; the chosen agent and its position.

The qualitative data, that is the participant's articulations and motivations of their choices, were noted manually during the session and transcribed within a few hours. In coding the answers to the question: "Why did you chose the agent you did?", all three coders independently chose the following categories for the arguments: *aesthetic*, *personality*, *gender*, and *other/none*. Some answers were classified in two of the categories. Upon comparing the classifications made by the three coders, a few differences occurred. After discussion, a joint result was arrived at (Table 2).

Table 2. Categorization and distribution of arguments for choice of agent (translated from Swedish).

Arguments	Freq.
Aesthetics	24
Personality	29
Gender	5
Aesthetics + Personality	6
Aesthetics + Gender	1
Personality + Gender	5
Other / None	20

5.2.2 Visual Style Preferences

Regarding visual style preferences, 63% of the participants (69% of the females, 57% of the males) chose an iconized agent, and 37% of the participants (31% of the females, 43% of the males) chose a realistic agent.

[6] The exact wordings differed depending upon whether the student was using the companion or the instructor version.

Examples of the participants' motivations for choice of agent can be seen in Table 3 below.

Table 3. Categorization (cf. Table 2) and number of arguments for motivating choice of agent.

Category (No.)	Arguments (typical examples)
Aesthetics (24)	"I think the other ones look a bit strange."; "[…] because it is a 3D-figure, that has much more style than a drawn one."; "I didn't want a 3D; I think they look a bit strange. The 2D ones look better, more trendy."
Personality (29)	"He looks as if he has good self-confidence. Some others look insecure and shy."; "I thought he looked kind."; "He looks like someone who could teach you something."; "She looked kind and reliable – not someone that will shout at you."; "It looked most sympathetic."
Gender (5)	"I wanted it to be a woman, because there are too few woman bosses. As long as it is a woman it is not so important which one of the figures."; "I don't know, but I am a girl and want to work with girls."; "[…] because he is male. Maybe there is criminality where one is going, and with a guy the risk of being attacked is less than if you are a boy and a girl."
Aesthetics & Personality (6)	"She looks good graphically, and she also looks like a chief editor."; "She was the best looking one, and also kind of fair."
Aesthetics & Gender (1)	"[…] because it is a girl and I think they look better. They are more ugly when they are computer made."
Personality & Gender (5)	"[…] because it is a girl, and because she looks happy and very kind."; "I chose here because I think it is fun with a girl if you are going to have a good cooperation, and she looked nice and the most human."
Other (5)	"It looked most normal and common."; "[…] because it is a computer game and I like computer games. I chose the one I think is best animated by the computer."
No reasons (15)	"It doesn't really matter – some of them look a bit special, but honestly – who cares?"; "I don't think it matters who is boss as long as he or she is kind, and you cannot see that from the outside."

As a part of the examination of a possible relation between a preference for iconized agents and a view of agents as social actors, we focused at the categories "aesthetics arguments" vs. "personality arguments" and related them to the choice of visual style (see Table 4, next page). A strong relationship was found between personality arguments and a preference for iconized agents.

Table 4. Distribution of arguments for visual style choices (χ^2[total distr.] = 1.47; p = 0.69).

Category	Realistic	Iconic	χ^2	p
Aesthetic arguments	10	15	1.00	0.32
Personality arguments	10	24	5.76	0.02**
Aesthetic & personality arguments	3	3	0.00	1.00
Other arguments	10	15	1.00	0.32

5.2.3 Social Style Preferences

Looking at social style preferences, 59% of the participants (65% of the females, 52% of the males) chose a relation oriented agent, and 41% of the participants (35% of the females, 48% of the males) chose a task oriented agent.

As to the arguments for choice of agent, 72 answers were considered after sorting out motivations such as: "That just seems better.", "I just think so.", and a few responses of silence.

Seventeen participants motivated their choice of a *(task and) relation oriented* agent as it being: "[…] more fun, nice or interesting.". Another eighteen participants gave this argument in a more elaborated form – some of them explicitly spoke about the importance of "[…] personal relations.". Eight participants motivated their preference for a relation oriented agent as: "[…] being more playful and easy-going – the other (task oriented) agent would make the task too serious and hard.". Three participants, finally, motivated their preference for a relation oriented agent in terms of what is "[…] normal or common.". Two of those found the relation oriented agent more interesting because it is: "[…] not so common.", whereas the third found the relation oriented agent "[…] more normal and common.".

All arguments in favor of a *(strictly) task oriented* agent were, notably, negatively formulated as arguments *against* a more social agent. The three most common categories of arguments, each occurring in seven instances, relate to one another: seven participants held that a relation oriented agent would be "[…] trying, tiresome and a nuisance."; another seven pointed at the risk of "[…] getting distracted."; the third group of seven participants spoke of a relation oriented agent as one that "[…] does unnecessary or meaningless things instead of focusing on what is important.". Finally, five participants stated that the agent "[…] is a computer character and not a human being, and that they therefore didn't want to know any personal things about it.".

Two participants explicitly answered that the ideal would be to have both versions available to choose from: "Sometimes you feel like talking, but sometimes you prefer a companion that is quiet and sticks to the task – the best would be if one could choose between companions that have different personalities."; "It depends – sometimes I would like one that is talkative and social, but sometimes I cannot stand that.".

5.2.4 Visual and Social Style Preferences Together

Participants who preferred a relation oriented agent tended to prefer an iconic style agent ($\chi^2(1) = 13.75$; $p = 0.00$), whereas participants who preferred a task oriented agent did not reveal any significant preference ($\chi^2(1) = 0.24$; $p = 0.62$), (Figure 4).

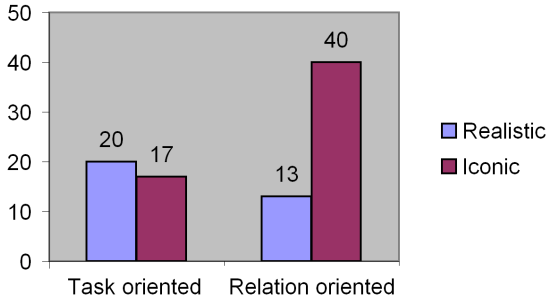

Figure 4. Frequency distribution: social style versus visual style (χ^2[total distr.] = 8.18; p = 0.00).

6. CONCLUSION AND DISCUSSION

A central question in the two studies was whether any relationships could be found between a) users' choice of *visual style* in agents with respect to realism versus iconicity and b) users' choice of *social style* with respect to task orientation versus (task and) relation orientation. In particular, the hypothesis that iconized visualization is better suited for representing a relation oriented, more subjective, agent – and therefore preferred by users who prefer a relation oriented agent – was tested.

Together, the results of the two studies provide some support to the hypothesis, even if further investigations are required in order to secure as well as to better understand the results.

A relationship appears in the studies between a preference for an iconized agent and a preference for a relation oriented agent. If, as we propose, this result is interpreted in terms of iconized agents being more easily conceived of as subjective, socially rich characters than realistic agents – a next step is to ask what the underlying cognitive processes in that case could be. A possible starting point is Laurel's [7] comparison of computer characters and theatre characters, declaring it as central in both cases that the characters function as *stereotypic "shorthand"* for understanding and predicting behavior, rather than as full-blown personalities. And "the artistic side of the design problem" means, according to Laurel, to represent the agent to the user in such a way, that *appearance* is shaped to suggest the internal traits of the dramatic character or the agent[7]. Elaborating on this, an iconized character in contrast to a realistic one prompts the user to develop the character. A highly *realistic* agent is a visual – and social – fact, which does not leave much for a user to imagine. It is like an objective statement, whereas an *iconic* agent can be elaborated by the user, who may fill in and create from his or her own subjective experiences. Thus, someone who is interested in understanding and creating psychological and personal issues and prefers a subjective, relation oriented agent, may also prefer an iconic be-

[7] Actually, in the case of theatre, the visual shaping of characters to a large extent makes use of visual stereotypes and heavy make-up – and the large distance to the scene reinforces the appearance of the artists on the theatre scene as visually iconized.

fore a realistic visual style, if offered a choice. This line of reasoning can also be associated to McCloud's thesis [10] that it is easier to identify with an iconic than a realistic character. A realistic agent is more of an object, a finished existence. An iconic agent is more subjective, enabling a user to float into the agent with his or her own experiences.

Furthermore, the series of studies by Reeves and Nass [12] show that a computer with only minimal visual or auditative cues – such as a pictured mouth and eyes or a voice – triggers social projection in the sense that humans treat computers as social actors. The present line of reasoning could be said to extend the conclusion from Reeves and Nass [12] one step, stating that social projection is not only *likely* with a simple visual representation, but sometimes even *more* likely than with a complex visual representation.

Thus, a *tentative* conclusion with respect to design is that if the goal is to design a pedagogical agent, rich in subjectivity and more relationally oriented, iconic visualization may be the better choice. Likewise, if the goal is to design an objective, task oriented pedagogical agent, a realistic representation may fit better.

Another outcome of the studies regards *user variability*. They show a considerable variability in user preferences. As regards social style (relation oriented – task oriented) this can be related to Bickmore's [2] observations that REA in the social condition evoked strong and diverging reactions. Several subjects "reported liking the social dialogue aspects of the interaction: […] It wasn't just real estate talk, so I felt like it made her more human […] It sounds like she's on your side when she says things are expensive" ([2], p. 84). Other subjects didn't like it at all: "I come in and I shop and I get the hell out. She seemed to want to start a basis for understanding each other." ([2], p 85).

Also, studies of Laura [2] indicate that user appreciation of her relation orientation ranged widely. According to Bickmore [2], a representative positive comment was the following: "I like talking to Laura, especially those little conversations about school, weather, interests, etc. She's very caring. Toward the end, I found myself looking forward to these fresh chats that pop up every now and them. They make Laura so much more like a real person" ([2], p. 184.) A representative comment from someone who was clearly of another opinion was: "I didn't really like Laura very much […] Actually I liked all of the software except for the animated conversation thing." ([2], p. 185).

Furthermore, Bickmore and Cassell [3], attempted to relate the varying user reactions towards REA to user characteristics, more specifically to the introversion-extroversion dimension. A significant difference showed up, both in the case with an embodied REA, and when there was only phone conversation, in that "overall *extroverts* liked REA more when she used *social dialogue*, while *introverts* liked her more when she *only talked about the task*" ([3], p. 21, emphasis added). In our second study, user characteristic data regarding *learning styles* have been collected. The analysis of this data will appear in coming articles.

Finally, given the apparent variability in user preferences and reactions, how can the issue of adaptation of the interaction be approached? Given the current state, it is hard to envision a system that in itself would adapt to a suitable visual and/or social style. So, for the time being, one simple "adaptation" is to present users with alternatives and let them choose – if for no other reason than the mood they happen to be in from one day to another.

7. ACKNOWLEDGMENTS

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