Virtual pedagogical agents – design guidelines regarding visual appearance and pedagogical roles

A. Gulz*,1, and M. Haake2

1 LUCS (Lund University Cognitive Science), Lund University, Sweden
2 Dept. of Design Sciences, Lund University, Sweden

Following a brief discussion on aspects of visual appearance and roles respectively, two user studies are presented and discussed. Both focus on learner experiences and explore the reciprocal relation between visual appearance of virtual agents and their pedagogical roles. The paper concludes with some preliminary guidelines for the early stages of the design process of virtual pedagogical agents.

Keywords: visual appearance; virtual pedagogical agent; pedagogical role; gender; design guideline
1. Introduction

Virtual pedagogical agents, i.e. computer generated characters in pedagogical roles, populate the digital society in increasing numbers. They are found in:

- educational programs from preschool to university
- broader educational contexts as virtual medical counsellors, physical exercise coaches and guides on city homepages
- edutainment and infotainment settings

AutoTutor
Univ. Of Memphis

Laura
MIT Media Lab

FearNot
VICTEC/eCIRCUS

Sam
MIT Media Lab
In the development of any virtual pedagogical agent, or VPA, a number of design decisions must be taken – whether consciously or not. E.g. decisions on:

- the *visual appearance* of the character: its gender, skin colour, age, facial features, body, hair-cut, clothing and attributes
- the *degree of visual naturalism* with which the character is depicted

Recently such decisions on the *look* of agents, have been recognized as *important* from a pedagogical perspective: No matter how well-designed the behaviour, dialogue and ‘intelligence’ in a VPA – if its visual appearance is inadequate, the pedagogical benefits may decrease considerably ...

... since the visual appearance of an agent affects learners’ expectations, attitudes, understanding and motivation.
But what is an adequate visual appearance for a given VPA, and how is such design supported?

There is no hope for overall and general guidelines. Whether a visual design decision is appropriate will depend both on the learning context and the group of learners. User involvement and evaluation is strongly recommended in the design of visual appearance.

However – in order to delimit the visual design space when generating initial alternatives, it is possible & desirable with support and guidelines. This is what the research presented here intends to contribute to.

The two studies presented focus on learner experiences and explore the reciprocal relation between visual appearance of VPAs and their pedagogical roles.
2. Roles and visual appearance as variables in the two studies

2.1. Roles of virtual pedagogical agents

Pedagogical roles may be divided into two categories: more authoritative roles such as teachers, instructors or mentors and less authoritative roles such as learning companions or study partners.

Study 1 involves two versions of an educational program: one with a virtual instructor and the other with a virtual learning companion.

Apart from prototypically pedagogical roles such as teachers, instructors, mentors and co-learners, there are less pronouncedly pedagogical roles that yet impact learning. E.g. someone lecturing on a certain medical topic may be a practicing physician, a nurse, or a researcher. Relations between these kinds of roles and issues of visualization are highlighted in Study 2.
2.2. Visual appearance of virtual pedagogical agents

*Visual appearance*, as used in this paper, refers to the design of a VPA in terms of:
- its body and face shape, gender, ethnicity, age, clothes and attributes
- the graphical style and degree of visual naturalism with which it is represented

*Study 1* involves the *degree of visual naturalism*.

*Study 2* focuses on *visual representations of masculinity and femininity*.

Examples of graphical styles
*Proc. of the 3rd Int. Conf. on Design for Engagement @ NordiCHI 2006.*
3. Method

Ninety 12-16 year-olds, 48 girls and 42 boys from a Swedish secondary school, participated in the study.

We developed two dummy versions of a scenario based multimedia program, where the student takes the role of a journalist. In the Instructor version the student is guided by a virtual instructor and in the Companion version accompanied by a virtual companion.
At one point the student chooses the instructor (chief editor) or companion (companion journalist) from eight different VPAs: four more stylized and four more naturalistic.
3.2. Result and interpretation

Relating the choice of visual style (*stylized vs. naturalistic*) to the pedagogical role of the agent (*instructor vs. learning companion*) the following was found: Participants who were presented with the instructor version showed a slight tendency \( p(\chi^2) = 0.11 \) to choose a stylized agent, whereas participants presented with the companion version showed a significant \( p(\chi^2) = 0.05 \) preference to choose an stylized agent.

\[
\begin{align*}
\chi^2_{\text{total}} &= 0.74 \\
\chi^2_{\text{instr}} &= 0.11 \\
\chi^2_{\text{comp}} &= 0.05 \\
p_{\text{male}}(\chi^2)_{\text{total}} &= 0.53 \\
p_{\text{male}}(\chi^2)_{\text{instr}} &= 0.28 \\
p_{\text{male}}(\chi^2)_{\text{comp}} &= 0.83 \\
p_{\text{female}}(\chi^2)_{\text{total}} &= 0.24 \\
p_{\text{female}}(\chi^2)_{\text{instr}} &= 0.24 \\
p_{\text{female}}(\chi^2)_{\text{comp}} &= 0.01
\end{align*}
\]
Separating the participants with respect to gender, the significant result for the Stylization preference in the Companion version is seen to originate from the female group. \( p_{\text{female}}(\chi^2)_{\text{comp}} = 0.01 \).

A starting point for interpreting this result is to consider the long tradition in comics to use stylized characters to facilitate the subjective identification and immersion into the characters.

If participants associate learning companions with ‘real friends’ to have a personal relation with (in contrast to a strictly task oriented, authoritative boss or instructor), it may be close at hands for them to select an stylized in contrast to a naturalistic character.

Since the significance arises from the female group, we may interpret the result as one where gender specific behaviours and social strategies are reproduced in a virtual context – girls/females being more competent in using subjective relational strategies, and boys/males relying more on formal, objective strategies for social interaction.
4. Study II: Gender, visual appearance and roles

4.1. Method

Whereas gender issues emerged from the results of Study 1, Study 2 had an explicit gender focus in the issues explored.

Study 2 parallels a study by Reeves and Nass carried out with 35 participants aged 18-23, which showed that the degree of femininity and masculinity in voices evoked the same gender stereotypes as in real life with corresponding expectations and judgments. For instance, more masculine voices were rated significantly higher in terms of will-power, reasoning skills and persuasive ability than more feminine voices.

Our study replaced voice with visual appearance as a carrier of masculinity and femininity.

Continued ➤
Four VPAs (a feminine female, a neutral male, a neutral female and a masculine male) were designed and pre-validated. All characters were designed as physicians, lecturing on the topic of shift work and health.

Each of the 90 participants (18-65 years old), encountered one female and one male character. They lectured on the same topic but on different sub-parts, tested for being as equivalent as possible in terms of affirmativeness, objectivity, difficulty, neutrality of language (nor a prototypically female or male way of expressing oneself). After each VPA encounter participants evaluated aspects such as credibility, trustworthiness, intelligence, knowledge, objectivity and emotionality, by means of Likert scales.
The most relevant differences between the original study and our study were:

- **the kind of interface**: a voice interface versus an agent interface that in addition to voice involves a visual representation of a humanlike agent
- **the carrier of gender**: voice versus visual representation
- **the time period**: late 1990s versus 2006
- **the cultures**: US versus Swedish participants
- **the role of the VPAs**: ‘anybody in the street’ versus a medical doctor
4.2. Results and interpretation

Gender stereotypes had some, but considerably weaker, impact than in the original study. Possible explanations that we regard as less likely are:

(i) that visual cues are weaker in carrying gender stereotypes than voice cues
(ii) that time has brought by a difference so that people are less susceptible to gender cues and gender stereotypes

Both (i) and (ii) are largely contradicted by several studies by Baylor et. al.

The parameters of cultures and of agent roles remain – and the interviews following the questionnaire do point towards a combination of these.

Here a strong conception of physicians as being credible, intelligent, knowledgeable and objective emerged. And consequently, expectations or stereotypes due to perceptions of gender and masculinity/femininity seem over-layered by even stronger expectations or stereotypes of a physician.
5. Discussion and conclusion

5.1. Making use of results like these – contributing to a visual design guidelines project

Step-by-step recipes on ‘how to visually design a VPA’ is a futile objective, since learning contexts, learning goals and groups of learners are such important and divergent parameters.

However, to delimit the visual design space – support and guidelines are both possible and desirable.

Designers can be helped by pointers such as: ‘these design aspects relate to each other’ and ‘this is a question that should be answered before making a choice on this visual parameter’. Such guidelines could be highly useful for navigating the immense visual design space of VPAs and to generate adequate initial alternatives.
Research results on VPAs should be used as a basis for the development of such design guidelines and be a way to ensure that research results are communicated to the wider business domain.

5.2. Preliminary guidelines

A shared result from the two studies is that the role of a VPA is in certain, non-obvious, ways related to visual design and visual design decisions.

From Study 1, we can extract some relatively straightforward guidelines.

- If one is interested in creating a non-authoritative pedagogical agent, it may be favourable to design it as a stylized character.
- Yet, the study also shows divergence in preferences, which is to be considered with respect to potential benefits in offering a choice.
From *Study 2* one take-away is the possibility to attend to other than prototypically pedagogical roles. This can be exploited, for example, if one wants to avoid a reconstruction of existing gender patterns in the educational area.

The inclusion of different roles, in a broad sense, may open alternative ways for navigating in the complexity around cultural stereotypes on gender.

It is also useful to look back at the parameters in *Study 1* and the option of visual stylization: Stylized representations of *androgynty* are likely to be less controversial and conspicuous than *androgynty* appearing in naturalistic (or real human) agents.
5.3. Conclusions

We have pointed at some relations between roles and appearance and derived some visual design guidelines from these.

We see it as an illustration of how to sort out design aspects with relevance for specific design contexts.

A long-term goal is to establish a more extensive set of guidelines to be used as check-lists and references while designing VPAs.

Thanks for your interest ... ... references can be found on the last page.
6. References (in the Paper)

- M. Haake and A. Gulz, A look at the roles of look & roles in virtual pedagogical agents, *Conf. on Intelligent User Interfaces (IUI)*, 2006.