Challenging Gender Stereotypes using Virtual Pedagogical Characters

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ABSTRACT
This paper explores motivational and cognitive effects of more neutral or androgynous-looking versus more feminine-looking and masculine-looking virtual characters. A user study is presented, in which 158 students, aged 17-19, encountered four virtual characters that were visually manipulated to represent gender stereotypicity versus androgyny. On the one hand we explored students’ attitudes towards the different characters as seen in how they ranked them as preferred presenters and articulated their arguments for doing so. On the other hand we looked for patterns as to which character(s) influenced female and male students most positively with respect to their attitude towards a university level computer engineering programme. Results from the study are presented and discussed. We conclude by pointing towards future research and potential within the area.

INTRODUCTION
A long-standing issue in higher education in engineering and other technical fields has been that of recruitment and retention of female students. The arguments for this are many, and here we will restrict our interest to recruitment with the support of virtual coaches. Baylor and collaborators demonstrated (Baylor & Plant, 2005; Baylor, Rosenberg-Kima, & Plant, 2006) that the use of virtual coaches portrayed as young and attractive females can increase the willingness of female students to chose technically oriented courses and help increase their belief in their own ability in technical domains. Processes of role modelling and identification (cf. Bandura, 1977, 2000) seem to be involved. The female students could more easily match these coaches with their personal identity compared to a virtual coach portrayed as a “typical male engineer” (see Figure 1).
When the results of Baylor and collaborators are analysed in detail it appears, however, that the increase in their belief in their own abilities partly stems from a conception of a “female, feminine, young and attractive” engineer as less competent than a “real, typical male engineer”. The prejudice that females, and in particular females with a strongly feminine appearance, are less competent in technical domains seems to spill over to the virtual area, generating increased self-efficacy of the kind ‘If she is able to do it, I can do it!’.

Now, this implies a potential conflict between a short-term pedagogical goal of recruitment and boosted self-efficacy in female students, and a long-term pedagogical goal of changing rather than reproducing gender prejudices and stereotypes. Attempting to avoid this conflict, the present study explores motivational and cognitive effects of more neutral- or androgynous-looking virtual characters versus more typically feminine-looking and masculine-looking ones – in a recruitment context. A multimedia presentation was developed, featuring four different virtual presenters of a university programme in computer engineering. The characters (presenters) were visually manipulated – and pre-validated during the design process – to represent a young feminine woman, a more androgynous young woman, a more androgynous young man, and a young masculine man. (The characters are depicted and described in detail later in the article.)

Participants encountered one of the four characters in the role as presenter (see Figure 2) and were afterwards asked whether and how the presentation had affected their attitude towards the computer engineering programme as well as what they thought of the presenter. Finally they were presented with all four characters and asked to rank them in terms of which one they themselves would prefer as the presenter of the computer engineering programme, and to motivate their ranking.
Issues in focus

We wanted to:

1a) Explore students’ attitudes towards the different characters, as seen in how they ordered them as preferred presenters of the computer engineering programme: Would the more neutral, androgynous characters be preferred to the more gender typical characters, or vice versa? Would the rankings of female students differ from those of male students?

1b) Explore how students articulated their attitudes towards the four characters: What reasons would they give for their first and last choice?

Additionally, we wanted to:

2) Explore which character(s) influenced female and male students most positively with respect to their attitude towards the computer engineering programme.

It should be emphasized that it was not assumed in advance whether or not there would be a concordance between the character(s) that the students explicitly chose and argued that they preferred most as presenters, and the character(s) that had the most positive influence on their attitudes to the educational programme presented. Many studies have shown that perceptual gender-related stimuli can have a considerable impact on peoples’ non-conscious cognitive processes that is not necessarily in accordance with what the same people are aware of and consciously report (e.g. Reeves & Nass, 1996; Brave & Nass, 2005).
Therefore the study was designed to collect both conscious, articulated responses in the format of preference rankings and arguments, and responses that reflect less conscious influences and processes.

**STUDY**

**Participants**
Eighty-six female and 72 male 17-19 year old students at four different high schools in two cities in southern Sweden participated.

**The virtual characters**

**Visual appearance**
The design aspect manipulated in the four virtual characters (see Figure 3) was their visual appearance. This was done by one of the team members (educated in visual arts) according to gender schemes used in design practice.

The two more neutral or androgynous-looking characters, \(FA\) (female androgynous) and \(MA\) (male androgynous), were developed out of an identical bust, differing in:
- the length of their hair
- the eye brows (with \(FA\) having more regular and slightly plucked eye brows)
- the clothing (somewhat neutral as to fashion but gender specific)
- \(FA\) having short eye lashes accentuating the eyes
- \(MA\) having a somewhat darker colour scheme, producing slightly bigger and more pronounced shapes

A more feminine-looking female character, \(FF\), was developed from the bust of \(MA\) and \(FA\) by using feminine attributes such as rounded head shapes, bigger eyes and smaller nose, make-up, long, dark eye lashes, the mouth modelled with fuller lips and the cheeks lifted and slightly more pronounced.

A more masculine-looking male character, \(MM\), was designed by using masculine attributes such as broader, angular and more pronounced head shapes (especially the shape of the jaw), broader shoulders, a distinct Adam’s apple and pronounced eyebrows.
Gender stereotypical and androgynous visual appearances
The focus on both conscious and articulated and more non-conscious responses to the characters, with respect to visually represented gender, set some constraints on the visual designs.

Over-explicit visual gender stereotypes had to be avoided. A feminine female character who looks like Pamela Anderson, and a masculine male character who looks like Arnold Schwarzenegger (cf. Figure 4), would probably initiate conscious reflections on gender and gender stereotypes, the purpose of the study, “politically correct” answers, and so on and dominate or rule out more immediate and non-reflected responses. Thus, FF and MM were not designed as pronouncedly gender stereotypical in their looks, and in particular, we sought to avoid the bimbo stereotype for FF.

FA and MA, in turn, are not pronouncedly androgynous in their looks, even though only a few visual parameters differ between them. In an early design phase, they were actually more similar to one another, and in particular FA appeared as more clearly androgynous. This, however, evoked negative responses in the validation process. In a pre-test a number of participants declared that they were at first uncertain whether the FA character was female or male, and that they found her – they all finally decided it was a girl – rather unattractive.

This was undesirable given the aim of the study. We wanted to explore the potential in using more androgynous in comparison to more strongly gender-differentiated visual characters. But such a comparison presupposes that all characters are comparable in the sense that none is perceived as particularly unattractive, irritating, strange or unusual, since this may otherwise take away the focus from the central variables.

However, the need to avoid strange or unusual characters is also a dilemma. Not being able to decide whether someone is a man or a woman is known to induce insecurity and unease in many people (Brave & Nass, 2005), and this constrains the possibility to explore more pronounced androgynous-looking characters. In order to progress here, our next step will be to use less naturalistic-looking, more cartoonish characters – more of this in the section on future research.
Figure 4. Examples of visual gender stereotypes in digital media. Left: two characters from the console game Ninja Gaiden® Sigma that reflect parts of the computer game domain’s action/fantasy-genre. (© 2008, Tecmo, Ltd. Used with permission.) Right: two characters designed by members in the online world Second Life™ Showcase. The characters could be found in a collection of examples (showcases) directly in the main menu of the home page (secondlife.com/showcase/).

Character features other than the visual appearance
Since we wanted to explore possible effects of visual appearances, we strived to keep all other character variables constant, or at least comparable, between the four characters. The slide show behind the characters was identical, as well as the information communicated by the characters. The characters’ facial expressions followed the same animation scheme. As to voice, one and the same recording – originally a woman’s voice – was digitalized into a female and a male voice. In this way features such as dialect and tone were well controlled for. It was also important to choose a female voice that would work with both the female characters, and a male voice that would work with both the male characters since mismatches between look and voice, like other inconsistencies in virtual agents, are known to disturb or irritate people (Nass, Isbister, & Lee, 2000).

Procedure
The computer program was run on four laptops. The 158 participants all used headphones to ensure that they were able to hear well and concentrate.

After filling in demographic data on the screen (see Figure 5a), the participants read brief texts about seven university level educational programmes and were asked to what extent they could imagine themselves as students on these different programmes. For each programme they were asked to check one of the following alternatives: <never>, <unlikely>, <perhaps>, <yes> or <absolutely> (see Figure 5b).
Thereafter they were told, in the digital environment, that a new presentational media was being developed, which they were invited to help evaluate. It would concern the computer engineering educational programme (from their perspective seemingly randomly chosen among the programmes they had just evaluated).

At this instance the virtual presenter appeared (see Figure 5c) and spoke about the educational programme for 2 minutes, with an accompanying slide show presentation. Parts of the presentation had been pre-validated as to its content and style by other students in the same age group in a previous and related study (Altmejd & Vallinder, 2007).

When the presentation was finished and the presenter had thanked the listener, a number of questions were posed. All were presented on-screen and filled out on the computer. First, the students were asked to evaluate on a 6-step Likert scale whether the presentation had influenced them in their attitude towards the computer engineering programme: in a positive or negative direction and to what extent. Thereafter they were asked why they had been influenced in this way (see Figure 5d).
The next question regarded their view of the presenter they had encountered. Thereafter all four alternative presenters were shown, and the participants were asked to rank them from 1 to 4 in order of preference: ‘Who would they prefer as presenter of the computer engineering programme?’ (see Figure 5e). Following this, the virtual character they had ranked as number 1 appeared and they were asked why this was their first choice. Thereafter the character they had placed as number 4 appeared and they were asked why this was their last choice. Finally, the participants were thanked on screen for their participation and asked to speak to one of the experiment leaders for debriefing and to receive a lottery ticket for cinema vouchers.

Ten groups of participants, in total about a fifth of the participants, also took part in focus group interviews after they had completed the session just described. These interviews centred around masculinity and femininity in appearance, behaviour, style, and occupations – as well as on the topic of androgyny.

RESULTS AND ANALYSIS

Character choices

First and fourth places in rank
The female participants most frequently chose MA and FA as favourite presenter with 29 and 28 choices respectively, versus 21 for FF and as few as 8 for MM. As many as 32 female participants put MM last and 24 put FF last. Only 16 and 14 put FA and MA, respectively, in fourth place. In other words, the two androgynous characters were clearly preferred. (See Figure 6.)
The first choice of the male participants was much more even (see Figure 7). As to the fourth place, the pattern was, on the other hand, very pronounced with 28 votes for FF, 25 for MM, and only 9 and 10 for FA and MA. In other words, also the male participants showed a preference for the androgynous characters, although primarily seen through their fourth place ranking (see Figure 7).

Two other choice patterns are particularly interesting from a gender point of view: (i) the extent to which participants ranked the two female characters or the two male characters in the two first places, and (ii) the extent to which participants put the two more androgynous characters in the two first places.

**Same-gender characters in the first two places**
Thirteen female and 12 male students, corresponding to random distribution, ranked the two female characters in first and second place (see Figure 8, leftmost bar). Ranking the two male characters in first and second place occurred much less often. Ten male and only 6 female students clearly correspond to less than random distribution (see Figure 8, second leftmost bar). In other words, even though computer engineering is an education and professional field with
strong male dominance, students and in particular female students, tended not to place two male characters in first and second place.

![Distribution of the two top ranked virtual presenters](image)

Figure 8. Distribution of the different combinations of the two top ranked (first and second) virtual presenters ($\chi^2$[total distr.] = 23.595; $p = 0.000$).

The two androgynous characters in the first two places

As many as 28 female and 18 male students, 46 in total (see Figure 8, second rightmost bar), put the two more androgynous characters as their two first choices of presenter. This is significantly above what is expected by chance. Placing the two more gender stereotypical characters in first and second place, on the other hand, was a little less common than what is expected by chance.

Arguments and reasons for character preferences

We now leave the ranking preference data and move to the participants’ arguments and reasons for their character rankings. The issues focused on in analyzing these are: (i) participants’ referring to the gender of the characters in arguing for a placement of the character, (ii) comments and arguments about the attractiveness of characters, and (iii) the nerd as appearing in arguments and comments. These issues are presented below in due order.

Referring to the gender of characters in arguing for ones preferences

On 35 occasions the gender of characters was brought up in motivating a first or last choice of presenter: by female participants in 22 cases and by male participants in 13. This difference in number may reflect a more pronounced gender consciousness in women compared to men (e.g. Hirdman, 2003). Below we look in more detail at the content of participants’ comments when referring to characters’ gender. This material gives indications both of ways of reasoning, and of how the different characters afford or mediate – or perhaps even trigger – different types of gender related arguments.

MM: Gender related arguments
The character that is least – only four times – referred to in gender terms in choice/non-choice arguments is MM. For instance, one male and one female student chose him since:

- ‘it is suitable for a boy to talk about technical things’
- ‘this is a guy, and I think that this [the computer engineering programme] is for guys’

**MA: Gender related arguments**

Nine participants raised gender related arguments concerning MA. Arguments for choosing MA as presenter were, for example:

- ‘it is a guy, and it is a computer education’
- ‘he looks like a computer-guy’
- ‘he looked nice, and in many contexts, many people find it more reliable when it is a man speaking’

An example of an argument for the ranking of MA in the *fourth place* is:

- ‘since he is a guy, and “the typical kind of guy” for this kind of education’ [In this female student’s further reasoning it was clear that she thought it would be good to break with the “usual” associations.]

One female student argued for ranking MA first in a way that might be interpreted as a wish to avoid gender typicality:

- ‘because he did not have typical short “boy’s hair”’

**FA: Gender related arguments**

Turning to the female characters, eight female and two male students came up with gender related arguments concerning FA. All argued *for* their choosing FA in terms of her *being female*. They said for example:

- ‘I think it is good that girls are more visible’
- ‘I think it is important that it is a women speaking since that can make more girls realize this can be for them’
- ‘she seems young and looks nice, and I think she would make more girls interested’
- ‘I like to see that also girls can be profiles for an engineering education, in particular one involving computers, which has many male students’
- ‘because she was good – and a girl’
- ‘I think women too ought to have influence in speaking for such programmes, so that girls can see that there are also female students here’
FF: Gender related arguments

FA was, thus, almost entirely described positively in gender related terms: she is chosen/preferred as a girl/woman. The gender related arguments about FF, by eight female and five male students, were in contrast more split and ambiguous.

Three females argued in positive terms about their choice of FF:
- ‘when one thinks about computer educations one thinks, at least I do, mostly of males – to hear a woman present is really a good thing’
- ‘because she was the best-looking and seems more conscious of what women want’
- ‘she looks like a focused woman, who knows what she wants =) ha-ha’

The other five females as well as the five males put FF in last place. Several of them seemed to defend this by saying that they do want women presenters in this context, but not this woman, not FF.

The female students commented:
- ‘it could perhaps be good to have a female presenter, but perhaps not her’ [She placed FA as number 2.]
- ‘I cannot say straight on that she would not be good as presenter but she just does not seem competent’ [She placed FA first, with the motivation that she finds it important to have a woman as presenter.]
- ‘she is a kind of woman I don’t like’ [She ranked FA first.]
- ‘I am not against her really but I think it should be mixed between women and men when it comes to influencing’ [She placed FA first.]
- ‘males are usually good at presenting these things’ [Nevertheless she ranked FA first, saying that FA was good.]

The males reasoned:
- ‘women are, on the whole, less interested in computers, and this one looked less motivated than the other woman’
- ‘she looked the least like someone dealing with technology’
- ‘she was a woman on a computer education and she did not seem to belong there’
- ‘she doesn’t give the feeling of being as serious as the man, doesn’t seem to have the same working experience as the man’
- ‘as I said, a woman feels more welcoming than a man, but she looked so styled, which I don’t like’

Summing up
In summary there is a considerable difference between ten arguments (five by girls and five by boys) against FF as presenter in terms of her being a woman – or as being ‘this kind of woman’ – and no argument against FA as presenter in terms of her being a woman. On the other hand, ten participants (eight female and two male students) argue for FA as presenter since she is a woman, but only three (three females) argue for FF as presenter since she is a woman.

Arguments involving the attractiveness of characters
In general, it appears to be crucial for young peoples’ educational choices that they can find adequate role models (Kessels, 2005; Rommes, Overbeek, Scholte, Engels, & de Kemp, 2007). One of the parameters known to influence the strength of a role model is attractiveness. If a role model is perceived as attractive the behaviour of the model is more often imitated (Rommes et al., 2007). Therefore, we wanted to analyse our material to see to what extent attractiveness and non-attractiveness was brought up in evaluating the characters as presenters of the computer education.

Indeed, comments on attractiveness were quite frequent in arguments for choosing a character as first place presenter, while comments on non-attractiveness were quite frequently involved in argument for placing a character in fourth place.

There were no large differences in the number of comments on attractiveness made by male students (52) and female students (67). The number of comments was relatively evenly distributed among the four characters with the exception of FF who received one third of the attractiveness/non-attractiveness comments. Notably, there was quite considerable divergence in students’ opinions regarding all four characters in terms of their attractiveness/non-attractiveness. Firstly, this is positive in view of the study design. If one character was found particularly attractive or non-attractive this might have interfered with the factor we intended to study, namely the influence of gender stereotypicality in visual appearance. Secondly, the divergence in opinions reinforces the notion that tastes differ.

Another appearance aspect relatively frequently commented upon was that of looking ‘plain’ or ‘common’. Also here all four characters were commented on as looking (most) ‘normal’/’plain’. That the perception and evaluation of who looks ‘normal’ and ‘common’ differ among participants is interesting since such perceptions as well can play a role in an identification process.

**The Nerd in arguments and comments**

The topic of attractiveness/non-attractiveness leads us to the topic of the nerd. An elaborate analysis of this issue, based on a rich empirical material from the Netherlands, is provided by Rommes et al. (2007). Using several methods, including focus group analyses and pictures drawn by young students, they pinpoint the Dutch cultural image of a computer scientist: male, unsociable, “married to his computer”, wearing unfashionable clothes and glasses, has a bad haircut, is overall unattractive and basically asexual – that is, a nerd.
Also organizers of computer engineering programs in Sweden mention a problematic image of the computer engineer student: a male student, constantly in front of his computer, drinking large amounts of coca-cola (Kihl, 2003).

Given that the image or prototype of a person studying a certain subject or belonging to a certain professional group seems important for young peoples’ educational and career choices (Hannover & Kessels, 2004) a nerd image associated with computer engineering is a major obstacle for young people who might potentially apply to such programmes. The nerd is not somebody to identify with or aspire to be, but someone extremely non-attractive and non-glamorous. Furthermore, relationships and sexuality are important during adolescence, and thus the risk of being associated with the “asexual” nerd image can be extremely threatening (Lippa, 1991; Rommes et al., 2007). Baylor and collaborators (Baylor & Plant, 2005; Baylor et al., 2006) also touch upon these issues, in calling for virtual role models, who are knowledgeable about engineering and simultaneously stand out as attractive and as affirmative in their sexuality.

Rommes et al. (2007) suggest that it is the nerd prototype of the computer scientist, rather than ideas of what is actually involved in studying or working in the field, that makes many young Dutch females – and males – refrain from applying to computer related programmes. Thus, not least given the student recruitment context that our study took place in, we were interested to see whether we would find “the nerd” in our material when subjects motivated why they chose or did not choose a certain presenter.

The Swedish nörd

The Swedish language has the word “nörd”, pronounced very similar to “nerd”, along with the specific word datornörd (computer nerd). In the logged material (we do not include the focus group interviews here) the word nörd was used twelve times, primarily by female participants. Additionally fifteen other arguments can be associated with the “nerd” concept, even though the word nörd was not used.
Six participants ranked MM last as a presenter because he was – explicitly or implicitly – a nörd, writing for example: ‘because I think he looked like a computer-nerd (datornörd) with his very ugly hair’, ‘he looks a little dull, and a little nerdy (nördig)’, ‘because he looks like a proper computer-person (äkta datamänniska), no one can recognize yourself in’, ‘he looks a bit dull and stiff, a typical computer-guy’. The last participant placed MA first since: ‘he is cool, and I got the impression that cool people study this educational programme’.

On the other hand, a student who had previously said that he was very interested in the computer engineering programme and later on declared that he had become even more positive after having heard the presentation by FF, argued for MM as his choice ‘because he looks nerdy (nördig)’. Another male student wrote that he chose MM: ‘because he looks like a genuine computer-guy’. (The word äkta (genuine) used here has a positive connotation in Swedish in general.)

Such variation in value ascribed to nörd recurs when turning to MA. Some participants chose MA and argued about the look of ‘computer-people’ and of ‘the nerd’ in positive terms: ‘he looks like a handsome computer-guy’, ‘he looks good, and looks like a computer-nerd (datanörd)’. On the other hand, one female ranked MA as her number one presenter, motivating this by MA not seeming like a nerd: ‘he looks good and not too nerdy (nördig)’.

Both male characters, then, were at some occasions held to be a nörd. However, none of them really fits with the description of the nerd offered by Rommes et al. (2007), and both were held to be good-looking by at least some participants. MM was slightly more often associated with a nörd than MA and more frequently said to look dull and boring. However, MA received many more comments than MM of the sort that ‘he fits in with this education’. Thus there is no support for the notion that the nörd is tightly connected to this education.

In connection with the female characters, nörd comments occurred more rarely. Yet one female student put FA in the fourth place ‘because she looks dull and nerdy (nördig)’, and put FF first, ‘because she is no nerd (nörd)’. Another female student chose FA ‘because she does not seem nerdy (nördig)’.

Summing up, what emerges from this material is not an equally strong cultural image as the one that emerged of the nerd as the typical computer scientist/engineer (Rommes et al., 2007). Perhaps nörd has a partly different meaning and use than the English nerd, with a less tight association to an unattractive appearance or look.

**Attitude influences**

We have come to the part of the analysis that is not based on participants’ explicit rankings and arguments about the characters, but instead on changes in participants’ attitudes towards the computer engineering programme after they had listened to the presentation by one of the four virtual presenters.

Before the presentation they had been asked to what extent they could imagine themselves as a student on some different educational programmes. After the presentation of the computer engineering programme they were asked to mark on a Likert scale the extent to which their attitude towards this programme had been influenced: very negatively, negatively, a little negatively, a little positively, positively, or very positively.

Eighty-six participants answered ‘a little positively’, and four answered ‘a little negatively’. In our analysis we do not include these two middle positions but only ‘negatively’ and ‘very negatively’ that were given the values 2- and 3-, and ‘positively’ and ‘very positively’ that were
given the values value 2+ and 3+. In Table 1 the added values character by character are presented.

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<th>Table 1. Attitude influences from the multimedia presentation.</th>
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<td>Males</td>
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<td>Females</td>
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<th>Added negative (−) influences only</th>
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<th>Added total (positive and negative) influences</th>
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<td>FF</td>
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<td>Males</td>
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Overall more male than female participants reported a clearly positive influence from the presentation. The total sum of positive values for the male participants was 171 (+) and for the females 139 (+). However, the values were overall relatively high. The negative influence, measured in negative values, was considerably smaller, with 33 (−) for males and 24 (−) for females.

When it comes to the presenters involved when participants reported a strong positive change in attitude towards the education, the results were as follows. For female students, the positive influence was evenly distributed over the characters. This is not in line with the results of another study (Baylor et al., 2006) where female students’ attitudes towards engineering classes were considerably more positive if the virtual coach was female. What must be borne in mind is however the difference in contexts. Baylor investigated students’ encounters over some time with a pedagogical coach, directing a tutorial. In our study there was one brief encounter with a presenter.

Also the very evenly distributed positive influences from the characters on the female participants was not in accordance with their strong preferences for the two androgynous characters indicated through their explicit ranking and reasoning about the characters.

With the male participants the contrast between their explicit ranking and reasoning about characters, and the positive and negative influences from characters, was even more striking. In explicit rankings and reasoning, the androgynous characters were preferred but the positive influence values were low for these characters. Furthermore, the character the male participants ranked lowest and argued most negatively about was MM. But the positive influence on attitudes among male participants was clearly strongest from MM, followed by relatively strong positive influences from FF.

Analyses in the pipeline
When circumstances allow we would, first of all, want to analyse the material from the focus group interviews where participants discuss androgyne, masculine and feminine professions, etc. Furthermore, we would like to pursue a more focused analysis from the perspective of recruitment of young females to computer engineering programmes. It would also be interesting to pursue culture comparative studies. In what ways do countries, such as the Netherlands and Sweden, differ as to whether computer engineering is an unattractive or attractive discipline – and can differences, if found, be related to different cultural images of the computer engineer and of “the nerd”?

**TENTATIVE CONCLUSIONS**

It has long been acknowledged that there are close symbolic associations between information technology, and masculinities and femininities (Cockburn & Ormod, 1993; Faulkner, 2003). Here, we suggest, virtual agents or characters, with their properties of interactivity and human-likeness, constitute a particular form of information technology endowed with a particular (re)constructive power with respect to gender. The presented study used virtual characters for presenting a university programme on computer engineering, but they could be used to present all kinds of educational domains, and may be of particular interest when aiming for less gendered occupational choices. Studies by Baylor and her collaborators (Baylor & Plant, 2005; Baylor et al., 2006) provided important background and a point of departure for our study in highlighting the importance of images and alternative cultural role models for engineering students. Also other researchers have suggested that more physically attractive and glamorous female role models might change the negative prototypes of computer scientists (Coltrane & Adams, 1997).

But Baylor and collaborators also pointed out problems of stereotype reproduction in using such characters and images. The aim of our study was to look for an alternative to the explicitly feminine female characters used in Baylor’s studies (Baylor & Plant, 2005; Baylor et al., 2006), and thus a means to reconcile the short-term pedagogical goal of recruitment and boosted self-efficacy in female students, and the long-term pedagogical goal of changing rather than reproducing gender prejudices and stereotypes.

**Using more than one character?**

For the female participants in our study, the following could be seen with respect to the two virtual female characters. In explicit rankings and arguments FA, with her in a relative sense more androgynous look, was clearly preferred to FF. In attitude influences no difference between FA and FF was seen on female participants.

A central result comes from the analysis of arguments that refer to the gender of the character. Here we found that a whole group of ten participants argued against FF as presenter in terms of her being a woman – or as being ‘this kind of woman’ – whereas no participant did so against FA. And vice versa, a considerably larger group of participants argued for FA as presenter as being a woman than correspondingly for FF. Our interpretation is that the more androgynous female character has more positive affordances in gender terms. The FA character was more frequently and more consistently used in positive reasoning and arguments about women in this computer technological context. Female students who already have thoughts about a positive role
for women in the computer science domain, or in technical domains in general seem more satisfied with picking the FA-character than the FF-character. The FF-character, on the other hand, seems to mediate or afford, or lend herself more easily, to arguments about women not fitting in this context.

But two things concerning divergence and multiplicity should be pointed out. First, it should not be neglected that there was one group of female participants for whom the FF character appeared to be valuable, as reflected in comments such as: ‘she looks as if she also knows what a woman wants’, ‘she has a chic look’, ‘she looks like a focused woman who knows what she wants’. Likewise, it should be remembered that opinions on attractiveness non-attractiveness, as well as on commonness/plainness, diverged for all four characters. In all, this points towards the possibility of using not just one virtual character, in this case one presenter, but two or several that take turns and interact with each other.

Second, it is important to situate the results of the present study in a cultural context. Virtual characters, which might function well and be adequate in Sweden, are not necessarily the ones that ought to be chosen in another country. For instance, we observed that the nerd seems to have less impact and be more modulated than the nerd in some other cultures – which might decrease a need to introduce attractive, sexy female and/or male characters as a counter balance.

Further potentials

On a broader scale the results from this and other studies indicate a possibility to exploit virtual characters to support identification and formation of identities in young people while avoiding the reproduction of undesired stereotypes. Smartly used, this kind of technology could, to borrow from Rommes (2007), be developed into tools that may increase the freedom for young people to create their personal “gender identity cocktails”.

There certainly exist information technological applications that to the contrary reproduce and even reinforce gender stereotypes, (compare Figure 4). But there is reason to focus also on the strong constructive potential for changing and broadening cultural images. For one thing, we have quite a different room in which to manoeuvre in virtual worlds than in the real world. As Brave and Nass (2005) reason: ‘Rapidly increasing the number of female teachers in stereotypically male disciplines (or vice versa) seems difficult. But technology provides a wonderful opportunity to […] “staff” educational software to counter stereotypes.’ (p. 29).

Furthermore, within computer game communities where members continually contribute to game development, we see a growing diversity in characters – not least new kinds of female heroines. In the wordings of Pinckard (2003) ‘[…] in MUDs and MOOs, one can often create a third sex and invent a pronoun and refer to oneself always with that pronoun (and insist others do the same). In these science-fiction and fantasy-themed online worlds, it’s perfectly plausible that ungendered, ambiguously gendered, or bi-gendered races could exist.’. Examples of gender busting characters can also be found in existing ready-made programs, such as: Nights into Dreams with the magical, androgynous character Nights whose identity can be assumed by both the female and male characters, The Legend of Zelda with gender ambiguity around all main characters, or Metroid with the gender bending action heroine Samus Aran.

SOME BROADER ISSUES & FUTURE RESEARCH
We regard the presented study as a first step in a larger programme of exploring the pedagogical potential of virtual characters that challenge stereotypes, with several different paths to follow and to explore. In this section we discuss some that have high priority on our agenda: (i) exploration of perceptions and attitudes towards androgyny in virtual characters and the pedagogical potentials herein, (ii) education and gender with respect to educational programmes where men are in the minority, and (iii) development of dedicated gender pedagogical digital tools involving virtual environments and characters.

More imaginative androgynities and their pedagogical potentials

The first study would explore perceptions and attitudes towards androgyny and how androgyny in virtual characters can be used pedagogically, focusing on more stylised and imaginative characters. As related earlier in the text, visually naturalistic characters like those from the presented study constrain possibilities of exploiting more pronounced androgyny, since naturalistic androgyny induces insecurity in many people. But with more imaginative characters, the design freedom and potentials appears wider (see Figure 10) while there is still evidence that identification processes with respect to visually less naturalistic characters can function well (GameGirlAdvance, 2003; Gulz & Haake, 2006a, 2006b; Haake & Gulz, 2007; McCloud, 1993).

![Figure 10. Androgynous and visually less naturalistic virtual characters. (From left to right, top to down: Two avatars from Second Life™ (secondlife.com); Illustration by Magnus Haake, © 2009, Magnus Haake; Illustration by Johnny Scharonne, © 2008, Johnny Scharonne (scharonne.wordpress.com); “The androgyne face”, a painting by artist Klaus Hausmann © 2008, Klaus Hausmann (www.arsvenida.de); Illustration by Magnus Haake, © 2009. All copyrighted images used with permission.)](image)

Attractiveness, mentioned above, would here be an issue, since it seems of importance for positive and well-functioning role models and cultural images. We will therefore look for and explore non-gendered, attractive characters. An implication is a need to avoid androgyny in the sense of in-between: greyish, neither feminine nor masculine, average.

In the context that we are dealing with, androgynous attractiveness could be a gain over gender-stereotypical attractiveness, and in particular over feminine attractiveness of the kind that Baylor and collaborators work with. By turning towards androgynous attractiveness, one may get away from associations of attractiveness and women and femininity leading to conceptions like ‘a woman’s primary role or function is not competence but to be good-looking and to attract’.
Our approach to androgyny is overall optimistic. We consider it a large space with many possibilities for combinations of characteristics – those classified as feminine and those classified as masculine. Other researchers who express an optimistic view on the boundary widening potential in digital world with respect to gender are Haraway (1991), Turkle (1995), Gilmour (1999), and Chess (2006). They all argue, in various ways, that androgyny in the digital world is a rich continuum with many possibilities for femininity, masculinity, both or neither.

Programmes with male students in the minority
The second study would focus on a domain with under-representation of male students, in contrast to the presented study which has focused on images of computer engineering, a domain where women are under-represented.

The underlying issue regards the possibility to influence such situations by offering examples that differ from culturally dominant prototypes of engineers, nurses, etc. We wish to explore the potential in virtual worlds to offer a broader range of styles and identities than in the real world. Can this be a place where cultural images are constructed, with potentials to countering other cultural representations of gendered technology? A number of researchers discuss or propose this (e.g. Reeves & Nass, 1996; Rommes, 2007), and we find it highly interesting. Not the least given the dynamics and interactivity of these novel digital media, which might make them even more powerful in mediating cultural norms than traditional media.

Dedicated gender pedagogical tools
Going one step further, there is a potential for a third study, constructing dedicated digital tools based on virtual characters to support gender perspectives in teaching/education. Already we see tools used for experimentation with simulations and virtual role-games, and toolboxes for designing virtual characters, such as SitePal (www.sitepal.com), PeoplePutty (www.haptek.com), and Meez (www.meez.com).

The use of such tools imply that a number of design decisions must be made: ‘What is this judge, this police officer and this arrested person going to look like and speak like?’, ‘Which gender, age, ethnicity, clothing, voice, and dialect shall we assign to them?’. Educationalists interested in discussing and challenging prejudices and proposing alternatives now have an opportunity to use such a situation as a basis for reflection and discussion: ‘Why did we choose this character in this role?’; ‘Whose appearance is exposed and whose voice is heard, in terms of gender, age, ethnicity, class, regional subgroup, etc?’, ‘What features did we combine with one another and which not?’.

Notably, various alternatives may be suggested and tried out. Such an active and dynamic situation can provide a natural basis for reflection and discussion – in contrast to a more disconnected classroom discussion on stereotypes.

This is perhaps particularly important in the academic context, where language and other abstractions often have a strong position compared to a more tangible visual tradition. Yet we know that visual, and other perceptual, stimuli and codes have a subtle but powerful influence on us all (Schneider, 2003). It is therefore unlikely that real success in attempts to reconstruct gender structures can be reached by too much focus on language. Perhaps virtual characters can help in the endeavor.
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**REFERENCES**


FOOTNOTES

1 An anecdotal observation in the context is that the Swedish “James Bond like” master spy Carl Hamilton (from books and films) has an alias as a computer expert.

KEY TERMS AND DEFINITIONS

Virtual pedagogical character
Computer generated character in a pedagogical role, for instance a virtual instructor, mentor, coach or learning companion. Appearing in educational programs, from preschool to university and in broader educational contexts such as edutainment.

Gender
The concept refers to the social and cultural processes that shape conceptions of women and men, masculinity and femininity.

Stereotype
A culturally shared conception of a “typical” representative of a human category, where a number of attributes are ascribed to this category and its representative.

Gender stereotype
An important aspect of many stereotypes, since a stereotype often “has a gender”. For instance a “typical craftsman” is a man and represents masculinity and a “typical air hostess” is a woman and represents femininity.

Androgynous
Transgressing gender boundaries, combining both feminine and masculine traits. (N.B. Androgynous differs from “non-gendered” in the sense of showing neither feminine nor masculine traits.)

**Role modeling**
A phenomenon where someone (a real or imagined person or representation) serves as an example and/or inspiration for another person – as someone that this other person would like to be associated with and be or become similar to.

**Identification**
While “role modeling” refers to what a person may strive for or wish for, identification refers to the ability to actually see oneself in another person or character.

**Cultural image**
A socio-culturally generated conception of a common agreed upon typical instance or representation of something – e.g. what a computer engineer looks like, is characterized by and what it means to be a computer engineer. (Cf. “stereotype”.)