

Mapping the Demographics of Virtual Humans

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ABSTRACT

This paper presents a census of 147 virtual agents, by examining and reporting on their physical and demographical characteristics. The study shows that the vast majority of agents developed are from a white ethnic background. Overall, female agents tend to be more photo realistic than their male counterparts who are more cartoon like. These findings highlight current stereotypes in relation to agents and contribute to a deeper understanding of virtual worlds.

Categories and Subject Descriptors

Human Factors

General Terms

Design and Human Factors.

Keywords

Embodiment, agents, age, gender, race.

1. INTRODUCTION

In the last few years, virtual bodies have become increasingly prevalent in HCI (for example, embodied conversational agents, ECA's, and avatars). ECA's are defined as being synthetic characters (full body, graphical or physical simulations of people) that can maintain a conversation with a user [1]. An ample amount of research on ECA's has been concerned with how to emulate human conversation following the assumption that ECA's will have the same properties as humans in face to face conversation [2]. This line of research has led to the definition of relational agents, as computational artifacts designed to build long term, social-emotional relationships with their users [3]. There are many domains which could benefit from the deployment of relational agents; such as in online shopping, e-learning, advice giving, behavioural change therapy, helping people to stop smoking or dieting, counseling, or coaching them [4].

The debate on anthropomorphism and its implications in designing agents with more human-like qualities has been going on for quite some time. Walker et al. [5] found that people spent more time interacting with a talking face display than text-only interface. Sproull et al. [6] showed that users were more positive in their response to a face by spending more

time with it than with a text only version, where users quickly got bored. Reeves and Nass [7] clearly identify several benefits of the anthropomorphic approach by concluding that people respond to computer agents in fundamentally the same social ways as they would to another person.

A recent trend in anthropomorphic design has seen an increase in research on the effect of demographic and physical appearance variables of virtual agents. According to De Meuse's [8] taxonomy, a number of non-verbal variables affect face-to-face communication. These variables can be broken up into those cues that are behavioural in nature and those which are not. Non behavioural actions are *demographic variables* (ethnicity, age and gender) and *physical appearance variables* (clothing/attire, bodily and facial attractiveness). Demographic variables are not under an individual's control, whereas physical appearance cues can be subject to rapid change. Hence, cues such as hair/eye colour, cosmetics, clothing style can all affect social reactions to an individual's or an agent's. [9].

When looking at the importance of such demographic elements in embodiment, studies have shown that users prefer interacting with agents that either match their own ethnicity, or agents that are young looking [9]. The design of pedagogical agents' ethnicity and gender do influence learner perception of agent personality, motivational qualities, and perceived influence on the learning process. Students also perceived agents of the same ethnicity to be more engaging and affable. In particular, African-American learners were more likely to choose a pedagogical agent of the same ethnicity, and have a positive attitude towards this chosen agent after the lesson [10].

Baylor and Kim [11] draw attention to the impact of demographic variables and realism of pedagogical agents on learners. The findings suggest that students had a greater transfer of learning when agents were more realistic, and when the agents were represented non-traditionally (as black versus white) in the 'expert' role. The more realistic looking agents positively affected transfer of learning. Students which worked with the Black Expert agents found this quite novel, and thus paid more attention to the black agents than the white expert counterpart (the 'novelty effect').

As regards to gender, Hone [12] suggests that a female agent is more effective than a male agent in reducing frustration. Hence, frustration reduction is improved when an agent is embodied. Furthermore, a study showing female agents acting as a non-traditional engineer (e.g. very attractive and outgoing) significantly enhanced student interest in engineering as compared to a more stereotypical 'nerdy' version (e.g. homely and very introvert) [13]. Female learners have been reported to prefer and choose a cartoon like pedagogical agent (as opposed to realistic looking agents) more often than their male

counterparts [10]. Despite this growing corpus of evidence suggesting a significant role of physical variables of virtual embodiments, at present, little research has evaluated the demographic characteristics of existing agents. In this paper, we report a census of virtual agents by looking at physical characteristics of existing ones. The main aim of this study was to determine what type of demographic and physical variables were commonly or rarely being assigned to agents.

2. METHOD

A database of 147 virtual faces was analysed. These faces were collected by conducting internet searches in online journals and conference proceedings (ACM library and Science Direct), search engines (Google Scholar) and Conference sites (IVA: Intelligent Virtual Agents conference from 2003) using the following keywords: Embodied Conversational Agents (ECA's), Synthetic Agents, Social Agents, Conversational Agents, Virtual Agents, Virtual human, Agents and Avatars. Several e-mails were also sent to mailing lists (British HCI, CHI Announcements, CHI Students) and individual researchers to invite them to share pictures of Agents/Avatars they had utilised in their research.¹

Agents were selected based on the following criteria: (a) Human like (No animal characters), (b) Frontal view only, and (c) Good quality image (at least 10 x 10 cm). Each agent was assigned a unique ID and recorded in a database system (Microsoft Access). The following attributes were researched and recorded in relation to each agent: Gender, Age, Ethnicity, Dressing Style, Profession, Anthropomorphism level, and Name. A coding/classification system was developed by the authors for each of the mentioned attributes. The source of each agent was recorded including details of the paper and authors who utilized/developed them in their research.

2.1 Framework of analysis

The framework of analysis was developed following an iterative process to accommodate different agent characteristics. Categories were refined and modified during the process. Double coding was conducted for 20% of the database yielding a reliability of almost 90%. All faces were coded according to a number of demographic and physical appearance variables [8]. Gender was divided into two categories: *Male and Female*. The remaining variables are discussed as follows:

Age consisted of four distinguished categories:

- *Child* – An individual between birth and puberty;
- *Young Adult* – An individual between puberty/teens and the age of 30;
- *Adult* – An individual between ages of 30 and 50; and
- *Older Adult* – An individual over 50.

Ethnicity consisted of 4 categories:

- *White* – Faces originating from Caucasian/European background;
- *Black* – Faces originating from African background;
- *Asian* – Faces originating from South Asian background; and

- *Oriental* – Faces originating from the Far East.

Dressing style was divided into 4 groups:

- *Casual* – Informal clothing and not dressy;
- *Formal* – Designed for wear or use in certain occasion/event or role;
- *Uniform* – A job specific outfit; and
- *Missing* – No outfit is visible, only face and neck displayed

Embodiments were also clustered into four broad categories according to their **level of anthropomorphism**:

- *Cartoon* – faces which do not represent real people. They can be sketches, or humorous images often displaying some exaggeration of facial characteristics (caricatures);
- *Drawing* – 2 dimensional representational images featuring human-like faces;
- *Mannequin* – 3 dimensional representational images of human-like faces; and
- *Photo realistic* - Pictures of real human beings or artificial faces which are extremely human like, so that they could be erroneously attributed to a real person.

Profession consisted of 5 main roles (the role source was where the agents were retrieved from as described in the paper):

- *Pedagogical Agent* – Agent that facilitate the learning process;
- *Actor* – Performs the role of a character within a scenario;
- *Storyteller* – A narrator of anecdotes, incidents, or fictitious tales;
- *Assistant* – Agent who assists, supports, guides and helps the user; and
- *Presenter* – Agent which presents/read out the daily news and weather forecast.

Name was classed into two groups:

- *Name* – Agent with a personal human like name (such as Peter, and Lucia); and
- *No Name* – Agent with no human like name.

3. RESULTS

Queries were used in order to collect data. The focus was on gender in comparison to the other attributes previously stated. Virtual embodiments were evenly divided between males (n=73) and females (n=74). Table 1 reports the frequency values for male and female agents as a function of their ethnicity. The vast majority of these agents were white (84%). The remaining ones were Black (n=17), Oriental (n=1), and Asian (n=5).

¹ The reason for concentrating on academic sources is due to the need for limiting the scope of our project, and looking at innovative design solutions which will constitute the future internet populations of virtual avatars.

Table 1. Gender by Ethnicity frequency distribution

	Male	Female	Total
Whites	61	63	124
Others	12	11	23
Total	73	74	147

A trend analysis indicated that non-white agents started to appear in 2004 [14], and are growing fast in number since then [10, 15].

Table 2 compares the frequency values for male and female agents as a function of their Age. It appears that the bulk of agents are young adults. There is an interaction between age and gender, where Adults and Older Adults are largely made up of males, and Young Adults are predominantly female.

Table 2. Gender by Age frequency distribution

	Male	Female	Total
Child	7	4	11
Young Adult	46	62	108
Adult	11	5	16
Older Adult	9	3	12
Total	73	74	147

Data on Dressing Style are summarised in Table 3. Agents were chiefly in Casual dress with no specific gender effect. An equal number of male and female agents could not be attributed any Dress Style (Missing), while only 2% of agents were dressed in a uniform.

Table 3. Gender by Dressing Style frequency distribution

	Male	Female	Total
Casual	42	46	88
Formal	13	11	24
Uniform	2	1	3
Missing	16	16	32
Total	73	74	147

A vast number of agents (75%) did not possess a name. Leaving 25% of agents with names, out of which almost half were assigned a role and the other half without. When looking at Age by Role it was surprising to see that over 90% of Child agents were Actors. Amongst Young Adults, Adults and Older Adults, the Pedagogical role was the most frequently assigned. Investigating Age by Anthropomorphism level highlighted over 90% of Child agents having a Cartoon like face. Amongst the other three age groups, each of the Anthropomorphic levels were distributed evenly.

Figure 1 illustrates frequency values for male and female agents as a function of Anthropomorphism. It is evident that a larger number of male agents are Cartoon like in comparison to female agents. Conversely, the number of female agents significantly increases as the realism of an agent increases.

Photo realistic agents are primarily female thus showing a specific gender effect.

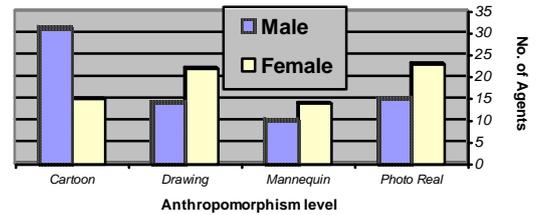


Figure 1. Gender by Anthropomorphism

Figure 2 represents agents that had a role assigned to them. Almost 46% of agents had no defined role showing no specific gender effect. The most common profession for a virtual agent is that of a tutor. The roles which are least common are those of a Storyteller and Presenter.

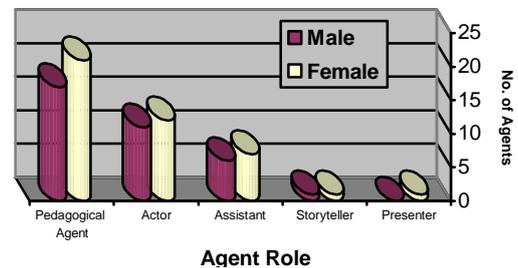


Figure 2. Gender by Role

4. CONCLUSION

The findings of our study add to a growing body of literature on the effect of agents' demographics on user perception, by presenting a census of this virtual world. This census can give an insight into the stereotypes of virtual agents held by their designers and is useful to predict biases and difficulties in the interaction with these virtual agents.

Our study indicates that females are in general more photorealistic and anthropomorphic than their male counterparts who are usually represented as cartoon like agents. This suggests that more emphasis is focused on the female appearance. Studies have shown [16] that the physical attractiveness stereotype is more potent when applied to women than to men, and females are generally seen as being more attractive than males. Thus the real-life bias which expects females to look more attractive than males may lead to the reason why the female agents are more realistic than the male counterpart.

Earlier research has shown [9, 10, 17] that users in general prefer to interact with agents of a similar ethnicity to their own. The results in this study clearly show that the vast majority of agents are from a white background, leading to a large mismatch between potential users and available agents. This may be due to the bulk of designers coming from a principally white background, as we have only analysed publications in English. Yet, we believe that this finding highlights a prevailing ethnocentric approach to agent design, which may strongly hamper their global adoption.

A point designers need to consider is that the presence of a wholly white agent world with a handful of agents from other ethnic backgrounds could increase the tendency of racist

behaviour towards the non white agents. Long ago, social psychology has posited a clear link between discrimination and minorities. More agents from various ethnic backgrounds should be developed in order to counteract this issue.

The vast majority of agents are young adults, and only a handful are classed as children. The reason for developing more younger adult agents may be the designer's view that the vast majority of users are also young adults who may prefer to interact with agents of a similar age group, backing Cowell et al. study [9]. On the contrary, these days users range from nursery children to the old aged pensioners. Ideally, these age groups should also be considered when developing agents. Yet, the results in this study indicate a minimal number of child and older aged agents being used.

The most prevalent type of role assigned to an agent is that of a pedagogical one. Perhaps this is the role researchers see most fitting for an agent; as a tutor, advisor and guide. Agents can play far more diverse roles, rather than being cocooned into the pedagogical role. Further work needs to be done to assign more agents to other roles and professions like a news/weather presenter, storyteller, online sales assistant and so on. This study highlights Child like agents predominantly playing an acting role; researchers should be aware of the benefits of assigning other roles to them (such as a kindergarten tutor or storyteller). The implications of these findings for design are:

- The function and role of an agent must be acknowledged and high on the functional spec agenda before commencing the development of an agent. Different embodiment may fit different roles, and it is important to clarify this relationship.
- What kind of user will be interacting with the agent? For example, are the users young or old? What is their gender as well as their cultural and ethnic background? Thus, agents can be modified according to the users that will interact with them.
- Allowing the user to choose from a drop down list of options as to what age, gender, and race they would prefer their agent to possess before interaction. This is more crucial in light of HCI's commitment to interfaces that are equally accessible and acceptable to all intended users.
- Agent designers should take greater care when choosing how to represent the agent's ethnicity, gender, and realism.

Further research will be conducted into the effects of the physical appearance of agents on user behaviour. In particular, the effect of agent facial attractiveness on the user perception has yet to be investigated

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5. REFERENCES

- [1] Olivier, P. (2004). Gesture Synthesis in a Real-World ECA, In: Elisabeth André, Laila Dybkjær, Wolfgang Minker, Paul Heisterkamp (Eds.): *Affective Dialogue Systems*, Kloster Irsee, Germany, *Proceedings*.
- [2] Cassell, J. (2000). Embodied Conversational Interface Agents. *Communications of the ACM*, 43, 70-78.
- [3] Bickmore, T. (2003). *Relational Agents: Effecting Change through Human-Computer Relationships*, MIT Ph.D. Thesis.
- [4] Bickmore, T. and Picard, R. (2005) "Establishing and Maintaining Long-Term Human-Computer Relationships" *ACM Transactions on Computer Human Interaction (ToCHI)*, 12(2): 293 – 327.
- [5] Walker J. et al. (1994). Using a Human Face in an Interface. *Proceedings of CHI '94*, ACM Press, 85-91.
- [6] Sproul et al. (1996). When the interface is a face. *Human-Computer Interaction*, 11, 97-124.
- [7] Reeves, B., & Nass, C. (1996). *The Media Equation: How people treat computers, television, and new media like real people and places*, Cambridge: Cambridge University Press.
- [8] De Meuse, K. P. (1987). A Review of the Effects of Nonverbal Cues on the Performance Appraisal Process. *Journal of Occupational Psychology*, 60, 207- 226.
- [9] Cowell, A. J. & Stanney, K. M. (2005). Manipulation of non-verbal interaction style and demographic embodiment to increase anthropomorphic computer character credibility *International Journal of Human-Computer Studies*, Volume 62, Issue 2, Pages 281-306
- [10] Baylor, A. L., Shen, E., & Huang, X. (2003). Which Pedagogical Agent do Learners Choose? The Effects of Gender and Ethnicity. Paper presented at the E-Learn (*World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education*), Phoenix, Arizona.
- [11] Baylor, A. L. & Kim, Y. (2004). Pedagogical Agent Design: The Impact of Agent Realism, Gender, Ethnicity, and Instructional Role. *Presented at International Conference on Intelligent Tutoring Systems*, Maceio, Brazil, p 592-603.
- [12] Hone, K., (2006). Empathic agents to reduce user frustration: The effects of varying agent characteristics. *Interact. Comput.* 18, 227–245.
- [13] Baylor, A. L. (2004). Encouraging more positive engineering stereotypes with animated interface agents. Unpublished manuscript.
- [14] Morency, L. P., and Darrell, T. (2004). From Conversational Tooltips to Grounded Discourse: Head Pose Tracking in Interactive Dialog Systems, *International Conference on Multimodal Interfaces*, pp. 32-37, College State, PA, October
- [15] Cassell, J., & Miller, P. Is it Self-Administration if the Computer gives you Encouraging Looks? (in press) In F.G. Conrad & M.F. Schober (Eds.), *Envisioning the Survey Interview of the Future*. New York: John Wiley & Sons.
- [16] Cross, J. F., & Cross, J. Age, sex, race, and the perception of facial beauty. *Developmental Psychology*, 1971, 3, 433-439.
- [17] Moreno, R., & Flowerday, T. (2006). Students' choice of animated pedagogical agents in science learning: A test of the similarity-attraction hypothesis on gender and ethnicity. *Contemporary Educational Psychology*, Volume 31, Issue 2, Pages 186-207