DeEvA, a Depot of Evolving Avatars

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Abstract. This paper introduces the DeEvA platform for the generation of virtual characters. The platform generates virtual characters using personality traits as input. The generation process is conceived to generate characters whose physical appearance responds to people's expectations. Characters generated using the platform can be used as believable Embodied Conversational Agents in interactive applications. The platform uses a combination of crowdsourcing techniques: Reverse Correlation and Interactive Genetic Algorithms. This paper describes the method as well as three working examples.

1 The importance of the appearance of virtual characters

Virtual characters are widely used in video games and movies. In these contexts, the production pipeline for virtual characters is the state of the art; it involves many professions, such as designers, modellers, and riggers, and it is thus very expensive and time consuming. However, there are contexts where such costs are unsustainable as, for example, in the creation of personalized Embodied Conversational Agents (ECAs) for healthcare or personal assistance. For these contexts it is still acceptable to use a virtual character whose quality does not match the high standards demanded by consumer industry. Nevertheless, the believability of the character can not be compromised by an inappropriate design. As shown in [6] and [1], ECAs are more effective, for a given duty, when their appearance corresponds to user's expectations. Due to the tendency of people to judge others according to their appearance [4], the ECA is believable only if it fulfills the expectations of the users in associating its personality to its appearance and to its behavior [5].

This paper introduces a method conceived to generate virtual characters from a symbolic description of their personality traits. The method uses a combination of two crowdsourcing techniques: reverse correlation and interactive genetic algorithms. The method has been implemented in web platform called DeEvA (Depot of Evolving Avatars)[3].

[3] https://deeva.mmci.uni-saarland.de/ - November 12th, 2015

2 Mapping symbolic descriptors to appearance

The method underlying DeEvA has been already described in detail in a previous publication [7] and it is summarised in the following.

The method is based on the use of Interactive Genetic Algorithms (IGAs) [3]; *interactive* because the computation of the fitness function is based on the contribution of human beings at each iteration of the algorithm. The administrator of DeEvA configures an experiment to find correlations between a set of *personality traits* and a set of *physical attributes*. At the beginning, DeEvA generates a set of virtual characters by associating random values to the physical attributes. The characters are shown to human users, who vote using Likert scales (see Figure 1 for an example). The votes are used to compute the fitness value of each character. When the users provide a sufficient number of votes, DeEvA elects the best rated individuals for a migration to the next generation of the genetic algorithm. Additional individuals are generated by cross-over and mutation of the elected ones. The way users vote the individuals is a Reverse Correlation technique, which is used in the field of psychology to find correlations between traits and appearance. The combination of the Reverse Correlation with a Genetic Algorithm is conceived to improve the correlation at each iteration. The experiments published in [7] partially confirm the effectiveness of this approach.

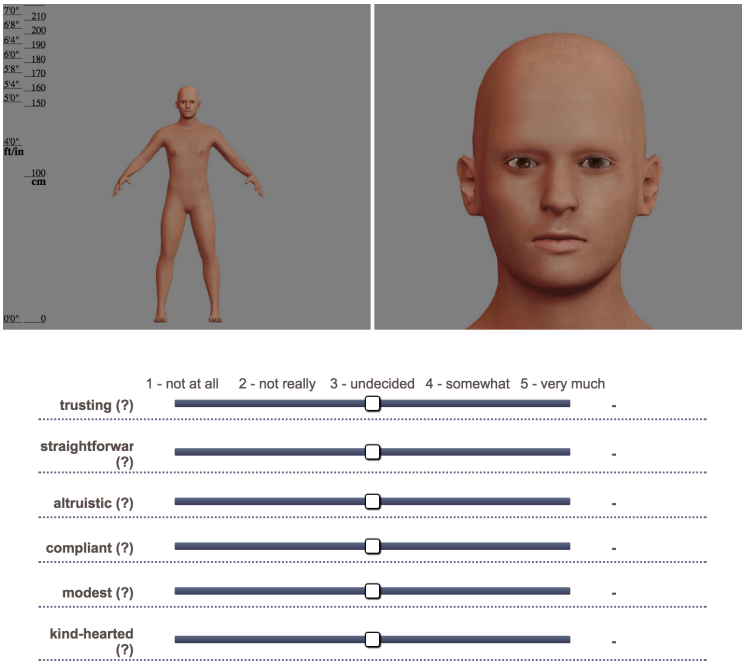

Fig. 1. Voting a character in the experiment *Does gender affect Agreeableness*?

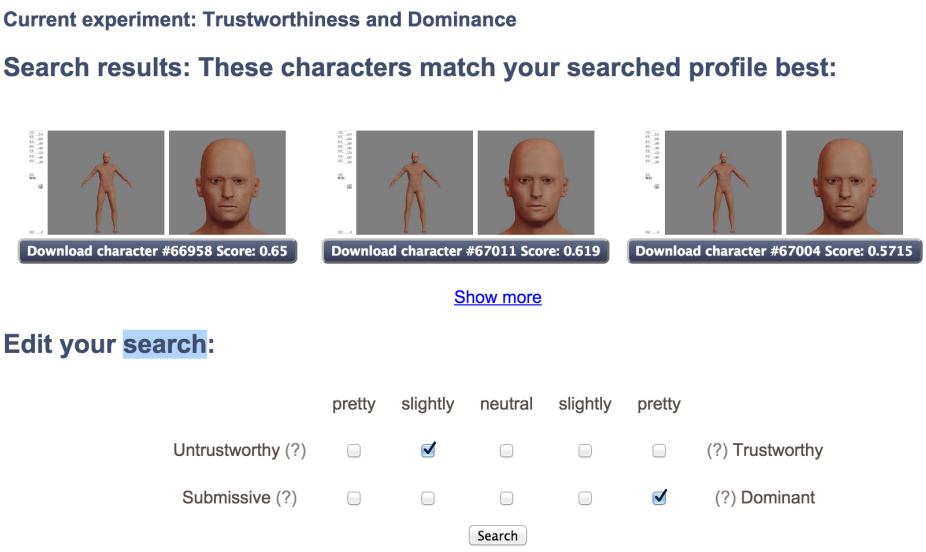

Fig. 2. Search results for the experiment *Trustworthiness and Dominance*

DeEvA offers also the possibility to "generate" virtual characters from a personality profile. A profile is a list of values, one for each trait, based on the same Likert scale used in the voting phase. The generation of a character is in fact implemented by searching for the individuals with the best fitness values within the space of the selected profile. Figure 2 shows an example.

3 Running experiments

This paragraph summarizes the results of two experiments, already presented in [7], and describes a new experiment recently conducted.

The experiment *Trustworthiness and Dominance* aimed at finding correlations between the aforementioned traits and two physical attributes: Age and Gender. The data analysis shows the potentiality of DeEvA in improving the correlation results through genetic evolution. The collected data present a correlation factor between Dominance and the combination Age+Gender of 0.56. The correlation factor increases to 0.61 when considering only the best 50% individuals, and raises to 0.77 when considering only the best 25% individuals. This result suggests that indeed the fitness function selects the best representatives for a generation.

The experiment *What affects dominance?* confirms the ability of DeEvA in supporting reverse correlation experiments. Coherently with previous research results, the data analysis shows that the perception of the dominance is correlated with the following physical attributes: the size of the bones of the chin, the inclination angle of the eyebrows, the rectangularity of the face, the width of the neck, and the width of the torso.

Our latest experiment, *Does gender affect Agreeableness?*[4], aims at finding the correlation between six facets of the Agreeableness trait (trusting, straightforward, altruistic, compliant, modest, and kind hearted) with two physical attributes influencing the perception of the gender (gender and breast size) and two other confounding variables (body proportion and age). Figure 1 shows a screenshot of the voting page. The age has been modulated in the range 0.4-0.6 (i.e., from 20 to 38 years old). The body proportions has been constrained to values which keeps the character to believable aesthetics (0.25 to 0.75). The gender and the breast size attributes are left to full range 0.0 to 1.0.

The experiment collected 68 votes from 14 different people, 6 males and 8 females, average 28.3 (standard deviation 8.0). Each user voted an average of 5.2 characters (standard deviation 9.2). The collected data have been analysed to discover how the physical attributes influence the perception of the traits. The analysis consisted of fitting a linear model predicting each trait separately. Table 1a reports the adjusted R-squared correlation value for the prediction of each trait using all the four physical attributes. In most cases, the Gender attribute has the biggest influence, as shown in the last column, which reports the p-value for the Gender. Existing research already provided evidence of a positive correlation between the gender and real agreeableness of individuals [2]. This experiment suggests that, in judging from aesthetics, the perception of agreeableness is influenced by the gender, at least in five out of six of its facets.

Table 1. (a) Correlation when predicting traits with all variables: *trait* ~ BreastSize + BodyProportions + Age + Gender. (b) The best prediction model for every trait obtained through a backward elimination using adjusted R-squared.

trait	R^2_{adj}	p for Gender
trusting	0.211	< 0.05
straightforward	0.176	< 0.05
altruistic	0.197	< 0.05
compliant	0.213	< 0.05
modest	-0.027	0.631
kind hearted	0.161	< 0.05

(a)

trait	predictors	R^2_{adj}
trusting	BreastSize + Gender	0.221
straightforward	Gender	0.204
altruistic	Age + Gender	0.221
compliant	Gender	0.244
modest	BreastSize	0.002
kind hearted	Age + Gender	0.182

(b)

In order to find the prediction model which maximises the correlation factor between the physical attributes and each of the traits, a backward selection using adjusted R-squared has been conducted. Table 1b reports the best combination of predictors and what is the relative correlation factor. The results show that gender is responsible for the perception of most of the agreeableness facets, except for modesty. For some traits, there is a marginal improvement in the prediction when combining the gender with either breast size or age.

[4] https://deeva.mmci.uni-saarland.de/individuals/vote/13 - November 12th, 2015

4 Conclusions

This paper presented a method for the generation of virtual characters from personality traits. The method uses a combination of two crowd sourcing techniques, reverse correlation and interactive genetic algorithms, to define a mapping between personality traits and physical attributes. In a previous work, the authors already demonstrated the potential of genetic algorithms to increase the performances of reverse correlation techniques. This paper presents the results of another experiment aiming at finding correlation between gender and the perception of agreeableness. Future work will focus on switching from a Likert rating to a pair-to-pair comparison in order to reduce voting biases. Future experiments will be conducted by taking advantage of massive crowdsourcing services in order to evolve over several generations.

The method has the potential of changing the production pipeline of low-cost character generation. By providing a symbolic description of a character's personality, the platform provides candidate avatars whose aspect fits with the context of application in a fraction of the time needed with traditional production practices.

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