The Attractiveness Stereotype in the Evaluation of Embodied Conversational Agents

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Abstract. Physical attractiveness is an important cue for social interaction. Psychology studies have long shown that physical attractiveness can elicit positive personality attributions as well as positive behaviour towards other people. This effect is explained by the attractiveness stereotype. In this paper, we investigate whether this stereotype apply to the interaction with virtual agents. We report the results of two experiments where the attractiveness stereotype was tested with and without interaction with the agent. Results indicate a strong effect of the attractiveness stereotype, showing that users tend to form and maintain a better evaluation of attractive agents than of unattractive ones independent of actual interaction with the agent or the agents' ethnicity. Implications for design are discussed.

Keywords: Embodied conversational agents, user evaluation, virtual bodies.

1 Introduction

Since the media equation paradigm posited a link between computers and social actors [1], a large corpus of research has investigated the role of social cognition in HCI [2, 3]. Embodied Conversational Agents (ECA's) are a favourite target for this type of research as their anthropomorphic aspect tends to elicit social inference. There is evidence that virtual bodies carry with them stereotypical attributions and that users respond differently to ECA's based on their gender [4, 5], age [5, 6], and ethnicity [2, 5]. Stereotypes are widely shared generalisations about people as members of a social group, whereby group members are attributed similar characteristics on the basis of the categories to which they belong regardless of actual variation [8]. Stereotypes strongly influence social behaviour by providing default setting information for perception and action. Stereotype-based expectations are also believed to shape personality development due to social pressure [9].

In this paper, we investigate the effect of the attractiveness stereotype on the perception of, and behaviour with, ECA's. According to the attractiveness stereotype, nice looking people are perceived as more socially competent, more intelligent, friendlier, and more successful in life than less attractive people. Results of two experiments provided strong evidence that users apply the attractiveness stereotype in the evaluation of ECA's, independently of actual interaction with the agent or its ethnicity.

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2 Related Work

Despite popular belief that "beauty is in the eye of the beholder", social scientists have demonstrated that attractiveness is defined by social consensus both within and across cultures and independently of gender [10]. Three main factors make a face attractive: symmetry, averageness and sexual dimorphism [11]. The more symmetrical a face is, then the more attractive it is perceived to be. Averageness refers to typicality of traits constituting a face, whereas sexual dimorphism signals the reproductive potential and sexual maturity of an individual. Research on sexual dimorphism suggests that attractive feminine traits corresponds to large eyes, high eyebrows, full lips, small nose, small chin, prominent cheekbones and narrow cheeks. Whilst, masculine traits such as square chins, thin lips, small eyes, and thick brows tend to signal dominance and status which enhance their mating value.

One of the earliest evidence of the attractiveness stereotype was reported by Dion and colleagues [12]. The authors asked participants to rate three photographs of fellow undergraduate students in terms of personality traits and behavioural characteristics. The stimuli differed on physical attractiveness: one picture represented an unattractive face, the second an average looking face, and the third an attractive face. Participants consistently attributed to attractive individuals more socially desirable traits than to unattractive individuals. Attractive individuals were also deemed to lead better lives in terms of occupational success and relationship satisfaction than their unattractive counterparts. Since this work, a large corpus of psychological research has investigated the reliability of the attractiveness stereotype. This research can be differentiated into three main streams according to objectives and methodology.

The first stream focused on the definition of the content of the stereotype adopting the stranger-attribution paradigm [7, 9]. Participants were invited to rate personality traits, as well as behavioural, social and emotional characteristics of hypothetical individuals depicted in photographs, sometimes enriched by minimal written information. Two independent meta-analyses of the stranger-attribution literature confirmed the strength of the attractiveness stereotype independently of gender and age of both evaluators and targets [7, 9]. Both meta-analyses concentrated on North American participants and highlighted very similar trait components of the stereotype [13]. Large to medium sized effects were found on all dimensions related to social behaviour, confirming that attractive people are perceived as possessing better social skills, and being more popular and more extrovert than unattractive individuals. Large effects also appeared in the perception of sexual warmth, suggesting that attractive people, and in particular attractive females, are perceived as being more sexually responsive. Medium sized effects were evinced for dimensions related to cognitive skills and dominance: attractive people are perceived as more intelligent, rational and bright, as well as being more dominant and assertive than unattractive people. No effect of attractiveness was found on character perception (e.g., trustworthiness, sincerity and honesty) or on concern for other. Negative effects emerged on modesty, implying that attractive people are perceived as vainer than unattractive people.

The second stream of research [9] investigated the objectivity of the attractiveness stereotype via correlational research looking at the relationship between self-rated attractiveness and measures of personality, social skills and mental ability. A meta-analysis of this research provided evidence in favour of the attractiveness stereotype

only with regard to personality traits related to social behavior (e.g., loneliness, self-consciousness and social anxiety), social behavior measures (e.g., number of friends and popularity with the opposite sex), and self-reported measures of sexual permissiveness.

The third research stream extended the stranger-attribution literature to more ecologically valid situations [10] with studies of social interaction, whereby the attractiveness stereotype was measured after actual interaction with a target. A set of meta-analyses revealed the persistence of the attractiveness stereotype even when the perceiver could make an informed judgment [10]. Attractive individuals (child or adult) were evaluated and treated more favourably than unattractive individuals by other people, even by those who knew them. These meta-analyses also revealed that attractive adults and children tended to display significantly more positive behavior than unattractive individuals.

Several theoretical frameworks have been invoked to explain the attractiveness stereotype. Fitness-related evolutionary theories posit that attractiveness is linked to health and reproduction fitness [10]. On the contrary, social expectancy theories stress the influence of socialization mechanisms, claiming that expectations about an attractive person influence people's interaction with that person who eventually change their self-perception and behavior in line with the social expectations [10]. Although no individual theory seems to explain the complexity of the effect, there is no doubt that attractiveness is a powerful and cultural independent cue driving interaction [10, 13].

A growing number of studies have investigated social affordances of 'virtual bodies', showing that their demographics subtlety affect user behaviour. For example, people tended to be more influenced by a virtual agent of the opposite sex [4] and preferred interacting with an agent of their same ethnicity [2, 5]. Attractive agents were regarded by users as being more persuasive and effective sales agents in purchasing goods [14]. A relevant corpus of research has addressed the perception of avatars, as mediators of human-human interaction in virtual environments [15, 16]. Results showed that people tended to perceive feminine avatars as being more attractive than masculine avatars, and anthropomorphic avatars as being more credible and attractive [15]. In online dating environments, users tended to create more attractive avatars, and participants represented by attractive avatars were more willing to approach members of the opposite gender [17, 18]. Investigations into user behaviour in Second Life [19] have found that users report on making their avatars not only similar, but also somewhat more attractive than themselves. Such users with avatars that are more attractive than their real selves reported being more outgoing, extrovert, loud, and risk-takers in Second Life than in real life [19].

3 Experiment 1

This experiment was designed to test the reliability of the attractiveness stereotype in the evaluation of ECA's within the stranger-attribution paradigm. It applied as closely as possible the procedure proposed by [12] for stimuli selection and testing but it used pictures of agent faces instead of real faces. Similarly to the original study, which

selected photographs from a University yearbook, the agent faces were selected from a large data-base of agent embodiments used in ECA research [6]. Contrary to [12], however, only female faces were tested as the variance in attractiveness and realism of male faces was more limited and did not allow proper differentiation between stimuli. Based on the face-to-face literature, we formulated the following hypothesis: (H1) *Attractiveness will affect the initial impressions on embodied conversational agents: the more attractive the virtual agent, the more positive the user evaluation.*

3.1 Method

Participants and Design. A total of 30 students at the University of Manchester (15 Male, 15 Female) took part in the experiment. Approximately 36% of participants were 18-25 years old, and the rest were between 26 and 35 years old. Attractiveness (3) was manipulated within–subjects. All participants evaluated three agents (attractive, average and unattractive).

Stimulus Materials. Six pictures of young female agents were used as stimuli in the study. These pictures were previously rated for attractiveness and realism by 545 independent evaluators. The 6 pictures were selected following the procedure applied in [12]. The 6 agents were assigned to one of two sets, each containing one attractive, one average and one unattractive face (Table 1).

Table 1. Agents used in the study

Agent Set 1		
		
Attractiveness: 1.68	**Attractiveness:** 3.09	**Attractiveness:** 4.63
Realism: 1.98	**Realism:** 3.71	**Realism:** 4.39
Agent Set 2		
		
Attractiveness: 2.02	**Attractiveness:** 3.23	**Attractiveness:** 4.15
Realism: 2.39	**Realism:** 3.04	**Realism:** 3.37

The following selection criteria were applied: (*a)* human-looking faces from a white ethnic background; (*b*) high inter-rater agreement as to their physical attractiveness; (*c*) faces representing the very attractive and the very unattractive target were not at the extreme end of the attractiveness distribution; (*d*) faces had a neutral expression and; (*e*) neck and shoulders were displayed in the picture.

Procedure. The experiment took place in a usability laboratory. Participants were introduced to it as a study looking into the user's opinion of ECA's. Before the experiment, each participant was shown a short video giving examples of four online agents available on the Internet and invited to provide comments on them. They were then shown one of the three pictures from either agent set 1 or set 2 on a computer screen and invited to evaluate them filling an on-line questionnaire. Presentation order was randomized and each picture was visible in a prominent position of the screen until the participants submitted the questionnaire. On completion, participants were presented with all three images of the agents they had evaluated and asked further questions about their physical appearance.

Dependent Variables. Participants were invited to record their impressions of each face along 7 dimensions. A measure of *physical attractiveness* was collected to validate the reliability of the experimental manipulation. It was measured by the relevant sub-scale of the Interpersonal Interaction Scale [20]. *Social competence* (unsociable – sociable, unfriendly – friendly, introvert – extrovert), *intellectual competence* (unintelligent – intelligent, emotional - rational, unambitious – ambitious), *social adjustment* (unstable – stable, immature – mature, poorly adjusted – well adjusted), *potency* (weak – strong, unassertive – assertive, submissive – dominant) and *integrity* (dishonest – honest, untrustworthy – trustworthy, insincere – sincere) were measured for hypotheses testing. These dimensions are well-known components of the attractiveness stereotype [13] and were used in this study as they may also apply to the evaluation of ECA's. The items within this investigation were taken from [13]. A*nthropomorphism* was measured by two likert-items (The Agent is human Like, The agent is machine like) from [21].

3.2 Results

Reliability analyses returned satisfactory results for each dimension tested in the study and each level of attractiveness (Cronbach alpha > 0.80). Seven indexes were computed averaging scores on individual items for each attractiveness level. Mean scores were entered as dependent variables into seven 3*2 mixed-design ANOVAs, with attractiveness (3) as within-subjects factor and agent-set (2) as between-subjects factor. Linear contrasts were run to test the difference between consecutive values of attractiveness based on a linear model [22]. Partial eta-squared (η^2) was computed as estimate of effect size. Partial $\eta^2 = .01$ indicate small effects, partial $\eta^2 = .06$ medium effects, and partial $\eta^2 = 14$ large effects [23].

Manipulation Check. The ANOVA on physical attractiveness returned a very strong effect for agent attractiveness ($F_{(2,56)} = 135.88$, $p < 0.001$, partial $\eta^2 = .83$), and a significant interaction attractiveness * agent-set ($F_{(2,56)} = 12.29$, $p < 0.001$, partial $\eta^2 = .31$). The interaction was due to the unequal distribution of attractiveness levels

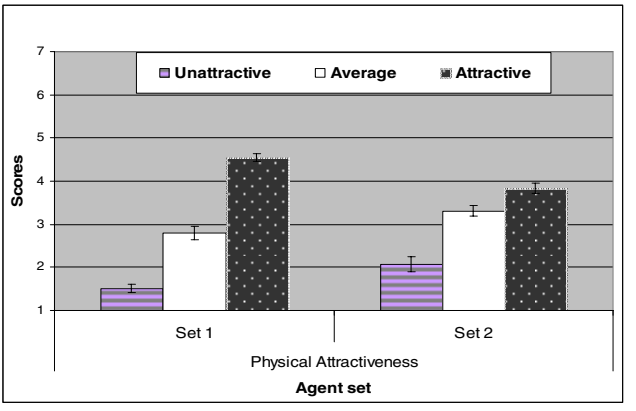


Fig. 1. Physical attractiveness scores as a function of experimental conditions

between the two agent-sets (Fig. 1). Although a significant linear trend was evident in each agent-set, the relative difference between attractiveness levels differed.

Test of Hypotheses. Perception of *social competence* was strongly influenced by attractiveness, $F_{(2,56)} = 97.68$, $p < 0.001$, partial $\eta^2 = .77$, with no interaction effect. Participants' evaluations increased linearly showing an improvement of about 1.5 points between consecutive levels of attractiveness.

The evaluation of *intellectual competence* and *social adjustment* revealed very similar patterns (Fig. 2). Both ANOVAs indicated a large main effect of attractiveness (in the order, $F_{(2,56)} = 51.99$, $p < 0.001$, partial $\eta^2 = .65$; $F_{(2,56)} = 45.52$, $p < 0.001$, partial $\eta^2 = .62$) and a significant 2-way interaction attractiveness * agent-set ($F_{(2,56)} = 7.22$, $p < 0.01$, partial $\eta^2 = .21$; $F_{(2,56)} = 9.19$, $p < 0.001$, partial $\eta^2 = .25$).

Although each agent set was affected by a significant linear trend, the increase between consecutive values of attractiveness was different. Set 2 followed a straight line, while the relative increase between the unattractive and the average looking agent in set1 was much larger than any other comparison, probably due to the lowest attractiveness scores of this agent.

Participants evaluated more attractive agents systematically better on the *integrity* dimension, $F_{(2,56)} = 54.5$, $p < 0.001$, partial $\eta^2 = .66$. The amount of improvement differed between the two agent-sets as reflected by the significant interaction attractiveness * agent set, $F_{(2,56)} = 3.3$, $p < 0.05$, partial $\eta^2 = .12$ (Fig. 3). The evaluation of agents in set 1 was more strongly affected by attractiveness than the evaluation of agents in set 2. Both sets however returned significant results to the linear trend test.

The ANOVA on *potency* as dependent variable displayed a different trend of results, due to the large interaction effect attractiveness * agent-set, $F_{(2,56)} = 7.52$, $p < 0.05$, partial $\eta^2 = .21$. Set 1 followed the linear trend evinced in all other analyses. In contrast, the most unattractive agent of set 2 was assigned the highest level on potency.

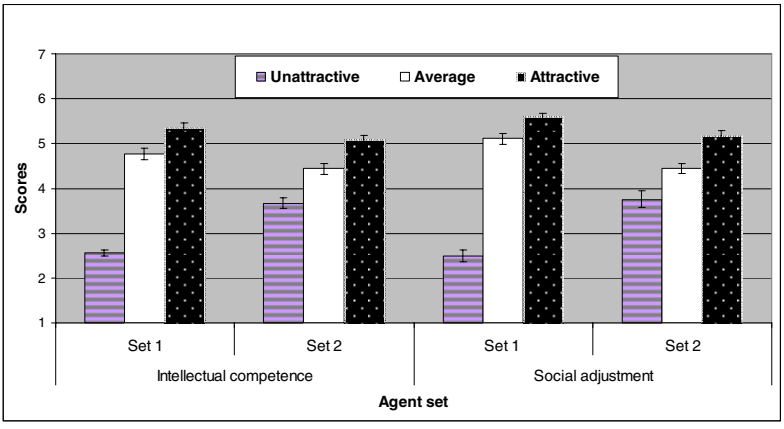


Fig. 2. Intellectual competence and social adjustment as a function of experimental conditions

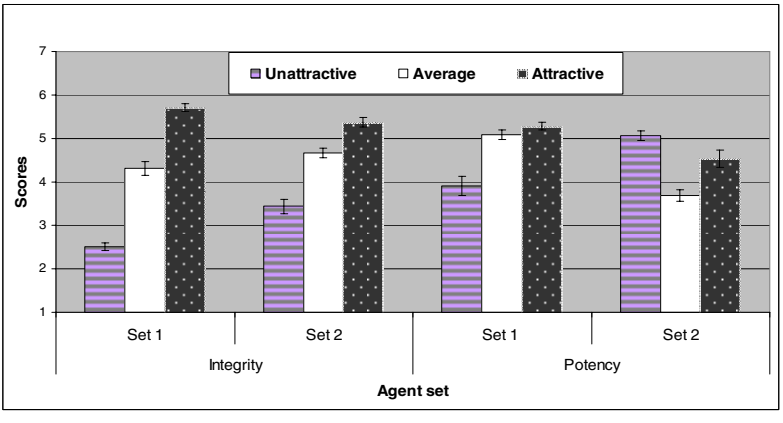


Fig. 3. Integrity and Potency scores as a function of experimental conditions

Anthropomorphism returned only a large main effect for attractiveness ($F_{(2,56)}$ = 41.59, $p < 0.001$, partial $\eta^2 = .59$). Both agent set 1 and 2 indicated a significant linear trend, but the increase varied between consecutive values of attractiveness.

3.3 Conclusion

The study provided strong support to the hypothesis that the attractiveness stereotype applies to ECA's, following the stranger attribution paradigm [7, 9, 13]. The components of the stereotype closely mirrored those of real humans. The large effect sizes for social competence, social adjustment and intellectual competence equalled the effect sizes reported in social psychology experiments. On the contrary, the effect size for integrity was much larger than that reported in studies with real human-beings. This suggests that the association between trustworthiness and beauty may be exasperated when the target is artificial and thus susceptible to limited attributions of intentionality.

The only exception to the attractiveness stereotype was the dimension of potency. This variable was found to be subject to variation also in studies with real human beings and it was hypothesised to reflect the North American stereotype which may not apply to collectivistic cultures [13]. The sample tested in our study was evenly split between Europeans and people from Eastern countries who may pay more attention to collectivistic values. However, the lack of effect on potency may also be due to the specific target analysed in this study. Indeed, it is reasonable to believe that potency assumes differential valence when applied to artificial agents or to real human beings. Users want ECA's to serve them [24]. Hence, in this context, dominance, assertiveness and strength may be associated to negative traits rather than to positive ones. This hypothesis was supported by several comments reported by participants during the final interview which highlighted difficulties in understanding and rating the dimension.

4 Experiment 2

To address the reliability of the attractiveness stereotype towards ECA's in a more ecological setting, a second experiment was designed whereby evaluations were collected before and after actual interaction with the agent [10] Participants were invited to engage in a spontaneous conversation with an embodied chatterbot for 10 minutes. Given the very strong impact of attractiveness on first impression of ECA's evinced in experiment one, and following the interaction studies literature [10] we hypothesized that (H1) an *advantage of attractive agents over unattractive agents would be evident also after actual interaction with the agent.* However, we also expected that (H2) *the effect should be weaker after interaction as participants acquired more contextualized information to inform their evaluation.* Therefore, we predicted to find smaller differences between the evaluation of attractive and unattractive agents after usage. This decrease was expected to be associated to (H3) *a more negative view of the attractive agents after interaction,* as they may pay the price of the high expectations raised at first impressions.

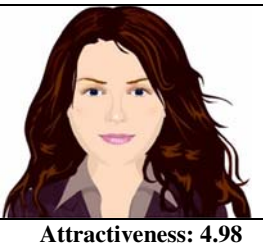
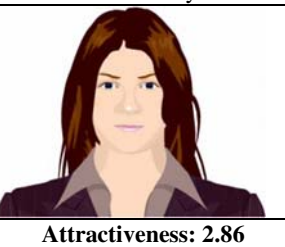
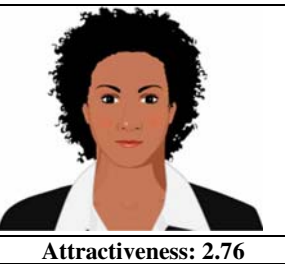
To account for the problems evinced in study 1 using existing embodiments, the stimuli for experiment 2 were created by manipulating the appearance existing agents.

4.1 Method

Participants. Forty-eight students (21 female, and 27 male) at the University of Manchester participated in this experiment. Over 60% of participants were 26-35 years of age, and around 30% were 18-25. Participants were randomly assigned to experimental conditions in equal size groups.

Stimuli. Six Oddcast female agents of different races were systematically manipulated to decrease their physical attractiveness, based on the literature on facial attraction. Modification criteria are summarised in Table 2 below. A total of 15 agents were designed and pilot tested for attractiveness and realism with a sample of 58 participants. Four stimuli were selected from two models (one White and one Black female) which achieved the highest difference between the most and the least attractive pairs (Table 2).

Table 2. Attractive and Unattractive Agents

Attractive Agent	Unattractive Agent
Nose - Proportional to face.	Nose - Widened by 50%.
Lips - Full.	Lips - Thinned by 25%.
Symmetry - Head and shoulders proportional to each other.	Asymmetry - Head width reduced by 16.5%. Head height reduced by 25%. Shoulder width increased by 30%.
	
Attractiveness: 4.98	**Attractiveness: 2.86**
Realism: 4.78	**Realism: 3.31**
	
Attractiveness: 4.76	**Attractiveness: 2.76**
Realism: 4.28	**Realism: 3.28**

Design. The experiment was based on a 2*2*2 design. Agents' attractiveness (attractive vs. unattractive) and ethnicity (white vs. black) were manipulated between-subjects. Evaluations were collected prior and after interaction with the agents.

Procedure. Participants were introduced to the experiment as a user evaluation of ECA's. Prior interaction, participants were required to evaluate a static image of one of the four targets using the same array of instruments employed in experiment one. Then, they were invited to chat with the agent on any topic they pleased for 10 minutes and left alone in the laboratory. The user wrote their input into a conversation window, whereas the agent spoke its answer back. Finally, participants evaluated the agent image using all the evaluation instruments.

4.2 Results

Mean scores were computed for all 7 dimensions measured in the pre- and post-test (Cronbach alpha > 0.80). Mean scores were entered into 7 mixed-design ANOVAs with Attractiveness (2) and Ethnicity (2) as between-subjects factors and Time (2) as within-subjects factors.

Manipulation Check. The ANOVA on physical attractiveness returned only a strong main effect for attractiveness, F(1,44) = 46.23, p < 0.001, partial η2 = .51, supporting the reliability of the manipulation (mean difference = 1.15).

Test of Hypotheses. The analysis of *social competence* indicated a large main effect of attractiveness ($F_{(1,44)}$ = 48.38, p < 0.001, partial η^2 = .52) and evaluation time ($F_{(1,44)}$ = 23.79, p < 0.001, partial η^2 = .35). The interaction attractiveness * time was also significant, $F_{(1,44)}$ = 6.63, p < 0.001, partial η^2 = .13. Fig. 4 reports mean and standard errors. (score values on social competence as a function of attractiveness and time). It is evident that participants gave better evaluation to the most attractive agents; and their evaluation improved after the interaction. However, this effect was mostly due to people who interacted with the unattractive agent, as they improved their evaluation significantly more (mean = difference .95) than participants who interacted with the attractive avatar (mean difference = .25).

The analysis on *integrity* returned similar results, although all effect sizes were smaller. The main effect of attractiveness ($F_{(1,44)}$ = 9.76, p < 0.01, partial η^2 = .18) and evaluation time ($F_{(1,44)}$ = 16.25, p < 0.001, partial η^2 = .27) were significant. Attractive agents were evaluated better than unattractive ones (Fig. 4). The evaluation improved with time especially for unattractive agents, although the interaction does not reach statistical significance (p = .11).

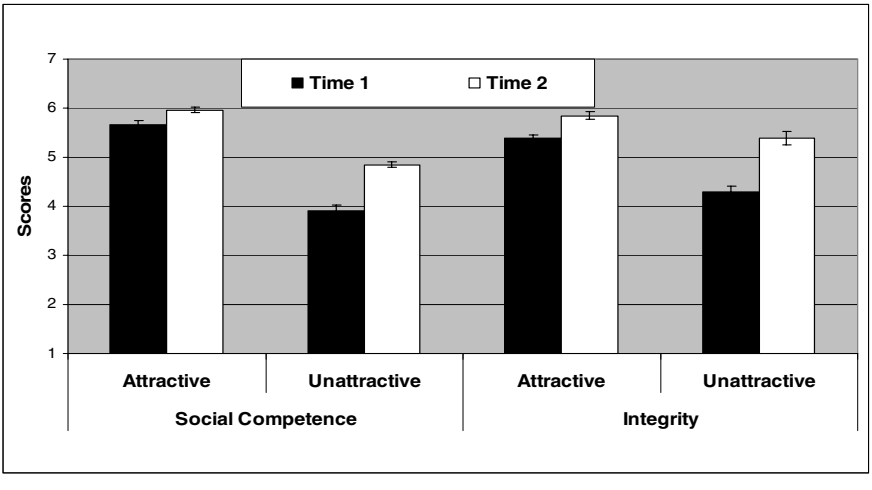


Fig. 4. Social competence and Integrity scores as a function of experimental conditions

The ANOVAs on *intellectual competence* (IC), *social adjustment* (SA) and *anthropomorphism* (A) returned significant effects for attractiveness (IC; $F_{(1,44)}$ = 10.14, p < 0.01, partial η^2 = .19; SA: $F_{(1,44)}$ = 18.45, p < 0.001, partial η^2 = .29; A: $F_{(1,44)}$ = 16.79, p < 0.001, partial η^2 = .28) and time (IC: $F_{(1,44)}$ = 12.49, p < 0.01, partial η^2 = .16; SA: $F_{(1,44)}$ = 8.64, p < 0.05, partial η^2 = .16; A: $F_{(1,44)}$ = 152.69, p < 0.001, partial η^2 = .77). Attractive agents were evaluated systematically better than unattractive agents in

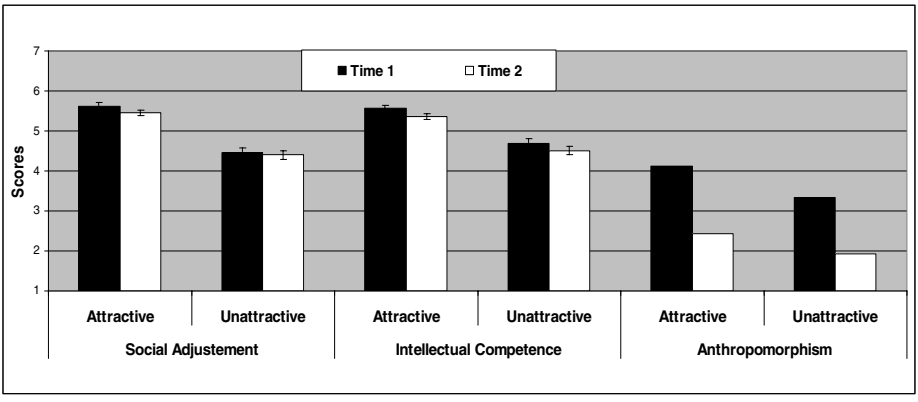


Fig. 5. Social Adjustment, Intellectual Competence and Anthropomorphism scores as a function of experimental conditions

all dimensions (Fig. 5). All evaluations significantly decreased after interaction. This drop was particular drastic in the case of anthropomorphism, as evinced by the higher effect size (A mean difference = .65).

The evaluation of potency followed a completely different pattern, showing a medium sized effect for ethnicity ($F_{(1,44)} = 7.54$, $p < 0.01$, partial $\eta^2 = .14$) and a marginally significant interaction ethnicity * attractiveness ($F_{(1,44)} = 3.74$, $p = 0.06$, partial $\eta^2 = .08$). The interaction effect was due to the unattractive white agent being scored lowest in potency and to the unattractive black agent being scored highest.

4.3 Conclusion

Results of study 2 are summarized in Table 3, which displays effect sizes of significant effects. The effect of attractiveness (A) is robust showing that attractive agents are regarded better in all experimental dimensions, confirming H1. Participants changed their evaluation over time (T), but the direction of this change differed according to the dimension. In particular, social competence and integrity increased, whereas intellectual competence, social adjustment and anthropomorphism decreased. Thus, we reject H2 and H3.

Table 3. Summary of Experiment 2 results

	A	T	E	A*T	A*E
Physical Attractiveness	.51				
Social Competence	.52	T1<T2 .35		.13	
Social Adjustment	.29	T1>T2 .16			
Intellectual Competence	.19	T1>T2 .22			
Potency			.15		
Integrity	.18	T1<T2 .27			
Anthropomorphism	.28	T1>T2 .77			

The only exception to the attractiveness stereotype was the dimension of potency, which also returned the only effect of ethnicity (E) found in the experiment. We argue that this dimension is rather subjective as participants may interpret it as being either a positive or negative trait in relation to an agent. It is worth noting that the agent's ethnicity did not have any major effect on the other dimensions.

5 Discussion

This paper contributes to the emerging literature on social implications of ECA's by showing that virtual bodies afford the attractiveness stereotype. This effect is very strong in first impressions (experiment 1 and experiment 2), but it pertains also to actual interaction (experiment 2). As in real life interaction, the stereotype particularly influences people's opinion of social competence, social adjustment and intellectual competence. The effect on integrity is generally stronger that in real life study, showing that appearance may influence character perception more strongly in ECA's than in real human beings, probably because ECA's are perceived as not to have hidden motives and agenda. Finally, the attributes of potency was found to be unaffected by attractiveness, probably because this is a culturally relevant attribute, or because of the specific target of judgment.

More research is needed to unveil the subtleties of user evaluation of embodied agents, this research provide some preliminary results and a methodology to foster this field.

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