Chapter 14
Can an Android Persuade You?

Kohei Ogawa, Christoph Bartneck, Daisuke Sakamoto, Takayuki Kanda, Tetsuo Ono and Hiroshi Ishiguro

Abstract The first robotic copies of real humans have become available. They enable their users to be physically present in multiple locations simultaneously. This study investigates the influence that the embodiment of an agent has on its persuasiveness and its perceived personality. Is a robotic copy as persuasive as its human counterpart? Does it have the same personality? We performed an experiment in which the embodiment of the agent was the independent variable and the persuasiveness and perceived personality were the dependent measurements. The persuasive agent advertised a Bluetooth headset. The results show that an android is perceived as being as persuasive as a real human or a video recording of a real human. The personality of the participant had a considerable influence on the measurements. Participants who were more open to new experiences rated the persuasive agent lower on agreeableness and extroversion. They were also more willing to spend money on the advertised product.

Keywords HRI · Android · Persuasion

This chapter is a modified version of a previously published paper [1], edited to be comprehensive and fit with the context of this book.

K. Ogawa (✉) · D. Sakamoto · T. Kanda · H. Ishiguro
ATR Intelligent Robotics and Communication Laboratories, 2-2-2 Hikaridai, Seika-cho Soraku-gun, Kyoto 619-0288, Japan
e-mail: ogawa@irl.sys.es.osaka-u.ac.jp

C. Bartneck
Department of Industrial Design, Eindhoven University of Technology, Den Dolech 2, 5600MB Eindhoven, The Netherlands

K. Ogawa · T. Ono
Department of Media Architecture, Future University-hakodate School of Systems Information Science, 116-2 Kamedanakano-cho, Hokkaido, Hakodate 041-8655, Japan

D. Sakamoto
Graduate School of Information, Science and Technology, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

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14.1 Introduction

A great advantage of having a robotic copy of yourself is that it allows you to be physically present in two locations simultaneously. In particular, politicians may appreciate the ability to give two speeches at the same time during an election campaign. However, while the physical appearances of androids have become almost indistinguishable from their human originals (see Fig. 14.1), it is not clear to what degree androids are able to convey the same personality and persuasive power as their human originals. Moreover, androids need to show a significant advantage over screen characters to justify the extra costs. A simple video transmission is currently easier and cheaper than using a robotic copy, but some situations require a representation that is truly 3D. Human doppelgangers, for example, are frequently used to confuse paparazzi and terrorists. A robotic doppelganger could take its owner's place and ease some of the ethical difficulties associated with this dangerous business. It would be of considerably less consequence if a robotic doppelganger took a bullet than if a human doppelganger did. In this study, we did not want to focus on the pure appearance of a robotic doppelganger, but on the persuasive power and personality that androids may have. After all, it is desirable that your robotic copy possesses the same persuasiveness and personality as yourself. Persuasion can be defined as a social influence. It occurs when one person attempts to induce change in the beliefs, attitudes, or behavior of another person or group of people [2]. Previous studies showed that the success of persuasion depends on the

Fig. 14.1 Geminoid HI-1 and Hiroshi Ishiguro

source of the message [3, 4], the strength of the argument [5], and the person being influenced [3, 6].

The persuasiveness of technology has become an important research field [7], and many robots are used in contexts where their main or primary purpose is to change the attitude, behavior, or opinions of humans [8]. The first studies on the persuasiveness of virtual characters and robots show promising results. Zanbaka et al. [2] compared the persuasiveness of virtual characters with that of real humans by communicating the benefits of comprehensive examinations to college students. They concluded that virtual characters are perceived as being as persuasive as real humans and that the realism of the character had no effect on its persuasive power. Shinozawa et al. used either a screen character or a robot to give recommendations to users. Their results showed that a robot's recommendation was more effective than that of a screen character [9]. Powers et al. compared people's responses to a screen agent and a robot in a health interview [10]. Their results showed only a few behavioral differences, but considerable differences in attitude. The participants spent more time with the co-located robots and had a more positive attitude. Kidd and Breazeal studied users' perceptions of a robot in the same room as compared with that of a robot shown on a screen [11]. They hypothesized that when the robot is physically present, it will be viewed as more persuasive than when it is telepresent. Their results showed that a robot is more engaging than an animated character and is perceived as more credible and informative, as well as providing a more enjoyable interaction.

However, it is not clear to what degree androids may compare to their human originals in terms of persuasiveness and personality, in particular the influence of the embodiment of a persuasive agent on its persuasiveness and perceived personality. It has been shown that when the personality of a computer voice matches the users' personality, (a) participants regarded the computer voice as more attractive, credible, and informative and (b) participants were more likely to buy a product from the computer [12]. It is therefore necessary to measure not only the perceived personality of the persuasive agent, but also the personality of the participants. In summary, we are interested in the following research questions:

1. What influence does the embodiment of an agent have on its persuasiveness and perceived personality?
2. To what degree does the personality of the users influence their perception of the persuasiveness and personality of a persuasive agent?

14.2 Method

We performed a between-participant experiment in which three conditions were applied to the persuasive agent. In the human condition, Hiroshi Ishiguro presented a persuasive message, in the video condition a recording of Ishiguro's persuasive message was presented, and in the android condition Geminoid HI-1 persuaded the

audience. The appearance of all three persuasive agents was very similar, which allowed us to focus on the embodiment of the agent, instead of its visual attractiveness.

14.2.1 Measurements

The participants' perceptions of the persuasive argument and message were assessed through a semantic differential questionnaire developed by Zanbaka, Goolkasian, and Hodges [2], which is based on the previous work of Mullennix et al. [13].

Items related to the perception of the argument and the perception of the message were measured on a Likert-type scale. The items for each were as follows: perception of the argument (bad–good; foolish–wise; negative–positive; beneficial–harmful; effective–ineffective; convincing–unconvincing); perception of the message (stimulating–boring, vague–specific, unsupported–supported, complex–simple, convincing–unconvincing, uninteresting–interesting). Zanbaka et al. performed a principle components analysis of both perceptions. The results of the factor analysis of the items related to the argument showed only one factor with a high reliability (Cronbach's alpha = 0.90). The factor analysis of items related to the message resulted in two factors. The interesting factor (stimulating, specific, supported, convincing, and interesting) accounted for 39% of the variance, and the conservative factor explained 19% of the variance. The Cronbach's alpha for the interesting factor was 0.76. We translated all the items into Japanese using the back-translation method.

In addition, we evaluated the persuasiveness of the speaker by asking the participants before and after the persuasive speech how much they would be willing to pay for the product. This repeated measure allowed us to compensate for individual differences. A certain participant, for example, might simply not like a given product. We calculated the variable price by subtracting the participant's evaluation before seeing the agent from that after seeing the agent. Hereafter, we refer to this collection of questionnaires as the "persuasion questionnaire."

Several models and measurement tools have been proposed for evaluating personality, including the acknowledged Big Five Model [14], a brief version of the Big Five Model [15], Mowen's Personality Scale [16], and the established Myers–Briggs Type Indicator [17]. Many of these instruments consist of more than 100 items, and their completion can require up to one hour. Since we intended to use several measurement instruments, it seemed unreasonable to dedicate that much attention to only one tool. We therefore used the NEO Five-Factor Inventory (NEO-FFI) that contains only 60 items, which is designed to take only 15 min to fill and is available in the Japanese language. This questionnaire is a short version of the NEO PI-R instrument of the same author [18]. Despite its brevity, the validity and reliability of this tool have been demonstrated. Ishiguro and the participants filled this questionnaire about themselves.

The five factors in this personality questionnaire are neuroticism, extraversion, openness, agreeableness, and conscientiousness, each of which is measured on a 0–48 scale. A person with a high neuroticism score can be described as "sensitive, emotional, and prone to experience feelings that are upsetting." A person with a low neuroticism score is "secure, hardy, and generally relaxed even under stressful conditions." A high extrovert score describes a person as "extrovert, outgoing, active, and high-spirited, and preferring to be around people most of the time," while a low score refers to a person who is "introverted, reserved, and serious and prefers to be alone or with a few close friends." "Open to new experiences and having broad interests and very imaginative" describes a person with a high openness score, and "down-to-earth, practical, traditional, and pretty much set in his/her ways" describes a person with a low openness score. A high agreeable score refers to a person who is "compassionate, good-natured, and eager to cooperate and avoid conflict," and a low score to a person who is "hardheaded, skeptical, proud, and competitive and tends to express anger directly." People with a high conscientiousness score are described as "conscientious and well-organized. They have high standards and always strive to achieve their goals," while people with a low score can be described as "easygoing, not very well-organized, and sometimes careless. They prefer not to make plans."

Unfortunately, the NEO-FFI version for rating another person has not yet been translated into Japanese. We therefore used the Japanese Property-Based Adjective Measurement questionnaire [19]. Its three components are highly correlated with the extraversion, openness, and agreeableness components of the NEO-FFI (Hayashi 1978).

The Geminoid HI-1 android has received a considerable amount of media attention, and hence, it is possible that the participants had previously seen or interacted with it. We therefore asked the participants whether they had previously seen (e.g., on television) the android or Ishiguro (seen-agent), whether they had met them (met-agent), or whether they knew them personally (know-agent). This allowed us to take a possible bias into account in the statistical analysis.

In summary, we measured the persuasiveness of the presentation by its components argument, interesting and conservative. In addition, we calculated the change in the price estimation of the headset by subtracting the value before the product presentation from the value after the presentation (price). We measured the personality of the participants and of Hiroshi Ishiguro using the NEO-FFI questionnaire. We measured the perceived personality of the persuasive agent using the Japanese Property-Based Adjective Measurement questionnaire. Finally, we measured the participants pre-knowledge of the android and Ishiguro.

14.2.2 Setup

We used the Geminoid HI-1 android for this experiment, since it allowed a direct comparison with its human equivalent, Hiroshi Ishiguro. The android's movement

Fig. 14.2 Three experimental conditions: video (left), android (middle), and human (right)

was based on motion data captured from Ishiguro performing the persuasive speech. The recording also included Ishiguro's voice, so that the lip movement of the android matched the speech signal.

One limitation of the android is that it cannot grip and hold products or press small buttons reliably. We therefore decided to advertise a Bluetooth headset, since it can be demonstrated without the android being required to handle it. Moreover, it may be assumed that a robot may be perceived as being more knowledgeable about electronic products than, for example, food products. The expertise of a speaker does have a considerable influence on his/her persuasiveness, which also holds true for the persuasiveness of machines [20, 21]. The headset was placed over the ears of the android and Ishiguro during the presentation.

A recording of Ishiguro performing the persuasive message was used in the video condition. For the recording, we placed a large television behind the camera that displayed the script of the persuasive message so that Ishiguro could more easily remember it. The same screen was placed behind the participants in the human condition. This procedure allowed Ishiguro to minimize the variations between his presentations. The video was projected onto a 110 by 175 cm screen, which approximates the actual size of Ishiguro and the android. The resolution of the video was 720 by 480 pixels. Figure 14.2 shows the experimental setup for the three conditions.

The advertised headset did not contain any label or brand icon, so that the participants were not able to identify the headset. It was therefore impossible for the participants to simply know the price of the product.

14.2.3 Procedure

The participants took part in the experiment in small groups. After welcoming the participants in room A, the experimenter asked them to fill and sign an informed consent form. Next, the experimenter asked the participants to fill a questionnaire that contained demographic questions and the NEO-FFI personality questionnaire. The participants were then asked how much they would pay for 30 products that were presented to them in a custom-made catalog. The products included furniture, electronic devices, and accessories (see Fig. 14.3).

The experimenter then guided the participants into room B, where the persuasive agent (android, human, or the television screen) was located. The participants were seated on chairs that were arranged in a circle, 1 m away from the persuasive agent (see Fig. 14.2).

The experimenter left the room, and the persuasive agent presented a Bluetooth headset. After the presentation was completed, the experimenter guided the participants back into room A where they filled a questionnaire that contained the question asking how much the participant would pay for the Bluetooth headset that had just been presented, the persuasion questionnaire, and the Japanese Property-Based Adjective Measurement questionnaire. In parallel to the experiment, we asked Ishiguro to fill the personality questionnaire.

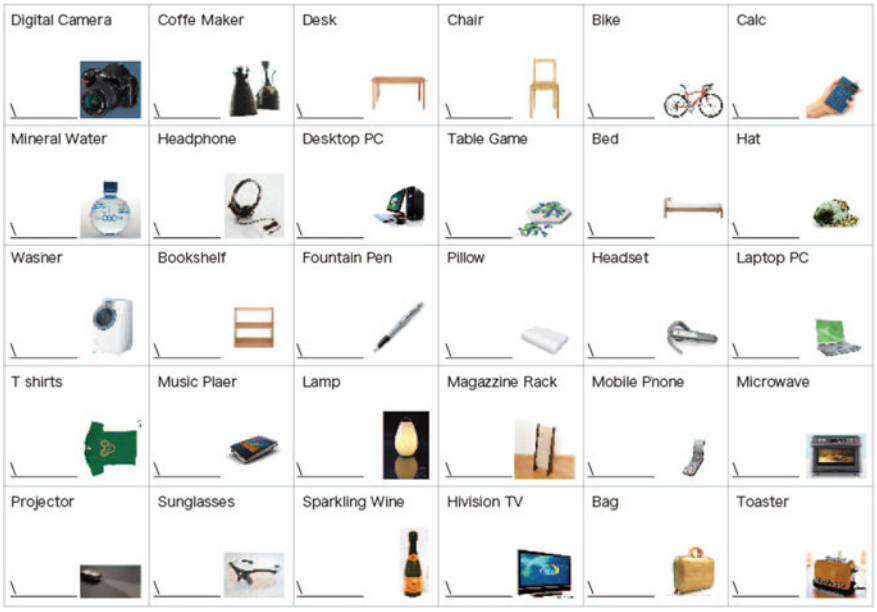

Fig. 14.3 Product catalog

14.2.4 Participants

Twenty male and 12 female subjects participated in the study. They were between 19 and 25 years old (mean 21.1), and they received 3000 yen for their effort. The participants were recruited from a temporary work placement company called Arbeit Network, which specializes in the work placement of students. All of the participants were students from a wide range of fields, including history, information science, and psychology. Fifty-six percent of the participants had never seen Ishiguro or the Geminoid HI-1 android (e.g., on television), 78% had never met them, and 91% did not know them personally.

14.3 Results

A reliability analysis across the six arguments items resulted in a Cronbach's alpha of 0.684, which is below the value of 0.90 reported in Zanbaka, Goolkasian, and Hodges' original paper [2]. The reliability of the interesting factor was 0.861, which is above Zanbaka's value of 0.76. The Cronbach's alpha for the three components of the Property-Based Adjective Measurement was 0.57 for openness, 0.86 for agreeableness, and 0.716 for extraversion. The reliability and validity estimations for the NEO-FFI are available in McCrae and Costa's paper [22].

We performed analysis of covariance (ANCOVA) in which the persuasive agent (human, video, android) was the independent variable and seen-agent and gender were the covariants. Price, argument, interesting, and conservative were the dependent variables. Neither covariant had a significant influence on the measurements. The persuasive agent also did not have a significant influence on the measurements (see Table 14.1).

We performed a second ANCOVA in which the persuasive agent was the independent variable and the seen-agent and the personality of the participant were the covariants. The perceived extraversion, openness, and agreeableness of the persuasive agent were the dependent variables. It should be noted that the Japanese Property-Based Adjective Measurement questionnaire does not have scales for the measurement of neuroticism or conscientiousness and therefore they do not appear in the further analysis. Figure 14.4 shows the mean personality scores for all three conditions.

Table 14.1 F and P values of the ANCOVA on price, argument, conservative, and interesting

	F(2, 27)	P
Price	0.259	0.774
Argument	0.266	0.768
Conservative	0.040	0.961
Interesting	0.179	0.837

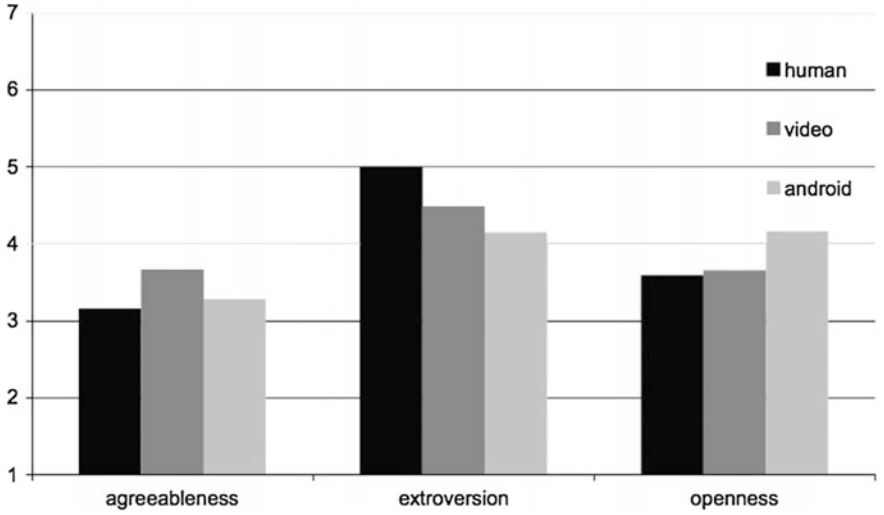

Fig. 14.4 Mean personality scores for the persuasive agents

The persuasive agent did not have a significant influence on any of the measurements, although a significant level for openness was approached ($F(2, 22) = 2.567$, $p = 0.100$). Post hoc t-tests with Bonferroni-corrected alpha showed that the human agent was rated almost significantly ($p = 0.153$) less open (3.590) than the android agent (4.169). The covariant seen-agent and gender had no significant influence on the measurements. The personality of the participant also significantly influenced the measurements. The openness of the participants had a significant influence on their rating on the extraversion of the agent ($F(1, 22) = 8.700$, $p = 0.07$).

We performed a linear regression analysis to explore the relationship between the openness of the participants and their personality ratings for the agent. The openness of the participants was significantly correlated with the ratings for the agent on neuroticism, extraversion, and openness (see Table 14.2). However, the personality ratings for the agent accounted for only 23.2% of the variance in the openness of the participant. Scatter plots revealed that the agreeableness and extroversion ratings for the agent decreased with the rising openness of the participant.

Table 14.2 Pearson correlation between the openness of the participant and the personality ratings for the agent (Italics indicate significant correlations at $P < 0.005$)

	Openness participant	Agreeableness agent	Openness agent
Agreeableness agent	−0.381		
Extraversion agent	−0.389	0.323	
Openness agent	−0.116	0.202	*−0.089*

Table 14.3 Mean scores for Ishiguro's self evaluation, mean score for agent, T and P values for extraversion, openness, and agreeableness

	Mean self score	Mean agent score	T	P
Extraversion	3.64	4.523	4.877	0.001
Openness	6.41	3.828	−26.194	0.001
Agreeableness	3.50	3.367	−0.945	0.352

Next, we performed a linear regression analysis between the participants' openness and the factors in the persuasive questionnaire (argument, interest, conservative, and price). Only the price was significantly correlated with the openness of the participant ($r = 3.57$, $p = 0.022$). A box plot revealed that the more open participants are to new experiences, the more they increase the amount they are willing to pay for the headset.

Finally, we were interested in the degree to which the participants' evaluation of the agent's personality matches the score that Ishiguro gave himself. We divided the scores from the 48-point scale of NEO-FFI questionnaire by $48/7 = 6.85$ to allow us to compare the scores with those of the 7-point scale of the Property-Based Adjective Measurement. Table 14.3 shows the mean scores of Ishiguro and the participants. We then performed three one-sample t-tests against the corresponding value from Ishiguro's questionnaire. The ratings for extraversion and openness were significantly different, and the mean scores from the Japanese Property-Based Adjective Measurement questionnaire hovered closely around the center of the scale.

14.4 Discussion and Conclusions

The focus of this study was on the effects of the embodiment of the persuasive agent. Embodiment refers to the visual and haptic representation of the agent and not to the agents' voice. The same human voice was used in all conditions. Other studies explicitly focused on the influence of the agents' voice [13, 23].

Zanbaka et al. [2] had previously shown that college students found a virtual character as persuasive as a real human being. Their results were in line with those of other studies that showed that virtual characters are often treated similarly to real humans [24, 25]. We extend their results by concluding that a robotic copy of a real human is perceived as being as persuasive as its human original. Androids can therefore be considered an alternative for presenting persuasive messages.

We also observed that the embodiment of the agent may influence its perceived openness. The android was perceived as more open than its human or robotic counterpart. This may give the android a slight advantage over the video agent and justify the extra expense. We hope that if the number of participants was increased, the effect would become significant.

Despite the considerable media attention that Ishiguro and his android have received, it did not seem to have influenced the participants. Seeing a report on television may still be a different experience from standing in front of the "real McCoy." Overall, the results suggest that the openness of the participants may play an important role in the participants' perception of the personality of the agent. The openness rating was negatively correlated with the agreeableness and extroversion ratings for the agent. Participants who were open also showed an increased willingness to spend money on the advertised headset.

However, the personality ratings that the agent received do not completely match the rating that Ishiguro gave himself. The short interaction time with the agent may not have been sufficient for the participants to understand the agent better. Ishiguro's great openness to new experiences may not be communicated in the context of an advertisement. To gradually get to know people and androids remains a pleasant necessity.

In addition to the doppelganger scenario described in the introduction, we can also envision another application domain for persuasive androids: advertisements. The androids could be used as sales agents in supermarkets and many other stores. Today, audio and video messages are already being used to persuade customers to purchase certain goods, and the first studies on the effectiveness of virtual agents are becoming available [26].

14.4.1 Limitations and Future Work

The results of our study are limited to the android used in this study and may not be generalizable to other robots. Further research is necessary to determine in more detail the aspects of the embodiment that contribute to the persuasiveness and personality of an android. We were also limited by the physical limitation of the Geminoid HI-1 android. It cannot move as smoothly as humans and is not yet able to grasp objects. Future androids may have much better abilities and therefore become even more persuasive.

Another drawback of this study was the limited number and diversity of the participants. To achieve more generalizable results, this study should be extended with a more diverse sample, in particular with more participants who are not university students. All the participants were Japanese, and it has been shown that the cultural background of the users influences their perception of a robot [27, 28]. It would therefore be interesting to repeat this experiment with users from other cultures.

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