The More You See Me the More You Like Me. Influencing the Negative Attitude Towards Interactions With Robots

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Abstract:

The main aim of this paper is to present the study designed to check whether negative attitudes towards interactions with robots may be influenced by demonstrating videos presenting advanced modern robots. The attitude was measured with the use of the Negative Attitude toward Interactions with Robots questionnaire (NATIR). 66 subjects participated in the study divided into the pre-test, a video presentation and the post-test. Our main findings are the following. There is a significant difference between pre-test and post-test NATIR scores—the attitude towards interactions with robots improved after our subjects watched a video. We also observe an effect of participants gender on NATIR results—men had more positive attitude than women.

Keywords: *Human-Robot Interaction, Human uniqueness, Acceptance of robots, Negative attitude towards robots, NATIR, BHNU*

1. Introduction

In this paper we are presenting the study of the attitude towards robots. Our aim was to check whether this attitude may be influenced by displaying videos presenting modern day advanced humanoid robots. It is worth to point out that the issues of human-robot interaction are considered in this paper from a cognitive and psychological perspective. For a survey of approaches that are more focused on technological aspects and hardware and software implementations, we refer to, for instance, [6].

The issue of a positive attitude towards robots is becoming more and more important nowadays. This is due to the fact that we encounter real robots more often in a regular day situations, like e.g. vacuum cleaners or autonomous cars. As it is pointed out in [16, p. 3–4] "the International Federation of Robotics has estimated that by 2019 more than 42 million robots have been sold for personal use; meaning, they are quickly becoming an unavoidable part of our social ecosystem". Robots are also present in our common imagination due to famous movie productions (like "AUTOMATA" (2014), "Chappie" (2015), "Ghost in the Shell" (2017), "Blade Runner 2049" (2017)), TV series ("Westworld" (2016), "Altered Carbon" (2018)) and video games (e.g. "Detroit. Become Human" (2018)). What is more, robots are often a subject of a popular media reports, see e.g. widely discussed 2017 interviews with the Sophia robot for the *Good Morning Britain* show (ITV) and CNBC; series of articles concerning autonomous cars and robo-ethics (e.g. "Self-driving cars will kill people. Who decides who dies?" in *Wired* 09.21.2017; "How to punish a robot who committed a crime" (in Polish) for *Gazeta Wyborcza* 10.16.2018) or recent discussion about sex robots (e.g. "Prediction: Sex Robots Are The Most Disruptive Technology We Didn't See Coming" in *Forbes* 09.25.2018; "Sex robots and us" for BBC3, 04.08.2018 or the *Netflix* 2018 documentary series "Watch us: Sex robots").

The issue of attitudes towards robots is also widely studied in the field of human-robot interaction (HRI). As we read in [19, p. 18]: "...designing robots with human-like traits can enhance their interactive and social proficiency. Also, different degrees of human likeness seem to impact differently potential user's expectations and behavior". Thus one of important contexts of HRI studies is the Uncanny Valley Hypothesis [12]. The hypothesis—stating that we will observe a decrease of affinity for almost human-like robots—is explored for real robots (see e.g. study of interaction with Geminoid HI-1 humanoid robot presented in [1]). Uncanny Valley is also observed and studied for computer generated characters in games and animated productions (see [4], [9], [11], [22]). HRI studies of people's attitudes towards robots address also social issues related to robots. Authors of [23] investigate attitudes towards service robots among German citizens, while [7] presents analysis of EU citizens' attitudes towards robots in caring for the elderly. Also cross-cultural studies of attitudes towards robots are conducted—see e.g. [15], where people's acceptance of humanoid robots among UK and Japanese citizens is analyzed. Researchers are also interested how previous contacts with robots influence aforementioned attitudes (see [17], [23]). There are also attempts of influencing attitudes towards robots, e.g. Reich-Stiebert and Eyssel [24] report the positive effect of subjects' participation in prototyping process on their attitude towards robots in educational contexts.

As a tool for the study described in this paper we have selected the well tested questionnaire called The Negative Attitude Toward Robots Scale (NARS) [13, 14]. NARS is designed to measure "psychological reactions evoked in humans by humanlike and non-humanlike robots" [17, p. 94]. NARS is widely used for studies addressing human-robot interactions. Syrdal et al. [25] use NARS to explain participants' evaluations of real robot behavior styles; Ciechanowski et al. [2] employ NARS into a wide study of human-chatbot interaction; Dinet and Vivian in [3] describe

results of a study of an attitude towards assistive robots among French citizens; authors of [10] discuss the usage of NARS in the context of the uncanny valley effect for computer generated robots. Another interesting and important study is the one presented in [8, Chapter 3.3], in which the relationships between negative attitudes, anxiety and an actual behavior toward robots were analyzed on the basis of interaction with Robovie (the humanoid robot). What is also important from our perspective is that the tool was successfully adapted into Polish (NARS-PL) [20]. Our study was conducted in Polish, thus we have decided to use the NARS-PL. As authors of this adaptation claim: "[...] NARS-PL is a useful tool to predict human responses to social robots in HRI studies in Poland." [20, p. 70].

In the aforementioned adaptation two sub-scales were identified on the basis of obtained study results: The Negative Attitude toward Interactions with Robots (NATIR) which aims at measuring the attitude towards interactions with robots and The Negative Attitude toward Robots with Human Traits (NARHT)—which "captures the responses to robots that display human traits like emotions, language, and agency" [20, p. 70]. NATIR items are listed in Section 2.2. Exemplary NARHT items are the following:

- I would feel uneasy if robots really had emotions.
- I would hate the idea that robots or artificial intelligences were making judgments about things.
- Something bad might happen if robots developed into living beings.

As in our study we wanted to focus only on the aspect of potential interactions with a robot, so we have decided to use only the NATIR sub-scale.

We have also decided to use The Belief in Human Nature Uniqueness (BHNU) questionnaire. BHNU aims at capturing the "the extent to which humans reserve human nature for their own group and deny the possibility of a human essence to robots" [20, p. 67]. We treat BHNU score as a useful information about our subjects—one may expect that when someone believes that humans are unique s(he) will hold more negative attitude towards such machines. (It is worth to notice that this relates to Turing's intuitions concerning artificial intelligence in general. See 'The Theological Objection' and 'The Heads in the Sand Objection' discussed in [26].) BHNU items are listed in Section 2.1.

The paper is structured as follows. In the second section we present details about tools, the study design and procedure. We also describe our subjects and research hypotheses. Section three contains results. The last—fourth—section covers summary and discussion.

2. Methods

2.1. Tools

Tools used in the study were BHNU and NATIR questionnaires. As the study was conducted in Polish we have used their Polish versions presented in [20]. Below we present these tools (with items in the original English formulation).

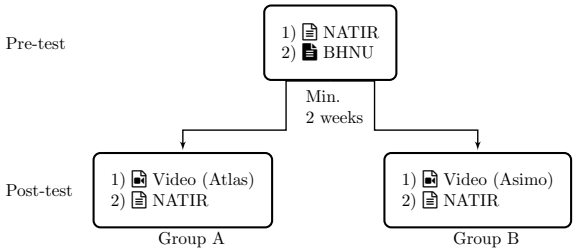

Fig. 1. The schema of the study

BHNU questionnaire [20, p. 69].
Even if ultra-sophisticated...

1) a robot will never be considered as human being;
2) a robot will never feel the same emotions as a human being,
3) a robot will never use language in the same way as a human being;
4) a robot will always be a mechanical imitation of the human being;
5) a robot will never have consciousness;
6) a robot will never have morality.

NATIR questionnaire [20, p. 69].

1) I would feel uneasy if I was given a job where I had to use robots.
2) I would feel nervous operating a robot in front of other people
3) I would feel very nervous just standing in front of a robot.
4) I feel that if I depend on robots too much, something bad might happen.
5) I would feel paranoid talking with robot.
6) I am concerned that robots would be a bad influence on children.

In both questionnaires participants responded on a 7-point scale (1 – totally disagree to 7 – totally agree). The score of an individual at NATIR and BHNUS is calculated by summing up the scores of all the items included in the scale (see [13] and [20]).

2.2. Procedure

The study was conducted with the use of online questionnaires (Google Forms). It consisted of two parts separated by at least two weeks break. The schema of the study is presented in Figure 1. Before each part of the study participants were informed about the aim of the study and their right to resign at any point without consequences. They were also informed that the gathered data will be processed only for scientific purposes. Before each part, participants gave their consent to take part in the study. After completing each part participants were thanked for their contribution.

In the first part we asked our participants to fill NATIR and BHNU questionnaires followed by questions concerning their socio-demographic data: age, gender, education and gaming habits.

The second part consisted of a short video presenting an advanced robot and its actions. The video was followed by NATIR questionnaire. [19, p. 19] provide an overview of previous studies indicating that the use of video materials for HRI studies proved to be a valid method. Participants first watched the whole video (it was embedded in the questionnaire, so participants would not leave Google Forms) and then they could proceed to the NATIR questionnaire (by clicking the "next" button).

For this part we have used two videos (for groups A and B—see the study schema in Figure 1). Video for the group A presented *Atlas* (by Boston Dynamics) robot performing advanced movements, like traversing outdoor terrain or avoiding obstacles (https://youtu.be/hSjKoEva5bg, the video lasted for 00:01:00). Video for the group B presented *Asimo* (by Honda) robot singing and performing a dance moves (https://youtu.be/gi71uXqCkvU, the video lasted for 00:01:22). The robots are presented in Figures 2 and 3. There were no additional narration in both videos. The choice of robots for the study was arbitrary but motivated by previous research, see e.g. [19] and [16], which suggest that Asimo should be evaluated as more friendly and likable than Atlas.

For the second part of the study we have decided not to include the BHNU questionnaire. Firstly, to keep this part relatively short in order to encourage more subjects to take a part. Secondly, as BHNU measures a general believes concerning human beings we would not expect to influence them by our short video stimuli. As we mention in the introduction we treat BHNU score as the valuable information about our participants.

The first part of the study was carried out from the 22nd of December 2018 until the 4th of January 2019. The second stage started at the 18th January 2019 (to ensure at least 2 weeks break between parts for each participant) until the 23rd January 2019.

2.3. Subjects

Participants were recruited from cognitive science students at the Institute of Psychology AMU (they received extra credits for participation) and *via* private communication as well as popular social networks.

In the first part of the study 66 subjects took part—40 women and 26 men aged from 17 to 45 (mean = 22.92, $sd = 5.97$, median =20). 23 declared higher education, 42 declared holding of a high school diploma, 1 was before graduating from a high school. Out of 66 subjects who took part in the study, 50% were the aforementioned cognitive science students.

We have also collected the data addressing gaming habits of our participants. The reason for this is that video games are the most common way in which we may get into some form of interaction with (virtual) robotic characters—that is why we wanted to control this variable. The group characteristics is the following. 31% of subjects declared that they do not play video games at all; 41% play games once a month or less than once a month. 20% declare that they play few times a week and 8% that they play every day. We also asked about

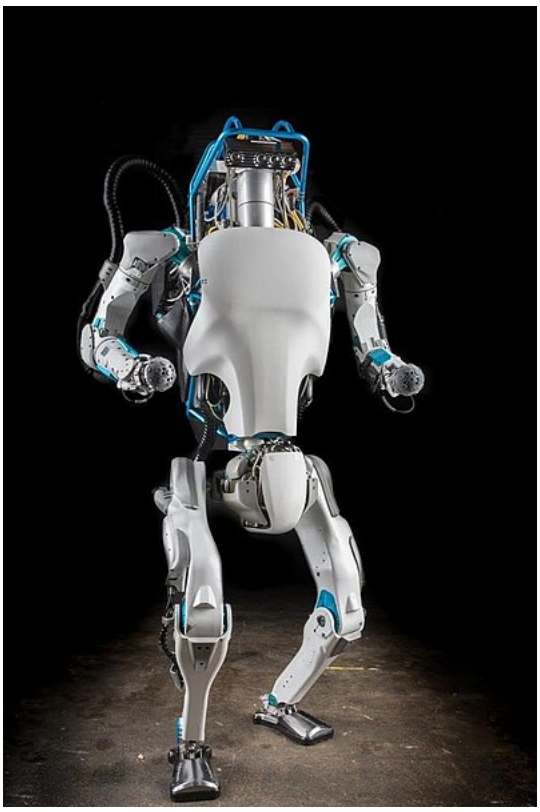

Fig. 2. Atlas robot (source https://commons.wikimedia.org). This robot was presented in the video for the group A.

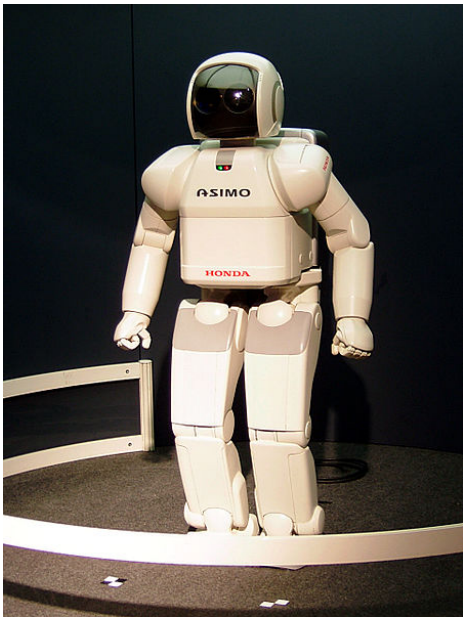

Fig. 3. Asimo robot (source https://commons.wikimedia.org). This robot was presented in the video for the group B.

titles of the most played games by our subjects. The mostly repeated titles were not related to robots and robotic themes—these were 'League of Legends', 'The Sims', 'Witcher' and 'Fifa'. We may say that our group of subjects was balanced when it comes to players and non-players. What is more, our participants were not exposed to games, which are directly related to HRI is-

sues. (We are aware that gathering more data about our subjects would useful, but we wanted to keep our study reasonably short in order to ensure that most of participants will be willing to take part in the post-test.)

The mean NATIR score for the first part of the study was 17.83 and the BHNU score was 29.09. The detailed characteristics of these results is presented in Table 1.

For the second part of the study we have divided the initial group into two balanced sub-groups (in what follows we refer to them as A and B). For this part we have sent separate invitations to group A and to group B. While dividing our subjects we have taken into account the following factors: gender, age, BHNU and NATIR results from the first part. Group A consisted of 33 subjects—20 women and 13 men with average age of 23.18 ($sd = 6.68$, median 20). Group B also consisted of 33 subjects, of which 20 were women and 13 were men. The mean age for this group was 22.67 ($sd = 5.25$, median 20). As for the mean BHNU scores for the groups they were following: 17.91 ($sd = 8.46$, median 17.00) and 17.76 ($sd = 6.03$, median 18.00). The t-test showed no statistically significant difference between these scores ($p = 0.9335$). For mean NATIR results we got: 27.82 ($sd = 9.29$, median 28) and respectively 30.36 ($sd = 7.24$, median 29). The difference in results was not statistically significant (t-test $p = 0.2192$).

Finally, in the second part of the study 50 subjects took part (group A: 28 subjects; group B: 22), so 16 participants from the initial group have not accepted our invitation. The demographic characteristics are the following: 33 women and 17 men, mean age = 22.14 ($sd = 6.34$, median =19); 11 subjects with higher education and 39 with high school diploma.

2.4. Hypotheses

Our research hypotheses were the following.

(H1) We will observe a positive correlation between BHNU and NATIR results for the first part of the study.

(H2) We will observe differences in results for women and men. Women should have higher BHNU and NATIR results than men.

(H3) There will be a difference in NATIR results in group A and group B in the second part of the study.

(H4) NATIR results in the first part of the study and in the second part should differ. Results from the second part should be lower.

As for (H1) and (H2) they are derived from the results reported in [20], [5] and [19]. As BHNU score tells us to which extent humans reserve human nature to human beings and deny such a nature for robots one may expect that it should correlate with the NATIR results. The more reluctant a subject is in ascribing human characteristics to robots, the more reluctant (s)he will be when it comes to interacting with them. Pochwatko et al. [20, p. 70] report a significant effect on participants gender on NATIR results—men had more positive attitude than women. Authors of

Tab. 1. BHNU and NATIR scores for the first part of the study

Score	N	Min	Max	Mean	SD	Median
BHNU	66	6	42	29.09	8.36	28.50
NATIR	66	6	41	17.83	7.29	17.50

[18] (see also [19]) suggest that the possible explanation for such a result is that male and female participants associate robots with different contexts, in which they may potentially get into interaction with them (industrial vs. domestic robots; help with unemployment vs. help at home). We expected similar tendency for BHNU results. Especially that our subject were informed at the beginning of the study, that it concerns human-robot interactions, so they filled out BHNU questionnaire with this information in mind.

In the second part of the study participants of groups A and B were presented with two different videos. They presented two different humanoid robots Atlas and Asimo. The design of these robots is different when it comes to revealing its construction elements (Atlas has more elements which are visible, as joints, cables and sensors)—see Figures 2 and 3. The are also differences when it comes to actions performed by robots. Atlas video presents an agile machine coping with difficult environment. It is more about physical activities. Asimo sings a song coordinated with dance hand movements—presenting higher-level cognitive functions. We expected that different look and actions performed by robots will evoke different reactions of subjects in group A and B (H3).

For the (H4) our expectation was that in the first part our participants used different ideas concerning robots that they have developed on the basis of their experience and knowledge. When asked NATIR questions in the pre-test they were not pointed at any specific robots, thus our participants use the aforementioned general ideas. Post-test video should make them focused on recent robotics developments and abilities of modern robots and thus we expect that it will influence their NATIR answers.

3. Results

For the data analysis we used R statistical software ([21]; version 3.5.1).

Reliability of the BHNU and NATIR questionnaires for the first part of the study ($N = 66$) is satisfactory—Cronbach's alpha coefficients are respectively 0.85 and 0.81. In the second part only NATIR questionnaire was used. Its reliability is also satisfactory (Cronbach's alpha 0.85 for $N = 50$).

3.1. BHNU and NATIR Scores

We have checked whether we observe correlation between BHNU and NATIR results for the first part of the study. Detailed BHNU and NATIR scores are presented in Table 1.

The distribution of NATIR and BHNU results was normal (as indicated by the Shapiro-Wilk normality test) thus we use the Pearson's test for correlation

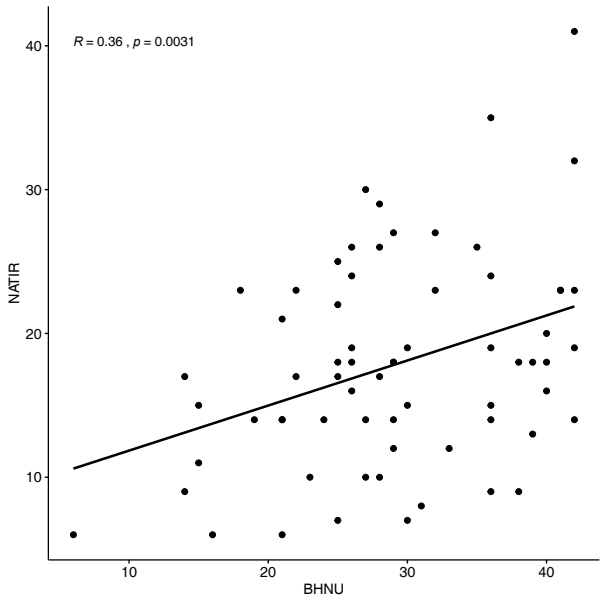

Fig. 4. BHNU and NATIR scores correlation plot

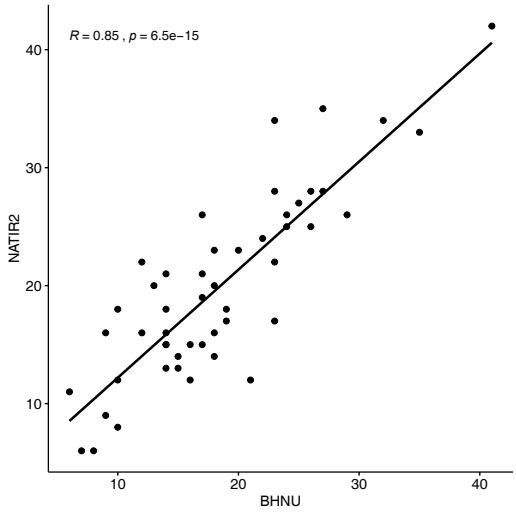

Fig. 5. BHNU and NATIR2 (post-test) scores correlation plot

check. We observe a weak positive relationship—the higher the BHNU result is, the higher NATIR results are ($r = 0.36$; $p = 0.0031$). This result is presented in Figure 4.

Interestingly the observed correlation becomes stronger when we take BHNU score and NATIR2 scores (for the post-test). For this comparison we have taken 50 participants who participated in both parts of the study (see discussion in Section 3.4). Distributions of BHNU scores for the selected sub-group and NATIR2 results in the post-test were normal (as indicated by the Shapiro-Wilk normality test), so we have used the Pearson's correlation check—the result is $r = 0.85$; $p = 6.5e - 15$ (Figure 5).

3.2. Gender and Attitude Towards Robots

In the first part of the study 40 women and 26 men took part—they filled out two questionnaires: BHNU and NATIR. As for BHNU the mean result for women

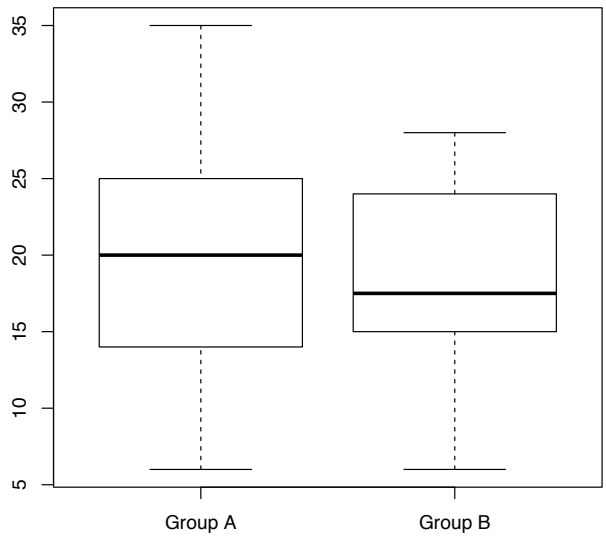

Fig. 6. NATIR results comparison for group A and group B

was 31.32 ($sd = 7.26$, median 30.50) and for men it was much lower 15.81 ($sd = 5.25$, median 15.50). The difference is statistically significant as the t-test results show ($p < 2.2e - 16$).

The mean result in NATIR for women's group was 19.15 ($sd = 8.04$, median 18.00) while (similarly as for BHNU) for men's group it was lower 15.81 ($sd = 5.25$, median 15.50). This difference is statistically significant as the t-test results show ($p = 0.0495$). This tendency in results is also observable in the second part of the study. In this part the mean result in NATIR for women's group ($N = 33$) was 21.27 ($sd = 8.71$, median 20.00) while for men's group ($N = 17$) it was lower 16.88 ($sd = 4.92$, median 16.00). This difference is statistically significant as the t-test results show ($p = 0.0275$).

3.3. Groups A and B Comparison

In the second part of the study 50 subjects took part—28 in group A and 22 in group B. For the comparison of NATIR scores between groups we have selected a random sub-sample of 22 results from group A. The distribution of NATIR results is normal in both groups (as indicated by the Shapiro-Wilk normality test). Mean NATIR result for A is 22.27 ($sd = 8.67$, median 21) while the result for group B is lower as the mean score equals 18.36 ($sd = 6.28$, median 17.5)—see Figure 6. However, this difference is not statistically significant (t-test, $p = 0.0949$).

3.4. Pre-test and Post-test Natir Scores

As no significant differences were observed between groups A and B for NATIR scores in the second part of the study, we have decided to take all the results together. We will report pre-test results (from the first part of the study) as NATIR1 and post-test results (from the second part) as NATIR2. For the comparison 50 subjects who participated in both parts of the study were taken into account. The distribution

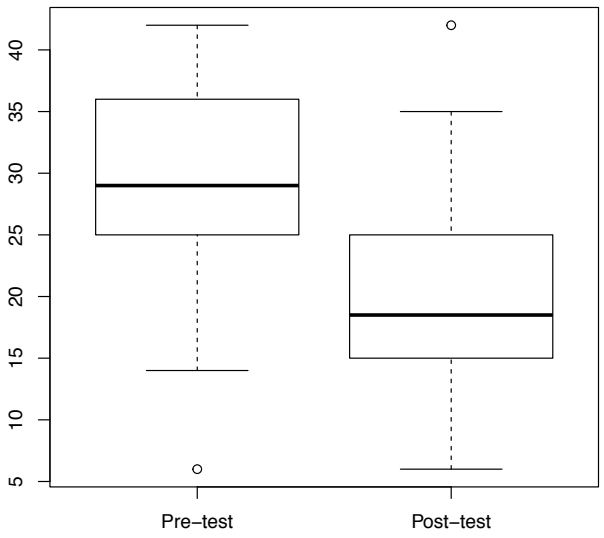

Fig. 7. Pre-test versus post-test NATIR results

of results in NATIR1 and NATIR2 was normal (as indicated by the Shapiro-Wilk normality test), thus we have used the paired t-test to establish the pre-test and post-test differences. A statistically significant ($p = 3.585e-09$) decrease in NATIR results is observable between NATIR1 and NATIR2 (from 29.54, $sd = 8.42$ to 19.90, $sd = 7.84$). The difference between NATIR1 and NATIR2 is presented in Figure 7.

Summary of our findings is the following:

1) Reliability of BHNU (for the first part of the study) and NATIR (for both parts) questionnaires is satisfactory.
2) There is a weak positive correlation between BHNU and NATIR scores for the first part of the study. (H1) is confirmed.
3) In our subjects' group we observe that women are less inclined to interact with robots and have stronger believes concerning human uniqueness than men. (H2) is confirmed.
4) We observe no statistically significant differences in NATIR scores between groups A and B in the second part of the study. Video manipulation was not successful in terms of modifying attitudes differently in these groups. (H3) is *not* confirmed.
5) There is an observable difference between pre-test (first part) and post-test (second part) NATIR results—post-test scores are lower that these in pre-test. The difference is statistically significant. (H4) is confirmed. (We should however stress that this effect is observed for our relatively small research group and may be a direct effect of the video, as such will not not last for long—we discuss these issues in the following section.)

4. Conclusion

Results reported in the previous section show that BHNU and NATIR questionnaires (in their Polish adaptations) have a good internal consistency (as measured with Cronbach's alpha). This result (together with the one reported in [10]) confirms that the Polish adaptation provides a proper tool for HRI research on Polish participants.

For our research group we also observe (weak) correlation between BHNU and NATIR scores. This is in line with previous results reported in [20] and [5] (as we read in [5]: "[...] the stronger the belief in human nature uniqueness, the less positive the attitude towards interactions with robots [...]"). Also the observed effect of gender on NATIR score—men had more positive attitude than women is in line with previously reported results. What is worth stressing this tendency holds for pre-test and post-test results in our study. We observe analogous results for human-uniqueness scale: men had weaker belief in human-uniqueness than women. As BHNU and NATIR scores correlate we may explain this observation along the same lines, suggested in [18, 19] and discussed in Section 2.4.

As the most important finding of our study we consider the effect of influencing NATIR scores by presenting a short video to our subjects. Our subjects significantly lowered their negative attitude towards robots after (at least) two weeks break from pre-test. It is worth to stress that videos were rather simple presentation of capabilities of modern day robots. The result needs further investigations as we discuss below in the context of limitations of our study. However it may be used at least in two ways. First of all, similarly as [24], it suggest that we may influence the attitudes towards robots without interactions with real devices. We may use videos, games or computer simulations. Secondly, the results indicate the need for pre-test and post-test scheme while using NATIR preceded by a video presentation of robots in order to control the influence of the used material. The procedure using video presentation of robots (but without pre-testing) was used in the Polish adaptation study reported in [20]—a subject was presented with one of three prepared videos about robots, which was then followed by NATIR questionnaire.

One of the main limitations of our study is visible in the lack of confirmation of (H3). We would understand better the influence of the presented video material when the difference between two groups in the post-test would be observed. However, no such significant difference appeared. One of possible explanations of this fact may be that differences between presented robots and their actions were too small for our subjects. The drawback of the study is that we have not collected any additional qualitative data from participants, e.g. concerning their motivations and reasons for choosing answers to NATIR questions. Such data would certainly shed light on the obtained results. Employing the Anthropomorphism Scale used in the Polish adaptation of NARS would be also beneficial. For future studies we will also consider a different video stimuli design. The wider range of robots may be used (e.g. ranging from non-anthropomorphic military robots to very human-like ones like Sophia). In our opinion it is also worth considering the use of

videos presenting explicit human-robot interactions which would evoke more emotional reactions (like e.g. widely commented videos from Boston Dynamics presenting an employee interrupting actions performed by Atlas—see an overview 'Boston Dynamics New Video Is Just Another Reason Robots Will Hate Us One Day' in *The Washington Post* 02.21.2018).

In our opinion further study would be required on a larger group of subjects (with more variety when it comes to age and education). We would like to add additional questions concerning previous experiences with robots and such (possible) experiences during the break period between pre-testing and post-testing. It would be also beneficial to add an additional group of subjects. This group would not be presented with any video material, but simply filled our NATIR questionnaire. This would allow to test whether a simple repetition of the same questionnaire may somehow influence its results. What is more, for the pre-test and post-test plan of our study a re-test should be added in order to control how long the observed attitude change would last.

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