The Effect of Interactivity on Participant Engagement in Robot-Taught Yoga

Finlo Heath
22071796 - MSc Robotics
University of the West of England, Bristol University
Bristol, England
Finlo2.Heath@live.uwe.ac.uk

***Abstract*—This study investigates the effect of varying interactivity in a robot-led yoga routine. As remote activities become more popular following the COVID-19 Pandemic, home exercise has seen rapid uptake. Robots provide an opportunity to restore some level of interactivity during exercise, which may impact subjective enjoyment and exercise quality. To investigate, a humanoid robot was programmed with a short yoga routine. Using the same physical routine, interactive and non-interactive versions were created. An experiment was designed and performed using a within-subject design, users participated in both interactive and non-interactive conditions, using a questionnaire to rate the robot subjectively. The user's engagement time and number of actions attempted were recorded. Results indicate that there is a significant increase in user engagement with the interactive condition ($p = 0.0350$), though participants performed a greater number of exercises in the non-interactive condition, due to a lack of choice to skip movements. We conclude that interactivity is an important tool to improve exercise quality and participant enjoyment. However, the method of implementation is important, providing too much choice can allow users to skip exercises, undermining the aims of the system. This study's original data is available publicly for researchers at the author's GitHub via the following link: GitHub Resources**

***Index Terms*—HRI, Humanoid Robot, Exercise, Robotic Rehabilitation**

I. INTRODUCTION

Among the many advances in robotics in recent years, the Covid-19 pandemic caused a cultural shift which has revealed new opportunities for positive human-robot interaction. Notably, lockdown policies forced people to perform previously social activities in their own homes. Home-exercise increased significantly in popularity and has continued as a popular choice beyond the pandemic [1]. While this offers convenience to all and is an essential exercise option for immunocompromised individuals, it lacks the engagement and adaptability available via live-instructed exercise.

Robot exercise instructors provide a potential solution where interactivity and personalisation can be restored while maintaining a home exercise routine. This solution may be particularly attractive to the immunocompromised, who have no option to attend human-led workout classes. The aim of this study is to determine whether interactivity in robot-led yoga contributes significantly to the quality of the subjective user experience and whether it affects the objective amount of time the user is active for. This will provide insight into whether personalised robot-led exercise constitutes a significant improvement over pre-recorded video workouts; the home-exercise industry mainstay. Given that interactivity allows users to tailor exercise to their own ability, we predict users will prefer this condition to the non-interactive equivalent, and will consequentially be more engaged in the activity. The humanoid NAO Aldebaran robot [2] was used as our robot instructor.

II. RELATED WORKS

A. HRI User Study

Human-Robot Interaction (HRI) is a field that focuses on the study of interactions between humans and robots. User studies are an essential aspect of HRI research, as they provide insights into the users' experience and can guide the design and development of robots that are better suited for human interaction [3]. User studies typically aim to assess the users' engagement with robots in completing particular tasks or gauge the emotional reaction of users towards the robot [4]. In our work, we are mainly concerned with user engagement.

Measuring user engagement can typically be done through three approaches, as commonly categorised in experimental design [5]. These include: i) subjective self-reports from users, ii) objective monitoring of user responses such as body postures, intonations, head movements, and facial expressions during the interaction, or iii) manual logging of behavioural responses to user experience. We choose to use an "active time" to capture engagement, as defined in Section III.

B. Coaching Robots for Physical Workouts

Studies have shown that the use of robots to facilitate physical exercises could potentially increase users' compliance and willingness to engage in exercise programs, as well as promote participation in physical activities [6].

The robotic systems that have connections to our physical exercise coaching system are the following. A socially assistive robot (SAR) system was introduced that aims to encourage physical exercise among elderly users by leveraging their intrinsic motivation and personalising the human-robot interaction [7]. Similarly, researchers developed a robotic fitness coach for the elderly and emphasised the importance of verbal interaction with the user [8]. An imitation learning system was presented for daily physical exercises, where the robot learned new exercises from therapists and demonstrated them to patients through voice and gesture communication. However, it could not provide active feedback or guidance to the patient [9].

C. The Effect of Interactivity

Our study considers the effect of interactivity on participant engagement and sentiment toward exercise. Considering the literature, participants who exercised with a physical robot made fewer mistakes and reported higher fitness levels and motivation compared to those who used a video-displayed robot on a tablet [10]. This may be because of human judgement of the physical robot as an interactive social partner [11]. Hence, our investigation is designed to verify the effect of interactivity in exercised-based HRI. To continually improve our robot's performance, user feedback is used to make iterative changes to the design.

III. Methods

A. Hypothesis & Independent and Dependent Variables

Given the discussion in section II, our study hypothesis is stated as follows:

Users will subjectively prefer a yoga routine led by a robot which is interactive and descriptive, compared to the performing same routine with no interactivity provided by the robot-instructor. This preference will manifest as an increase in "active time" - the amount of time in which the user is actively engaged in the routine.

The validity of this hypothesis will be discerned by recording participants' subjective feedback using a questionnaire and measuring the "active engagement time" in each trial. We define active engagement time as follows:

"Any moment where the participant is performing a pose, or attempting to do so. Engaging with the robot verbally, or paying direct attention to what the robot says."

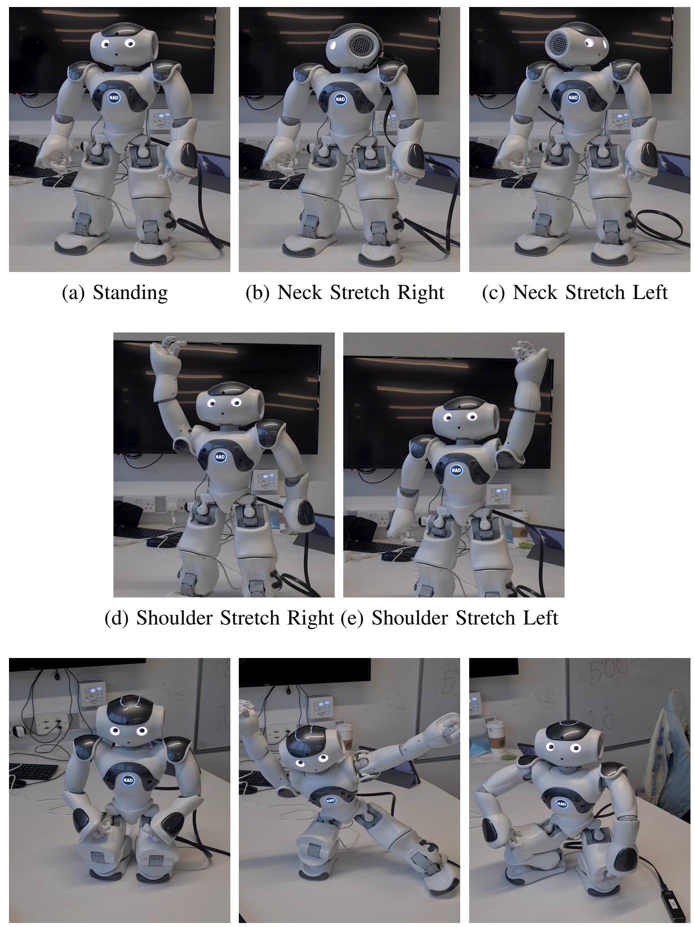
Actions such as not following an instruction from the robot, or not paying attention as it describes a yoga pose, constitute time when the user is not actively engaged. This quantitative measure allows for some level of statistical comparison between the two conditions, an improvement on subjective feedback alone. During each condition and across each participant, the same researcher records active engagement time, to maximise the consistency of this judgement. The number of actions that the participant attempts (out of 2 warm-up stretches, 3 poses, 5 total) are recorded. The three dependent measures are, therefore, questionnaire response (qualitative and subjective), active engagement time (quantitative, but subjective to researcher judgement) and the number of actions attempted (quantitative, objective). While the independent variable is the interactivity level of the robot.

B. Study Design

To ensure clarity and , we provide a step-by-step description of the study procedure.

The study consists of one participant trialling both conditions sequentially. The two conditions are **interactive** and **non-interactive**. Both Conditions involve the same physical yoga routine, demonstrated by the NAO:

1) NAO robot stands.
2) Warmup consisting of neck and shoulder stretching.
3) Pose 1: Upright Heel Sit (Thunderbolt Pose).
4) Pose 2: Side Lunge With Raised Arms.
5) Pose 3: Standing Squat.
6) NAO robot finishes by moving to its rest position (kneeling).



(a) Standing (b) Neck Stretch Right (c) Neck Stretch Left

(d) Shoulder Stretch Right (e) Shoulder Stretch Left

(f) Heel Sit Pose (g) Side Lunge Pose (h) Squat Pose

Fig. 1. The movements performed by the NAO robot in both conditions. These were programmed using Choregraphe [12].

The poses are shown in Fig. 1. Pose options were limited by the balance capabilities of the robot. The chosen poses maintain a stable posture throughout, minimising the risk of damage to the robot or its surroundings if it fell. The two conditions differed in the robot's verbal instruction and use of natural language processing to react differently to user responses to questions.

In the non-interactive condition, the robot informs the user that they will do yoga, beginning with a warm-up, and instructs the user to mimic their actions, holding each pose for ten seconds. No options are provided and no verbal detail, such as counting the hold time or describing the pose, is given.

Conversely, in the interactive condition, the robot describes all actions as they are performed. For example, during the heel pose demonstration, the robot instructs the user *" Kneel on the floor, sit back on your heels."*. The robot then asks *"Is this pose too difficult?"*, giving the user a verbal choice. If the user states *"Yes"*, the robot responds *"Okay, let's skip this pose."* and the pose is skipped. If the user states *"No"*, the robot will then instruct the user to hold the pose for ten seconds, counting the seconds out loud. The robot is also more encouraging in this condition, saying *"All done, You did great! Thank you for joining me and come back soon!"* instead of simply *"All done."*, used in the non-interactive condition.

A custom questionnaire was created for our study, inspired by the NASA TLX [13] and Godspeed questionnaires [14] commonly utilised in HRI. A bespoke questionnaire was chosen as none of the standardised questionnaires focused on the study aspects we are investigating. The NASA TLX discerns the cognitive load on the user, while Godspeed likeability and intelligence are near to our investigation focus, we are more concerned with how the user perceives the quality of the exercise session to change. Hence, we made use of the Godspeed 1-5 scale indicating negative to positive sentiment and NASA TLX category separation when designing our own questionnaire.

The study procedure allows for a single participant in each trial and runs as follows:

1) Participant Consent acquired and study aims explained
2) Randomise the condition order.
3) Initialise the first condition.
4) Participant given questionnaire.
5) Initialise the second condition.
6) Participant repeats questionnaire.
7) Participant given a debrief and researchers answer any post-study questions they have.

Our participant demographic was limited by the study location and time constraints. As such, the participants were all in the age range 18-30, and all robotics students. This is likely to greatly affect participant engagement and sentiment in questionnaire responses, as all participants can be considered both experienced with and interested in robots. The majority of participants spoke English as a second language, which may affect how clearly NAOs instruction comes across. In total, we recruited 11 participants.

IV. Results

Our questionnaire consisted of 11 rating questions, with participants rating their experience from 1 to 5 based on their perceived level of satisfaction. In each question, 5 was the most positive response, whereas 1 was the most negative response. These questions covered topics such as the overall experience with the robot, ease of understanding instructions, and level of comfort in interacting with the robot. Additionally, three open-ended questions were asked to elicit qualitative feedback on the features that participants liked or disliked, and any other comments.

Based on the average scores of the 11 rating questions, we constructed box plots to visualise the differences between the two experimental conditions. The box plot is shown as Fig. 2.

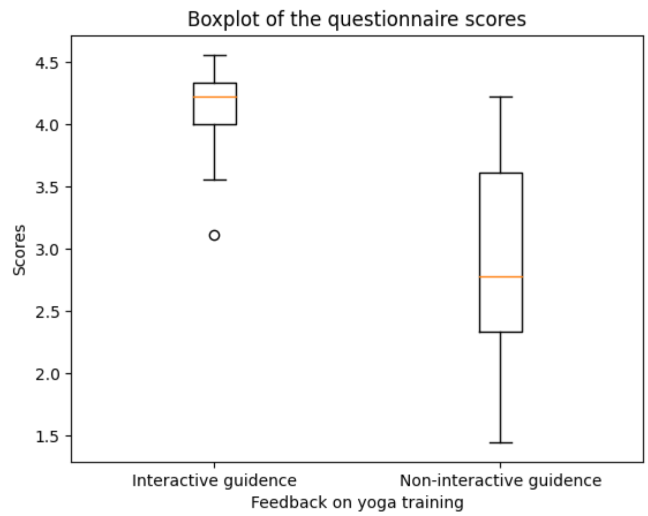


Fig. 2. A box plot displaying the mean questionnaire scores in each condition. The orange horizontal line displays the median score, while the whiskers show the standard deviation in scores.

As the chart indicates, doing yoga lessons with interactive guidance from NAO generally satisfies users more, as they rated the questions higher scores and more concentrated around 4 points. As for the non-interactive condition, the scores vary more and tend to be lower, around 3 points. The bar chart shown in Fig. 3, provides the mean scores for each question across both conditions.

The results indicate that Interactive guidance received higher and more concentrated scores than Non-interactive guidance. This suggests that the use of interactive guidance is more effective in improving participant satisfaction and engagement with the robot-guided yoga workout.

We recorded the engagement time and experiment time of our study participants for each personality type tested. Using this data, we calculated the percentage time during which participants engaged with the robot during each condition, t_E using:

$$t_E = \frac{\text{engagement time}}{\text{condition duration}} \times 100$$

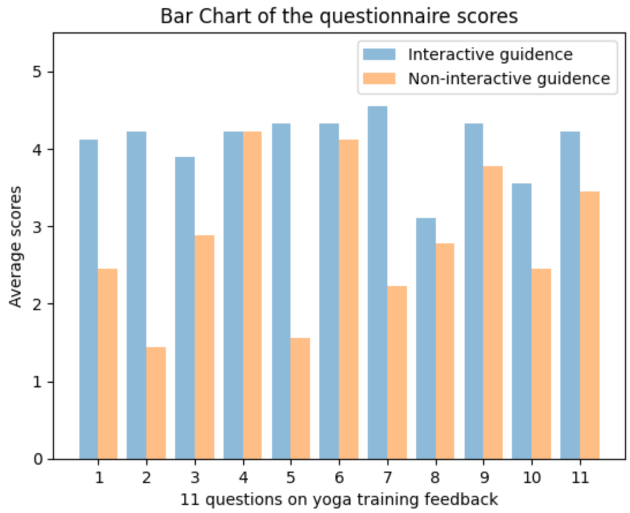


Fig. 3. A bar chart displaying the average score for each question across both conditions. This corroborates the finding that participants scored the interactive condition both more highly and more consistently.

We present the results in Fig. 4, which displays a bar and whisker plot comparing the means and standard errors of the percentage of participants engaged for each personality type. The results indicate that the percentage of time in which participants engaged varies significantly depending on the personality type of the robot instructor, suggesting that instructor interactivity can affect engagement time.

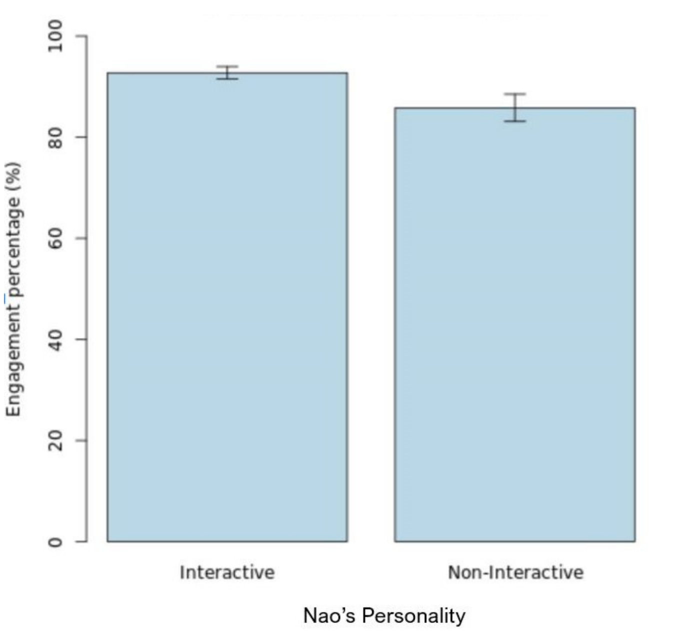


Fig. 4. This bar plot compares the mean percentage engagement time, t_E in the non-interactive and interactive conditions. The whiskers display the standard deviation in this mean.

The engagement percentages of our participants were analysed using histograms, as illustrated in Fig. 5. In light of our relatively small sample size, we conducted the Shapiro-Wilk test to assess the normality of our data. Results of this test yielded a p-value of 0.06012 and 0.08095 for the Non-interactive and Interactive personalities, respectively, utilising a significance level of 5%. These values indicate that our data conforms to normality assumptions, and therefore, we conducted a t-test to investigate the statistical significance between our conditions. Our null hypothesis stated that there was no difference between the means of our groups, and we performed a t-test on the engagement percentage of the Interactive group versus the Non-interactive group.

Table I presents a comprehensive summary of the results of our study. Utilising the standard significance level of 5% and a p-value of 0.03497, we could reject our null hypothesis and confirm the existence of a statistically significant difference between our two study groups. Furthermore, we calculated Cohen's d value to assess the effective size of our experiment. Our findings revealed an effective size of 0.9960312, indicating a large effect size between the Interactive and Non-interactive variables. These results underscore the significance of our research and the impact of human-robot interaction on engagement levels.

p-value	0.0350
t	2.336
Degree of freedom	13.933
Mean of Interactive group	92.731
Mean of Non-Interactive group	85.809
Cohen's d (Effective size)	0.996

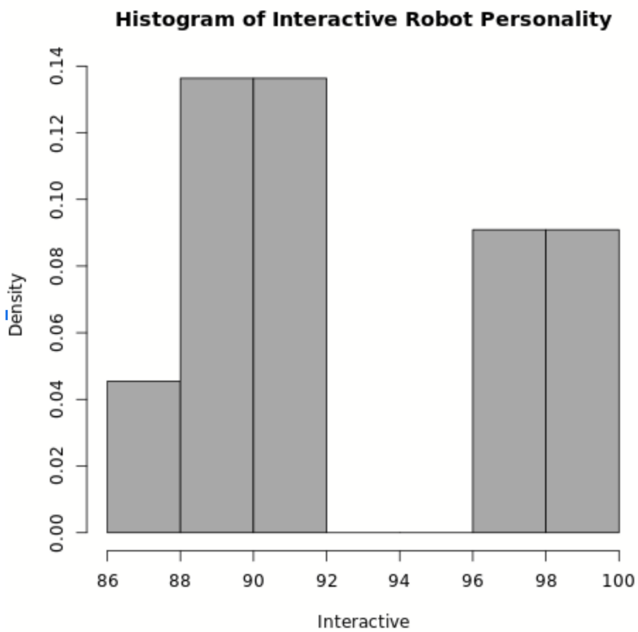
TABLE I
T-TEST RESULTS. ALL VALUES ARE ROUNDED TO THREE DECIMAL PLACES.

As detailed in section III, there were five total actions for participants to complete. On average, 4.46 poses are completed under non-interactive guidance while 3.82 poses are completed under interactive guidance. This result shows that participants took advantage of the option to skip exercises in the interactive condition, and generally obeyed the robot's commands in the non-interactive condition.

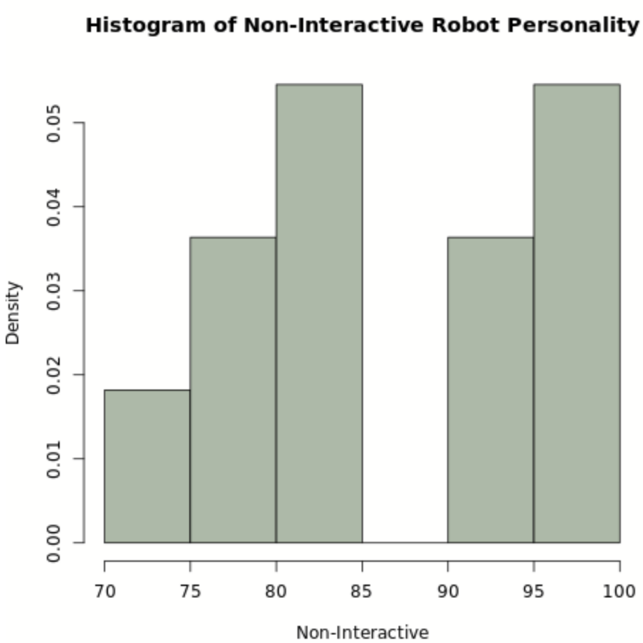
Regarding qualitative feedback, on balance, the participants preferred verbal explanations alongside demonstrations. Positive comments were made regarding action guidance, the pose variety and the NAO humanoid form. The features participants dislike include the robot moving too slowly and some poses being too difficult. Suggestions include adding social functions to share details with friends and providing a short break between each pose.

V. DISCUSSION

The results of our study indicate a clear user preference for interaction during robot-guided exercise. This is measured explicitly with the questionnaire responses, and implicitly with the percentage engagement time during each condition. There is however an interesting phenomenon in that participants on average attempted more actions in the non-interactive condition, despite preferring its counterpart. This suggests



(a) Histogram showing the distribution of Engagement percentage across participants for the interactive robot personality.



(b) Histogram showing the distribution of Engagement percentage across participants for the non-interactive robot personality.

Fig. 5. Distribution of participants' engagement time percentage across the two conditions.

that the more commanding non-interactive robot, which gave no options to users, results in users performing more exercise. The interactive robot gave users the option to skip poses they perceived as "too difficult", resulting in less exercise, though this feature is sensible to prioritise user safety and may encourage them to exercise more frequently if they know they won't be commanded to perform every pose. Overall, the interactivity of the robot should be preserved, but future robot iterations can utilise more commanding rhetoric to aid users in pushing their limits.

However, there are conflicting factors in this result. Firstly, in the interactive condition, the robot states *"Please watch the next pose I show you, wait until I finish before you move."*. We observed that many participants ignored this command, testing the pose instead as the robot demonstrated it. Some of these then decided it was too difficult, opting to skip it when NAO provided this choice. This resulted in their not completing the pose, despite testing it. This could be partially due to misunderstanding. The majority of participants spoke English as a second language, it would be preferable to provide a robot instructor who uses the participant's native language to avoid confusion during the routine. Further, this study used a within-subject design. While trial order was alternated between participants, we observed some relevant ordering effects. When performing the interactive trial before the non-interactive trial, the number of actions attempted in the second trial either stayed the same or increased for all participants. However, when performing the non-interactive trial before the interactive trial, in one-third of cases, the number of actions attempted in the second trial decreased. We postulate that this is due to participants opting to skip poses they have already tried and have become fatigued to. If the non-interactive condition is second, participants are simply commanded to imitate the robot, rather than given a choice, leading more of them to do so. This accounts for some of the disparity in the average number of actions attempted in each condition. A necessary improvement to the study design is therefore to design two yoga routines, the robot performing each of these in an interactive and non-interactive manner, alternating the routine as well as the order of conditions. For example, participant A has Routine 1 as interactive, Routine 2 as non-interactive. Participant B has Routine 1 as non-interactive, Routine 2 as interactive. This removes novelty effects whilst accounting for potential difficulty differences across the routines.

Considering section IIC, we can see that our results align with *Salomons et al.* [10] and *Bainbridge et al.* [11] who both espouse the benefits of physically present robots compared to those shown on video; fundamentally the benefits of an increase in interactivity level. Our contribution solidifies this finding and shows that further developing the interactivity of the robot improves user rating of the interaction and engagement during it.

VI. Conclusion

In comparing interactive and non-interactive robot-taught yoga, this study found that including interactivity resulted in higher participant engagement and positive sentiment toward the robot and task. However, providing authority to skip exercises as part of the interactivity, resulted in participants completing fewer poses in this condition. Hence, the way in which interactivity is implemented must be carefully considered, to avoid undermining the purpose of the system.

Future iterations of the study must correct for potential order effects as outlined in section V. The robustness of the robot should be improved, as temperamental hardware led to unplanned delays for participants between conditions, which could affect results. While active engagement time is a useful measure, it is subjective to the researcher recording it. User-tracking would provide a more objective method of recording detailed user engagement, and so should be used. Finally, to be able to generalise these results, the study must recruit a wider demographic of participants and collect data on their familiarity with robots and yoga, given this is likely to impact their enjoyment of the experience. With further refinement, robot-taught exercise could provide an engaging and convenient activity for many people adopting more remote lifestyles.

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Appendix

Overleaf, readers can find study resources. Specifically, our questionnaire, informed consent form, participant information sheet and privacy notice.

Dear Participant,

Thank you for participating in our user study on the using the Nao robot for yoga instruction. Your feedback is invaluable in helping us improve the robot's performance and user experience. The purpose of this survey is to gather your thoughts and opinions regarding your interaction with the robot during your guided yoga workout.

Instructions:

Please take a few minutes to complete this questionnaire. We estimate that it will take approximately 10 minutes to finish. Read each question carefully and provide your response by selecting the most appropriate option or writing your response in the space provided.

All your responses will be kept confidential and used solely for the purpose of this research. There are no right or wrong answers; we are interested in your honest feedback.

Now, please answer the following questions:

1. How would you rate your overall experience with the yoga-guiding NAO robot? (1 - very poor, 5 - excellent)

2. Did you find the robot's instructions easy to understand? (1 - not at all, 5 - very easy)

3. How helpful was the robot in guiding you through the yoga workout? (1 - not helpful, 5 - very helpful)

4. Did you feel comfortable interacting with the robot during the workout? (1 - not comfortable, 5 - very comfortable)

5. How would you rate the robot's ability to adapt to your skill level or limitations? (1 - poor, 5 - excellent)

6. How well did the robot maintain a suitable pace throughout the workout? (1 - too slow or too fast, 5 - just right)

7. Did the robot provide adequate feedback or corrections during the workout? (1 - not at all, 5 - very much)

8. How would you rate the robot's ability to motivate and engage you during the workout? (1 - poor, 5 - excellent)

9. How likely are you to use this robot-guided yoga workout again? (1 - not likely, 5 - very likely)

10. How likely are you to recommend the robot-guided yoga workout to a friend or family member? (1 - not likely, 5 - very likely)

11. What features or functionalities did you like most about the yoga-guiding Nao robot?

12. What features or functionalities did you dislike or find challenging to use?

13. Do you have any suggestions for improvements or additional features you would like to see in the yoga-guiding robot.

14. Any other comments or feedback regarding your experience with the yoga-guiding Nao robot?

Consent Form

Study Title: *A study of the effect of interactivity level on participant engagement in robot-taught yoga*

This consent form will have been given to you with the Participant Information Sheet. Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions before you sign this form. If you have any questions please contact a member of the research team, whose details are set out on the Participant Information Sheet.

If you are happy to take part in this study please sign and date the form. You will be given a copy to keep for your records.

Please read the statements below and sign below to give consent:

I have read and understood the information sheet
I have been given the opportunity to ask questions and have had my questions answered to my satisfaction.
I am aware of the risks and benefits of taking part in the study
I am aware that data collected will be anonymised, kept in accordance with General Data Protection Regulation (GDPR), and will be viewed and analysed by the research team as part of their studies.
I am aware that I have the right to withdraw consent and discontinue participation without penalty before or during the study.
I am aware that I have the right to withdraw my data from the experiment up to 7 days after the completion of the experiment, using the participant ID that the researcher will provide.
I have freely volunteered and am willing to participate in this study.
I am willing to have my questionnaire responses collected.

Name (Printed)……………………………………………………………………….

Signature……………………………………………………. Date…………………….

Study Information Sheet

Study Title: *A study of the effect of interactivity level on participant engagement in robot-taught yoga.*

PLEASE READ THIS SHEET IN ITS ENTIRETY

You are invited to take part in research taking place at the University of the West of England, Bristol. It is carried out as assignment for module UFMFHP-15-M Human-Robot Interaction. Before you decide whether to take part, it is important for you to understand why the study is being done and what it will involve. Please read the following information carefully and if you have any queries or would like more information please contact *Finlo Heath, Ao Li, Ziqi Xiong, Haoxiang Tang, Tianwei Qiao, Oloruntoba Olajubu,* Faculty of Environment and Technology, Bristol Robotics Laboratory, University of the West of England, Bristol, Finlo2.Heath@live.uwe.ac.uk, Ao2.li@live.uwe.ac.uk, ziqi2.xiong@live.uwe.ac.uk , Haoxiang2.tang@live.uwe.ac.uk, tianwei2.qiao@live.uwe.ac.uk, oloruntoba2.olajubu@live.uwe.ac.uk

Who is organising the research?

The project is led by *Finlo Heath, Ao Li, Ziqi Xiong, Haoxiang Tang, Tianwei Qiao, Oloruntoba Olajubu,* at the University of the West of England. Manuel Giuliani is the supervisor for this research. Please find their details at the end of this document.

What is the aim of the research?

The overall aim of the research is to evaluate the impact of a NAO robot as a yoga instructor on user experience, engagement, and learning outcomes in a yoga workout context. The main aims of the study are to:

- Assess users' satisfaction with the robot's instructions, demonstrations, and pace during a yoga workout.
- Measure the level of user engagement and motivation while interacting with the robot-guided yoga workout.
- Evaluate the robot's ability to adapt to users' skill levels, limitations, and provide personalized feedback.
- Identify areas for improvement in the robot's design, functionalities, and interactions to enhance the user experience.
- Explore the potential of the robot-guided yoga workout as a viable alternative to human-led classes for various user groups.

The purpose of this study is to conduct a comprehensive user evaluation of a NAO robot acting as a yoga instructor, examining its effectiveness in guiding participants through a yoga workout and its impact on their overall experience. The user study will involve participants engaging in a robot-led yoga session, followed by the completion of a questionnaire designed to collect their feedback on various aspects of the interaction, such as the robot's instructions, demonstrations, adaptability, and engagement. The insights gained from this study will help inform potential improvements and future developments in the field of human-computer interaction and robot-guided exercise programs.

Why have I been invited to take part?

We are recruiting participants who are already working at the University of the West of England and are aware of the current risk and safety procedures due to COVID-19 restrictions.

Do I have to take part?

You do not have to take part in this research. It is up to you to decide whether or not you want to be involved. If you do decide to take part, you will be given a copy of this information sheet to keep and will be asked to sign a consent form. If you do decide to take part, you are free to stop and withdraw from the study at any time without giving a reason.

What will happen to me if I take part and what do I have to do?

1. Participant Consent & Explain study.
a. We are interested in using robots to lead exercise programs
b. Explain concept of the study – robot demonstrates yoga and user follows.

2. Initialise the first condition. Randomly interactive or non-interactive
a. Experimenter uses a stopwatch to record the amount of the time the participant is active (Active: Engaged in the activity, posture active and ready, or holding a pose, Inactive: Poster relaxed/slumped, waiting for robot to do something). This should be the same experimenter for both conditions.
b. Experimenter records the number of poses attempted out of three. As well as whether the warmup is attempted.

3. Questionnaires 1: Participants fill out our custom questionnaire.

4. If time, enforce a 2-minute break.

5. Initialise the Second condition. This is whichever the participant did not do last time.
a. Experimenter uses a stopwatch to record the amount of the time the participant is active (Active: Engaged in the activity, posture active and ready, or holding a pose, Inactive: Poster relaxed/slumped, waiting for robot to do something). This should be the same experimenter for both conditions.

b. Experimenter records the number of poses attempted out of three. As well as whether the warmup is attempted.

6. Questionnaires 2: Participants fill out our custom questionnaire.

7. Participant debrief.

Data will be gathered using the following methods:

Questionnaire - Questions based on participant experience.

Task Performance

1.Active time during the trial.
Explanation:
How long the participant is active[1] during the trial?

[1](Active: Engaged in the activity, posture active and ready, or holding a pose,
Inactive: Poster relaxed/slumped, waiting for robot to do something)

2.Number of actions(out of 5) attempted.
Explanation:
How many actions the participants have tried?

What are the possible risks of taking part?

When participating in a study involving a robot-guided yoga workout, there are several possible risks to consider. However, these risks are generally minimal and can be managed with proper precautions. Some potential risks include:

Physical discomfort or injury: Engaging in any physical activity, including yoga, carries a risk of discomfort or injury, particularly if the participant has pre-existing medical conditions or is unfamiliar with the exercises. Proper warm-up, cool-down, and following the robot's guidance can help minimize these risks.

Emotional distress: Participants may experience feelings of frustration, anxiety, or embarrassment if they have difficulty following the robot's instructions or are uncomfortable with the technology.

Privacy concerns: Participants may be concerned about the privacy of their personal information, including their performance and feedback during the study. Researchers should ensure that data is collected and stored securely, and participants should be informed about the confidentiality measures in place.

Technical issues or malfunctions: The NAO robot or other equipment used in the study may encounter technical issues or malfunctions, which could disrupt the user experience or pose a risk if the robot behaves unexpectedly.

What will happen to your information?

All the information we receive from you will be treated in the strictest confidence.

All the information that you give will be kept confidential and anonymised. You will be assigned a participant ID that you can use to request the removal of your data from the study up to 7 days after completion of the experiment. After this point, the anonymised data will be analysed, and we will ensure that there is no possibility of identification or re-identification from this point.

Hard copy material (the consent form) will be kept in a locked and secure setting to which only the researchers will have access in accordance with the University's and the Data Protection Act 2018 and General Data Protection Regulation (GDPR) requirements.

Where will the results of the research study be published?

The results of this usability study will be reported in the coursework report for UWE module UFMFHP-15-M Human-Robot Interaction.

Who has ethically approved this research?

The project has been reviewed and approved by University of the West of England University Research Ethics Committee. Any comments, questions or complaints about the ethical conduct of this study can be addressed to the Research Ethics Committee at the University of the West of England at: Researchethics@uwe.ac.uk

What if something goes wrong?

If you have any questions about the ethical conduct of this research, have any complaints or concerns, or are uncertain about any aspect of your participation please contact the project supervisors or the University's research ethics committee.

Project Supervisor:
Professor Manuel Giuliani manuel.giuliani@uwe.ac.uk

What if I have more questions or do not understand something?

If you would like any further information about the research please contact in the first instance:

Finlo Heath, Ao Li, Ziqi Xiong, Haoxiang Tang, Tianwei Qiao, Oloruntoba Olajubu,

At:
Finlo2.Heath@live.uwe.ac.uk, Ao2.li@live.uwe.ac.uk, ziqi2.xiong@live.uwe.ac.uk , Haoxiang2.tang@live.uwe.ac.uk, tianwei2.qiao@live.uwe.ac.uk, oloruntoba2.olajubu@live.uwe.ac.uk

Thank you for agreeing to take part in this study. You will be given a copy of this Participant Information Sheet and your signed Consent Form to keep.

Privacy Notice

Study Title: *A study of the effect of interactivity level on participant engagement in robot-taught yoga*

Purpose of the Privacy Notice

This privacy notice explains how the University of the West of England, Bristol (UWE) collects, manages and uses your personal data before, during and after you participate in this focus group. 'Personal data' means any information relating to an identified or identifiable natural person (the data subject). An 'identifiable natural person' is one who can be identified, directly or indirectly, including by reference to an identifier such as a name, an identification number, location data, an online identifier, or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

This privacy notice adheres to the General Data Protection Regulation (GDPR) principle of transparency. This means it gives information about:

- How and why your data will be used for the research;
- What your rights are under GDPR; and
- How to contact UWE Bristol and the project lead in relation to questions, concerns or exercising your rights regarding the use of your personal data.

This Privacy Notice should be read in conjunction with the Participant Information Sheet and Consent Form provided to you before you agree to take part in the research.

Why are we processing your personal data?

UWE Bristol undertakes research under its public function to provide research for the benefit of society. As a data controller we are committed to protecting the privacy and security of your personal data in accordance with the (EU) 2016/679 the General Data Protection Regulation (GDPR), the Data Protection Act 2018 (or any successor legislation) and any other legislation directly relating to privacy laws that apply (together "the Data Protection Legislation"). General information on Data Protection law is available from the Information Commissioner's Office (https://ico.org.uk/).

How do we use your personal data?

We use your personal data for research with appropriate safeguards in place on the lawful bases of fulfilling tasks in the public interest, and for archiving purposes in the public interest, for scientific or historical research purposes.

We will always tell you about the information we wish to collect from you and how we will use it.

We will not use your personal data for automated decision making about you or for profiling purposes.

Our research is governed by robust policies and procedures and, where human participants are involved, is subject to ethical approval from either UWE Bristol's Faculty or University Research Ethics Committees. This research has been approved by UWE Bristol's Ethics Committee. The research team adhere to the **Ethical guidelines of the British Educational Research Association (and/or the principles of the Declaration of Helsinki, 2013) and the principles of the General Data Protection Regulation (GDPR).**

For more information about UWE Bristol's research ethics approval process please see our Research Ethics webpages at:
www1.uwe.ac.uk/research/researchethics

What data do we collect?

The data we collect will vary from project to project. Researchers will only collect data that is essential for their project. The specific categories of personal data processed are described in the Participant Information Sheet provided to you with this Privacy Notice.

Who do we share your data with?

We will only share your personal data in accordance with the attached Participant Information Sheet and your Consent.

How do we keep your data secure?

We take a robust approach to protecting your information with secure electronic and physical storage areas for research data with controlled access. If you are participating in a particularly sensitive project UWE Bristol puts into place additional layers of security. UWE Bristol has Cyber Essentials information security certification.

Alongside these technical measures there are comprehensive and effective policies and processes in place to ensure that users and administrators of information are aware of their obligations and responsibilities for the data they have access to. By default, people are only granted access to the information they require to perform their duties. Mandatory data protection and information security training is provided to staff and expert advice available if needed.

How long do we keep your data for?

Your personal data will only be retained for as long as is necessary to fulfil the cited purpose of the research. The length of time we keep your personal data will depend on several factors including the significance of the data, funder requirements, and the nature of the study. Specific details are provided in the attached Participant Information Sheet. Anonymised data that falls outside the scope of data protection legislation as it contains no identifying or identifiable information may be stored in UWE Bristol's research data archive or another carefully selected appropriate data archive.

Your Rights and how to exercise them

Under the Data Protection legislation you have the following **qualified** rights:

(1) The right to access your personal data held by or on behalf of the University;
(2) The right to rectification if the information is inaccurate or incomplete;
(3) The right to restrict processing and/or erasure of your personal data;
(4) The right to data portability;
(5) The right to object to processing;
(6) The right to object to automated decision making and profiling;
(7) The right to complain to the Information Commissioner's Office (ICO).

Please note, however, that some of these rights do not apply when the data is being used for research purposes if appropriate safeguards have been put in place.

We will always respond to concerns or queries you may have. If you wish to exercise your rights or have any other general data protection queries, please contact UWE Bristol's Data Protection Officer (dataprotection@uwe.ac.uk).

If you have any complaints or queries relating to the research in which you are taking part please contact either the research project lead, whose details are in the attached Participant Information Sheet, UWE Bristol's Research Ethics Committees (research.ethics@uwe.ac.uk) or UWE Bristol's research governance manager (Ros.Rouse@uwe.ac.uk)

v.1: This Privacy Notice was issued in April 2019 and will be subject to regular review/update.