Simon Says with NAO: Investigating Enjoyment of Social Games with Robots

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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ABSTRACT

There is a high likelihood it will soon be common for humans to interface with robots, but it is unclear how humans will feel about them in social environments. Within the structure of our HRI (Human-Robot Interaction) course, four students and I collaborated to investigate how the enjoyment of the social game Simon Says could be impacted by the introduction of a robot participant. We conducted a small study with 24 participants and one NAO robot. They were split into control (just humans) and experimental (humans with one NAO) groups in which they played Simon Says. To collect data, we had participants fill out questionnaires following their experiences. The study indicates that the presence of the NAO robot in a social game like Simon Says can enhance enjoyment and lead to positive interactions between humans and the robot. However, it is unclear to what extent the enhanced enjoyment is caused by its novelty. Further work could include a longitudinal study to observe how novelty could have been influencing enjoyment. In addition, improving the robot's competence and effectiveness could be of interest.

1. INTRODUCTION

In a hypothetical world where humanoid robots are widely integrated into our society, how will humans feel about interacting with them? This is an increasingly likely scenario considering the rate at which the field of robotics is progressing. Companies such as Boston Dynamics are manufacturing robots that can perform backflips and other acrobatic maneuvers recently thought to be impossible to successfully pull off with robots.

Robots can help humans in many ways. They can perform unsafe tasks, automate boring ones, entertain humans, and even provide companionship. One could wonder how the presence of robots in social settings could change the atmosphere. This type of thinking is common in the field of Human-Robot Interaction (HRI). In my HRI class, I was a member of a team of five students in which we investigated how the enjoyment of a social game could be impacted by the inclusion of a robot. We chose to use the humanoid robot, NAO, provided to us by the University of Virginia Engineering Department.

2. RELATED WORKS

The inspiration for choosing this topic came from Zewe (2021), which covers some of the ways robots currently integrate into our society, then describes current efforts to enhance their ability to engage in social interactions.

The idea of social activities with robots, specifically with social games like Simon Says and humanoid robots like NAO, has been explored in robotics literature. Li, et al. (2019)

discuss how they had the NAO robot play the game of Simon Says as the "Simon" through programming it with image recognition. This inspired my group to explore the game of Simon Says with the robot. The fact that the authors chose to make NAO the Simon made us confident that we could flip the roles, since the role of Simon is much more complicated to program.

3. PROJECT DESIGN

We had prior experience programming the NAO robot due to labs we had in class, so we had an idea how this experiment could be done. We had even programmed specific movements that could be used in the Simon Says game, like having the hands raised or out to the side. The game Simon Says was an obvious choice since it is commonly known and easy to learn.

To determine whether there was a significant difference in enjoyment of the game with the robot present, we planned to have two groups, each with 12 study participants, play the game. The control group would play the game normally, with only human participants. The experimental group would have the same number of participants, except one was replaced with the NAO robot. We had successfully programmed the robot to follow instructions using the software that comes with it. NAO had learned to recognize certain instructions, but only act on them if the word "Simon" had been said before them. Some of the obstacles we faced were lack of voice recognition in a noisy environment, inaccurate interpretation of the commands, and movements performed at high speeds which knocked the NAO off balance.

Once we were confident our robot could play relatively consistently, we invited the study participants to play some rounds of the game. NAO experienced some issues in the beginning, so the experimental group witnessed some of the set-up and trouble-shooting. In addition, the experimental group had to crowd around the robot sort of unnaturally due to its low height and limited hearing.

Once the game was concluded, each participant was asked to complete a post-game survey. The survey was a Google Form in which we could easily collect quantitative and qualitative data tied to each participant. In order to collect quantitative data, we employed Likert scales surrounding our questions related to enjoyableness. Short-form response boxes were helpful in collective qualitative data to capture more in depth each participant's subjective experience.

Since the game could be played with many participants simultaneously, the entire process was, fortunately, brief. After we collected the responses, we compiled them and conducted a thorough comparison analysis.

4. RESULTS

Our analysis of the collected data yielded several interesting findings regarding the impact of the NAO robot on participants' enjoyment of the Simon Says game. To begin with, we found that the average enjoyment rating was higher in the experimental group where the NAO robot was present, compared to the control group with only human participants. This suggests that the inclusion of the robot added an element of excitement and novelty to the game, which was reflected in the participants' positive responses.

The participants in the experimental group also provided valuable feedback on their interactions with the robot. Many described the robot's participation as "fun" and "unique," while others appreciated the robot's ability to accurately follow the game's instructions. However, some participants expressed concerns about the robot's voice recognition

capabilities in a noisy environment and the occasional misinterpretation of commands. These observations were consistent with the technical challenges we faced during the set-up and trouble-shooting phases.

We observed that participants' perception of the robot's human-like qualities played a role in their overall enjoyment of the game. Those who rated the robot as more human-like generally reported higher levels of enjoyment, suggesting a correlation between perceived human-likeness and positive human-robot interactions.

Despite the higher enjoyment ratings in the experimental group, it is important to consider the influence of novelty on the results. Participants' excitement about the robot's presence may have been amplified due to the new and uncommon experience of playing a social game with a robot. We recognize that further research is needed to assess whether this enhanced enjoyment would be sustained over time as the novelty wears off.

5. CONCLUSION
We gained a new and interesting perspective into how robots could be perceived in social environments. The NAO robot, as limited as it was functionally, managed to provide some measurable increase level of enjoyment for human participants in the social game Simon Says. This is a positive development that could encourage more exploration in this field, and the results of which could improve as the technology in these humanoid robots improves.

6. FUTURE WORK
Future work on this could explore changes in results related to novelty factor, or the level of competence of the robot. In regards to investigating whether novelty could have influenced our results, one could conduct longitudinal studies following the enjoyment

of various social games with robots by study participants who become accustomed to playing the games with the robot. One could also improve the NAO's competence in social games with better sensors, more involved programming, and the choice of social games more suited to the NAO robot's capabilities. This could grant insight into how the level of competence of a robot participant could influence the enjoyment of the social games.

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