Social Reading: Field Study with an In-Home Learning Companion Robot

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Abstract: This study explores changes in childrens' (N = 12) responses to interacting with a learning companion robot for reading over time. Initial comparisons of pre- and post-interviews with the children revealed that social companionship, and situational interest were maintained after two weeks of in-home interaction.

Introduction

While the promise of interactive learning technologies has widely been demonstrated, little is known about how an interactive robot might play a role in the development of interest for an activity. Social interactions between humans have been found to positively influence interest and learning in a task (Sansone & Thoman, 2005), and prior research in human-computer interaction has found children to readily interact with robots in social ways (Tung, 2016). Since, robots have a more dramatic social impact compared to other learning technologies (Han, Jo, Park, & Kim, 2005), researchers have utilized the social ability of robots to improve educational outcomes, but little has been done to explore how interest in reading may be developed using social robots.

To further explore the use of a social robot to develop interest in reading, we used eight design features based on recommendations from interest-development (e.g. Renninger & Hidi, 2011) and human-robot-interaction (e.g. Mutlu, 2011) literatures to design *Minnie*, an in-home learning companion robot for upper elementary aged children (see Figure 1). In a pilot study, we tested the robot to explore families' perceptions about reading with the learning companion robot (Michaelis & Mutlu, 2017). We found that children described a very strong social companionship with Minnie, they felt the robot would help them improve their reading, and they described their experience in ways consistent with the development of interest.

A concern with any learning technology is that positive impressions of the technology may be due to initial excitement of working with a new technology. As this *novelty effect* wears off over time, researchers find reductions in interacting with a robot, including: after a week of learning English (Kanda et al., 2004), and steadily over five weeks of playing chess (Leite, et al., 2009). However, this is not always the case (cf. Hayashi et al., 2007), and the quality of the robot's functionality can overcome the negative impact of the novelty effect wearing off (Letie, Martinho, & Paiva, 2013). To assess how the novelty effect would impact interaction with our robot we conducted a two-week long follow up study, and present initial findings to address the question: How do childrens' experiences with interacting with a learning companion robot change over time?

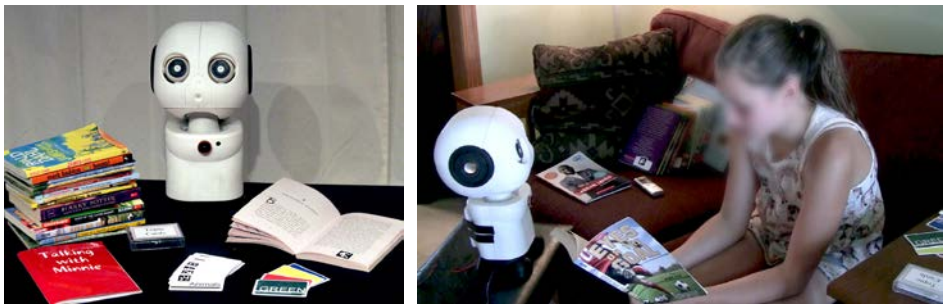

Figure 1. The robot, Minnie, with augmented books (left), and interacting with a child (right).

Methods

Participants were children (N=12; *male* = 4) between the ages of 10 and 12 (*M* = 10.9), were described as *very disinterested* (n = 4), *somewhat interested* (n=4), and *very interested* (n=4) in a pre-study survey. During an initial visit with each family, children completed interviews and surveys, and were introduced the robot. The robot was then left in the child's home for two weeks, and children were asked to interact with the robot when they desired to. After two weeks, we returned to the home to conduct further interviews and surveys. In this poster, we report on pre- and post- comparisons of situational interest surveys and interviews.

The robot is designed to listen, while making eye contact and idle head movements, to children while they read books out-loud. Children were each given a set of 25 books with unique QR-type tags added every 3-5 pages. When these tags are scanned, the robot is programmed to respond with a specific comment written to correspond to the story at that place. The robot adaptively sets, monitors, and encourages children to meet

reading goals during each reading session. To select a new book, the robot offers three suggestions based on their ability, interests and reading habits, but the child is free to choose any book. Children are told they are entirely in charge of their reading sessions, and the amount of their reading has no impact on study completion. For a complete description of the robot development and interaction process see Michaelis & Mutlu (2017).

Results and Discussion

We conducted situational interest surveys after the child's first interaction with the robot (pre) and after two weeks (pre), comprised of 5 Likert-style items on a scale of 1 (*strongly disagree*) to 7 (*strongly agree*), as a quantitative measure of each child's interest in working with Minnie. Scores were computed as an average of the five items on each survey, and were found to be highly reliable for both pre ($\alpha = 0.93$) and post ($\alpha = 0.86$) surveys. Situational interest scores for the post-survey ($M = 5.16$) were not significantly different than pre-survey ($M = 5.44$; $t(11) = 0.92$, $p = 0.37$; $d = 0.26$). While the small sample size does not provide enough power to make generalizable statistical claims, it does indicate that there was some measurable decrease in situational interest over time. This decrease was not statistically significant, and of only a small effect size, and may be interpreted as an indication that situational interest was nearly the same after two weeks.

In our initial analysis of the interview data, we coded pre and post interviews for several factors, and report here on comparisons between two of the code categories, social companionship and positive affect, as a qualitative measure. During pre-interviews, we found that children described their experience similar to our findings from the previous study with Minnie. They felt a social companionship with the robot, and said that they liked "reading with somebody", that "it was more fun reading with her [Minnie] than just reading by myself", and that "it feels like she's one of my friends." These social sentiments were accompanied by strong positive affect, as children said they "loved Minnie", they were "excited" to work with her, and though she was "fun". The social companionship was often related to improving their reading and comprehension of the books, as one child said, "it's a partner that you can read with and almost seem like you can get more information."

These same sentiments have been echoed in our analysis of the post-interview data. Children continue to see the robot as a social companion, and said "It is kind of fun because you have like someone to like read to so you're not - like you don't feel alone." They also describe their experience as "exciting" and "awesome". One common theme that has emerged in the post-interviews that was not strongly present in the pre-interviews was an additional attribution of emotions to the robot. After two weeks they may have felt that Minnie's reactions to the books showed an emotional response. One child told us, "I liked her because she had a lot of emotions about the books. She was scared when I was reading about The Magic Treehouse."

Conclusion

Prior work has indicated that children enjoy working with social robots, and their use can be effective for learning (Han et al. 2005). In this study, evidence from quantitative and qualitative sources suggest the sense of social companionship with a learning companion robot can be sustained over time. Understanding how children respond to a robot over time is important to inform the design of future learning technologies, and to understand the process of children's interaction with learning robots. Larger scale testing over a broader range of domains is needed to further explore these findings. We feel that our initial findings provide promising evidence that a social robot can successfully fulfill the role of a learning companion over time.

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