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Using a Humanoid Robot as a Co-therapist with Children with ASD

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Background

Individuals with Autism Spectrum Disorders (ASD) exhibit significant impairments in development in social relatedness, reciprocal social behavior, social communication, joint attention, and language learning.

Children with ASD have a preference for objects over people (Lombroso et al., 2009) in addition to superior nonsocial skills constructing and analyzing systems (i.e., computers and robots) (Baron-Cohen, 2005; Baron-Cohen, 2009).

Recent research suggests that despite individual differences in performance, children with ASD show more social engagement with a robot as compared to humans or other technological devices (Diehl et al., 2014; Bekele et al., 2013).

Purpose

To examine specific features of the robot-child interaction that may facilitate social engagement and understanding of social situations in children with ASD.

Specifically, to investigate differences in engagement related to the child's level of functioning (i.e., minimally verbal vs. fluent) and therapy condition (i.e., student-led vs. robot-led) while playing a follow-the-leader type game.

Hypothesis

Both minimally verbal and fluent children with ASD will be more engaged with both the therapist and the robot (i.e., Milo) in the student-led condition as compared to the robot-led condition.

Method

Participants

- 9 children with ASD between 5-14 years
  - Minimally verbal
  - Fluent speech
- Inclusion criteria
  - Understand cause and effect
  - Understand how to use a tablet to communicate with Milo
  - Have picture symbol recognition
  - Answer yes/no questions

Procedure

- Randomized crossover design, with wash-out condition
- Two conditions were utilized: a robot-led condition in which Milo provided simple 1-step commands to the child, and a student-led condition in which the child provided simple 1-step commands to the robot via a tablet.
- The two conditions were separated by a 6-minute wash-out condition in which the child engaged in a low-key interaction with a therapist.
- Sessions were recorded for later analyses.

Analyses

- Engagement was coded based on continuous microanalytic coding with quarter-second precision. If an engagement state was less than a quarter second, it was not counted.
- Each session was coded for the following:
  (1) Engagement with Milo
  (2) Engagement with a research assistant
  (3) Engagement elsewhere (disengaged)
- Due to the small sample size, Cohen's *d*, a standardized measure of effect size that is not influenced by sample size like p –values, was used to analyze the data.
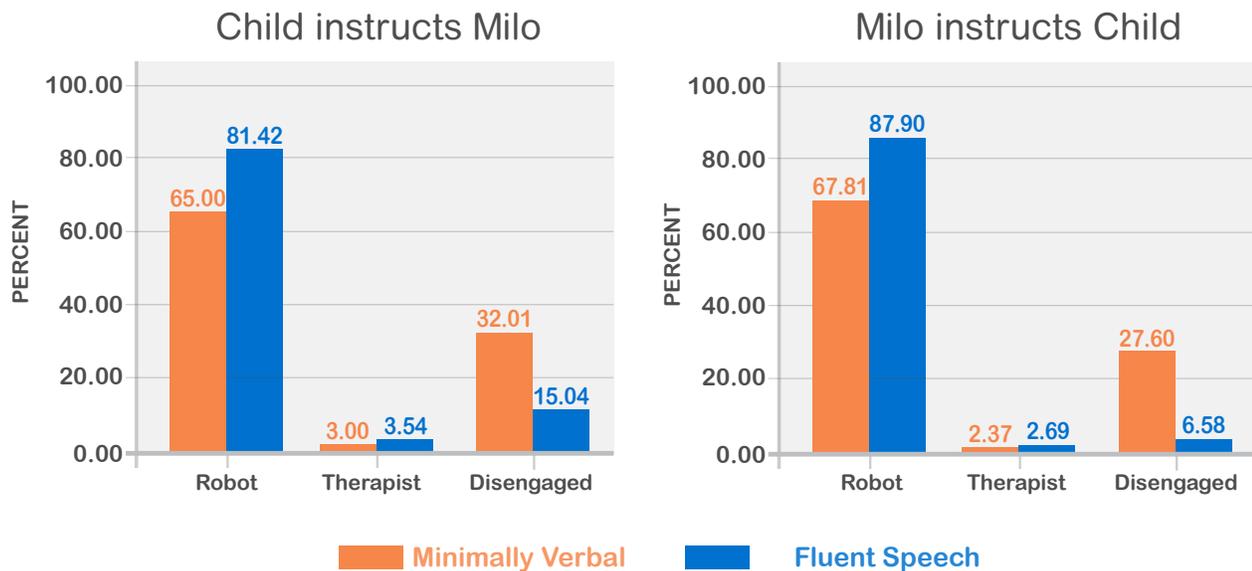
- ENGAGEMENT WITH THERAPIST

- ENGAGEMENT WITH MILO

Mean Percent Engaged

Child instructs Milo

Robot: Minimally Verbal 65.00, Fluent Speech 81.42
Therapist: Minimally Verbal 3.00, Fluent Speech 3.54
Disengaged: Minimally Verbal 32.01, Fluent Speech 15.04

Milo instructs Child

Robot: Minimally Verbal 67.81, Fluent Speech 87.90
Therapist: Minimally Verbal 2.37, Fluent Speech 2.69
Disengaged: Minimally Verbal 27.60, Fluent Speech 6.58

■ Minimally Verbal   ■ Fluent Speech

RESULTS

Quantitative Analyses

• Fluent children had more engagement with the robot compared to minimally verbal children in both conditions.

• While minimally verbal children did not differ by condition, fluent children were moderately more engaged (d =.56) with Milo in the robot-led condition.

• Children rarely engaged with the therapist even though she tried to interact with them.

• When children were not engaged with Milo, they tended to be disengaged.

• Disengagement did not differ across condition for the minimally verbal children; however, the fluent children were more disengaged in the student-led condition (d =.783).

Qualitative Analyses

• Minimally verbal children took longer to warm up to Milo than did the fluent children.

• Once they warmed up, performance resembled the fluent children.

• Fluent children appeared to treat Milo as a friend.

SUMMARY & DISCUSSION

Our research found that children with ASD are more engaged with Milo than with the therapist, especially when Milo was instructing them.

And we know children who are more engaged learn better.

Our future research will focus on using Milo to facilitate understanding of social situations and generalization to humans.

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