CircleTime Data Analyses

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2023-11-21

About the Study

Introduction to Circle-Time

Circle-time is a group activity based on Applied Behavior Analysis (ABA) for children with Autism Spectrum Disorder (ASD) to prepare them for attending in traditional classroom activities alongside neurotically developed children. In circle-time, children sit together semicircular, and an instructor give them group instruction activities such as dance, yoga, labeling animals, finding objects, etc.

Research Questions

In this research, we address the following research questions:

1. How learning behaviors differ between conditions?
2. Is there any interaction between learning behaviors and time?
3. Is there any interaction between different learning behaviors?
4. Between learning behaviors (e.g., affect, engagement, and communication), which one is more effective on the performance learning behavior?

Experimental Design

In this study, we evaluate the efficacy of a social robot in delivering group instruction activities to children with ASD. Throughout the six month of experiment, Six children participants received 10 sessions of group instructions from a human instructor and 10 sessions from a Pepper humanoid social robot as a within-subject study design. To compare children learning behaviors between the human and the robot instructor conditions their activities were video recorded and coded for the sessions 1, 4, 7, and 10.

Study Design

For this longitudinal within-subject study with 6 participants we defined the following variables:

Independent Variables

- Instructor Conditions:
  - Human
  - Robot

- Time
  - Session 1 ~ 1
  - Session 4 ~ 2
  - Session 7 ~ 3
  - Session 10 ~ 4

Dependent Variables

- Affect
- Communication
- Engagement
- Performance

Data Collection

The evaluation of the learning behavior is based on the following metrics:

Affect children's happiness level was defined as:

- Positive
- Negative
- Neutral

A video was divided into 10 seconds intervals, and a human coder, focusing on one child in the group, labeled that interval as Positive if the child was happy, Negative if they was sad, and Neutral if they was neither happy or sad. Percentage of each measurement is used for analysis.

Communication Communication of the children was coded into 4 categories. Communication with:

- Instructor
- Instructor-Prompted
- Behavior Therapist (BT) or peers
- Indeterminate

Engagement Engagement was coded into 3 categories. Engagement with:

- Instructor or screen (On Target)
- BT or peers
- Off Target

Performance Children's performance was coded into two categories:

- Positive
- Negative

Inter-observer Agreement (IoA) At the beginning of the coding procedure, coders' understanding of the metrics had to be on the same page. We used Cohen's Kappa score to evaluate the IoA on the coding procedure. An individual coder was allowed to code independently only if their Cohen's Kappa IioA score was higher than 80%. All session ones and tens were double coded as well as the 30% of the session fours and sevens. For the sessions with lower than 80% agreement, coders went through coding together and came up with 100% agreement. We considered this conservative approach since we were looking into the highest reliability of data on our 6 participants.

Research Hypotheses

Regarding the research questions above, we form the following hypotheses:

H1. There is no significant change on children's learning behaiors between conditions.

H2. Children's learning behavior does not change significantly in the human instructor condition over time.

H3. Children's learning behavior changes significantly in the robot instructor condition over time.

To address the research questions 3 and 4, we conduct an exploratory analysis.

Data Analysis

For data analyses, we use a Linear Mixed-Effect Model.