

Curriculum Accuracy Effect Across the Autism Spectrum

Utilizing evidence-based practices delivered through innovative technology demonstrates 85% mastery of social and emotional skills in longitudinal control study.

A randomized control trial conducted at the Kennedy Krieger Institute (KKI) investigated the effects of a robot-mediated social skills intervention for children with autism spectrum disorder (ASD). The primary aim of the study was to examine whether a robot-mediated facial affect recognition intervention would (a) be engaging to children with ASD, and (b) would result in greater improvement in facial affect recognition compared to a control group. The principal investigator was Rebecca Landa, Ph.D., CCC-SLP.

For the purpose of this summary, results from the Milo group (n=20) are reported according to participant progress through the robots4autism® curriculum. To do so, curriculum accuracy, instructional methodology validation, and overall curriculum accuracy by subgroups are reported.

Participants in the study included children between the ages of 4 and 8 years who were diagnosed with ASD. Utilizing a matched pairs design, eligible children were randomly assigned to the robot mediated intervention (Milo) group or the control group. Children assigned to the Milo group participated in a maximum of 24, 30-minute sessions in the 8-12-week intervention study. The intervention included Milo robot and an instructor, who facilitated progression through the robots4autism® Emotional Understanding curriculum.

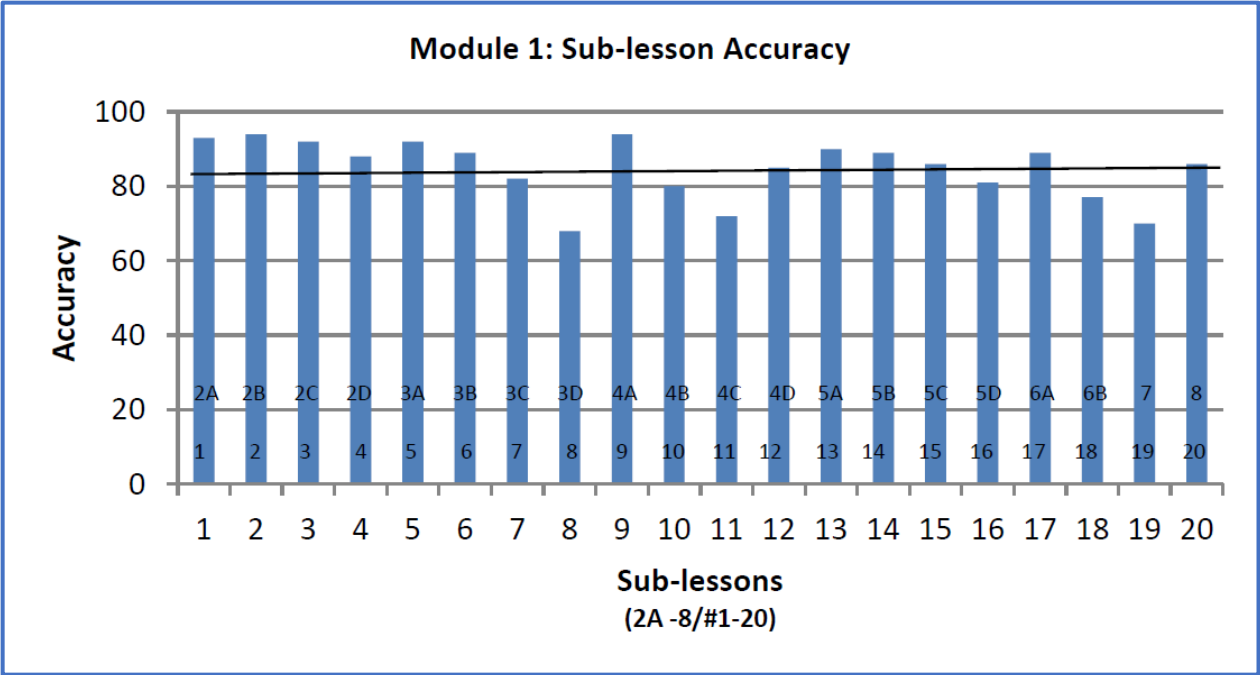
The Emotional Understanding curriculum consisted of three modules with 20 lessons each that taught specific emotions through Milo modeling and teaching each emotion combined with visual supports and video modeling. These 20 sub-lessons are scaffolded and increased with complexity and difficulty by design.

Of the children who participated in the Milo group, 7 out of 20 (or 35%) completed all 60 sub-lessons within the three modules over the study. All participants completed at least 34 of the 60 consecutive sub-lessons or 56% of the entire curriculum. The number of sessions required to complete at least 34 sub-lessons varied among participants and ranged from 9 to 24, 30-minute sessions.

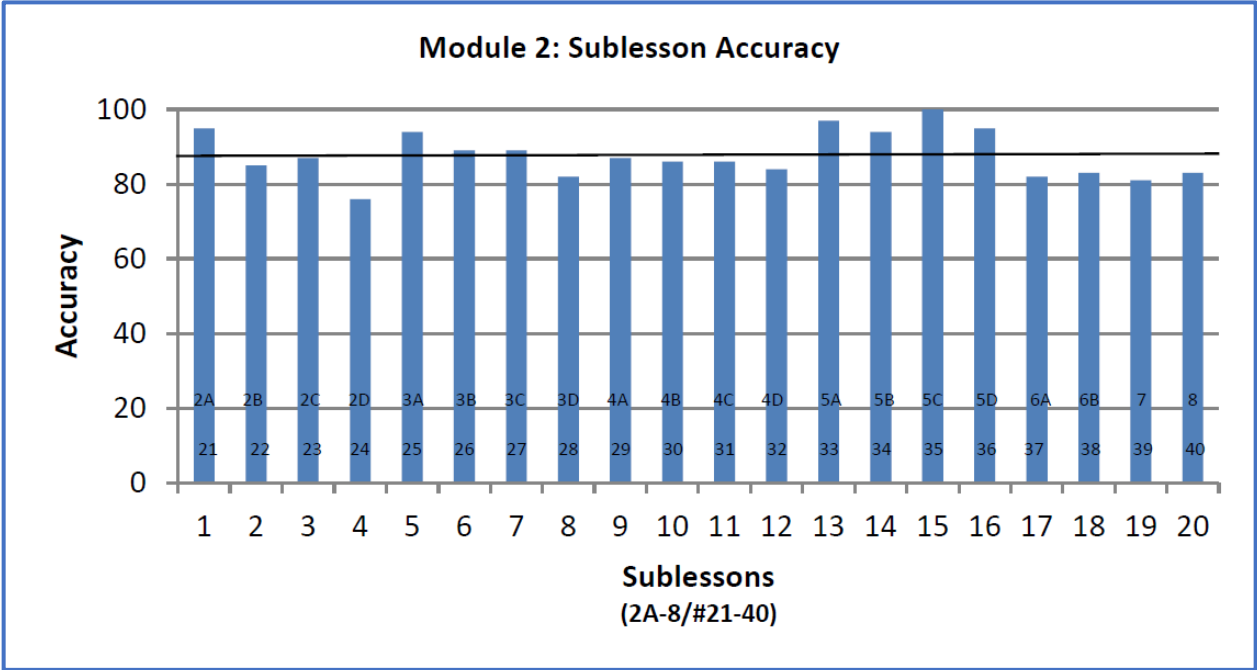
Curriculum Accuracy, including sub-lesson, module, and overall module accuracy, was examined. Sub-lesson curriculum accuracy (i.e., the number of correct trials out of the total number of trials) was calculated for each of the 20 sub-lessons within each module. In a like manner, module accuracy was determined by calculating the mean accuracy across the 20 sub-lessons of each module. Lastly, overall module accuracy was determined by calculating the mean accuracy score across the three modules.

The average curriculum accuracy across all three modules was 85%. The level of curriculum accuracy achieved for each module was: Module 1, 85%; Module 2, 88%; and Module 3, 81% respectively. It is noted that not all participants completed this third module due to varying rates of progress through the curriculum.

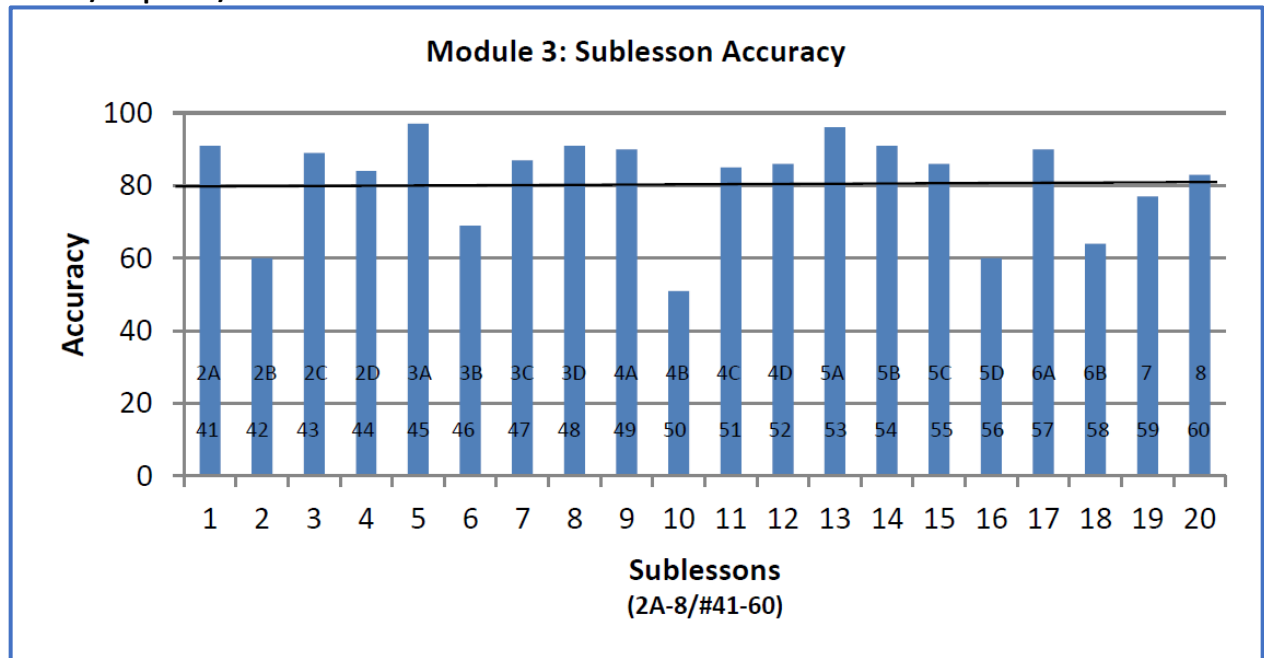
Happy/Sad/Angry



Hurt/Tired/Excited



Scared/Surprised/Worried



Validation of Instructional Methodology: As the example below shows, scores varied dramatically when comparing the three methodologies of presentation that were studied. When Milo demonstrated an emotion, scores were definitively higher than when instructors used only still or static pictures of people, which is the most common practice used in therapy. Additionally, the video modeling of the targeted behavior that is a part of the robots4autism® curriculum resulted in curriculum accuracy near the same levels achieved when using Milo to instruct and model the targeted behavior. This “high-low-high” accuracy pattern consistently occurred in all three modules. Overall, this pattern clearly showed presentation affects the ability of students to identify and comprehend emotions.

High-low-high Example

| <i>Sub-lesson/Level</i> | <i>Emotion/Instructional Format</i> | <i>Percent Accuracy</i> |
|-------------------------|---|-------------------------|
| #41/2A | Identifying Scared in photos of Milo | 91.7% - (High) |
| #42/2B | Identifying Scared in photos of people | 60.7% - (Low) |
| #43/2C | Identifying Scared in videos of people | 89.7% - (High) |
| #45/3A | Identifying Surprised in photos of Milo | 97.0% - (High) |
| #46/3B | Identifying Surprised in photos of people | 69.5% - (Low) |
| #47/3C | Identifying Surprised in videos of people | 87.3% - (High) |
| #49/4A | Discriminating Scared or Surprised in photos of Milo | 90.7% - (High) |
| #50/4B | Discriminating Scared or Surprised in photos of people | 51.6% - (Low) |
| #51/4C | Discriminating Scared or Surprised in videos of people | 85.2% - (High) |
| #57/6A | Discriminating Scared, Surprised, or Worried in photos of Milo | 90.4% - (High) |
| #58/6B | Discriminating Scared, Surprised, or Worried in photos of people | 64.9% - (Low) |
| #59/7 | Discriminating Scared, Surprised, or Worried in videos of people | 77.0% - (High) |

Overall Curriculum Accuracy: Three sub groups were created according to participants' progress through the curriculum. These groups included: Minimal Responders, Moderate Responders, and Average Responders. The Minimal, Moderate, and Average responders' overall accuracy relative to the Milo curriculum sub-lessons and modules were examined. The mean accuracy scores across groups were above 80% on all three modules of the curriculum. The Average responder group (M=86) and Moderate responder group (M=85) yielded the highest mean scores. The mean accuracy score for Minimal responders was slightly lower (M=83) compared to Moderate and Average Responders. These findings demonstrate Milo and the robots4autism® curriculum yields consistent results across the spectrum.

Summary: The reported findings are helpful in understanding an instructional methodology design and curriculum utilizing a facially expressive robot to teach and model emotions is effective across the autism spectrum. Caution is advised, however, not to over-interpret findings given the small and unequal group sizes.

The comprehensive analysis of the Milo group revealed important and unique trends that serve to inform future research and/or clinical practice in social robotics intervention for children with ASD. Most notably, the use of still or static photos or flash cards are less effective than using a robot to animate or model the correct emotion. Similarly, the use of video modeling of targeted behavior by humans within the context of social narratives achieved curriculum accuracy at or above those found with robot instruction. Trends indicated that participants' responsiveness to the intervention may be most impacted by age and the presence and severity of ASD symptoms. Younger children and those with most severe ASD symptoms and severity tended to progress through the curriculum at a slower rate than older child or those with lower levels of ASD-related impairment. However, holding the effect or accuracy of response as the constant and time as a variable, Milo and the robots4autism® curriculum produced consistent results across the range of participants.

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