



Playing with a Robot: Enhancing Social Communication & Interaction

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ABSTRACT

Background:

Intelligent robots were first developed in the 1950's. Initially the focus was on cognition and problem-solving abilities. The use of robots with social-emotional intelligence, either socially evocative or socially competent, only developed more recently. These potential uses are just beginning to be explored. Some initial studies using such robots to teach play skills to autistic preschoolers found they successfully mediated turn-taking, joint attention, imitation, and proactive behavior (Dautenhahn, 2007). Recent reports of “humanoid” robots (KASPAR and Bandit) suggest they are successful in generating social attention and social smiles from more isolated severely autistic children (Dautenhahn, Nehaniv, Walters, Robins, Kose-Bagci, Mirza and Blow, 2009; Woolston, 10-17-11). Furthermore, initial results using the “humanoid” robot NAO indicate future potential for using this technology during traditional therapy sessions (Shamsuddin, 2012). PARO, a baby harp seal robot, has been used in nursing homes and hospitals to promote positive social interaction from withdrawn and socially isolated individuals (Wada and Shibata, 2007).

Objectives:

To determine if interaction with PARO will be effective for children with autism in...

- stimulating individual/social play, language and emotional expression, attention and joint attention, and appropriate sensory play while decreasing stereotypical behavior.
- aiding students demonstrating an initial fear of PARO (with a history of fear of dogs/small animals), in decreasing that fear through repeated exposure as measured by the behavioral variables of the study.

Methods:

18 students at the Boston Higashi School (15 boys and 3 girls) with diagnoses on the autism spectrum, aged 8 to 14, participated. 8 of these students (44%) were day students while 10 (56%) were residential students, participating 24/7 based on severity of need. The students, divided into groups of 4 or 5, met once a week to “play with PARO”. Over 9 sessions, each group began with 3 Free Interaction for the initial “A”, then 3 each for the Facilitated Interaction and Representational Play for the “B” or intervention, and then 1 Free Interaction session for the second “A” generalization session. A repeated measures analysis of variance, other relevant statistical tools, and qualitative data was analyzed to determine if there was a significant difference in how students interacted with PARO before and after the intervention.

Results:

Preliminary findings suggest...

- Providing structure (“B”) aides students in developing emotional interactions with PARO.
- Social interaction and communications increased during the intervention phase and sensory seeking decreased as hypothesized
- Most variables returned to pre intervention levels when structure was removed except for seeking peers out which remained improved.
- Fearful students decreased their levels of fear and anxiety over the repeated trials, measured by their proximity to PARO, willingness to engage in contact and observable facial expressions.

METHODS

Participants: 18 students, 15 boys, 3 girls, aged 8-14, all with moderate to severe autism diagnosed by their individual physicians prior to school admission in an autism specialized school, were divided into 4 groups, approximately balanced by teacher’s assessment of social and verbal ability.

Condition: Each group met once a week to “play with PARO” for 10 weeks under an initial free play condition, 2 experimental conditions, and one generalization session with a lead teacher, watched by 2 therapists who scored behaviors and a videographer recording the session.

Scoring: Measures were taken of the frequency (F) and Intensity (I) of a variety of behaviors in each group. Sessions were videotaped and scored according to a video coding process developed at BHS for 30-second intervals yielding inter-observer agreement (IOA) of 88% for Frequency data and 83% for Intensity data overall among 3 raters.

Measures taken: the main categories measured were: **Self-Stimulatory Behavior** F and I, **Relates to PARO** F and I, **Attentiveness** F, **Social Interaction** F, **Affect** I, **Sensory Response** I, and **Communication (Expressive)** I, and **Communication (Purpose)** I.

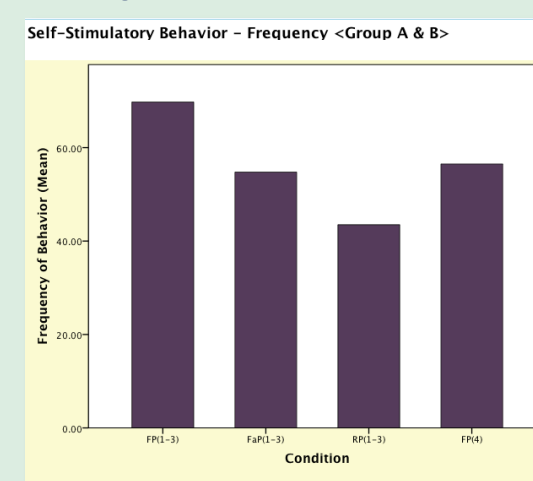
Grouping: Group A: N= 5 (M=4/F=1), all full sessions; Group B, N=5 (M=3/F=2), 1 short session. Groups C & D had fewer students, all boys, and more variability in session length. These findings present the data for Groups A & B together.

RESULTS

Statistical analyses were done by computing the proportion of cases in groups A & B as they were distributed in each of the 4 conditions (FP, FAS, RP, FP2), dividing by the sum total number for each behavioral type, and applying the *Z-Test Between Dependent Proportions Test* to see if there were any differences across the proportions for each condition by behavior.

No statistically significant findings were obtained.

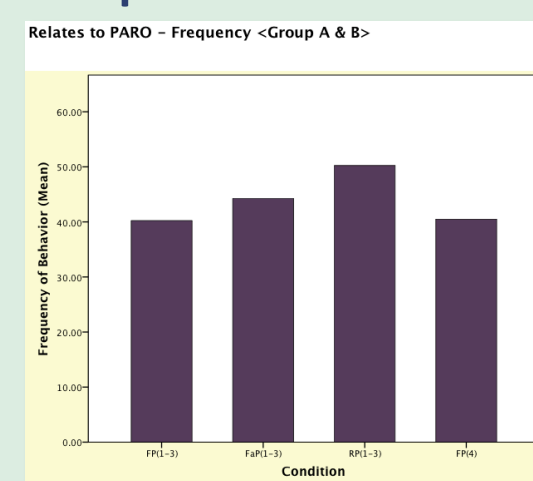
Graph 1



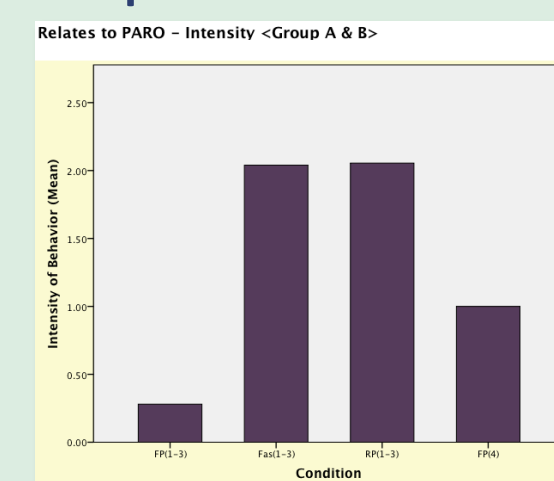
Frequency of Self-Stimulatory behavior decreased as expected across each experimental condition with increasing structure and social play, but increased again when structure was removed during Generalization session, although not to initial level.

The graph for Sensory Response (not shown) mirrors that for Self-Stimulatory behavior, indicating that students’ sensory exploratory play with PARO was very high during free play sessions but became more social when prompted.

Graph 2



Graph 3



These graphs present the frequency and intensity of how students Relate to PARO as a meaningful play companion. The frequency of Relating to PARO (Graph 2) tended to increase under each condition, as more students showed more interest in interacting with the robot in varied ways, again except during the last FP condition.

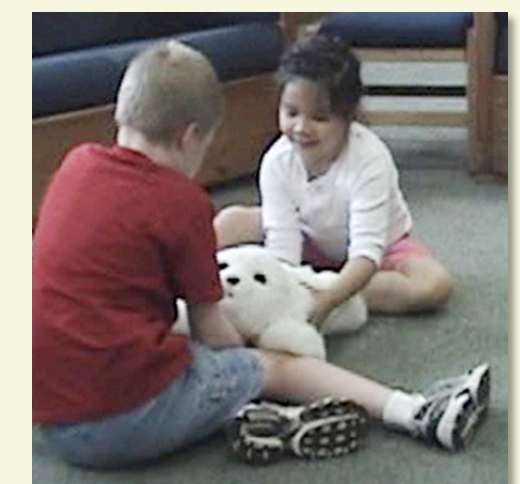
Graph 3 shows that under structured play (FAS and RP) students related in a much more intense and focused way to PARO. That relatedness then carried over to their last FP session more intensely than they had initially shown on their own.

Affect (graph not shown) similarly increased over the first three conditions. While affect was largely positive in relation to PARO, it does involve some anxiety from one youngster who exhibited fear and some arguing over possession time as well.

DISCUSSION & CONCLUSIONS

The statistical analyses were limited by the use of aggregate data rather than data for each student, preventing the calculation of statistically significant conclusions. On the other hand, qualitatively on a case-study basis, these numbers trend in the predicted directions, suggesting support of PARO as a facilitator of social communication for young students severely impacted by autism, particularly when structure is provided by a familiar teacher.

Reviewing the videos of these student sessions and taking data on an individual level will help us obtain meaningful statistical data to buttress qualitative findings in future analyses of this work and in related studies.



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