Utility of Socially Interactive Robots for Intervening with Young Children with Autism Spectrum Disorders

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Utility of Social Robots for Promoting Joint Attention in Infants and Toddlers with Disabilities Research Project

- Funded by the U.S. Department of Education, Office of Special Education Programs, Steppingstones of Technology Innovation Program

- Develop procedures and guidelines for using socially interactive robots as part of early intervention and to test the feasibility and effectiveness of using socially interactive robots to promote joint attention

Major Project Activities

- Research Syntheses of Interest-Based Child Learning and Social Robot Intervention Studies

- Survey of the Social Validity of Robot-Facilitated Child Behavioral Interactions

- Attributional Survey of the Characteristics of Socially-Interactive Robots

- Multiple Baseline Design Intervention Studies

Session Overview

- Brief presentation of the four social robots that are the focus of our research and practice

- Brief description of the research syntheses of interest-based and socially interactive robot interventions

- Summary of the findings from the social validity and attributional surveys

- Present an overview of the intervention studies

- Socially interactive robot "show and tell"

Meet the Socially Interactive Robots

Keepon

Popchilla

Cosmobot

KASPAR

Selected Characteristics of Socially-Interactive Robots

- Autonomous vs. teleoperated
- Responsive vs. initiates behavior (or both)
- Contingent vs. noncontingent behavior
- Function (elicit social interaction, imitative, etc.)
- Behavioral repertoire (limited vs. multifunctional)

Research Syntheses

- Meta-analysis of studies incorporating the interests of young children with autism spectrum disorders into early intervention practices
- Research synthesis of studies investigating the behavior enhancing effects of socially interactive robots

Interest-Based Child Learning Opportunities Meta-Analysis[a]

- Twenty-four studies including 78 children 2 to 6 years of age with autism spectrum disorders

- Combination of baseline/intervention and comparative conditions (interest vs. non-interest) studies

- Outcome measures included four different types of child behavior (prosocial behavior, communicative competence, improved performance, decreased negative behavior)

- Cohen's *d* effect sizes used to evaluate the influences of the interventions

[a]Dunst, C. J., Trivette, C. M., & Hamby, D. W. (in press). Meta-analysis of studies incorporating the interests of young children with autism spectrum disorders into early intervention practices. *Autism Research and Treatment.*

Effect Sizes and 95% Confidence Intervals for the Different Categories of Child Outcomes

Type of Comparison/Child Outcomes	Number		Average Effect Size	95% Confidence Interval
	Studies	Effect Sizes		
Baseline vs. Intervention Studies				
Prosocial Behavior	4	10	3.55	1.76-5.33
Communication	5	16	5.03	3.61-6.45
Performance	8	45	2.92	1.87-3.98
Negative Behavior[a]	6	25	2.25	0.92-3.56
Low vs. High Interest Studies				
Prosocial Behavior	7	20	2.53	1.37-3.70
Communication	4	8	1.07	0.17-2.20
Performance	9	36	1.17	0.56-1.78
Negative Behavior[a]	7	13	1.11	0.64-1.57

[a] Reverse scoring.

Socially Interactive Robot Research Synthesis[a]

- Forty eight studies including 800+ children 2 to 10 years of age with and without disabilities. (Sixteen studies of typically developing children, 22 studies of children with autism)

- The studies investigated the use of 20 different kinds of socially interactive robots

- Combinations of baseline vs. intervention and between conditions studies

- Main focus of analysis is the conditions under which socially interactive positively influence child behavior

- Both quantitative (Cohen's *d* effect sizes) and qualitative (pattern matching) analyses of the studies are being conducted to ascertain the effects of the robots on child behavior.

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[a]Dunst, C.J., Trivette, C.M., Prior, J. (in preparation). Research synthesis of studies using socially interactive robots to affect child behavioral interactions and responses.

Preliminary Findings from the Social Robot Research Synthesis

- Both typically developing children and children with disabilities show a preference for social robots compared to other types of toys (novelty effect?)

- Contingently responsive robots have the most positive child behavior enhancing effects

- Wide range of child behavior are influenced by socially interactive robots (Engagement, social interactions, communication, imitation, etc.)

- Socially interactive robots can be used to promote child-adult interactions

Socially Interactive Robot Social Validity Survey[a]

- One hundred and six parents/caregivers of children 2 to 12 years of age with Autism, Down syndrome or other Attention Related Disorders

- Participants randomly assigned to complete a 12 item social validity scale on one of four robots (Keepon, KASPAR, Cosmobot, Popchilla)

- Results expected to identify which robot(s) parents and other caregivers consider most appropriate for use with young children with disabilities

[a]Dunst, C. J., Trivette, C. M., & Prior, J. (in preparation). *Social validity of four socially interactive robots for use with young children with Autism, Down syndrome, and Attention Deficit Disorders.*

Social Validity

- The extent to which an intervention is likely to be adopted and valued is dependent upon the intervention agent's social validity judgments of the intervention and its outcomes

- Social validity is measured in terms of an intervention agent's judgments of both the acceptance and importance of an intervention and the expected consequences of the intervention[a]

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[a] Foster, S. L., & Mash, E. J. (1999). Assessing social validity in clinical treatment research: Issues and procedures. *Journal of Consulting and Clinical Psychology, 67, 308-319.*

Social Acceptance Ratings
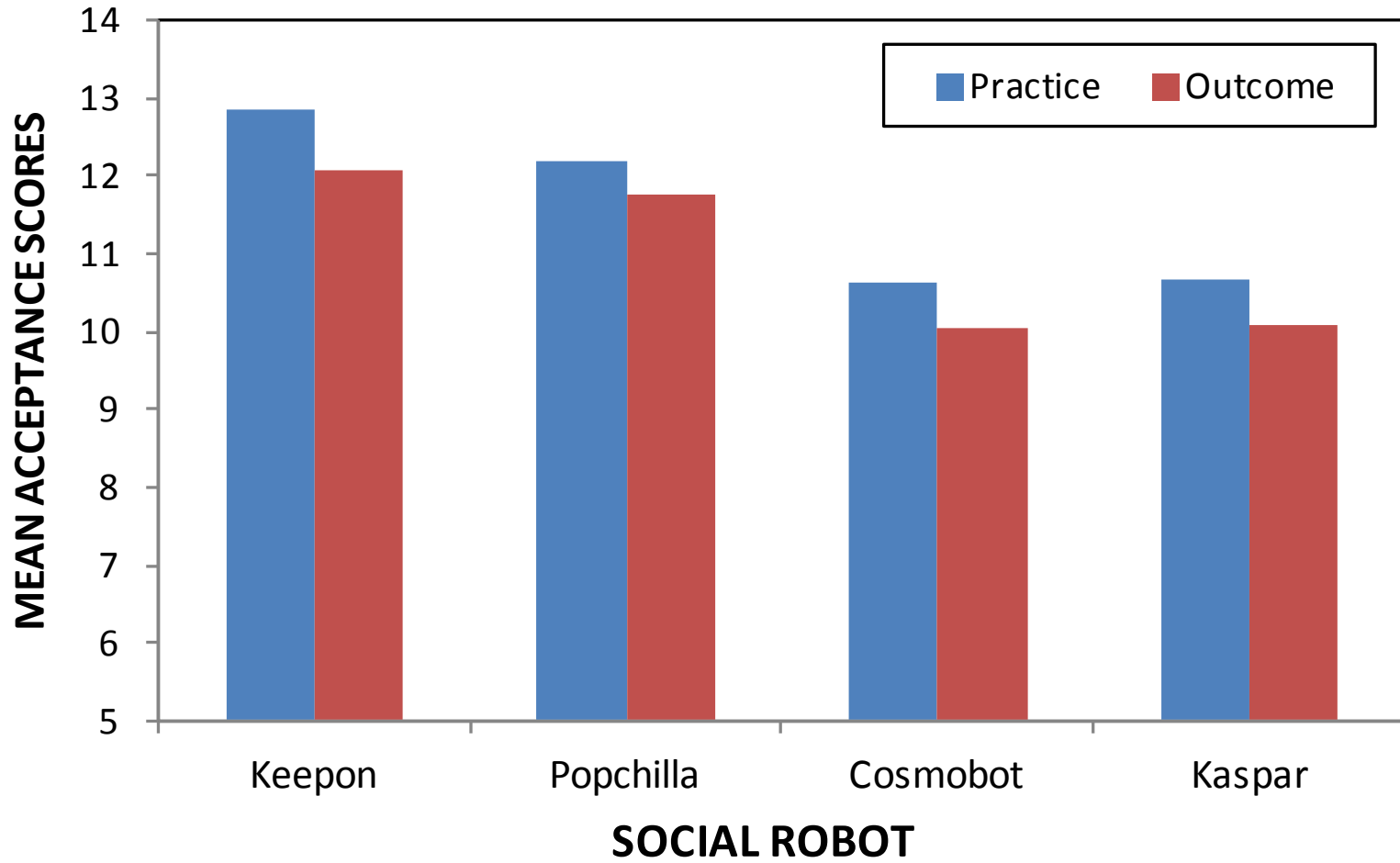
Social Importance Ratings
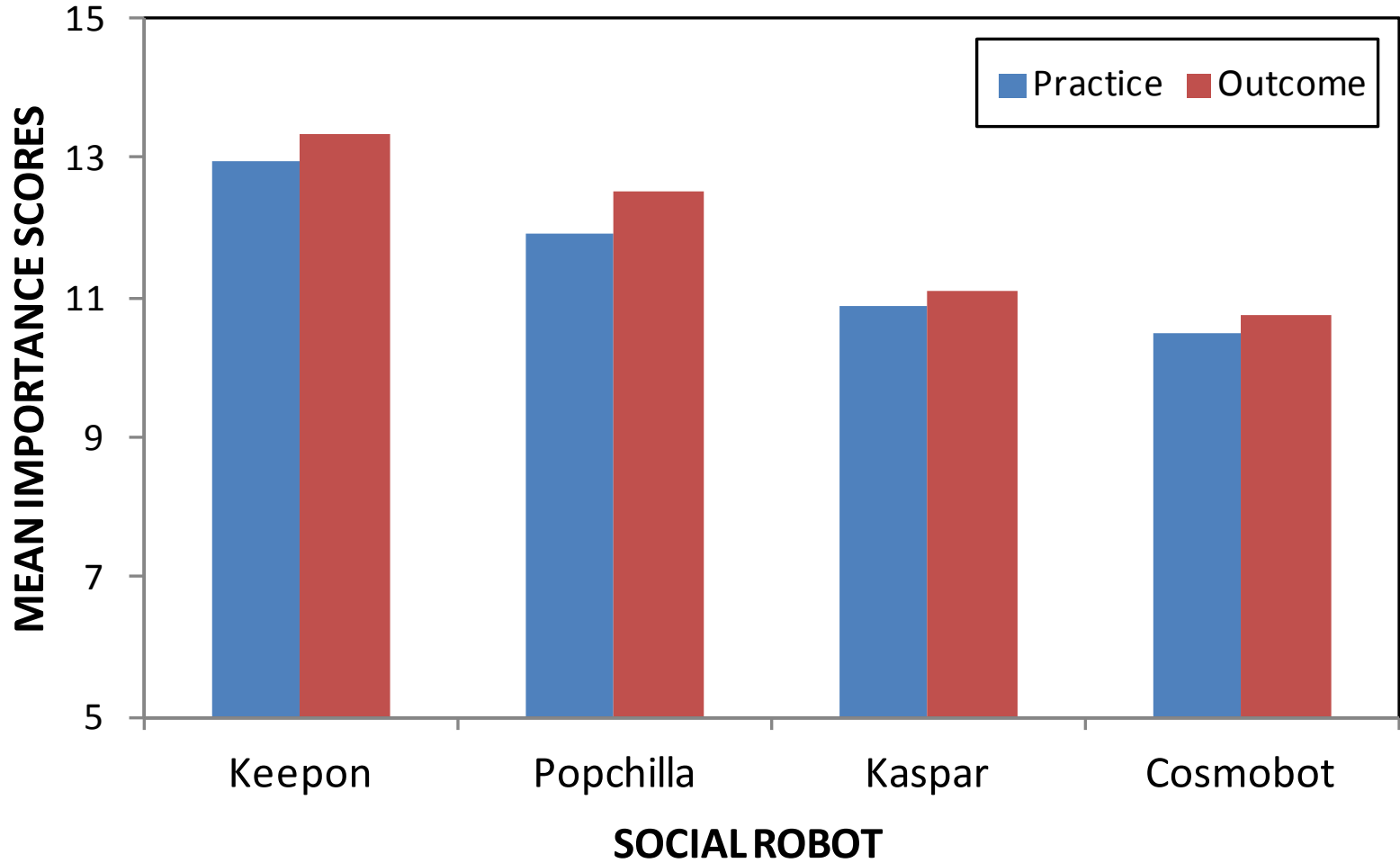
Attributional Survey of Socially Interactive Robots[a]

- One hundred and twenty (anticipated) parents/caregivers of young children 2 to 10 years of age with Autism, Down syndrome or other Attention Related Disorders (78 completed surveys to date)

- Each participant is asked to complete an 8-item survey of the attributes of robots considered important characteristics for engaging young children in social interactions

- Participants completed the survey on four robots (Keepon, KASPAR, Cosmobot, Popchilla) where the order of administration was randomly determined

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[a]Dunst, C. J., Trivette, C. M., & Prior, J. (in progress). *Evaluation of the anthropomorphic features of socially interactive robots.*

Attributional Survey Items

- Animary (life or human-like)
- Attractiveness (friendly, likeable)
- Expressiveness (animated, positive emotions)
- Engaging (playful, interesting)
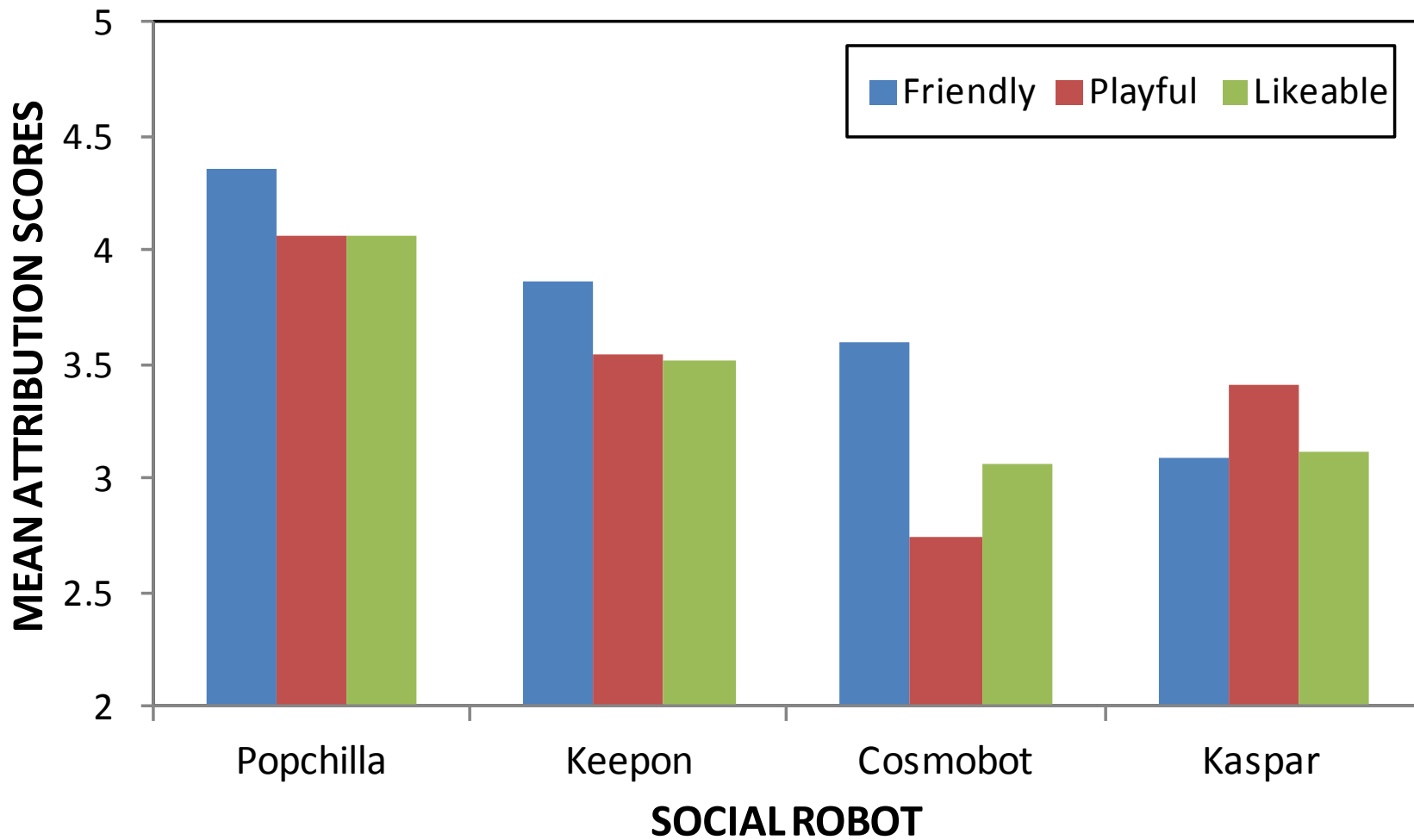
Intervention Studies

- A series of multiple baseline design studies of young children with the same diagnosis (autism, Down syndrome, or Attention Related Disorders) will be used to evaluate the effects of socially interactive robots on child behavior

- The main focus of the interventions will be child engagement in joint attention activities improving child-adult social interactions

- Child outcomes that will be the focus of analysis will include social initiations, communicative competence, and joint attention

- LENA (Language Environment Analysis System) will be used to record the effects of the robots on child vocalizations, conversational turns, and adult-child language

- Observational measures will be used to code child interests and child affective state during interactions with the robot and his or her parent

Lessons Learned (Thus Far)

- Most socially interactive robots for use with young children are not capable of autonomous behavior implicitly suggested by the developers

- Because socially interactive robots can be programmed to produce different behavior and facilitate child engagement, they are (potentially) more useful than commercial toys

- Preliminary findings from our meta-analysis indicate that robots that can be made to contingently respond to child behavior are more likely to elicit child competence and maintain child engagement

- Popchilla and Keepon appear to be the robots preferred by parents of young children with disabilities

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