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Parents' Appraisals of the Animacy and Likability of Socially Interactive Robots for Intervening with Young Children with Disabilities

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KEY WORDS

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Anthropomorphism
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Autism spectrum disorder
Down syndrome
Attention deficit disorder

ABSTRACT

Findings from a survey of parents' ratings of seven different human-like qualities of four socially interactive robots are reported. The four robots were Popchilla, Keepon, Kaspar, and CosmoBot. The participants were 96 parents and other primary caregivers of young children with disabilities 1 to 12 years of age. Results showed that Popchilla, a highly engaging toy-like robot, was judged as more animate and likeable compared to the other three robots. Implications for intervening with young children with disabilities are described.

The extent to which adults or children are likely to interact with social robots is dependent upon a number of features and characteristics of the socially interactive robots (Becker, 2006; Fussell, Kiesler, Setlock, & Yew, 2008; Kose-Bagci, Dautenhahn, & Nehaniv, 2008; Lee, Kim, & Kang, 2012). These features and characteristics include, but are not limited to, emotional expression (Kirby, Forlizzi, & Simmons, 2010), appearance (Lohse et al., 2007), animacy (Bartneck, Croft, & Kulic, 2009), likeability (Bartneck et al., 2009; Niculescu, van Dijk, Nijholt, Li, & See, 2012), positive affect (Kirby et al., 2010; Lee et al., 2012), and communicative capabilities (Duffy, 2003). Attributing these qualities to social robots is termed anthropomorphism (Zawieska, Duffy, & Sprońska, 2012). The more socially interactive robots are perceived or judged to have anthropomorphic features and qualities, the more likely they will engage humans in interactions and especially when the robots manifest these qualities in a manner similar to humans (Duffy, 2003; Fussell et al., 2008; Kirby et al., 2010; Zawieska et al., 2012).

The purpose of the study described in this research report was to determine if parents of young children with disabilities attributed different features and qualities to four different socially interactive robots. The four robots that were the focus of parents' attributional appraisals are shown in Figure 1. They are Popchilla (Interbots, 2011), Keepon (Kozima, Michalowski, & Nakagawa, 2009), CosmoBot (Brisben, Safos, Lockerd, Vice, & Lathan, 2005; Lathan, Brisben, & Safos, 2005), and Kaspar (Dautenhahn et al., 2009). Each of the four robots have been used to engage young children with disabilities in child-robot interactions to promote their social behavior (Kim et al., 2012), joint-attention (Nagai, Asada, & Hosoda, 2006; Robins, Dickerson, Stribling, & Dautenhahn, 2004), and communication and language skills (Robins, Dautenhahn, & Dickerson, 2009).

The study was based on the rationale and assumption that parents might not see the value of socially interactive robot interventions for their children if the robots were not judged as having socially engaging features and characteristics. We were particularly interested in determining if parents' appraisals of the four socially interactive robots were similar or different. The findings, together with results from a study of parents' judgments

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of the social validity of the four robots (Dunst, Trivette, Prior, Hamby, & Embler, 2013), were expected to inform the selection of one or more robots to be used as part of intervention studies with young children with disabilities and their parents (Dunst, Prior, & Trivette, 2012).

METHOD

Participants

The participants were 96 parents of children with disabilities 1 to 12 years of age (72 males, 24 females). The children's diagnoses included autism spectrum disorders, chromosomal conditions (e.g., Down syndrome), and other identified conditions. Participants were recruited through local, regional, and national parent and professional organizations. The majority of the participants (94%) resided in the United States (N = 35 states) whereas the other participants resided in three other countries.

The participants' ages ranged between 20 and 50+ years with the majority (81%) being between 30 and 50 years of age. One fourth of the participants had completed high school or some college whereas 75% had completed undergraduate or graduate degrees. A majority (96%) of participants were married or living with a partner.

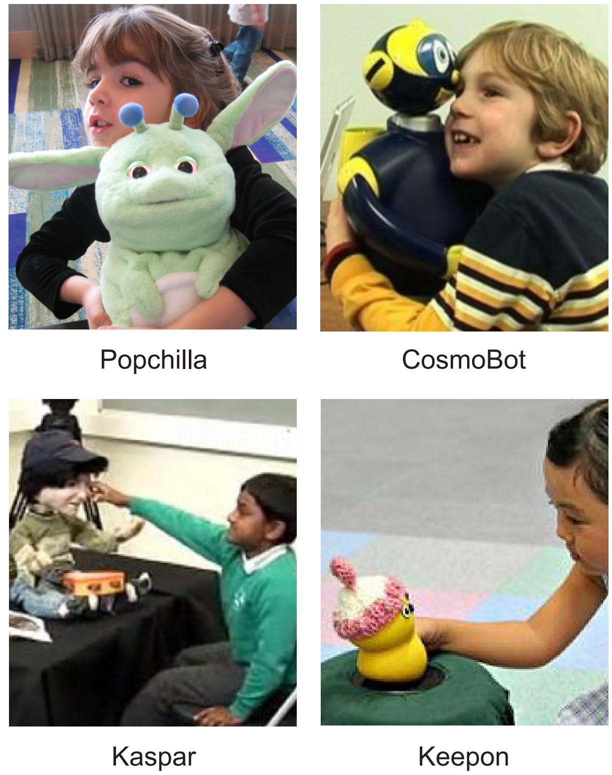

***Figure 1.* The four socially interactive robots that were the focus of parents' appraisals of the human-like qualities of the robots.**

Survey

An 8-item survey was developed to obtain participants' judgments of the animacy and likeability of the four social robots. The items included indicators of appearance, expressiveness, playfulness, engagement, attractiveness, positive emotions, and likeability. The selection of these particular traits was based on a review of the literature to identify the particular features and characteristics of socially interactive robots that are considered important for encouraging human-robot interactions (e.g., Bartneck et al., 2009; Duffy, 2003; Filip, 2012; Fussell et al., 2008; Werry, Dautenhahn, Ogden, & Harwin, 2001; Zawieska et al., 2012). A single item was used to assess the human-like appearance of the four robots (Hegel, 2012) and was included in order to have a divergent validity measure (Nunnally & Bernstein, 1994). We expected that Kaspar would be the one robot that would be judged as having the most human-like appearance.

The eight items were all phrased in terms of either their appearance or specific features or characteristics (e.g., a friendly appearance, shows positive emotions, likeable). Each item was rated on a 5-point scale ranging from *do-not-agree-at-all* to *totally agree* with each statement. Items rated either a 4 (*mostly agree*) or a 5 (*totally agree*) on the 5-point scale were used to make comparisons between the participants' ratings of the four social robots.

Procedure

The survey was completed online by all the participants. The introductory comments stated that the purpose of the survey and our interest in the participants' judgments of the different characteristics and features of the four socially interactive robots. They were told that they would view a short video of each of the robots and then would be asked to complete the survey. Each video segment of each robot lasted approximately 30 seconds and highlighted the particular characteristics that the robot developers emphasize in their descriptions and illustrations of the capabilities of the robots. The order in which the social robot video segments were viewed by each participant was random. The order in which the survey items were completed by each participant was also random for each robot.

Data Analysis

A series of 4 Between Social Robots X 5 Between Response Category chi-squares were used to analyze the participants' responses. Separate analyses were performed for each of the survey items because of the exploratory nature of the study.

RESULTS

Preliminary analyses showed that the participants' ratings of the qualities and features of the four robots did not differ as a function of child condition or child age. Participants' ratings did differ as a function of the type of robot for all eight behavior characteristics. Those differences are shown in Table 1 in terms of the percentage of items rated either *mostly agree* or *totally agree* on each of the seven items. The *p*-values for the between robot comparisons are for the differences in five response category ratings made by the participants (*do not agree, agree a little, agree somewhat, mostly agree, totally agree*).

Popchilla, by far, was judged as the most animate and likeable of all four robots. More specifically, Popchilla was judged as more friendly, animated, playful, attractive, emotive, and likeable compared to the other three robots. Popchilla and Kaspar were judged similarly in terms of their engaging movements and both were judged as more engaging compared to either CosmoBot or Keepon. Except for a friendly appearance, CosmoBot was judged as the least animate and likeable of all of the socially interactive robots.

The overall differences in the participants' judgments of the animacy and likeability of the four robots are shown in Figure 2 in terms of the average percent of items rated either *mostly agree* or *totally agree* for all of the survey items except human-like appearance. The results are displayed in terms of the order in which the social robots were judged as having anthropomorphic features. The order from most to least anthropomorphic were Popchilla, Kaspar, Keepon, and CosmoBot.

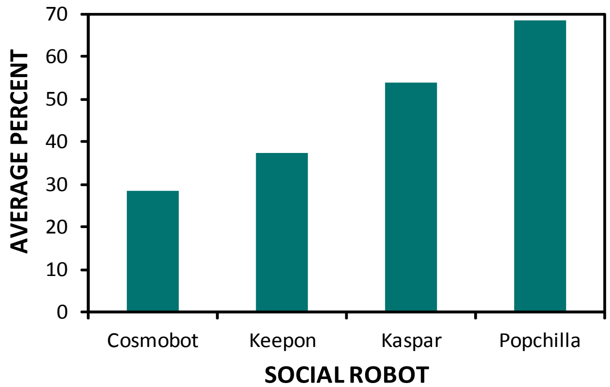

Figure 2. **Average percent of items rated mostly agree or totally agree for the seven animacy and likeability items for each of the four socially interactive robots.**

As expected, Kaspar was judged as having the most human-like appearance. As described earlier, this one item was included as a divergent validity measure. The divergent validity of the results were demonstrated by Kaspar being rated as appearing more human-like than the other three robots and by Popchilla being rated as more animate and likeable compared to Kaspar on all but one item (engaging movements).

DISCUSSION

Results from the study reported in this paper showed that Popchilla, a toy-like socially interactive robot, was judged as having the particular human-like qualities that would likely be most engaging to young children with disabilities. These results, together with findings from a

Table 1
Percentage of Items Rated Mostly Agree or Totally Agree for the Four Socially Interactive Robots

	Social robots					
Items	Kaspar	CosmoBot	Keepon	Popchilla	χ^2	*p*-value
Friendly appearance	42	60	69	87	59.09	.0000
Animated expression	54	18	13	66	136.60	.0000
Playful nature	58	32	57	79	66.44	.0000
Engaging movements	67	18	41	64	87.58	.0000
Attractive features	37	18	27	67	71.56	.0000
Positive emotions	55	31	31	72	59.08	.0000
Likeable	47	39	53	79	51.36	.0000
Human-like appearance	71	12	8	33	139.13	.0000

study of parents' social validity judgments of the same four robots constituting the focus of investigation in the present study (Dunst et al., 2013), suggest that Popchilla would most likely be the robot parents would find appropriate and indicated as part of interventions with young children with disabilities.

In our social validity study of Popchilla, Keepon, CosmoBot, and Kaspar (Dunst et al., 2013), the two toy-like robots (Popchilla and Keepon) were both judged as more acceptable and important for intervening with young children with disabilities compared to the two humanoid-like robots (CosmoBot and Kaspar). In the present study, Popchilla, one of the two toy-like social robots, was judged as more human-like on all seven animacy and likeability items compared to Keepon. This was confirmed by a series of *post hoc* chi-square analyses which ranged from χ^2 = 12.99, p = .0110 to χ^2 = 82.69, p = .0000 for the seven 2 Between Social Robot (Popchilla vs. Keepon) x 5 Within Response Category (*Do-Not-Agree-At-All* to *Totally Agree*) analyses. This is additional evidence indicating parents' preference for Popchilla as the social robot of choice as part of interventions with young children with disabilities.

Findings reported in this research report as well as the companion research report (Dunst et al., 2013) were the foundations for selecting Popchilla as the socially interactive robot as part of a series of intervention studies investigating the effects of child-robot and child-robot-parent interactions on a number of different child outcomes (interests, social behavior, vocal production, joint attention). These results will be reported in other *Social Robots Research Reports* (www.socialrobots.org).

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