BRIEF REPORT

A PRELIMINARY TEST ON THE POTENTIAL OF CONTACT WITH DOGS TO ELICIT SPONTANEOUS IMITATION IN CHILDREN AND ADULTS WITH SEVERE AUTISM

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ABSTRACT

This preliminary study aims at a first attempt to evaluate whether promoting contact with dogs may be a useful approach to elicit spontaneous imitation in individuals with ASD. Ten children and fifteen adults diagnosed with severe ASD completed a spontaneous imitation task under three experimental conditions: following a free play interaction with a live dog or a robotic dog, and following a waiting period with no stimuli involved. Imitation ratio, imitation accuracy and indicators of social motivation were assessed. Children appeared more motivated and engaged more frequently in spontaneous imitation in the dog condition than in the other conditions. No differences between conditions were found for adults, neither regarding imitation nor social motivation. Also, obtained correlations suggested a possible trend in time spent engaging with the live dog before testing and increased imitation frequency. Larger-scale studies are recommended and might be of major relevance for therapeutic interventions for ASD.

Keywords: Autism, dogs, spontaneous imitation, social motivation, social robots

INTRODUCTION

It has long been recognized that imitation can serve as a learning tool enabling individuals to acquire new skills and knowledge, and as a strategy to engage in social exchanges with others (Uzgiris, 1981). Imitation, therefore, by being foundational to learning and development of social communication skills (Uzgiris, 1981), is targeted in many pediatric therapeutic interventions. Occupational therapists, for instance, often use task demonstration in their daily practice with children, with the aims to promote cognitive development and acquisition of new motor skills (Liew, Garrinson, Werner, & Aziz-Zadeh, 2012).

When compared to their typical peers, children – and also adults - with Autism Spectrum Disorder (ASD) exhibit significant deficits in imitation, and particularly in the spontaneous use of imitation during social interactions (Edwards, 2014; Van Etten & Carver, 2015). Ingersoll (2008), for example, showed that children with ASD tend to perform worse on tasks assessing spontaneous imitation as compared to tasks measuring elicited imitation. Also, they tend to perform worse on tasks involving the imitation of body movements and gestures arguably non-meaningful than on tasks involving actions on objects or actions that have a clear meaning or visual goal (e.g., Zachor, Ilanit, & Itzchak, 2010). Thus, it has been suggested that therapies concentrating on improving imitation in individuals with ADS, as is often the case in occupational therapy, should adequately address the social use of imitation, notably by also focusing on increasing intrinsic motivation for social interactions (Van Etten & Carver, 2015). In other words, a therapist should not only use focus on whether a child can learn a new skill through imitation but also on whether the child *wants* to imitate and engage in social interactions through imitation.

Social motivation, as indexed by social orienting, social seeking and liking, and social maintaining, is often profoundly impaired in individuals with ASD (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). Interestingly, both neurobiological evidence and behavioral data suggest that children with ASD tend to perceive higher social reward from contact with animals than with people, and show strong motivational preferences towards animals (Whyte, Behrmann, Minshew, Garcia & Scherf, 2015; Celani, 2002). Also, data have been reported suggesting that interaction with animals may decrease social anxiety in children with ASD while also motivating or facilitating positive social behaviour towards other persons, such as peers and therapists (O'Haire, McKenzie, Beck, Slaughter, & 2015; Silva, Correia, Lima, Magalhães, & de Sousa, 2011; for reviews see O'Haire, 2013, 2017). Sams, Fortney, and Willenbring (2006), for example, compared the performance of children with ASD receiving two forms of occupational therapy - occupational therapy using standard techniques, and occupational therapy incorporating animals – and showed that the children demonstrated significantly greater use of language and significantly greater social interaction in sessions incorporating animals when compared to sessions using exclusively standard occupational therapy techniques. Importantly, to date, no research on human-animal interactions has focused on adults with ASD (as pointed out in O'Haire, 2017).

Base on the above, this study aims at providing a first and preliminary experiment on the potential benefits of dogs for children and adults with ASD, in the particular context of imitation. Specifically, in this study, we aimed at testing whether promoting contact with a friendly dog before a spontaneous imitation task may impact on participants' performance during the task. A within-subject design was used to compare the effects of three experimental conditions varying on whether the imitation task was preceded by a waiting period or by a free play interaction with either a live dog or a robotic dog. Imitation ratio, imitation accuracy, and indicators of social motivation were assessed during the task. We tested whether, following free play with the live dog, participants would i) engage in spontaneous imitation more frequently and more precisely than in the other two conditions, and ii) appear more socially motivated than in the other two conditions. Also, we could test whether greater engagement with the animal - but not with the robot - before the imitation task would be associated with better performance during the task.

METHODS

Participants

Forty individuals were identified for study participation through two local agencies serving individuals with ASD. Inclusion criteria included a clinical diagnosis of severe ASD (established using the Autism Diagnostic Interview-Revised; ADI-R; Lord, Rutter, & Le Couteur, 1994). Exclusion criteria included motor impairments, pet ownership, allergies to, and fear of, dogs, and abnormal sensory reactivity to the test stimuli. Due to practical considerations (e.g., families agendas), family consent for study participation was only obtained for twenty-five individuals (see Table 1 for descriptives on participants). Participants' symptom severity at the moment of the study was assessed using the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000). All participants in this study had severe language impairments (preverbal/single words).

Stimuli

The dog in this study was a four-year-old male Labrador Retriever certified as a therapy dog by ÂNIMAS (Portuguese association, member of the Assistance Dogs International Inc.). He was selected based on previous involvement in dog-assisted intervention programs. The robotic dog, serving as the live dog surrogate, was the Zoomer dog from SpinMaster™. It can be programmed to act autonomously, emulating the behavior of a live dog (e.g., it can roll, sit, bark and approach a person as live dogs usually do).

Experimental procedure

Participants were tested in a quiet room, either at home (children) or at the day center in which they were enrolled (adults). A first meeting was arranged with each participant to obtain family written consent for study participation, familiarize the participant with the experimenters and the stimuli (the live dog and the robotic dog), and acquaint the animal with the settings. Importantly, during this first meeting, no participant in the study showed abnormal sensory reactivity to the stimuli; all accepted to touch and be touched by both the live and the robotic dogs.

The experimental procedure began within 48h following the first meeting. Two experimenters (E_1 and E_2) were present during testing: one interacted with the participant (E_1), the other (E_2) video-recorded the session and never interacted with the participant. As in O'Haire et al. (2015), the video camera was positioned on a tripod, approximately 10 feet in front of E_1 and the participant. It was monitored and adjusted by E_2 to ensure that participants were in view at all times. The roles of E_1 and E_2 were kept constant throughout the study. In addition to the experimenters, and for ethical reasons, a familiar person to the participant was also present during testing. He/she was instructed to refrain from engaging in any interaction with the participant during testing. The presence of the familiar person aimed uniquely at avoiding causing additional stress to the participants.

All participants were involved in three test sessions - one test session per experimental condition - separated by a 1-week 'wash-out' period. Experimental conditions involved either the live dog ('dog condition'), the robotic dog ('robot condition') or no-stimulus ('no-stimulus condition'). To achieve balance across participants, the order of conditions was determined through constrained randomization.

Depending on condition, sessions began either with a 5-min waiting period (no-stimulus condition), or a 5-min free play interaction period with the stimulus (dog or robot). This means that, in the dog condition, for example, participants were presented with the dog and interacted with the animal before the spontaneous imitation task. The same procedure was followed in the robot condition. Importantly, during this free play period, E_1 remained passive (pretending to be doing some paperwork) and did not attempt to influence the participant's interaction with the animal or the robot. This was planned so to compare the participants' engagement with each of the dogs (live and robotic).

In the no-stimulus condition, the participant was told to wait a moment so that E_1 could finish some paperwork before playing together. During this waiting period, the participants were free to act as he pleased.

The spontaneous imitation task began with E_1 inviting the participant to sit on a chair opposite to her so they could play a game. In the dog and the robot conditions, participants were told that the dog/robot needed to rest but that they could play again together at the end of the session. As to avoid inducing stress in the participants from the removal of the stimulus, the live dog, and the robotic dog remained present during testing. The dog was instructed to lay down and stay, and the robot was put in its sleeping mode.

The spontaneous imitation task was adapted from previous studies (e.g., Rogers, Young, Cook, Giolzetti, & Ozonoff, 2010). It involved a small battery including four manual actions (clap hands, pat legs, touch nose, wave goodbye) and two orofacial actions (extend tongue, make a noisy kiss). Such a small battery was chosen following clinical advice and considering participants' reduced tolerance to testing.

Modeling of each action was paired with a verbal marker including the participant's name so to draw his attention to E_1. Modeling only occurred when the participant looked directly at E_1. No instruction for imitation was ever provided. Each action was modeled a total of three times, and order of actions was randomized. Participants were given a response period of 5 seconds after each modeling.

This experimental protocol was approved by the ethics committee of the Institute of Biomedical Sciences Abel Salazar, Porto University (Portugal) (PROJ121/2015CETI).

Coding

Two independent raters coded the sessions using the Observer XT® software (Noldus Information Technology). The participant's response following each modeling was scored following previous studies (Rogers et al., 2010): '0' for no movement, '1' for a contingent movement appearing unrelated to the modeled action, and '2' for some degree of imitation. Whenever imitation occurred, the number of errors in production were coded following the performance criteria described in Table 2 (and also following Rogers et al., 2010). Six categories of errors were considered: bilateral versus unilateral, position, location, dynamic, repetition, and direction (Table 2).

Two variables were generated: i) imitation ratio (total number of '2' scores divided by the total number of imitation opportunities), and ii) imitation accuracy (mean number of errors in each response).

As indicators of social motivation (Chevallier et al., 2012), response to name (i.e., mean number of calls it took a participant to look at E_1 before modeling) and participants' emotional expressions during testing were assessed. Emotional expressions were coded in 5-seconds intervals ranging from 1 (laughing) to 4 (neutral) to 8 (cry). A mean emotional rating was calculated.

As a measure of engagement with the stimuli, the total duration of the participants' social contact (i.e., eye gazing and physical contact) with the dog and the robot was also coded. A preliminary viewing of the sessions revealed that participants only rarely looked at or tried to touch the stimulus during the imitation task. We therefore just coded participant-stimulus interaction during free play.

Statistical analysis

Data were tested for effects of Group (children and adults) and Condition (dog, robot, and no-stimulus) using repeated measures ANOVAs. To examine whether greater engagement with the stimuli (dog and robot) before testing was associated with individual differences in imitation ratio and accuracy, Spearman correlations were ran. Assumptions of statistical tests were checked as appropriate. Greenhouse-Geisser correction to degrees of freedom was applied when violations of sphericity were present ($p<0.05$). Post-hoc tests using the Tukey's honest significant difference method of contrasting individual treatments were carried out with Bonferroni correction. Inter-Rater Reliability was computed as Cohen's Kappa for categorical variables and as Pearson correlation coefficient for continuous variables. All analyses were carried out using the Statistical Package for the Social Sciences, version 24. *P*-values < 0.05 were considered significant.

RESULTS

For descriptive purposes, Table 3 shows Cohen's Kappas, means, and standard deviations for all variables considered in this study. ANOVA results showed a significant Group x Condition interaction effect on imitation ratio, emotional expressions, and response to name behavior (Table 4). Post-hoc tests indicated significant differences between conditions only in the children group. Imitation ratio was higher in the dog condition than in the other two conditions (dog vs. robot: p= .009; dog vs. no-stimulus: p= .002; Table 3). Emotional ratings were lower (thus emotions were less negative) in the dog condition than in the other two conditions (dog vs. robot:

p= .001; dog vs. no-stimulus: p= < .001; Table 3). Mean number of prompts before a response to name were also lower in the dog condition than in the other two conditions (dog vs. robot: p= .026; dog vs. no-stimulus: p= <.001; Table 3). Post-hoc tests also showed significant differences between groups. Children's imitation ratio was higher than adults' in the dog condition. Children's emotional ratings were higher than adults' in both the robot and the no-stimulus condition (p < .001 in both cases; Table 4). Mean number of prompts before a response to name were also higher for children than for adults in these same conditions (p < .001 in both cases; Table 3). No significant effects were found on imitation accuracy (Table 4).

A significant Stimuli x Group interaction effect was also found on the duration of social contact with the stimulus (Table 4). Children engaged more with the dog than with the robot (p < .001; Table 3), while the opposite was found in adults (p < .001; Table 3). In the dog condition, children engaged longer with the dog than adults did (p < .001; Table 3). Results of the Spearman correlations showed a marginally significant trend. In the dog condition, participants who spent more time engaging with the animal before testing tended to imitate more frequently (r = .390; p = .054).

DISCUSSION

Only the children in this study showed differences in behavior across conditions that seem consistent with the possibility that free play with the live dog before the imitation task was effective in promoting spontaneous imitation. As opposed to adults who showed no differences in imitation between conditions, children engaged more frequently in spontaneous imitation in the dog condition than in the other two conditions. Moreover, children showed more positive emotional expressions and needed fewer prompts before responding to name in the dog condition than in the other conditions, thus suggesting higher levels of social motivation following free play with the live dog. No such differences between conditions were found in the adult's groups.

At this point, no conclusive considerations can be made on why the dog condition, when compared to the other conditions, was associated with increased spontaneous imitation and seemingly higher social motivation only in the children group. When compared to adults, however, children engaged in more social contact with the dog during free play than adults did. This is worth noting considering studies (in healthy individuals) showing that stroking a friendly (live) dog can have neurophysiological effects - notably on the levels of the 'social bonding' neuropeptide oxytocin (Beetz, Uvnäs-Moberg, Julius, & Kotrschal, 2012) - impacting on social behavior, and particularly on social motivation. Oxytocin, interestingly, has been implicated in the social deficits in ASD (Lerer, Levi, Salomon, Darvasi, Yirmiya, & Ebstein 2008; Stavropoulos & Carver, 2013) and it has been proposed that, by combining oxytocin administration to behavioral interventions, impaired social motivation - one problem hindering therapeutic success - might be diminished (Stavropoulos & Carver, 2013). Thus, it might be that adults in this study, during free play, did not engage in enough contact with the dog allowing for effects on behavior to occur during the subsequent imitation task.

Interestingly, as opposed to children, adults showed increased social contact directed at the robot than at the animal, suggesting that the robotic dog was more attractive to them than the live dog, or piqued their interest in a different, more engaging, manner. This is interesting in that, if mere engagement with an interesting stimulus had accounted for the pattern of results observed in the children group, one could have expected adults in the robot condition to show increased social motivation and better performance during the imitation task (as compared to the other two conditions). This, however, was not the case, thus pointing to particular effects, in children, of contact with the live dog *per se*. Importantly to note, this study only tested for short-term effects. Thus, the possibility exists that the here reported seemingly positive effects of interaction with the dog on children's imitation behavior and social motivation may be based on novelty/attentional processes and, thus, may vanish overextended testing periods. Though one should not discard this possibility, it is important to note that studies have been published reporting long-term benefits associated with pet ownership in families with children with ASD (Hall, Wright, Hames, Mills, & PAWS Team, 2016).

As referred, previous research in the particular context of occupational therapy has found evidence that "the therapeutic use of animals may be an effective way to engage a wide variety of therapy clients, as well as to enhance the effectiveness of established occupational therapy techniques" (Sams et al., 2006). By focusing on one such "established occupational therapy techniques", that is, imitation, this study adds to the field and is relevant to the profession. Importantly, results here obtained are preliminary and do not indicate the utility of integrating (live) dogs into interventions aimed at promoting social motivation and enhancing imitation skills in individuals with ASD, notably within the occupational therapy's scope of practice. Replication at a larger scale is now warranted so that detailed suggestions can be made for practice. In this regard, active collaborations between researchers and occupational therapists allowing for studies to be conducted within a therapeutic context may provide the most interesting insights. Clearly, finding strategies to enhance imitation skills in individuals with ASD is of major clinical relevance, and research should continue explore the potential of incorporating animals into such strategies.

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CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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TABLES

Table 1. Descriptives on participants (N=25).

Group	**Gender**	**Mean age (in years)**	**Age range**
Adults (n=15)	3 females; 12 males	36	24-48
Children (n=10)	0 females ; 10 males	7	5-8

Table 2. Performance criteria for each of the actions included in the imitation battery.

	Performance criteria					
	Unimanual-bi-manual	**Position**	**Location**	**Dynamic**	**Repetition**	**Direction**
Manual actions:						
Clapping hands	Both hands move	Open hands	Hands touch each other	Audiable sound.	Reapeated movement (3x)	N.A.
Patting legs with both hands	Both hands move	Open hands	Right hand touches right leg; left hand touches left leg	Audiable sound	Reapeated movement (3x)	N.A.
Touching nose with one finger	Only one hand moves	Extented index finger	Index finger touches the tip of the nose	N.A.	N.A.	N.A.
Waving goodbye	Only one hand moves	Raised hand with the fingers pointing upward and the palm facing outward.	N.A.	At least three downward motions must be made by flexing either the fingers or the wrist.	N.A.	Eye gaze directed at E2.
Orofacial actions:						
Extending tongue	N.A.	N.A.	N.A.	Visible extension of the tongue outside of the mouth, followed by retration of the tongue inside the mouth.	N.A.	Eye gaze directed at E2.
Making a noisy kiss	N.A.	N.A.	N.A.	Audiable sound	N.A.	Eye gaze directed at E2.

Table 3. Descriptive statistics for the behavioral variables considered in this study (N=25; 15 adults and 10 children).

Behavioral variables	Experimental condition		
	Dog	**Robot**	**No-stimulus**
Imitation ratio (in %)			
Children (K=1)	77.5 ± 21.9	51.7 ± 29.3	44.2 ± 31.7
Adults (K=1)	52.2 ± 36.7	51.1 ± 42.1	48.9 ± 29.5
Initatation accuracy			
Children (K=0.96)	0.7 ± 0.3	1.4 ± 1.0	1.0 ± 0.3
Adults (K=0.95)	0.9 ± 0.4	0.8 ± 0.7	1.0 ± 0.5
Emotional expressions			
Children (K=0.83)	4.3 ± 0.4	5.0 ± 0.2	5.4 ± 0.3
Adults (K=0.80)	4.4 ± 0.5	4.3 ± 0.5	4.3 ± 0.5
Response to name			
Children (K=1)	1.9 ± 0.4	2.7 ± 0.8	5.4 ± 1.1
Adults (K=1)	2.0 ± 1.3	1.5 ± 0.7	2.1 ± 0.9
Social contact with the stimulus (in seconds)			
Children (r=0.89*)	237.1 ± 32.81	112.4 ± 58.38	n.a.
Adults (r=0.91*)	109.4 ± 53.97	212.6 ± 35.90	n.a.

Values are presented as mean ± s.d.
Cohens’ kappa (K) and Pearson correlation r values are given; *p < 0.05.

Table 4. Analysis of variance of the data recorded in this study (N=25; 15 adults and 10 children).

Source	df	SS	MS	F	P	η^2
Imitation ratio						
Group	1	891.36	891.36	0.33	0.570	0.014
Condition	2	4329.94	2164.97	6.58	0.003*	0.222
Group x Condition	2	3078.09	1539.04	4.68	0.014*	0.169
Imitation accuracy						
Group	1	0.25	0.25	0.40	0.538	0.023
Condition	1.19	0.74	0.62	2.06	0.165	0.108
Group x Condition	1.19	1.4	1.18	3.89	0.056	0.186
Emotional expressions						
Group	1	6.06	6.06	21.72	< .001*	0.486
Condition	2	3.62	1.84	14.34	< .001*	0.384
Group x Condition	2	4.30	2.15	16.81	< .001*	0.422
Response to name						
Group	1	499.10	499.10	433.37	< .001*	0.596
Condition	2	47.14	23.57	30.51	< .001*	0.570
Group x Condition	2	34.63	17.31	22.41	< .001*	0.494
Social contact with the stimulus						
Group	1	2261.53	2261.53	0.92	0.35	0.039
Stimulus	1	1390.23	1390.23	.75	.397	0.031
Group x Stimulus	1	155965.48	155965.48	83.71	< .001*	0.784

*$p<0.05$