

# Effects of Classroom Animal-Assisted Activities on Social Functioning in Children with Autism Spectrum Disorder

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## Abstract

**Objective:** The objective of this study was to implement and evaluate a classroom-based Animal-Assisted Activities (AAA) program on social functioning in children with autism spectrum disorder (ASD).

**Design:** This was a multisite, control-to-intervention design study.

**Settings/location:** The study was conducted in 41 classrooms in 15 schools in Brisbane, Australia.

**Subjects:** Sixty-four (64) 5- to 12-year-old children diagnosed with ASD comprised the study group.

**Intervention:** The AAA program consisted of 8 weeks of animal exposure in the school classroom in addition to 16 20-minute animal-interaction sessions.

**Outcome measures:** Teacher- and parent-reported child behavior and social functioning were assessed through standardized instruments at three time points: upon study entry (Time 1), after an 8-week waiting period during the week prior to the AAA program (Time 2), and during the week following the 8-week AAA program (Time 3).

**Results:** Significant improvements were identified in social functioning, including increases in social approach behaviors and social skills, and decreases in social withdrawal behaviors, from before to after the AAA program, but not during the waitlist period. Over half of parents also reported that participants demonstrated an increased interest in attending school during the program.

**Conclusions:** Results demonstrate the feasibility and potential efficacy of a new classroom-based Animal-Assisted Activities model, which may provide a relatively simple and cost-effective means of helping educators and families to improve the social functioning of children with ASD.

## Introduction

CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD) in inclusion classrooms tend to be rejected and victimized by their peers, which can lead to social isolation, anxiety, and problem behaviors.<sup>1</sup> These stressful school experiences often carry over into maladaptive and difficult behaviors at home.<sup>2</sup> Lack of peer social support and friendships can lead to impaired mental and physical health; therefore, it is important to find new ways to improve social functioning for children with ASD in inclusion classrooms.

Currently, the main avenue of intervention for children with ASD is through the education system.<sup>3,4</sup> Unfortunately, the most successful treatments to date are expensive and time-consuming and require highly trained staff to implement.<sup>4</sup> One viable addition to current practices may be the inclusion of an animal in the classroom.

Preliminary evidence suggests that individuals with ASD may seek out interaction with animals<sup>5,6</sup> and acquire social benefits from them.<sup>7,8</sup> The field of *Human-Animal Interaction* (HAI), or *Anthrozoology*, provides theoretical support for beneficial interactions between individuals with ASD and animals.<sup>9</sup> HAI social support theory suggests that animals can enhance social support both directly, as a source of comfort, and indirectly, as a facilitator of human interactions.<sup>10</sup> In addition, HAI attachment theory suggests that animals may provide a source of comfort and safety for children, as transitional objects that can alleviate distress and may reduce problem behaviors.<sup>11–13</sup> These theoretical underpinnings have spurred a growing field of inquiry into the practice of *Animal-Assisted Intervention* (AAI).

AAI is an umbrella term, encompassing both *Animal-Assisted Therapy* (AAT) and *Animal-Assisted Activities* (AAA).<sup>12</sup> AAT is defined as a goal-directed intervention facilitated

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by trained personnel, in which an animal is an integral part of the treatment process. In contrast, AAA is defined as activities with animals that provide opportunities for motivational, educational, recreational, and/or therapeutic benefits without the presence of specified treatment goals or objectives. It does not have to be implemented by trained personnel, and session content is spontaneous.<sup>14</sup>

The emerging research on AAI for ASD has focused largely on AAT, rather than AAA.<sup>15–17</sup> However, a recent AAA study demonstrated that the mere presence of a guinea pig encouraged increased social behaviors in children with ASD, compared to the presence of toys.<sup>18</sup> The current study builds upon this work by evaluating the impact of animal (guinea pig) presence and interaction over time through an 8-week, classroom-based AAA program. We assessed generalized changes in social behaviors both in the school classroom (teacher-reported) as well as at home (parent-reported) following an 8-week waitlist period, as well as following an 8-week AAA program. On the basis of HAI theory and previous AAI research, we hypothesized that participants with ASD would demonstrate increases in social functioning from before to after the AAA program, but not during the waitlist period.

## Materials and Methods

### Participants

Sixty-four (64) children with ASD (50 male; 14 female) aged 5.2–12.8 years ( $M=8.9$ ;  $SD=2.2$ ) participated. They were spread across 41 kindergarten through seventh-grade

classrooms in 15 different schools throughout the greater Brisbane area in Australia. All had a previous, independent diagnosis of ASD ( $n=25$ ), Asperger's Disorder ( $n=21$ ), Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS;  $n=10$ ), or Autistic Disorder ( $n=8$ ). A subset of participants also participated in an 8-week waitlist control condition before starting the AAA program. Demographic data for both the waitlist and non-waitlist groups are presented in Table 1.

### Procedures

**Participant groups and outcome assessment.** Participants were cluster-assigned to one of two groups: (1) waitlist group ( $n=37$ ) or (2) non-waitlist group ( $n=27$ ) at the school level in order to prevent cross-contamination between groups. The waitlist group completed outcome measures upon entering the study (Time 1), after an 8-week waiting period during the week prior to the AAA program (Time 2), and during the week following the AAA program (Time 3). Participants in the non-waitlist group were assessed at Time 2 and Time 3 only. In order to control for variability across the school year, the study start date was staggered by school over the course of the year. Response rates for teacher questionnaires were 100% ( $n=37$ ) at Time 1, 95.3% ( $n=61$ ) at Time 2, and 100% ( $n=64$ ) at Time 3. Response rates for parent questionnaires were 94.6% ( $n=35$ ) at Time 1, 89.1% ( $n=57$ ) at Time 2, and 84.4% ( $n=54$ ) at Time 3.

**AAA program.** Guinea pigs were selected as the intervention animal because they have been reported as one of

TABLE 1. DEMOGRAPHIC AND BASELINE MEASURES OF TARGET PARTICIPANTS WITH AUTISM SPECTRUM DISORDER

Variable	Group			Waitlist vs. non-waitlist p
	All ( $n=64$ ) n (%)	Waitlist ( $n=37$ ) n (%)	Non-waitlist ( $n=27$ ) n (%)	
<b>Demographics</b>				
Sex (male)	50 (78.1%)	28 (75.7%)	22 (81.5%)	NS
Pet owners	45 (70.3%)	29 (78.4%)	16 (59.3%)	NS
Current ASD treatment	35 (54.7%)	20 (54.1%)	15 (57.7%)	NS
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	
Age (years)	8.9 (2.2)	9.5 (2.4)	8.2 (1.7)	NS
Grade	3.6 (2.4)	4.0 (2.6)	3.0 (1.9)	NS
<b>Parent measures</b>				
<i>n</i>	57	33	24	
PDDBI Social Approach Behaviors	67.8 (13.2)	67.6 (14.2)	68.0 (12.0)	NS
PDDBI Social Withdrawal Behaviors	27.3 (10.2)	26.7 (10.6)	28.0 (9.9)	NS
SSRS Social Skills	76.5 (15.3)	76.0 (17.2)	77.3 (12.5)	NS
SSRS Problem Behaviors	120.5 (14.4)	121.6 (14.1)	119.1 (15.0)	NS
<b>Teacher measures</b>				
<i>n</i>	61	34	27	
PDDBI Social Approach Behaviors	52.6 (15.5)	55.9 (14.8)	48.3 (15.6)	NS
PDDBI Social Withdrawal Behaviors	22.6 (13.2)	21.2 (14.2)	24.3 (12.0)	NS
SSRS Social Skills	84.1 (16.4)	85.7 (15.4)	82.1 (17.7)	NS
SSRS Problem Behaviors	112.0 (13.2)	111.9 (13.2)	112.1 (13.4)	NS

Pervasive Developmental Disorder Behavior Inventory (PDDBI) values are raw scores and Social Skills Rating System (SSRS) values are standard scores.

Baseline measures are pre-Animal-Assisted Activities (AAA) program assessments during the week prior to the AAA program.

NS, not significant; ASD, autism spectrum disorder; PDDBI, *Pervasive Developmental Disorder Behavior Inventory*; SSRS, *Social Skills Rating System*.

the best choices for young children and as classroom pets because they are diurnal, relatively easy to handle and care for, generally like to be held, and seldom bite.<sup>19</sup> Guinea pigs are social animals that require companionship; therefore, each participating classroom housed one pair of guinea pigs of the same sex to prevent breeding. The animals remained in the classroom during the school week (Monday to Friday) for the duration of the program.

The implementation of the program was coordinated by one of the researchers (MEO) with no clinical background or training. The purpose of enlisting a nonspecialist program facilitator was to present a basic activities program that could potentially be implemented by parents, volunteers, or teachers without clinical background or training. The AAA program consisted of two main components: (1) animal care and (2) animal interaction (Table 2).

The AAA sessions were conducted in groups of three participants. To simulate peer presence in the classroom during these sessions, we randomly selected two typically developing peers from each child's classroom to partake in the sessions alongside the child with ASD. The sample of typically developing peers included 128 children aged 4.8–12.7 years ( $M=8.6$ ;  $SD=2.3$ ).

The purpose of the AAA sessions was to ensure that study participants had at least 40 minutes of contact time with the guinea pigs per week (two 20-minute sessions) as well as to collect basic data about the types of activities children chose to engage in with guinea pigs. Materials were provided for all activities in every session, as described in Table 3. A detailed description of the AAA program and procedures can be found elsewhere.<sup>20</sup>

### Measures

**AAA program implementation.** The implementation of the AAA program was documented by collecting data on AAA sessions (activity frequency and session attendance) as well as post-program animal adoption. Parent-report data were also collected regarding whether or not participants showed any changes in their interest in attending school during the time the guinea pigs were in the classroom.

**Outcome measures.** The *Pervasive Developmental Disorder Behavior Inventory* (PDDBI) is a 180-item (teacher version) and 188-item (parent version) rating scale designed to

assess responsiveness to interventions in children with ASD.<sup>21</sup> In order to minimize parent and teacher burden, a shortened 48-item (teacher version) and 52-item (parent version) was used. The PDDBI was designed so that two domains of Social Approach Behaviors and Social Withdrawal Behaviors can be independently assessed. It has good internal consistency as well as developmental, construct, and criterion-related validity.<sup>22</sup>

The *Social Skills Rating System* (SSRS) is a 57-item (elementary-level teacher version) and 55-item (elementary-level parent version) questionnaire designed to assess overall social skills in children with or without a clinical diagnosis.<sup>23</sup> It demonstrates adequate internal consistency and test-retest reliability.<sup>23</sup>

### Data analysis

In order to account for the nested study design (i.e., multiple assessments nested within participants nested within classrooms) as well as the unequal group sizes at Time 1 (waitlist group only) compared to Time 2 and Time 3 (both waitlist group and non-waitlist group), data were analyzed using hierarchical linear modeling (HLM).<sup>24</sup> Primary outcome measures included raw scores from the PDDBI Social Approach Behaviors and PDDBI Social Withdrawal Behaviors subscales, and standard scores from the SSRS Social Skills and SSRS Problem Behaviors subscales.

Prior to examining the primary hypothesis regarding social functioning outcomes, potentially confounding variables were examined using two-level HLMs. To check for differences between the waitlist group ( $n=37$ ) and the non-waitlist group ( $n=27$ ) prior to the AAA program, the fixed effect was identified as group (waitlist, non-waitlist) and a mixed model analysis was conducted for each demographic variable and each outcome measure during the week prior to the AAA program (Time 2). To check for differences between participants with complete parent questionnaires (Time 1:  $n=35$ , Time 2:  $n=57$ , Time 3:  $n=54$ ) and those with missing parent questionnaires (Time 1:  $n=2$ , Time 2:  $n=7$ , Time 3:  $n=10$ ), the fixed effect was identified as missing parent data at each time point (e.g., Time 1 missing, Time 1 complete) and a mixed-model analysis was conducted for each demographic variable and each teacher-reported outcome measure for a given time point.

TABLE 2. OVERVIEW OF ANIMAL-ASSISTED ACTIVITIES PROGRAM COMPONENTS AND PARTICIPANTS

Program component	Supervisor	Participants		Description
		All students in class	Study participants only	
<b>Animal care</b>				
Introductory lesson	Facilitator	x		1×15-minute lesson on guinea pig care
Week (Mon.–Fri.)	Facilitator & teacher	x		Classroom care (feeding, cage cleaning)
Weekend/holiday	Parent	x		Home care by eligible families (transport, feeding)
Post-study	Teacher or parent	x		Adoption of guinea pigs offered to teachers, then parents
<b>Animal interaction</b>				
Classroom Sessions	Teacher	x		Classroom animal exposure and handling
	Facilitator		x	16×20-minute AAA sessions outside classroom

TABLE 3. DESCRIPTION OF ANIMAL-ASSISTED ACTIVITIES SESSION ACTIVITIES AND THEIR MEAN OCCURRENCE ACROSS GROUPS

Activity	Description Picture activity card (materials)	% Occurrence across groups	
		M (SD)	Range
Holding	Holding guinea pig in arms or lap "Hold" (towels)	100.0% (0.0%)	100.0%
Feeding	Preparing fruit/vegetables or hand feeding "Feed" (grass/hay, fruits or vegetables, cutting board, plastic knife)	88.6% (16.6%)	37.5%–100.0%
Floor time	Sitting in a circle, allowing guinea pigs to roam freely in center "Floor" (blanket, towels)	70.9% (21.8%)	12.5%–100.0%
Visual art	Drawing pictures or taking photographs of guinea pigs "Draw" (markers, pencils, paper, blank notebook) "Camera" (photo camera)	42.9% (24.0%)	6.3%–100.0%
Health monitoring	Weighing, measuring, recording physical and behavioral characteristics "Weigh" (kitchen scale) "Measure" (measuring tape) "Record" (health checklist, blank notebook)	37.1% (24.1%)	6.3%–87.5%
Construction	Building housing additions, shelters, mazes, or animal toys "Build" and "Maze" (recycled materials such as cardboard or tissue boxes, scissors, glue, string)	30.3% (21.6%)	6.3%–87.5%
Grooming	Brushing coat or bathing "Brush" (baby brush and comb) "Bath" (small-animal shampoo, bathing tub, towels, hairdryer)	26.9% (16.4%)	6.3%–75.0%
Cage cleaning	Emptying cage to clean and provide fresh bedding "Clean" (cleaning solution, paper towels, trash bags, fresh bedding)	17.6% (18.3%)	0.0%–56.3%

In order to evaluate the primary hypothesis regarding social functioning, a three-level HLM was conducted to examine change in outcome measures at all three times. The three levels of the model reflected change over time (Level 1), individual effects (Level 2), and classroom effects (Level 3). We conducted a series of mixed model analyses—one for each teacher-reported and parent-reported outcome. Fixed effects were identified as time (Time 1, Time 2, Time 3), current pet ownership (yes, no), current ASD treatment status (receiving treatment, not receiving treatment), grade, and school (nested within group [waitlist, non-waitlist]). Random effects were identified as classroom and individual (nested within classroom). The repeated-measures effect of time (nested within individual within classroom) was also identified. The intraclass correlation coefficient (ICC) was used to calculate the random effects of classroom and individual. It was evaluated for significance via the Wald Z test.

Follow-up analyses were conducted using the Bonferroni correction.<sup>25</sup> Cohen's *d* effect sizes<sup>26</sup> were computed for significant effects using the correction for dependence among means.<sup>27</sup> All significance tests were two-tailed with an  $\alpha$  value of  $p < 0.05$ .

## Results

### AAA program implementation

**AAA sessions.** All participating classrooms completed the 8-week AAA program. Attendance at AAA sessions by study participants was not mandatory; however, all participants elected to take part in sessions when they were present at school. Due to school absences, participants missed one session on average over the course of the 16-session program ( $M = 92.2\%$ ;  $SD = 8.6\%$ ; range: 68.8–100.0%).

Participant groups engaged in an average of 4.5 activity categories per 20-minute session ( $SD = 0.5$ ; range: 3.4–5.8). The most consistent activity was holding the guinea pigs, which occurred in all sessions. All other activities had high variability, with the most common being feeding and floor time, which occurred in most sessions (Table 3).

**Post-AAA program.** Over half of parents (51.8%) reported that their child demonstrated an increased interest in attending school while the guinea pigs were in the classroom. Following the AAA program, all guinea pigs were adopted, half by teachers to keep in the classroom (53.7%) and the rest by families of participants.

### Preliminary analyses

Results revealed no significant differences between the waitlist and non-waitlist group on any of the demographic or outcome variables ( $p > 0.118$ ; Table 1). There were no significant differences between participants with completed versus missing parent questionnaires on any demographic variables ( $p > 0.133$ ) or teacher-reported outcome measures ( $p > 0.065$ ).

### Social functioning outcomes

**HLM random effects.** The variance of the random effect of classroom was not significant in any analysis ( $ICCs < 0.15$ ,  $p > 0.590$ ), but the random effect of individual was significant in all analyses ( $ICCs > 0.42$ ,  $p < 0.025$ ), indicating variability across individuals, irrespective of classroom. There were no significant differences for the fixed main effects of school ( $F < 1.42$ ,  $p > 0.193$ ), grade ( $F < 1.35$ ,  $p > 0.256$ ), pet ownership ( $F < 2.51$ ,  $p > 0.121$ ), or outside ASD treatment ( $F < 1.39$ ,  $p > 0.247$ ) for any analyses. Thus, the

main effects of the AAA program were independent of classroom differences, school differences, and individual differences in grade, pet ownership, and receipt of outside ASD treatment services.

**HLM main effects.** There was a significant fixed main effect of time for PDDBI Social Approach Behaviors on both the teacher-version ( $F(2, 48.05)=13.87, p<0.001$ ) and the parent-version ( $F(2, 48.67)=5.12, p=0.010$ ; Table 4). Post-hoc testing showed that changes from before to after the waitlist period (Time 1 to Time 2) were not significant on the teacher-version ( $p=1.00$ ) or the parent-version ( $p=1.00$ ), but changes from before to after the AAA period (Time 2 to Time 3) were significant on both the teacher-version ( $p<0.001, d=0.64$ ) and the parent-version ( $p=0.012, d=0.35$ ). There was also a significant main effect of time for PDDBI Social Withdrawal Behaviors on both the teacher-version ( $F(2, 54.04)=8.41, p=0.001$ ) and parent-version ( $F(2, 51.31)=4.83, p=0.012$ ). Post-hoc testing revealed that changes from before to after the waitlist period were not significant on the teacher-version ( $p=0.134$ ) or the parent-version ( $p=1.00$ ), but changes from before to after the AAA period were significant on both the teacher-version ( $p<0.001, d=-0.59$ ) and the parent-version ( $p=0.007, d=-0.40$ ). Therefore, teachers and parents did not perceive changes in participants' social approach and withdrawal behaviors during the waitlist period, but did perceive more social approach behaviors and less social withdrawal behaviors following the AAA program.

The mixed-model analyses for SSRS Social Skills showed a significant main effect of time on standard scores for both the teacher-version ( $F(2, 52.26)=6.16, p=0.004$ ) and the parent-version ( $F(2, 45.24)=9.55, p<0.001$ ). Post-hoc testing indicated no significant changes from before to after the waitlist period on either the teacher-version ( $p=0.917$ ) or the parent-version ( $p=0.174$ ), but significant changes from before to after the AAA program on both the teacher-version ( $p=0.008, d=0.45$ ) and the parent-version ( $p=0.006, d=0.33$ ). Thus, teachers and parents perceived no changes in social skills from before to after the waitlist period, but reported that participants en-

gaged in more socially skilled behaviors following the AAA program than prior to it. The analyses for SSRS Problem Behaviors showed no significant main effect for time on either the teacher-version ( $F(2, 58.06)=1.22, p=0.303$ ) or the parent-version ( $F(2, 44.18)=1.29, p=0.284$ ), indicating that teachers and parents perceived no changes in problem behaviors following the waitlist period or the AAA period.

## Discussion

An 8-week AAA program for 64 children with ASD in 41 inclusion school classrooms demonstrated increases in ASD-diagnosed children's social functioning. Specifically, both teachers and parents reported increases in social approach behaviors, decreases in social withdrawal behaviors, and increases in social skills following the program. These outcomes were independent of a child's school, teacher, grade, pet ownership, or outside treatment.

All participating classrooms completed the 8-week AAA program, demonstrating feasibility of the protocol. Over half of teachers opted to keep the guinea pigs in the classroom following the program. The remaining animals were adopted by families of participants.

Over half of parents reported that their child demonstrated an increased interest in attending school during the time the guinea pigs were in the classroom. Previous research has documented that the inclusion classroom can be a stressful and lonely environment for children with ASD.<sup>28-30</sup> HAI studies have revealed that the simple presence of an animal can enhance people's perception of social scenes, making them appear happier and less threatening.<sup>31-33</sup> The presence of the guinea pigs may have enhanced the atmosphere of the classroom, leading to increases in the children's motivation to attend.

The key finding of the study was that on the primary social functioning outcome measures, there was significant improvement following the AAA program, but not the waitlist period. These positive changes in the children's behavior were perceived by both parents and teachers. These effects may have been related to the ability of an

TABLE 4. MEAN OUTCOMES FOR ASSESSMENTS AT TIME 1 (PRE-WAITLIST), TIME 2 (PRE-AAA), AND TIME 3 (POST-AAA)

Variable	Time						p		
	T1 n	M (SD)	T2 n	M (SD)	T3 n	M (SD)	Overall (T1, T2, T3)	Waitlist <sup>a</sup> (T1-T2)	AAA <sup>a</sup> (T2-T3)
PDDBI Social Approach Behaviors									
Teacher-version	37	56.2 (14.3)	61	52.6 (15.5)	64	58.5 (14.5)	<0.001	NS	<0.001
Parent-version	35	67.7 (14.0)	57	67.8 (13.2)	54	71.2 (12.3)	<0.025	NS	<0.025
PDDBI Social Withdrawal Behaviors									
Teacher-version	37	18.6 (13.3)	61	22.6 (13.2)	64	18.3 (12.0)	<0.0025	NS	<0.001
Parent-version	35	27.0 (10.4)	57	27.3 (10.2)	54	24.4 (10.7)	<0.025	NS	<0.01
SSRS Social Skills									
Teacher-version	37	85.1 (15.4)	61	84.1 (16.4)	64	88.2 (14.6)	<0.005	NS	<0.01
Parent-version	35	73.9 (14.5)	57	76.5 (15.3)	54	80.9 (16.8)	<0.001	NS	<0.01
SSRS Problem Behaviors									
Teacher-version	37	112.9 (12.2)	61	112.0 (13.2)	64	111.1 (12.5)	NS	NS	NS
Parent-version	35	122.1 (15.3)	57	120.5 (14.4)	54	118.6 (14.6)	NS	NS	NS

PDDBI values are raw scores and SSRS values are standard scores.

<sup>a</sup>Bonferroni-adjusted  $p$ -values.

animal's presence to facilitate social interaction between people<sup>34</sup> and provide social support in stressful social situations.<sup>35</sup>

Despite positive outcomes in the current study, several limitations should be noted. First, the use of a waitlist control rather than an attention control precludes concluding that outcomes were due to the animal itself rather than the program as a whole. Further studies should enlist attention controls such as a program focused on plant care or engaging toys to determine whether the animal is indeed an essential ingredient of the program. Component analyses of the AAA program, itself, are also warranted to determine which elements were effective (e.g., animal care instruction versus animal interaction, animal presence in the classroom versus time outside of the classroom with the animals and peers). Second, teachers and parents were not blinded to participant conditions, which could have biased their ratings, especially if they had high expectations or desire for change from the AAA program. Third, limited data were collected regarding participant characteristics such as verbal ability, IQ, level of assistance in the classroom, or independent confirmation of ASD diagnoses. Given the significant variability in outcomes at the individual level and the broad spectrum of ASD traits, the collection of these items as potential moderators of program effects is warranted in further studies. Finally, although the program facilitator had no clinical training or experience, the use of only one facilitator for all sessions limits the ability to determine whether obtained effects are truly attributable to the program, or whether they are instead the result of interacting with that individual. Further studies should use multiple facilitators and carefully measure treatment fidelity.

## Conclusions

In summary, findings from the current study largely support the hypothesis that the AAA program would increase social functioning in children with ASD. This outcome appears to confirm previous theoretical and anecdotal literature highlighting the capacity of animals to draw children with ASD out of the "autistic bubble" and connect them socially with others.<sup>9</sup> It suggests that appropriately designed AAI in inclusion classrooms may be a feasible and effective way to engage and improve the social functioning of children with ASD.

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## Disclosure Statement

No competing financial interests exist.

## References

1. Kasari C, Rotheram-Fuller E. Peer relationships of children with autism: Challenges and interventions. In: Hollander E, Anagnostou E, eds. *Clinical Manual for the Treatment of Autism*. Washington, DC: American Psychiatric Publishing, 2007:235–257.
2. Twachtman-Cullen D. Communication and stress in students with autism spectrum disorders. In: Baron GM, Groden J, Groden G, Lipsitt LP, eds. *Stress and Coping in Autism*. Oxford: Oxford University Press, 2006:302–323.
3. Lord C, McGee JP. *Educating Children with Autism*. Washington, DC: National Academy Press, 2001.
4. Lord C, Wagner A, Rogers S, et al. Challenges in evaluating psychosocial interventions for autistic spectrum disorders. *J Autism Dev Disord* 2005;35:695–708.
5. Celani G. Human beings, animals and inanimate objects: What do people with autism like? *Autism* 2002;6:93–102.
6. Prothmann A, Ettrich C, Prothmann S. Preference for, and responsiveness to, people, dogs and objects in children with autism. *Anthrozoos* 2009;22:161–171.
7. Grandin T, Fine AH, Bowers CM. The use of therapy animals with individuals with autism. In: Fine AH, ed. *Handbook on Animal-assisted Therapy: Theoretical Foundations and Guidelines for Practice*, 3rd ed. San Diego, CA: Academic Press, 2010:247–264.
8. Pavlides M. *Animal-Assisted Interventions for Individuals with Autism*. London: Jessica Kingsley Publishers, 2008.
9. O'Haire ME. Companion animals and human health: Benefits, challenges, and the road ahead. *J Vet Behav* 2010;5: 226–234.
10. McNicholas J, Collis GM. Animals as social supports: Insights for understanding animal-assisted therapy. In: Fine AH, ed. *Handbook on Animal-Assisted Therapy: Theoretical Foundations and Guidelines for Practice*, 2nd ed. San Diego, CA: Academic Press, 2006:49–71.
11. Katcher AH. Animals in therapeutic education: Guides into the liminal state. In: Kahn PH, Jr, Kellert SR, eds. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. Cambridge, MA: MIT Press, 2002:179–198.
12. Kruger KA, Serpell JA. Animal-assisted interventions in mental health: Definitions and theoretical foundations. In: Fine AH, ed. *Handbook on Animal-Assisted Therapy*:

- Theoretical Foundations and Guidelines for Practice, 3rd ed. San Diego, CA: Academic Press, 2010:33–48.
13. Triebenbacher SL. Pets as transitional objects: Their role in children's emotional development. *Psychol Rep* 1998;82: 191–200.
  14. Delta Society. Standards of Practice for Animal-Assisted Activities and Therapy. Renton, WA: Delta Society, 2003.
  15. O'Haire ME. Animal-assisted intervention for autism spectrum disorder: A systematic literature review. *J Autism Dev Disord* 2013;43:1606–1622.
  16. Berry A, Borgi M, Francia N, et al. Use of assistance and therapy dogs for children with autism spectrum disorders: A critical review of the current evidence. *J Altern Complement Med* 2013;19:73–80.
  17. Silva K, Correia R, Lima M, et al. Can dogs prime autistic children for therapy? Evidence from a single case study. *J Altern Complement Med* 2011;17:1–5.
  18. O'Haire ME, McKenzie SJ, Beck AM, Slaughter V. Social behaviors increase in children with autism in the presence of animals compared to toys. *PLoS ONE* 2013;8:e57010.
  19. American Society for the Prevention of Cruelty to Animals. Pets in the Classroom: Considerations. ASPCA Resource Guide for Teachers. New York: ASPCA, 2008:13–14.
  20. O'Haire ME, McKenzie SJ, McCune S, Slaughter V. Effects of animal-assisted activities with guinea pigs in the primary school classroom. *Anthrozoos* 2013;26:445–458.
  21. Cohen IL, Schmidt-Lackner S, Romanczyk R, Sudhalter V. The PDD behavior inventory: A rating scale for assessing response to intervention in children with pervasive developmental disorder. *J Autism Dev Disord* 2003;33:31–45.
  22. Cohen IL. Criterion-related validity of the PDD behavior inventory. *J Autism Dev Disord* 2003;33:47–53.
  23. Gresham FM, Elliott SN. Social Skills Rating System. Circle Pines, MN: American Guidance Service, 1990.
  24. Raudenbush SW, Bryk AS. Hierarchical Linear Models: Applications and Data Analysis Methods. Thousand Oaks, CA: Sage Publications, 2002.
  25. Tabachnick BG, Fidell LS. Using Multivariate Statistics, 5th ed. Boston: Allyn and Bacon, 2012.
  26. Cohen J. Statistical Power Analysis for the Behavioral Sciences, 2nd ed. Hillsdale, NJ: Lawrence Erlbaum, 1988.
  27. Morris SB, DeShon RP. Combining effect size estimates in meta-analysis with repeated measures and independent-groups designs. *Psychol Methods* 2002;7:105–125.
  28. Bauminger N, Shulman C, Agam G. Peer interaction and loneliness in high-functioning children with autism. *J Autism Dev Disord* 2003;33:489–507.
  29. Lasgaard M, Nielsen A, Eriksen ME, Goossens L. Loneliness and social support in adolescent boys with autism spectrum disorders. *J Autism Dev Disord* 2010;40:218–226.
  30. White SW, Oswald D, Ollendick T, Scahill L. Anxiety in children and adolescents with autism spectrum disorders. *Clin Psychol Rev* 2009;29:216–229.
  31. Friedmann E, Lockwood R. Validation and use of the animal thematic apperception test (ATAT). *Anthrozoos* 1991;4:174–183.
  32. Wells M, Perrine R. Pets go to college: The influence of pets on students' perceptions of faculty and their offices. *Anthrozoos*. 2001;14:161–168.
  33. Lockwood R. The influence of animals on social perception. In: Katcher AH, Beck AM, eds. *New Perspectives on Our Lives with Companion Animals*. Philadelphia: University of Pennsylvania Press, 1983:64–72.
  34. McNicholas J, Collis GM. Dogs as catalysts for social interaction: Robustness of the effect. *Br J Psychol* 2000;91:61–70.
  35. McConnell AR, Brown CM, Shoda TM, et al. Friends with benefits: On the positive consequences of pet ownership. *J Pers Soc Psychol* 2011;101:1239.

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