Routledge
Taylor & Francis Group

Anthrozoös

A multidisciplinary journal of the interactions of people and animals

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rfan20

Effects of Dolphin-Assisted Therapy on the Social and Communication Skills of Children with Autism Spectrum Disorder

Nazaret Hernández-Espeso, Eva Rosa Martínez, Dolores Grau Sevilla & Luis Abad Mas

To cite this article: Nazaret Hernández-Espeso, Eva Rosa Martínez, Dolores Grau Sevilla & Luis Abad Mas (2021) Effects of Dolphin-Assisted Therapy on the Social and Communication Skills of Children with Autism Spectrum Disorder, Anthrozoös, 34:2, 251-266, DOI: 10.1080/08927936.2021.1885140

To link to this article: https://doi.org/10.1080/08927936.2021.1885140

ANTHROZOÖS
2021, VOL. 34, NO. 2, 251–266
https://doi.org/10.1080/08927936.2021.1885140

Routledge
Taylor & Francis Group

Effects of Dolphin-Assisted Therapy on the Social and Communication Skills of Children with Autism Spectrum Disorder

Nazaret Hernández-Espeso[a]*, Eva Rosa Martínez[b], Dolores Grau Sevilla[c], and Luis Abad Mas[d]

[a]Department of Occupational Sciences, Speech Therapy, Evolutionary and Educational Psychology, Universidad Católica de Valencia San Vicente Mártir, Valencia, Spain; [b]Department of Psychology, University of Valencia, Valencia, Spain; [c]Department of Personality, Assessment and Therapeutic Intervention, Universidad Católica de Valencia San Vicente Mártir, Valencia, Spain; [d]Red Cenit, Valencia, Spain

ABSTRACT

Although several studies have shown that dolphin-assisted therapy (DAT) may be beneficial for children with autism spectrum disorder (ASD), most of these studies have methodological weaknesses. This study tested the effectiveness of DAT in improving the social and communicative skills of children with ASD. We used a pretest–posttest design with a control group. The 48 participants were selected according to the following inclusion criteria: age between 4 and 5 years, diagnosis of ASD, and clear impairment in communication. Participants were randomly assigned to the groups: DAT and Therapy Without Dolphins (TWD). The research lasted 10 weeks. The intervention phase lasted 6 weeks and consisted of three weekly 45-min sessions, with a total of 18 sessions per participant. Therapy sessions for both groups, DAT and TWD, were conducted by a dolphin trainer and a health professional in the same facilities and under the same conditions, except for the use of the interaction with the dolphin as support for the activities. Three instruments were used to assess communicative and social skills: The Autism Diagnostic Observation Schedule-Generic, the Reynell Developmental Language scales, and the Vineland Adaptive Behavior scales. Significant improvements were observed between the pretests and posttests in both groups, DAT and TWD, on the total scores of all the scales, except for the Social Interaction Domain of the ADOS-G. These improvements were significantly greater for the DAT group on only two items of the Language and Communication Domain, ADOS-G: "frequency of vocalizations toward others" and "gestures" ($\eta^2 = 0.11$, $p < 0.05$) in both cases. In conclusion, we found some evidence that DAT is a useful therapeutic intervention to foster the social and communication skills of children with ASD and that dolphins specifically can enhance the improvement of some communication-related aspects.

KEYWORDS

Animal-assisted therapy; autism spectrum disorder; communication skills; dolphin-assisted therapy; human–animal interaction; social skills

CONTACT Eva Rosa Martínez eva.rosa@uv.es Universitat de València, Department of Psychology, Av. de Blasco Ibáñez, 21, 46010 València, Spain
*Nazaret Hernández-Espeso and Eva Rosa Martínez are Joint Senior Authors.

Animal-assisted intervention (AAI) is "a goal oriented and structured intervention that intentionally includes or incorporates animals in health, education and human services for the purpose of therapeutic gains in humans" (IAHAIO, 2018, p. 5). Research has already shown that AAI for children with autism spectrum disorder (ASD), mainly with dogs and horses, can lead to improvements in areas, such as social interaction and language and communication skills, or reduce behavioral problems and stress. However, these studies frequently have methodological weaknesses that highlight the need for more rigorous research (O'Haire, 2013; Srinivasan et al., 2018). Although dolphin-assisted therapy (DAT) is one of the interventions with animals that creates greater expectations in the families of children with ADS (Herzog, 2010), empirical research in this field has also shown numerous problems (O'Haire, 2013; Umbarger, 2007). Specifically, most of the published studies, supporting the benefits of DAT for interventions in people with disabilities and developmental disorders (Breitenbach et al., 2009; Dilts, 2008; Kohn & Oerter, 2013; Nathanson et al., 1997), have had several methodological weaknesses. For this reason, some authors (Kazdin, 2010; Marino & Lilienfeld, 2007; Morrison, 2007) highlight the need to improve DAT research designs (Humphries, 2003; May et al., 2016). As described in the Methods section, this study addresses the deficiencies in previous research by using the following experimental design: a control group identical to the experimental group, except for the interaction with the dolphin; random assignment of the participants; and standardized measuring instruments with adequate psychometric properties.

As the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V, APA, 2013) states, ASD is characterized by a central triad of impairments: social communication deficits (combining social and communication problems), and restricted/repetitive behaviors. In general, people with ASD experience alterations in communication and social interactions that are manifested in three areas:

(1) Deficiencies in social-emotional reciprocity, ranging from abnormal social approaches to failure to initiate or respond to social interactions.
(2) Deficiencies in nonverbal communicative behaviors used in social interactions (eye contact, body language, understanding and use of gestures, facial expressions, and nonverbal communication).
(3) Impairments in the development, maintenance, and understanding of relationships, which are also manifested as difficulties in adjusting their behavior to various social contexts.

Among the proposed interventions for social communication deficits in ASD, AAI is receiving increasing attention because it is a very attractive type of intervention for the children's families due to the motivation produced by interaction with animals. Different theories about the factors involved in DAT programs have been presented (Fiksdal et al., 2012). One of these theories proposes that echolocation signals, emitted by dolphins, might have a healing effect (Birch, 1997). However, some authors have rejected this line of research and suggested further research on aspects of the relationship established between dolphins and humans during their interaction (Brensing et al., 2003). Another hypothesis proposes that dolphins might foster the motivation to learn

(McKinney et al., 2001). Greater motivation and interest could make children with ASD look for more learning opportunities and engage in social interactions, which can promote social development (Koegel et al., 2010; O'Haire, 2017). Along these lines, Marino and Lilienfeld (2007) suggested using interaction with dolphins as positive reinforcement when the person shows specific behavior or achieves the intervention targets. The focus of the present study is aligned with this latter hypothesis because we believe that the key to improving social and communication skills is the motivation that the therapeutic context produces in participants. Performing therapy outdoors, utilizing the water and a playful methodology, providing information through pictograms, and the presence of the therapists and the animal can be highly motivational elements.

More specifically, the aim of this study was to determine the changes in social and communication skills in a group of children with ASD after an intervention using a DAT program. They were compared with another group of participants who received the same intervention under the same conditions, except that the therapeutic intervention was carried out without dolphins (henceforth TWD, Therapy Without Dolphins). We focused on the area of social and communication skills because we believed that they would benefit the most from a DAT intervention. In fact, as described in the methodology section, intervention activities included: greeting the coach and dolphin, playing with them, and asking for different things. We expected to find significant improvements in both groups, although improvements in communication skills in the DAT group were expected to be greater than in the TWD group because the interaction with the dolphin would increase the participants' motivation and involvement in these activities.

Methods

All the procedures, performed in this study involving human participants, were carried out in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments and approved by the Experimental Research Ethics Committee of the University of Valencia, Spain (code: H1509095887450). The procedure involving the dolphins had previously been approved by the internal animal care committee of *L'Oceanogràfic*, which considered it noninvasive and non-stressful or painful, without any potential harmful impact on the animals and, hence, not requiring any other additional permits.

Participants

Four dolphins *Tursiops Truncates* (two males and two females) between 6 and 17 years old participated in the research. They were not the object of the research, but rather provided support for the therapy. They were not specifically trained in any behaviors or procedures for the purposes of this study, and they were not physically or chemically restrained at any point.

In order to recruit the human participants, all the clinics, specialized in the care of children with ASD in the Valencian Community (Spain), were invited to participate in the study via e-mail. An informative meeting was held with the directors of the clinics in the Oceanographic center to explain the details of the research project. Psicotrade and Red Cenit were the two clinics that agreed to participate. Subsequently, the teams of

healthcare professionals from both clinics selected the 48 participants, according to the following inclusion criteria: (1) age between 4 and 5 years (up to 5 years and 11 months); (2) diagnosis of ASD (the children were evaluated by neuro-pediatricians from the Valencian public health system, who, after the diagnosis, referred the participants to the Red Cenit and Psicotrade clinics to receive the assigned intervention); and (3) clear impairment in the communication area (according to the previous evaluation in their former intervention clinic). Participants were selected in this age range because they had received interventions from the Valencian Public Healthcare System (from 6 years of age, this public assistance is no longer available). Thus, homogeneity in the type and amount of therapeutic intervention received by the children was also ensured. The exclusion criteria were the following: comorbidity with acquired brain injury, ASD diagnosis of high functioning autism (Asperger's Syndrome), phobia or excessive fear of the water or animals, frequent uncontrolled seizures, other highly disabling or infectious diseases that can negatively influence their performance, and serious patterns of self-injurious behavior or aggressive behavior toward others. Informed consent was obtained from the parents of all the individual participants, except the material pertaining to the children. Parents were guaranteed that individual participants could not be identified through the manuscript.

Participants were randomly assigned to one of the intervention groups (DAT or TWD). Gender and age were controlled in order to distribute the participants evenly in the two groups. No other variables were controlled. The dropout rate during the research was 10.41% (5 participants). The reasons for dropout were the following: two children due to illness, one child due to family problems, two children whose families lost interest in the research because they were not assigned to the dolphin therapy. The final distribution of participants was: 24 in the DAT (19 males and 5 females) group and 19 (14 males and 5 females) in the TWD group. The average age in months was 52.9 for the DAT group and 53.9 for the TWD group. The standard deviation was 10.4 and 6.4, respectively.

Design

We used a pretest–posttest design with a control group: the social and communication skills of the children in both groups, DAT and TWD, were evaluated before and after the therapeutic intervention. The TWD group acted as a control because it was identical to the DAT group in all respects, except in the use of the interaction with the dolphins as support for the activities.

Assessment Instruments

Three instruments were used to assess communicative and social skills: The Autism Diagnostic Observation Schedule-Generic (ADOS-G) (Lord et al., 2000), The Reynell Developmental Language Scales (RDLS: Reynell, 1977), and The Vineland Adaptive Behavior Scales-Second Edition (Vineland-II, Sparrow et al., 2005, 2008). These instruments have previously been used in the evaluation of interventions for the development of social and communication skills with variable durations (between 5 and 25 sessions and between 6 weeks and 6 months), with some of them using animals as a therapeutic

element (Ajzenman et al., 2013; Anderson & Meints, 2016; Borgi et al., 2016; Stevenson et al., 2015; Warreyn & Roeyers, 2014).

The ADOS-G (Lord et al., 2000) is used to evaluate people with suspected autism with a wide range of developmental problems. It is a semi-structured and standardized interview, in which the children are asked to interact with toys appropriate for their developmental level while their behavior is observed. The ADOS-G assesses four different domains: Restrictive Behavior, Repetitive Behavior, Social Interaction, and Communication. However, based on the objectives of the research, only the last two domains were used. In addition, it has four modules adapted to different levels of cognitive development, which allows the judgment about social skills and communication to be as independent as possible from the absolute level of language delay. The examiner decides which module to use to evaluate each individual, depending on the chronological age and level of expressive language: children without language or who use simple sentences (level 1); children who use flexible three-word phrases (level 2); children and young adolescents with fluent language (level 3); and adolescents and adults with fluent language (level 4). The expressive level of the majority of the participants (all of them, except two from the DAT group and two from the TWD group) corresponded to module one. The scale's interrater reliability values range from 0.82 to 0.93, and test–retest reliability ranges from 0.59 to 0.78 (Albores-Gallo et al., 2008).

The Reynell Developmental Language Scale (RDLS) (Reynell, 1977) provides both quantitative and qualitative information about comprehensive and expressive language. This scale can be administered to children aged 1–6 years. It contains two subscales that assess Verbal Comprehension and Expressive Language. On the one hand, the Verbal Comprehension subscale assesses the understanding of nouns, verbs, and prepositions, as well as the extent to which the child can follow simple and complex instructions. On the other hand, the Expressive Language subscale provides information about the areas of syntax, vocabulary, and content.

The Vineland Adaptive Behavior Scales-Second Edition (Vineland-II, Sparrow et al., 2005, 2008) assesses aspects of adaptive behavior from a social perspective from birth to 18 years old. It is completed through an interview with a caregiver and provides adaptive behavior scores in four dimensions. However, in the present study, only two dimensions were used: Communication and Socialization skills. Each item is scored using a Likert scale with three possible values: 2, 1, or 0. According to the authors, the instrument has high validity and reliability (split half means for the domains range from 0.83 to 0.9) (Sparrow et al., 2005).

Pre-assessments and post-assessments were carried out by raters who did not know whether the child was assigned to the control group or the experimental group. The initial assessment was conducted over a period of 2 weeks prior to the start of the intervention, and the final assessment was held during the 2 weeks that followed the intervention.

Location

The study was conducted in the dolphinarium of *L'Oceanogràfic* (Valencia, Spain). The areas used were an exclusive dressing room for participants to dress and undress, an

open space where out-of-water games were held (with a wooden panel that kept the children from seeing the pool area), and three pools. For the first contact with the aquatic environment, the adaptation phase, the medical dolphinarium pool was used. This is a circular pool measuring 10 m in diameter and 3.5 m deep, with a lifting platform that made it possible to work at different depths and allowed the children's gradual and easy entry into the water. It also had opaque doors to keep the children from seeing the animals that were in the adjoining pool. The sessions of the intervention phase for the TWD group also took place here, so that the children could not see the animals in the adjacent pools. For the DAT intervention sessions, pools 2C and 2B were used, both of which had an area of 15×15 m and were 11 m in depth. The interaction activities with the animal out of the water were carried out sitting on the edge of the pool, 5 cm from the surface of the water. The water in all the pools came from the sea, was treated, and had a temperature of 24°C.

Procedure

The 48 children, who participated in the study, were divided into three intervention shifts with 16 participants in each. Each intervention shift comprised a period of about 10 weeks, during which the three phases of the research were developed: initial assessment (2 weeks), intervention (6 weeks), and final assessment (2 weeks).

Initial Assessment Phase

The aim of the initial assessment was to establish the baseline for the participant's communication skills. Assessment tests were administered by neuropsychologists. All participants in both groups, TWD and DAT, were evaluated using the protocol described in the instrument section.

Intervention Phase

This phase consisted of three weekly sessions lasting 45 min each, with a total of 18 sessions per participant. Therapy sessions for both groups, DAT and TWD, were conducted by a dolphin trainer, along with the same professional team, in the same facilities, and under the same conditions, except for the use of the interaction with the dolphins as support for the activities. A health professional (an occupational therapist, a physiotherapist, or a psychologist) was involved in each session for both groups. The professional team took every opportunity to promote the child's communication during the session, taking advantage of the motivation generated by this unusual therapeutic context.

The first three sessions were designed to facilitate the adaptation of the children with ASD to the different elements of the therapeutic environment, such as wearing a wetsuit, the professional team, the different spaces, and the aquatic environment where the intervention program took place. The purpose of the adaptation phase was to obtain the best attitude from the child during the intervention phase, minimizing possible rejection due to fear or ignorance about these elements. The intervention consisted of 15 sessions structured as specified below.

DAT Group

10 min to put on their wetsuits and shoes; 5 min to tell the children how the session would evolve by using a panel of pictograms reminding them of the safety rules, and greeting the coach; 10 min to play in an open space, out of the pool, and with no dolphins in sight. The games were designed using different materials (i.e., colorful rings, balls, baskets, frisbees, and numbered diving sticks), so that the children had to use both expressive and comprehensive communication skills. In addition, the games required the children to ask for specific material, ask for help to make a circuit, ask and answer questions, and understand the instructions the professional gave. The therapist and the dolphin trainer played with the children, creating a highly motivational context. The sessions were designed and implemented in the same way for all the children, although individual characteristics were taken into account. In addition, in each session, the out-of-water games were different to avoid boredom or lack of motivation in participants. Subsequently, 5 min was set aside for feeding the dolphin and giving the initial greeting, and 10 min was spent sitting on the edge of the pool doing activities that involved interacting with the dolphins out of the water. Activities included: petting and naming different parts of the dolphin's body; asking the dolphins questions that could be answered with "yes" or "no"; giving instructions to them to carry out actions through gestures; asking them to bring rings and frisbees; simulating their medical treatment (the children had to name the components of the medical kit and ask the therapist for them); and asking the coach for fish and giving it to the dolphins, among others. Finally, the children spent 5 min in the water doing activities such as being pulled along by the dolphins or relaxing with them. While in the water, the children were always accompanied by the therapist and the dolphin trainer.

TWD Group

The structure was the same as in the DAT group sessions, except that the time, dedicated to interacting with the dolphins, was used to conduct recreational activities, interacting with the therapist and the dolphin trainer on the edge of the pool and in the water. These activities were similar to those done out of the pool, as described above, but adding the water component and the possibilities it offered. To end the session, these children also participated in a relaxing activity in the water.

In short, the objective in designing the activities was to match the activities done with the dolphins and the activities done without them as much as possible. This was achieved by analyzing the communicative and social demands required in each activity with the dolphins and proposing similarly demanding activities for the TWD. For example, in one of the activities, the dolphin gently pulled the child through the water, whereas in the TWD version, the therapist or dolphin trainer did this. In the latter, the child held on to the person's shoulders, and s/he moved the child through the water. Moreover, in the relaxation-focused activity, the child in the DAT group relaxed in the water, establishing contact with the dolphin's head, whereas the child in the TWD group performed the same relaxation exercise, but making contact with the hand of the professional who accompanied him/her instead. Another similar example can be found in the throwing activities. In the DAT group, the therapist asked the child to throw a ring or frisbee of a certain color to the dolphin. Then, the child had to ask the animal to go and get it, and bring it back. In the TWD group, this activity was done with the dolphin trainer (i.e., no

dolphins were involved). The trainer was in charge of picking up the object and bringing it back, following the child's instructions. Along the same lines, the rest of the activities of the DAT group that involved requesting things or asking questions of the animal were substituted in the TWD group by similar activities, where requests or questions were directed to the dolphin trainer or therapist. This was done in order to maintain the same level of communicative demand in both groups. Table 1 shows the structure of the intervention sessions: the distribution of time in each session and a description of the activities carried out in the two groups.

Data Analysis

Several tests were conducted to verify compliance with the assumptions of the analysis of variance parametric test: the Levene variance homogeneity test for each dependent variable in all level combinations of between-subject factors, the Box M test of homogeneity

Table 1. Structure of intervention sessions.

DAT	Time	TWD	Time
Put on their wetsuits and shoes.	10 min	Put on their wetsuits and shoes.	10 min
Introduce the session structure to the child and remind him/her of safety rules. Greeting the dolphin trainer.	5 min	Introduce the session structure to the child and remind him/her of safety rules. Greeting the dolphin trainer.	5 min
Play in an Open Space (activities require the child to communicate. The material used consisted of colorful hoops, balls, baskets, Frisbees, and numbered diving sticks): – Make circuits – Asking and answering to get objects – Running, jumping, and understanding instructions to get objects – Throwing objects by teams – …	10 min	Play in an Open Space (activities require the child to communicate. The material used consisted of colorful hoops, balls, baskets, Frisbees, and numbered diving sticks): – Make circuits – Asking and answering to get objects – Running, jumping, and understanding instructions to get objects – Throwing objects by teams – …	15 min
Feed the dolphin and make the initial greeting.	5 min		
Activities on the edge of the pool with the dolphin: – Petting and naming different parts of the dolphin's body – Asking the dolphin questions that it answers with "yes" or "no" (with body and head movements) – Play veterinarian and simulate wound healing – Throw Frisbees and hoops and ask the dolphin to bring them back – Ask the dolphin, through gestures, to perform different behaviors (dance, sing, jump, etc.)	10 min	Activities on the edge of the pool with the therapist and the dolphin trainer: – Asking the dolphin trainer or therapist or child questions related to the game (choose color hoop, throw it near or far, etc) – Throw Frisbees and hoops and ask the dolphin trainer or the therapist to bring them back – Ask the dolphin trainer or therapist, through gestures or vocalizations, to perform different behaviors in the water (jump, dive, throw the water, etc.)	5 min
Activities in the water with the dolphin (and therapist and dolphin trainer): – Pulled through the water by the dolphin – Relaxing in the water with the dolphin	5 min	Activities in the water with the therapist and the dolphin trainer: – Game to mimic movements in the water – Play water races – Pulled through the water by the dolphin trainer or therapist – Relaxing in the water with the therapist and the dolphin trainer	10 min
	45 min		45 min

DAT, dolphin-assisted therapy; TWD, therapy without dolphins.

of the covariance matrices of the dependent variables throughout all the combinations of levels of the between-subject factors, and Shapiro–Wilk's normality test for each dependent variable in all level combinations for both factors. Both the Levene test and the Box M test were nonsignificant for all of the dependent variables ($p > 0.05$), and compliance with the assumptions was assumed in all cases. However, for all the dependent variables, the normality assumption was not met in some of the populations.

To find out if there were significant differences between the pre-intervention scores of the two groups, DAT and TWD, we calculated the Mann–Whitney *U*-test for each dependent variable. We also calculated several Mann–Whitney *U*-tests to see if there were differences between the pre-intervention scores of males and females.

Because the assumption of normality was not met in some of the populations, we calculated the Wilcoxon test for the main effects of the repeated-measures factor "Time," which should provide greater statistical sensitivity.

Due to the absence of nonparametric procedures to analyze the interaction effect in the usual statistical packages, we used a nonparametric method, the Aligned Rank Transform (ART), described by Wobbrock et al. (2011). According to the authors, the ART is much more powerful than parametric tests when certain assumptions, underlying the use of these tests, are violated. Furthermore, it can be applied to within-subject, between-subject, or mixed experimental designs, and it is based on regular *F* distribution tables. Following this method, after transforming the adjusted raw data to ranks, a factorial ANOVA was carried out to test the interaction. Specifically, we had a between-subjects factor, "Type of Therapy," with two levels: DAT and TWD, and a repeated-measures factor, "Time," with two levels: pre-intervention assessment and post-intervention assessment. Regarding the assumption of sphericity of the variance–covariance matrix for the ANOVA of repeated measures, the corrected and uncorrected results were the same in all cases.

Results

The results of the Mann–Whitney *U*-test showed that the pre-intervention scores on all the dependent variables were homogeneous for the DAT and TWD groups, as well as for boys and girls ($p > 0.05$ in all cases).

The Autism Diagnostic Observation Schedule-Generic

As mentioned above, we used the language and communication domain and the social interaction domain. Because the expressive level of the majority of the participants corresponded to module one, data from the four participants, who had an expressive level corresponding to modules two or three, were eliminated from these analyses.

Language and Communication Domain, ADOS-G

Table 2 shows the descriptive statistics for each of the four study conditions. For all conditions, there was a decrease in the post-intervention phase average score compared with the pre-intervention phase, which indicates improved communication skills because it is a measure of communication alterations.

Table 2. Descriptive statistics for the Autism Diagnostic Observation Schedule-Generic.

		Pre-intervention		Post-intervention	
Measure	*n*	*M*	SD	*M*	SD
Language and communication domain (possible scores: 0–28)					
DAT	22	5.87	2.39	4.73	2.25
TWD	17	5.12	1.40	4.53	1.33
Item "Frequency of vocalizations" (possible scores: 0–2)					
DAT	22	1.39	0.72	1.18	0.59
TWD	17	1.53	0.62	1.53	0.62
Item "Gestures" (possible scores: 0–2)					
DAT	22	1.45	0.67	1.14	0.64
TWD	17	1.29	0.69	1.35	0.70
Social Interaction Domain (possible scores: 0–28)					
DAT	22	9.14	3.03	8.82	3.18
TWD	17	10.12	3.35	9.94	4.12

DAT, dolphin-assisted therapy; TWD, therapy without dolphins.

In both groups, participants' scores in the communicative dimension improved significantly from pre- to posttest ($Z = -3.86$, $p < 0.001$). However, the interaction between "Time" and "Type of Therapy" was not significant ($F < 1$), which means that the benefits of both intervention modalities, DAT and TWD, were similar. At the item level, the results showed that for the item "frequency of the vocalizations directed towards others," both the "Time" factor ($Z = -2.24$, $p < 0.05$), and its interaction with the "Type of Therapy" ($F_{(1,37)} = 4.47$, $\eta^2 = 0.11$, $p < 0.05$), were significant. Following Cohen's (1988) guidelines for interpreting eta squared in terms of r squared, this represents a medium effect size. In this case, the intervention only produced improvements in the DAT group. The interaction between "Time" and "Therapy Type" was also significant for the "Gestures" item scores ($F_{(1,37)} = 4.54$, $\eta^2 = 0.11$, $p < 0.05$); however, this was not the case for the main effect of "Time" ($Z = -1.6$, $p > 0.05$). Again, the intervention was only effective for the DAT group, and eta squared represents a medium effect size. As Table 2 shows, the mean score for "frequency of vocalizations directed towards others" and "gestures" in the DAT group decreased between the pretest and posttest, which actually means that the children vocalized more and used more gestures on the posttest. When looking at the rest of the scale items, no significant effect was obtained for the "Time" × "Type of Therapy" interaction.

Social Interaction Domain

Neither the within-subjects factor "Time" ($Z = -1.1$, $p > 0.05$) nor the interaction between "Time" and "Type of Therapy" ($F < 1$), was significant, meaning that there was no significant change in the social interaction skills as a result of either intervention. At the item level, no significant effects were obtained.

The Reynell Developmental Language Scales

The two subscales from The Reynell Developmental Language Scales (RDLS; Reynell, 1977) were used to assess Verbal Comprehension and Expressive Language.

Table 3. Descriptive statistics for the Reynell Developmental Language Scales.

		Pre-intervention		Post-intervention	
Measure	*n*	*M*	SD	*M*	SD
Comprehension Scale (Possible scores: 0–62)					
DAT	24	24.04	15.63	28.38	15.16
TWD	19	18.52	18.72	23.00	19.68
Expression Scale (Possible scores: 0–62)					
DAT	24	12.00	9.43	13.58	9.55
TWD	19	10.84	10.63	13.58	13.15

DAT, dolphin-assisted therapy; TWD, therapy without dolphins.

Comprehension Scale, Reynell

There was an improvement in comprehension skills in both groups because the main effect of the "Time" factor was statistically significant ($Z = -4.24$, $p < 0.001$). Descriptive statistics for each of the study conditions are presented in Table 3. As for the interaction between "Time" and "Type of Therapy," again, it was not statistically significant ($F < 1$), which means that the benefits obtained with both types of therapy were similar. At the item level, no significant effect was obtained for the "Time" × "Type of Therapy" interaction.

Expression Scale, Reynell

As a result of the intervention, in both groups, the participants' expression skills improved significantly ($Z = -3.39$, $p < 0.001$). The "Time" × "Type of Therapy" interaction was not significant ($F < 1$). Table 3 shows that the increase in the average scores from the pre- to post-intervention assessment was similar for both groups. At the item level, no significant effect was obtained for the "Time" × "Type of Therapy" interaction.

The Vineland Adaptive Behavior Scales (Vineland-II)

Taking into account the study objectives, we decided to use only two of the scales: the Communication Scale and the Socialization Scale.

Communication Scale, VSMS

The descriptive statistics for each condition can be seen in Table 4. The mean scores show that both types of therapy resulted in improved communication skills in the participants. The "Time" factor was significant ($Z = -2.8$, $p < 0.01$). However, the "Time" × "Type of

Table 4. Descriptive statistics for the Vineland Adaptive Behavior Scales.

		Pre-intervention		Post-intervention	
Measure	*n*	*M*	SD	*M*	SD
Communication Scale (Possible scores: 0–198)					
DAT	24	76.88	25.99	80.42	25.87
TWD	19	78.05	25.87	81.05	29.9
Socialization Scale (Possible scores: 0–198)					
DAT	24	64.83	16.27	70.21	16.07
TWD	19	70.11	12.93	73.74	16.06

DAT, dolphin-assisted therapy; TWD, therapy without dolphins.

Therapy" interaction was not significant ($F < 1$), which leads us to conclude that both intervention modalities (DAT and TWD) were equally effective. At the item level, no significant effect was obtained for the "Time" × "Type of Therapy" interaction.

Socialization Scale, VSMS

Regarding social skills, the effects of the two types of therapy, DAT and TWD, were positive (Table 4). The "Time" factor was statistically significant ($Z = -2.74$, $p < 0.01$). However, the "Time" × "Type of Therapy" interaction was not significant ($F < 1$), showing that both intervention modalities (DAT and TWD) were equally effective. At the item level, no significant effect was obtained for the "Time" × "Type of Therapy" interaction.

Discussion

The aim of the present study was to rigorously test the effectiveness of DAT for improving one of the most affected areas in children with ASD, namely, social and communicative skills. Due to the proliferation of clinical interventions in recent decades, it is necessary to establish selection criteria based not only on clinical judgment, but also on the evidence provided by empirical research. Nonetheless, the integration of empirical evidence in professional practice has not been fully consolidated (Herbert, 2003).

For the purposes of this research, we used a pretest–posttest design with a control group. As previously described, participants were randomly assigned to the DAT and TWD groups, which both had therapy sessions conducted under the same conditions, except for the use of interaction with a dolphin as support for the activities in the DAT group. The procedures were always carried out ensuring the welfare of the animals, which did not suffer stress or pain.

Regarding communication, significant improvements were observed in the communicative skills of all the participants between pre-assessment and post-assessment. These improvements were observed on all the assessment instruments: The Language and Communication Domain of the ADOS-G, the Comprehension Scale and the Expression Scale of the Reynell Developmental Language Scales, and the Communication Scale of the Vineland-II. Moreover, on these overall scores, the changes were equivalent for both groups, which means that no significant advantages were found for one group over the other. These two types of therapy have common elements that would reasonably increase children's motivation to participate in activities, compared with more conventional therapies: the intervention methodology adapted to children with ASD through visual anticipation, the aquatic and outdoor environment, the playful activities, and the novelty brought to the participants' daily routine. Although we assumed that the interaction with the dolphin would increase the participants' motivation and involvement in the activities even more, this did not lead to better results on the overall scale scores for the DAT group.

As for social interaction skills, disparate results were obtained, with significant improvements on the Socialization Scale of the Vineland-II, but not on the Social Interaction Domain of the ADOS-G. This could be explained by the characteristics of the instruments and the type of information they collect. The Socialization Scale of the Vineland-II is more sensitive to developmental changes than the Social Interaction Domain of the ADOS-G, which is basically a diagnostic tool used in formal evaluation environments. By contrast,

with the Socialization Scale of the Vineland-II, the family members observe the children in their daily functioning in natural environments, where there are more opportunities to check whether their interaction skills with others have improved. It is reasonable to assume that until communication skills are consolidated, their evolution may not be noticeable on all the measures.

In a more detailed analysis of the item scores, some significant effects, related to the interaction with the animal, were found. Specifically, we found differences between groups in the scores of two communication-related aspects of the ADOS scale: "frequency of vocalizations toward others" and "gestures." These results can be explained by analyzing the nature of the activity with the dolphins, which involved addressing them through vocalizations and gestural commands to ask them to perform different actions (e.g., they had to clap to ask the dolphins to dance). However, in the TWD group, although all the activities were aimed at developing communication, the participants did not always have to use gestures, except for those participants without oral language who used gestures as their common way to communicate. Moreover, the communicative context of the DAT is richer than that of the TWD because it includes one more element that participants could interact with the dolphin. In addition, the time spent interacting with the animal in each session was primarily used to give it instructions and ask the dolphin trainer or therapist for different objects (fish, toys, and several elements for the animal's care, such as gauze pads or cream). All of these mean that, in the DAT context, the communication aspects related to expression were more relevant, compared with the TWD, which could explain the differences between the two groups in the frequency of vocalizations toward others.

Limitations

Although improvements between pre-assessment and post-assessment were found in both groups that can be reasonably attributed to the intervention, and evidence has been found that DAT can enhance the improvement of some communication-related aspects, new lines of research have to be developed to further explore the potential applications of this type of intervention. Psychological interventions have to be shown to be not only effective, but also efficient. Scientific controls must be used to determine whether their application is more effective than doing nothing or using another type of therapy that is shorter, less expensive, or requires fewer resources. However, the only way to prove that these changes are due to the intervention, and not to mere maturation, would be to have a control group that does not receive any intervention, which is not ethically possible. Instead, it would be desirable to carry out a new experiment using a traditional therapy as a control group, in order to test the efficiency of this kind of therapy. Likewise, new research is needed to compare the benefits of DAT versus therapies assisted by domestic animals. This is important if we consider the difficulty of accessing DAT and the existing limitations to the incorporation of wild and exotic animals into AAI programs posed by the IAHAIO (2018) on ethical and animal welfare grounds. Nor should we forget that DAT is an expensive therapy. Although participation in the DAT and TWD sessions of our research was free for families, it is clear that maintaining the infrastructures, animals, and professionals involved in this type of therapy has a high economic cost. In future

research, we plan to study the effectiveness of AAI compared with more conventional therapies and assess how motivation and biophilia (human interest in the interaction with other living species) can influence the success of animal-assisted therapy. For this purpose, it would be useful to include these variables as potential mediators of the success of AAI and, thus, determine for what types of profiles (children with ASD and their families) this type of intervention is more effective.

Furthermore, a limitation of this study was the difficulty of identifying subtle changes in specific aspects of social and communication skills after a brief intervention because the tools usually employed for diagnostic purposes use developmental milestones. Future studies should narrow the target skill focus (e.g., use of communicative gestures) and use instruments that are more sensitive to short-term changes. After a first approach using standardized measurement instruments, observation tools could be designed *ad hoc* for these purposes.

Finally, another limitation of this study is that it did not examine whether the benefits of the intervention continued after the intervention ended. More research is needed to determine how long the intervention should last to achieve long-term effects.

Conclusion

The main contribution of this work is that it rigorously analyzes the effectiveness of a specific element, interaction with dolphins, which is often used without adequate scientific support for intervention in ASD. For this purpose, we experimentally compared DAT with TWD. The results showed improvements in social and communicative skills in both groups, with an advantage of the DAT group in some very specific aspects (i.e., "frequency of vocalizations toward others" and "gestures").

Acknowledgements

This project was made possible by the children and families who participated in it, and by all the professionals who were involved in an altruistic and totally supportive way. We thank the collaborating entities for their logistical support and for providing infrastructure and human resources: Ciudad de las Artes y las Ciencias, S.A. (Oceanogràfic), Parques Reunidos Valencia, S.A, Red Cenit, IVASS, INVANEP, Psicotrade, and Universidad Católica de Valencia.

Disclosure Statement

The authors declare that they have no conflicts of interest.

References

Ajzenman, H. F., Standeven, J. W., & Shurtleff, T. L. (2013). Effect of hippotherapy on motor control, adaptive behaviors, and participation in children with autism spectrum disorder: A pilot study. *American Journal of Occupational Therapy*, *67*(6), 653–663. https://doi.org/10.5014/ajot.2013.008383

Albores-Gallo, L., Hernández-Guzmán, L., Díaz-Pichardo, J. A., & Cortes-Hernández, B. (2008). Dificultades en la evaluación y diagnóstico del autismo: Una discusión. *Salud Mental*, *31*(1), 37–44.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing.

Anderson, S., & Meints, K. (2016). Brief report: The effects of equine-assisted activities on the social functioning in children and adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *46*(10), 3344–3352. https://doi.org/10.1007/s10803-016-2869-3

Birch, S. (1998). *Dolphin–human interaction effects: Frequency mediated psychophysiological responses in biological systems* (Doctoral dissertation). Monash University, Victoria, Australia. Available online at: https://monash.hosted.exlibrisgroup.com/primo-explore/fulldisplay?vid=MONUI&docid=catau21161569500001751&context=L&search_scope=au_everything

Borgi, M., Loliva, D., Cerino, S., Chiarotti, F., Venerosi, A., Bramini, M., Nonnis, E., Marcelli, M., Vinti, C., De Santis, C., Bisacco, F., Fagerlie, M., Frascarelli, M., & Cirulli, F. (2016). Effectiveness of a standardized equine-assisted therapy program for children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *46*(1), 1–9. https://doi.org/10.1007/s10803-015-2530-6

Breitenbach, E., Stumpf, E., Fersen, L. V., & Ebert, H. V. (2009). Dolphin-assisted therapy: Changes in interaction and communication between children with severe disabilities and their caregivers. *Anthrozoös*, *22*(3), 277–289. https://doi.org/10.2752/175303709X457612

Brensing, K., Linke, K., & Todt, D. (2003). Can dolphins heal by ultrasound? *Journal of Theoretical Biology*, *225*(1), 99–105. https://doi.org/10.1016/S0022-5193(03)00225-X

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Erlbaum.

Dilts, R. M. (2008). *A summative evaluation of a dolphin assisted therapy program for children with special needs* (Doctoral dissertation). Oregon State University, Corvallis, OR, USA. Available online at: https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/pn89db316?locale=en

Fiksdal, B. L., Houlihan, D., & Barnes, A. C. (2012). Dolphin-assisted therapy: Claims versus evidence. *Autism Research and Treatment*, *2012*, 1–7. https://doi.org/10.1155/2012/839792

Herbert, J. D. (2003). The science and practice of empirically supported treatments. *Behavior Modification*, *27*(3), 412–430. https://doi.org/10.1177/0145445503027003008

Herzog, H. (2010). *Some we love, some we hate, some we eat: Why it's so hard to think straight about animals*. Harper.

Humphries, T. L. (2003). Effectiveness of dolphin-assisted therapy as a behavioral intervention for young children with disabilities. *Bridges*, *1*(6), 1–9.

International Association of Human–Animal Interaction Organizations. (2018). *The IAHAIO definitions for animal assisted intervention and guidelines for wellness of animals involved in AAI*. http://iahaio.org/wp/wp-content/uploads/2018/04/iahaio_wp_updated-2018-final.pdf.

Kazdin, A. E. (2010). Methodological standards and strategies for establishing the evidence base of animal-assisted therapies. In A. H. Fine (Ed.), *Handbook on animal-assisted therapy: Theoretical foundations and guidelines for practice* (pp. 519–546). Elsevier Academic Press.

Koegel, L. K., Singh, A. K., & Koegel, R. L. (2010). Improving motivation for academics in children with autism. *Journal of Autism and Developmental Disorders*, *40*(9), 1057–1066. https://doi.org/10.1007/s10803-010-0962-6

Kohn, N., & Oerter, R. (2013). Dolphin assisted therapy works: Scientific findings from Eilat and Florida. *International Journal of Clinical Psychiatry*, *1*(1), 1–16. https://doi.org/10.5923/j.ijcp.20130101.01

Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Leventhal, B. L., DiLavore, P. C., & Rutter, M. (2000). The autism diagnostic observation schedule – generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*, *30*(3), 205–223. https://doi.org/10.1023/A:1005592401947

Marino, L., & Lilienfeld, S. O. (2007). Dolphin-assisted therapy: More flawed data and more flawed conclusions. *Anthrozoös*, *20*(3), 239–249. https://doi.org/10.2752/089279307X224782

May, D. K., Seivert, N. P., Cano, A., Casey, R. J., & Johnson, A. (2016). Animal-assisted therapy for youth: A systematic methodological critique. *Human–Animal Interaction Bulletin*, *4*(1), 1–18.

McKinney, A., Dustin, D., & Wolff, R. (2001). The promise of dolphin-assisted therapy. *Parks & Recreation*, *36*(5), 46–50.

Morrison, M. L. (2007). Health benefits of animal-assisted interventions. *Complementary Health Practice Review*, *12*(1), 51–62. https://doi.org/doi:10.1177/1533210107302397

Nathanson, D. E., de Castro, D., Friend, H., & McMahon, M. (1997). Effectiveness of short-term dolphin-assisted therapy for children with severe disabilities. *Anthrozoös*, *10*(2–3), 90–100. https://doi.org/10.2752/089279397787001166

O'Haire, M. E. (2013). Animal-assisted intervention for autism spectrum disorder: A systematic literature review. *Journal of Autism and Developmental Disorders*, *43*(7), 1606–1622. https://doi.org/10.1007/s10803-012-1707-5

O'Haire, M. E. (2017). Research on animal-assisted intervention and autism spectrum disorder, 2012–2015. *Applied Developmental Science*, *21*(3), 200–216. https://doi.org/10.1080/10888691.2016.1243988

Reynell, J. K. (1977). *Reynell developmental language scales*. NFER-Nelson.

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2005). *Vineland adaptive behavior scales: Second Edition (Vineland II), Survey interview form/caregiver rating form*. Pearson Assessments.

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2008). *Vineland adaptive behavior scales: Second edition (Vineland II), The expanded interview form*. Pearson Assessments.

Srinivasan, S. M., Cavagnino, D. T., & Bhat, A. N. (2018). Effects of equine therapy on individuals with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, *5*(2), 156–175. https://doi.org/10.1007/s40489-018-0130-z

Stevenson, K., Jarred, S., Hinchcliffe, V., & Roberts, K. (2015). Can a dog be used as a motivator to develop social interaction and engagement with teachers for students with autism? *Support for Learning*, *30*(4), 341–363. https://doi.org/10.1111/1467-9604.12105

Umbarger, G. (2007). State of the evidence regarding complimentary and alternative medical treatments for autism spectrum disorders. *Education and Training in Developmental Disabilities*, *42*(4), 437–447.

Warreyn, P., & Roeyers, H. (2014). See what I see, do as I do: Promoting joint attention and imitation in preschoolers with autism spectrum disorder. *Autism*, *18*(6), 658–671. https://doi.org/10.1177/1362361313493834

Wobbrock, J. O., Findlater, L., Gergle, D., & Higgins, J. J. (2011, 7–12 May). The aligned rank transform for nonparametric factorial analyses using only ANOVA procedures. *Proceedings of The SIGCHI Conference on human factors in Computing Systems* (pp. 143–146), ACM Press.