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Equine-Assisted Activities (EAAs) for Children with Autism Spectrum Disorder (ASD): Positive Effects Revealed Using an Ethological Approach

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Abstract: Equine-assisted activities (EAAs) are considered a suitable innovative rehabilitative practice for children with neurodevelopmental disorders, including autism spectrum disorder (ASD). While standardized scales have been previously used as a tool to evaluate the effects of EAAs on different domains of functioning in ASD children, few studies have considered an ethological approach as a means to describe human–horse interactions in the context of ASD. In this study, we aimed to evaluate the behavior of 19 children with ASD, in comparison with 19 typically developing children (TD), during EAA sessions. We developed an ethogram from the video recordings to assess spatial relationships, social interactions, and communicative behaviors displayed by the child toward the horse, as well as the occurrence of problem behaviors. Results indicate that children's behaviors during EAA sessions are modulated by sex and age, while previous children's experience with EAAs appeared to improve interpersonal distance and horse handling. Results from this study highlight the importance of exploring children's behavioral responses during animal-assisted activities through direct measurements. This may allow linking the quality/strength of the child–horse relationship to the benefits obtained by the child, particularly in the social/communicative domain, a core symptom of ASD.

Keywords: equine-assisted activities; autism spectrum disorder; ethogram; social interactions; communicative behaviors; problem behaviors

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1. Introduction

Research reporting relevant effects of human–animal interaction on human health is rapidly growing [1]. Animal-assisted activities with horses, also known as equine-assisted activities (EAAs), include mounted riding activities or ground activities such as grooming and stable management. EAAs represent complementary approaches that have been shown to exert positive effects on social, emotional, and physical domains for persons with physical or mental disabilities [2–4]. It has been recently hypothesized that, owing to their particular communicative skills, horses may react to human emotional states by modifying their own behavior (emotional transfer mechanism). Such an emotional tuning may depend upon the synchronization of physiological activities, such as cardiovascular, hormonal, or behavioral function, forming the basis for the positive effects of EAAs on human health [5–7].

In addition to the emotional relationship that is established with the rider, the horse stimulates the rider's body simulating human gait, thus improving flexibility, balance, and muscle strength, providing important motor stimulation. The positive effects of motor

stimulation, together with recreational opportunities for individuals that enjoy the activity outdoors, make EAAs especially suitable to improve patients' overall quality of life [8].

Having the potential to stimulate multiple areas of functioning, EAAs have been considered a suitable innovative rehabilitative practice for children with neurodevelopmental disorders [9]. Autism spectrum disorders (ASDs) represent a heterogeneous group of neurodevelopmental disorders characterized by impairment in social communication and social interaction (e.g., deficits in social–emotional reciprocity; deficits in non-verbal communicative behaviors; deficits in developing, maintaining, and understanding relationships), repetitive and unusual sensory-motor behaviors (e.g., stereotyped or repetitive motor movements, hyperreactivity, or hyporeactivity to sensor input) [10]. The multifactorial nature of ASD necessitates a multi-faceted therapeutic approach, and EAAs may complement other interventions that children with ASD are exposed to, including educational/behavioral therapies and pharmacotherapy [8,11].

Social deficits represent the core impairment in individuals with autism, and the inclusion of an animal as a complementary approach for children with ASD is motivated by the fact that an animal may act as a social facilitator, improving children's social skills [12,13]. Reported positive outcomes of EAAs for the ASD population include effects on mood [14], reduction in problem behaviors such as irritability, lethargy, stereotypy, hyperactivity [15], aggressiveness [16], improved physical, emotional and social functioning [4,9,13,17–24], improved executive functioning [9] and improved postural stability [25].

The evaluation of the effects of EAAs on ASD children's behavior has so far relied on surveys and scales, mostly filled by parents and/or therapists before and after the EAA sessions [2,4,9,13–15,21,22,26]. Direct behavioral observation using an ethogram obtained from the video recordings is considered more objective than surveys and scales, but so far, few studies have used an ethological approach to assess human–horse interactions in children with ASD [27–33].

In this study, we aimed to evaluate the behavior of 19 children with ASD, in comparison with 19 typically developing children (TD), during EAA sessions and to explore the effect of other child-related factors, namely sex, age, and experience with the horse. To this aim, we developed a specific ethogram to collect information on children's communicative/relational style during EAA sessions, as well as any occurrence of problem behaviors shown by children.

2. Materials and Methods

2.1. Ethical Statement

The methods and procedures of this study were in accordance with Italian legislation (D.L.vo n. 26 of 4 March 2014) on the protection of animals used for scientific purposes (authorization n°1055/2015-PR). Owners of horses provided written consent to the enrolment of their animals in the study. Moreover, parents of participants signed informed written consent for the involvement of their children in riding sessions, and all data about their children were processed in compliance with privacy and data protection law. The research protocol was approved by the Ethics Committees of the Istituto Zooprofilattico Sperimentale delle Venezie (EC protocol number 6/2014) and the Istituto Superiore di Sanità (Prot. PRE-790/15).

2.2. Participants

2.2.1. Children

A total sample of 38 children (12 females and 26 males) was selected for the study (see Table 1 for children's characteristics). Of 38 children, 19 had a previous diagnosis of ASD (4 females and 15 males), and 19 served as a control group (TD children; 8 females and 11 males). All children were aged between 5 and 17 years old. Children with ASD were characterized by IQ scores ranging from 60 to 80 according to the Wechsler Intelligence Scale for Children test (WISC III test), a psychometric test exploring different dimensions of intelligence [34].

Children were selected among those who attended the riding centers participating in the study, and they were divided into two groups according to their experience in EAAs: (i) less than 1 month of experience (*n* ASD = 9; *n* TD = 7); (ii) more than 1 month of experience in EAAs (*n* ASD = 10; *n* TD = 12). The exclusion criteria were animal allergy symptoms and/or fear of children for horses.

2.2.2. Horses

A total of 19 horses were selected for the current study. They were all between 8 and 26 years old; 13 horses were geldings, and 6 were mares. They were of different breeds, were recruited from 4 Italian riding centers, and no foals were chosen. All horses were specially trained for EAAs with an average of 5 years of experience in EAAs (Supplementary Materials Table S1). The horses were of medium size, in a suitable state of health, and suitable for morphology, biomechanics, and behavior. The horse's health was guaranteed by a veterinarian specialized in equestrian rehabilitation for the entire duration of the study, taking into account health care, living conditions, work schedules, and equipment requirements.

Table 1. Characteristics of participants (*n* = 38).

Riding Center	Child Number	Diagnosis	Sex	Age (Years)	EAA Experience (Months)
Center 1	1	TD	M	17	>1
	2	TD	M	11	>1
	3	TD	M	8	>1
	4	TD	M	6	>1
	5	ASD	M	13	>1
	6	ASD	M	8	>1
	7	ASD	M	9	>1
	8	ASD	M	6	≤1
Center 2	9	TD	F	9	>1
	10	TD	M	8	>1
	11	TD	M	9	>1
	12	TD	M	9	>1
	13	ASD	F	8	>1
	14	ASD	F	11	>1
	15	ASD	M	na	>1
	16	ASD	M	8	>1
Center 3	17	TD	F	7	≤1
	18	TD	F	10	>1
	19	TD	F	9	>1
	20	TD	F	7	>1
	21	TD	F	9	>1
	22	TD	F	7	≤1
	23	ASD	F	10	>1
	24	ASD	M	7	≤1
	25	ASD	M	6	≤1
	26	ASD	M	10	≤1
	27	ASD	M	17	>1
	28	ASD	M	11	>1
Center 4	29	TD	F	6	≤1
	30	TD	M	9	≤1
	31	TD	M	6	≤1
	32	TD	M	na	≤1
	33	TD	M	10	≤1
	34	ASD	F	7	≤1
	35	ASD	M	8	≤1
	36	ASD	M	5	≤1
	37	ASD	M	6	≤1
	38	ASD	M	na	≤1

Abbreviations. TD, typically developing; ASDs, autism spectrum disorders; EAAs, equine-assisted activities; na, not available.

2.3. Procedures

2.3.1. Settings

The EAA sessions occurred at four certified riding centers: (a) Centro di Riabilitazione Equestre "Vittorio di Capua", Azienda Ospedaliera Niguarda Ca'Granda, Milano; (b) Il Grande Ranch, San Francesco al Campo, Torino; (c) Centro Ippico Meisino, Torino; and (d) A.S.D Equitazione per tutti Onlus, Fiumicino.

The riding instructors were different in the different centers. Thus, in order to harmonize and standardize all procedures, we included only riding centers with the same working standard and approach, as well as high standards for the welfare/health of animals employed. Moreover, all the riding instructors have followed the same training program according to the Italian National Guidelines for Animal-Assisted Interventions [35].

In order to further guarantee that the therapeutic sessions were homogenously delivered, before the beginning of the study, all riding instructors attended preliminary meetings with the researchers and were provided with both written and video materials (a DVD appositely prepared) describing the session to be delivered. The therapeutic setting included the patient, the horse, a certified horse handler, and a therapist; the same team was involved in all sessions according to the Italian National Guidelines for Animal-Assisted Interventions [35]. The settings included fences, stalls, arenas, halters, ropes, bridles, and hitching areas, all designed to contain horses and manage their behavior.

2.3.2. EAA Sessions

Therapeutic sessions with horses were carried out in the riding centers during the winter season (November 2015–January 2016). All sessions were carried out between 2:00 pm and 4:00 pm, and they were conducted by means of a standardized procedure adapted from Borgi and colleagues [9]. The session duration was about 30 min and followed the protocol described in Table 2. Each horse was involved in two EAA sessions: one day with a child with ASD and the day after with a TD child (the order of sessions was counterbalanced among horses).

Table 2. Session description (phases, duration, and activities performed).

Phase	Time (min)	Activities
Grooming	5′	Child's knowledge of the horse (morphology, behavior); first contact; main security rules; grooming techniques and saddling.
Horse at hand	5′	The child leads the horse with a lead rope around the arena.
Mounting	-	The horse stops, and the child mounts the horse.
Riding exercises	10′	Learning riding basic elements (walk); performing exercises while riding the horse at a walk (rotating/bending, outstretching upper arms and trunk).
Stationary exercises/Games	5′	Performing exercises on the horse (horse halted); games such as rods, cones, or balls are used.
Dismounting	-	The child dismounts.
Reward	5′	The child rewards the horse with something to eat (e.g., carrot, sugar, hay) and greets him.

2.4. Behavioral Analysis

2.4.1. Data Collection

All sessions were filmed with Sony cameras (Handycam DCR-SX21E, Weybridge, Surrey, UK). Behavioral analysis was performed using a focal sampling method (Altmann, 1974) and dedicated software (BORIS) (Friard and Gamba, 2016).

2.4.2. Children's Behaviors during EAAs

Videos of the sessions were subsequently scored to record children's behaviors during therapeutic sessions. An ethogram was developed to assess children's spatial relationships with the horse, social and communicative behaviors with the horse, as well as children's

problem behaviors during the EAA sessions. Relevant literature was reviewed, taking into account both studies on human–animal interaction [27,28,36–38] and on behavior of children with ASD [39]. The complete ethogram is shown in Table 3. Recorded behaviors include: spatial relationship (Table 3a), social interactions and communicative behaviors displayed by the child toward the horse (Table 3b), and problem behaviors (Table 3c). The behaviors of children were categorized as state events or point events; a state event describes behaviors that have a duration, while a point event represents behaviors that are too fast to be noted as a state event (they do not have duration) [40]. Duration and frequency of behaviors were expressed, respectively, as minutes spent performing the behavior and as the number of occurrences of that behavior out of the total time observed (in minutes). The total time observed was computed, taking into consideration the time intervals in which the child was out of the field of view of the camera.

Table 3. List of child's behaviors scored during the EAA sessions (ethogram).

Behavior	Description	Mode
(a) Spatial relationship (interpersonal distance)		
Closeness	The child stays at a short distance from the horse (≤contact distance).	State
Withdrawal Avoidance	The child walks away from the horse (to be categorized as 'Withdrawal', it must end 'Closeness') or refuses to interact with the horse when solicited by turning the whole body around its axis (or turning the face away) more than 90°.	Point
(b) Social interactions and communicative behaviors		
Grooming	The child brushes/cleans the coat of the horse (with tools).	State
Physical contact	The child establishes positive physical contact with the horse (not work-related), e.g., petting, stroking the horse (without suitable equipment), lying down on the horse, kissing the horse, head contact with the horse's head, neck, back, or rump.	State
Visual contact	The child looks, i.e., directs her/his gaze (looks at, turns the head) toward the head/eyes of the horse or extends the hand/arm in the horse's direction (not touching), e.g., to allow the horse to sniff the hand.	Point
Emotional behaviors	The child changes facial expression by turning up the corners of the mouth/spreading the lips and the mouth is closed or slightly open (smile) or smiling while making sounds with voice (laugh) (child's face is turned toward the horse).	Point
(c) Problem behaviors		
Distraction	The child is not interested in the session (e.g., looking around, interested in objects, etc.).	Point
Motor stereotypy	The child displays repetitive, relatively invariable sequences of behavior with no obvious function, including: rock (rhythmic up and down movements, either in a lateral or dorsal–ventral way); flapping (stereotyped hand flapping); jump (abruptly raises body with or without feet leaving the floor; does not include skipping, galloping or dancing); tiptoe (the child walks on toes); clap (claps hands repetitively out of context); finger (moves fingers in a flicking motion, often near the head); spin (rotating the body around own axis repetitively and out of context); head spin (rotates the head around own axis repetitively and out of context); nod (moves the head up and down several times); shake (rotates head from side to side several times).	Point
Other problem behaviors	The child displays other problem behaviors, including screaming, crying, stamping foot near the animal, auto-aggression/self-injury (the child hurts own body, e.g., scratching skin, pulling the hair, biting hand, banging head against something), hetero-aggression (the child physically hurts another person or the horse, e.g., hair pulling, kicking, punching, biting, scratching, hitting with fists, hands, or whips), auto-manipulation (the child manipulates own body, e.g., finger against teeth, picking nose or teeth), covering eyes/ears with own hands, vocalizations (the child produces an unintelligible sound with mouth).	Point

2.5. Data Management and Statistical Analysis

Regarding the analysis of children's behaviors during EAAs, non-parametric statistical tests were applied since most of the dependent variables (children's behavior as described in Table 3) deviated from a normal distribution (checked with the Shapiro–Wilk normality test). Frequency/duration of behaviors (spatial relationships, social interactions, communicative behaviors, problem behaviors) shown by children with ASD vs. TD and by children of different sex (male and female), age (5–9 years old and 10–17 years old) and EAA experience ($\leq$1 month vs. >1 month) were compared by means of a series of Mann–Whitney tests (two groups compared) and Kruskal–Wallis tests (more than two groups compared). Post hoc analysis was carried out using Dunn's Test with the significance level adjusted to 0.013 (0.05/4) in the case of four planned comparisons. Data were analyzed with Statview II (Abacus Concepts, Berkeley, CA, USA) and IBM SPSS Statistics for Windows, Version 27.0 (Armonk, NY, USA: IBM Corp.).

3. Results

3.1. Main Effect of Diagnosis, Sex, Age, and EAA Experience on Children's Behaviors

We assessed the effect of diagnosis (ASD vs. TD) on children's behaviors shown during EAAs. Analyses with the Mann–Whitney test showed that children with ASD spent significantly less time in physical contact with horses than children with TD ($U = 59.000$, $p = 0.0004$) and displayed significantly less visual contact toward the horses than children with TD ($U = 70.000$, $p = 0.0013$). By contrast, children with ASD showed a higher frequency of withdrawal/avoidance from the horse ($U = 92.000$, $p = 0.0098$) and of problem behaviors ($U = 19.000$, $p < 0.0001$) than TD children. For other behaviors, no significant differences were observed (all $U_s > 135.000$, all $p_s > 0.05$).

As for the effect of the sex (female vs. male), analyses with the Mann–Whitney test showed that female children stayed at a shorter distance from the horse (closeness; $U = 77.000$, $p = 0.0131$) and showed a lower frequency of problem behaviors than male children ($U = 79.000$, $p = 0.156$). For other behaviors, no significant differences were observed (all $U_s > 137.000$, all $p_s > 0.05$).

We did not observe significant effects of age (5–9 years vs. 10–17 years) on children's behaviors shown during EAAs (all $U_s > 77.000$, all $p_s > 0.05$).

Children with more experience in EAAs (>1 month vs. $\leq$1 month) stayed at a shorter distance from the horse (closeness; $U = 40.000$, $p < 0.0001$) and showed more grooming of the horse ($U = 38.000$; $p < 0.0001$) than children with less EAA experience. For other behaviors, no significant differences were observed (all $U_s > 150.500$, all $p_s > 0.05$).

3.2. Effect of the Interaction between Diagnosis and Sex on Children's Behaviors

We assessed the interaction effect between diagnosis (ASD vs. TD) and sex (F vs. M) on children's behaviors during EAAs. Analyses with the Kruskal–Wallis test showed a significant interaction effect on the frequency of withdrawal/avoidance behavior ($H(3) = 9.692$, $p = 0.0214$), visual contact ($H(3) = 12.596$, $p = 0.0056$), and problem behaviors ($H(3) = 24.163$, $p < 0.001$), as well as on the duration of physical contact ($H(3) = 13.836$, $p = 0.0031$).

More in particular, post hoc analysis (Dunn's multiple comparison test; four planned pairwise comparisons; level of significance set at $0.05/4 = 0.013$) showed that the higher frequency of withdrawal/avoidance from the horse shown by ASD children in comparison to TD children (main effect) was due to female children ($p = 0.005$; Figure 1a), while no difference was found between ASD and TD male children ($p = 0.180$).

The lower frequency of visual contact toward the horses shown by ASD children in comparison to TD children (main effect) was due to male children ($p < 0.001$; Figure 1b), while no difference was found between ASD and TD female children ($p = 0.520$). Likewise, the lower duration of physical contact with horses shown by ASD children in comparison to TD children (main effect) was due to male children ($p = 0.002$; Figure 1c), while no difference was found between ASD and TD female children ($p = 0.054$).

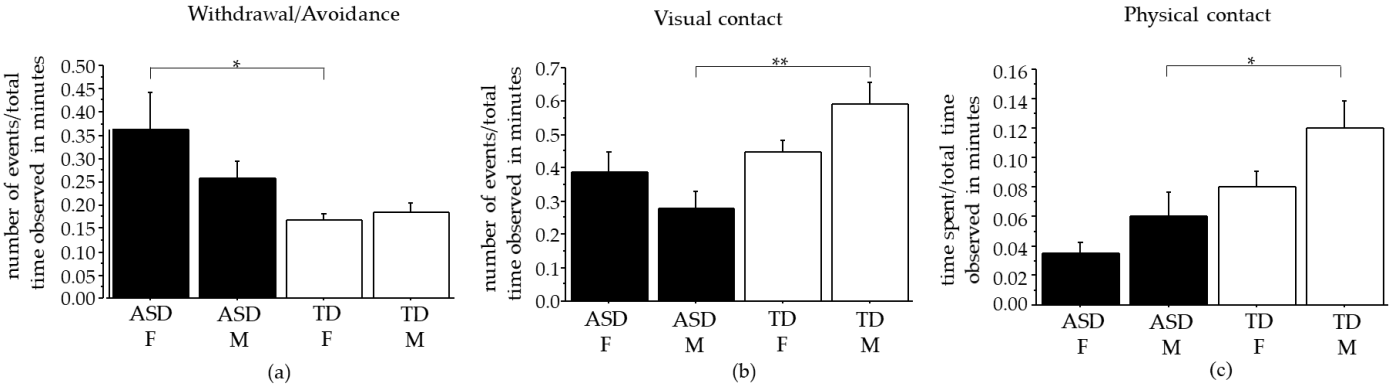

Figure 1. (**a**) Frequency (number of events/total time observed in minutes) of withdrawal/avoidance; (**b**) frequency of visual contact; (**c**) duration (time spent/total time observed in minutes) of physical contact in female (F) and male (M) ASD children (black bars) and TD children (white bars); * $p < 0.01$; ** $p < 0.001$.

Moreover, the higher frequency of problem behaviors shown by ASD children in comparison to TD children (main effect) was due to male children ($p < 0.001$), while no difference was found between ASD and TD females ($p = 0.025$).

For other behaviors, no significant differences were observed (all $H_s(3) < 7.441$, all $p_s > 0.05$).

3.3. Effect of the Interaction between Diagnosis and Age on Children's Behaviors

We assessed the interaction effect between diagnosis (ASD vs. TD) and age (5–9 years vs. 10–17 years) on children's behaviors during EAAs. Analyses with the Kruskal–Wallis test showed a significant interaction effect on the duration of physical contact with horses ($H(3) = 12.498$, $p = 0.0059$), as well as on the frequency of problem behaviors ($H(3) = 19.588$, $p = 0.0002$).

More in particular, post hoc analysis (Dunn's multiple comparison test; four planned pairwise comparisons; level of significance set at $0.05/4 = 0.013$) showed that the lower duration of physical contact with horses shown by ASD children in comparison to TD children (main effect) was due to the younger children ($p = 0.003$) while no difference was found between ASD and TD older children ($p = 0.055$).

Likewise, the higher frequency of problem behaviors shown by ASD children in comparison to TD children (main effect) was due to the younger children ($p < 0.001$), while no difference was found between ASD and TD older children ($p = 0.022$).

No age-related differences were found in the frequency of withdrawal/avoidance from the horse and of visual contact toward the horse, for which only an effect of diagnosis was observed ($H(3) = 8.128$, $p = 0.0434$ and $H(3) = 11.970$, $p = 0.0075$, respectively; see also Section 3.1).

For other behaviors, no significant differences were observed (all $H_s(3) < 3.753$, all $p_s > 0.05$).

3.4. Effect of the Interaction between Diagnosis and EAA Experience on Children's Behaviors

We assessed the interaction effect between diagnosis (ASD vs. TD) and EAA experience ($\leq$1 month vs. >1 month) on children's behaviors during EAAs. Analyses with the Kruskal–Wallis test showed a significant diagnosis * experience interaction effect on the duration of closeness to the horse ($H(3) = 18.020$, $p = 0.0004$), grooming of the horse ($H(3) = 17.756$, $p = 0.0005$) and physical contact with horses ($H(3) = 12.887$, $p = 0.0049$), as well as on the frequency of visual contact toward the horse ($H(3) = 12.136$, $p = 0.0069$) and problem behaviors ($H(3) = 22.771$, $p < 0.0001$).

More in particular, post hoc analysis (Dunn's multiple comparison test; four planned pairwise comparisons; level of significance set at $0.05/4 = 0.013$) showed an effect of EAA experience on the duration of closeness and grooming only in children with ASD ($p < 0.001$),

while no difference was found between TD children with different levels of experience (closeness: $p = 0.048$; grooming: $p = 0.023$; Figure 2a,b).

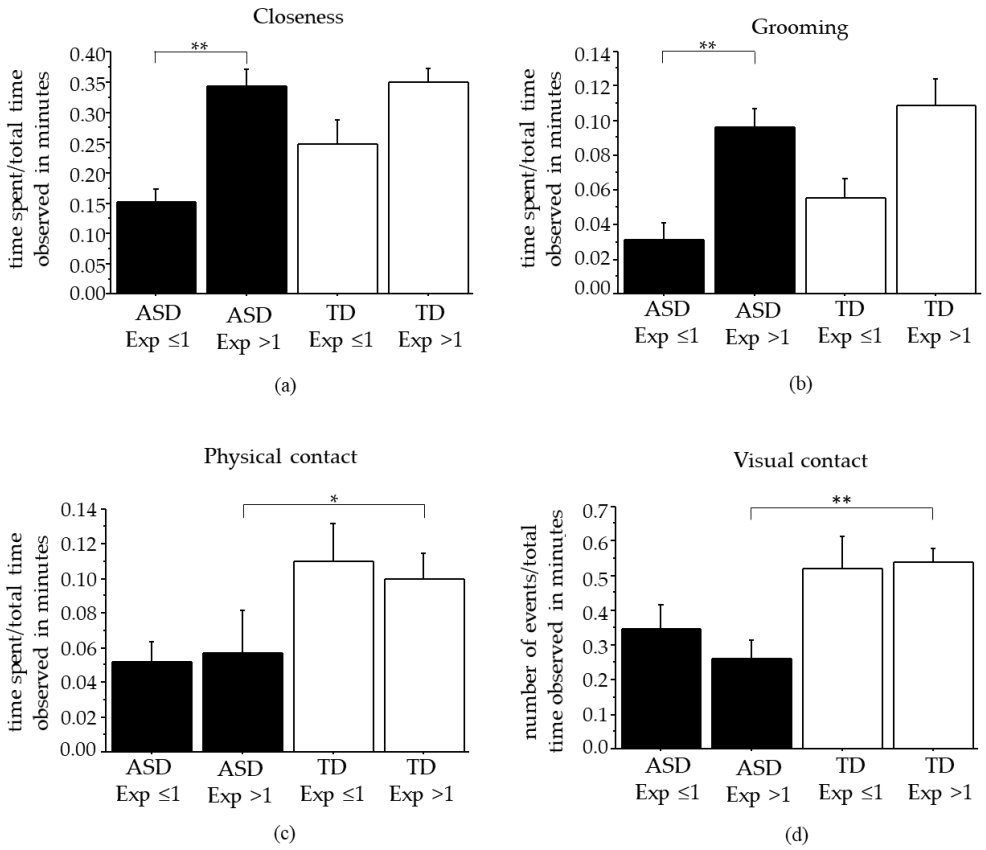

Figure 2. (**a**) Duration (time spent/total time observed in minutes) of closeness, (**b**) grooming (duration), (**c**) physical contact (duration), (**d**) frequency (number of events/total time observed in minutes) of visual contact in ASD children (black bars) and in TD children (white bars) with EAA experience of ≤1 month or >1 month; * $p < 0.01$; ** $p < 0.001$.

By contrast, in the case of physical and visual contact with horses, ASD children with more EAA experience were those displaying less occurrence of (or shorter) social behaviors than TD children with the same level of experience (physical: $p = 0.004$; visual: $p < 0.001$; Figure 2c,d). No experience-related differences were found in the frequency of problem behaviors for which only an effect of diagnosis was observed ($p = 0.508$ for ASD children and $p = 0.748$ for TD children); see also Section 3.1).

For other behaviors, no experience-related differences were observed (all $H_s(3) < 7.290$, all $p_s > 0.05$).

4. Discussion

This study was specifically aimed at evaluating the behavior of ASD children, in comparison with typically developing children (TD), during standardized EAA sessions. Overall, data indicate that interaction with a horse is able to elicit social interactions and communicative behaviors in a sex- and age-dependent fashion in ASD children. Furthermore, we were able to show that previous experience with EAAs can improve interpersonal distance and some interactions with the horse (i.e., grooming), suggesting that positive effects resulting from EAAs may build over time.

ASDs are characterized by impairment in social communication and social interaction, as well as repetitive and unusual sensory-motor behaviors [10]. As expected, in our study, we found that ASD children showed more withdrawal/avoidance from the horse and more

problem behaviors. Likewise, they displayed significantly less visual and physical contact with the horses than children with TD, indicating social and communicative deficits.

Female ASD children showed more withdrawal/avoidance from the horse than female TD, while male ASD children displayed less visual and physical contact with the horse and more problem behaviors than their TD counterparts. ASD is characterized by a higher prevalence in males than females [41] and higher symptomatology in the female gender [42]. These data indicate a clear sex difference in the behaviors shown by the two sexes, although data have to be taken with caution as the number of female ASD children recruited in this study was less than half the number of males.

When we considered the interaction effects between diagnosis and age on children's behaviors, we observed that younger ASD children (5–9 years old) showed a lower duration of physical contact with horses than younger TD children. Consistently, younger ASD children showed more problem behaviors than TD children. These differences tend to decrease with increasing age, probably as a result of an increase in social experience and overall neurobehavioural development.

We grouped ASD children according to their experience with EAAs, i.e., less than 1 month of experience or above 1 month of experience. One of the most interesting results of this study is that ASD children with more EAA experience showed a higher duration of closeness to the horse and more grooming than ASD children with less experience. This is probably due to the previously learned skills concerning the approach to the horse and the use of tools for its handling (i.e., grooming).

By contrast, we did not observe an effect of previous EAA experience in the case of physical and visual contact behaviors. It is of interest here that, in both ASD and TD children, the experience did not affect these behaviors, which might reflect the fact that they are not a result of experience but involve spontaneous interaction with the animal, which was found constantly lower in ASD children, compared to TD. Overall, these data can be interpreted to indicate that those behaviors that are mediated by the operator handling the sessions, such as closeness and grooming, appear more amenable to be affected by the experience compared to spontaneous interactions, which remain less pronounced in ASD children, no matter how much experience they might have with EAAs.

This observation can direct future research efforts on the effect of EAAs on other domains of functioning that might be more susceptible to change than social behaviors. A promising avenue of investigation is represented by the potential use of EAAs to improve executive functioning in children with ASD. In a previous study, we observed that being involved in structured activities requiring the use of tools (such as grooming the horse) is able to improve problem-solving skills in children with ASD after a 6-month EAA program [9]. An increase in attention, ability to focus on tasks, and less distractibility following EAAs have also been reported and linked to participants with a high level of engagement and involvement during therapeutic riding sessions [13,15,22]. However, these results are promising. An investigation assessing whether children's improvement after an equine-assisted program generalizes to other contexts (such as at home and in the community environments; [43]) is still needed.

5. Conclusions

Results from the current study highlight the importance of exploring children's behaviors during EAAs through direct measurements. We developed a specific ethogram to collect information on children's communicative/relational style during EAA sessions, as well as any occurrence of problem behaviors. This approach may allow evaluating child–animal interactions during therapeutic sessions and linking the quality/strength of the child–horse relationship to changes in ASD symptomatology (e.g., social behaviors) obtained by standardized and widely used scales. Moreover, we were able to capture specific aspects of the social and communicative behavior of children during their interaction with the horse, getting a much more ethologically relevant picture of their actions in the session setting.

There is increasing evidence of EAAs being a promising complementary intervention for ASD children. Being able to stimulate the physical, social, and cognitive domains [2,11,18] and being carried out outdoors and in green spaces [44], activities with horses have a great potential to be well integrated within the overall rehabilitation plan of children with ASD. In the future, long-term assessments and a combination of qualitative and quantitative tools (parent questionnaires, standardized tests, video coding) should be used to evaluate their overall effectiveness, allowing EAAs to become an evidence-based practice for ASD.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/app13137417/s1, Table S1: Description of horses involved in the current study.

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