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A SYSTEMATIC REVIEW OF CANINE-ASSISTED THERAPY AND ITS EFFECT ON SOCIAL BEHAVIOURS IN AUTISTIC CHILDREN

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ABSTRACT

Introduction: Assisted-animal interventions (AAI) have become a popular therapy for people with ASD.[1, 2] Little is known about the clinical effects of canine-assisted therapy on social behaviours in children with autism.

Method: An integrative systematic review was used to investigate the effects of canine assisted therapy on social behaviours. Sixteen articles met the criteria for inclusion in this review. Three main themes for intervention outcomes were found: (A) Non-Verbal Behaviour, (B) Verbal Behaviour and (C) Social Communication with Body Language. Six sub-themes were identified; these included Smiling, Eye Contact, Speech, Positive Statements, Synchrony and Confidence.

Results: The results showed that canine-assisted therapy may have a positive effect on social behaviours in autistic children, including on non-verbal behaviour, verbal behaviour, and social communication with body language. However, the quality and rigour of studies suggest that future studies should include wait-list controls as well as pre-post and follow-up designs, as well as RCTs. Improvement in design and sample size will help strengthen assertions regarding to AAI's possible benefits.

INTRODUCTION

Aim and Design:

The aim of this review is to explore and collate the existing body of evidence around canine-assisted therapy, socialisation and children with autism spectrum disorder (ASD) using a systematic integrated review research design. This method uses the combination of empirical and theoretical literature to provide a comprehensive understanding of the topic and to explore the diverse research methodologies available. [3]

Non-verbal Behaviour:

Children with ASD frequently avoid eye contact, making them appear aloof, indifferent, or inattentive to those who do not understand ASD (National Institute of Deafness and Other Communication Disorders (NIDCD).[4] Social smiling is associated with two main components; correct orientation of eye gaze towards others and positive affective facial expressions.[5] However, children with ASD display significant impairments in the affective and attentional components of social smiling.[6] This impairment results in the lower reactivity in episodes of joint attention, lower capacity of name recognition, general lack of expressions and reduced eye contact.[7] Human gaze serves a variety of social roles, including providing information, regulating contact, expressing intimacy, mediating social control, and improving communication and cooperation.[8] ASD is correlated with poor eye contact and diminished face orientation.[9]

Verbal Behaviour:

Verbal behaviour is defined as a pattern of conduct whose reinforcement is mediated by another.[10] A recent study depicted how an estimated one-third of children with ASD develop limited spoken language and communication skills, by the time they enter mainstream education.[11] This results in the children being labelled as “minimally verbal” in terms of cognitive and social communication ability, language understanding and language use.[12] This impairment is considered the most significant disadvantage experienced by those with ASD,[13] resulting in fewer social contacts either through initiation or in

response to peer initiation than those without ASD.[14]

Comorbidity:

Comorbidity is when an individual experiences two or more diagnostic conditions.[15] The two most common in children diagnosed with ASD are specific phobia and obsessive-compulsive disorder (OCD).[16] However, the prevalence of comorbidity with attention deficit hyperactivity disorder (ADHD) has significantly increased from 14% to 78%.[17] Children with ASD often suffer from high levels of anxiety. A study conducted in 2012 found that children with ASD demonstrated a significantly higher rate of avoidance than children who were diagnosed with PDD or considered neurotypical.[18] Due to its impact on a child's everyday functioning pro-social behaviour is frequently regarded the most critical issue to address in children with ASD.[19]

Animal Assisted Therapy:

The benefits of canine-assisted interventions were first noted in the 1960s by psychologist Boris Levinson.[20] Canines do not rely on subtle features of human behaviour to communicate, such as facial expressions, gestures, or verbal words[21] and can address the contact void frequently found in children with ASD.[21] Canines can act as a "social catalyst" or "social icebreaker", producing a safe and secure environment that promotes positive social behaviours.[22]

Assisted Animal Interventions (AAI) have become a popular and recognised aspect of contemporary therapy.[1] Development of appropriate behaviour,[23] motor functioning skills,[24] cognition and interpersonal social skills[25] are example focus areas for interventional therapy. Animal-assisted interventions may represent a feasible and helpful intervention for autistic individuals.[3] It has been argued that dogs have established similar cognition to humans, as a result of domestication,[26] with the capacity to understand verbal and non-verbal language, such as eye contact and hand gestures, as well as to engage in abstract thinking.[27]

As outlined by the International Association of Human-Animal Interaction Organisation (IAHAIO), animal assisted intervention provides educational, health and service

necessities.[28] Interactions between animals and humans result in a significant decrease in anxiety, loneliness, and increase positive social interactions and self-esteem in autistic individuals.[29]

The Current Study:

This study provides a systematic review of the existing literature on the effects of canine-assisted therapies on the social behaviours of children clinically diagnosed with ASD. Despite the increasing popularity of animal assisted interventions and its benefits for humans, a limited amount of research has looked explicitly at the role of child–dog interaction in ASD individuals.[30] The extant literature contains limitations due to its reliance on anecdotal evidence and poor study designs and sample sizes, with few follow-up studies and small sample sizes.[30] The literature also lacks clarity on the therapeutic efficacy specific to animal-assisted interventions.[2]

METHOD

Research Question

The PEO (Population, Exposure, Outcome) approach was chosen as it is the most appropriate method when dealing with both qualitative and quantitative research.[31] The research question formulated for this investigation was:

"What are the effects of canine-assisted therapy on social behaviours of children with autism?"

Database Selection and Keywords

The two databases selected were **Cinahl** and **PsycINFO**.

Keywords relating to ASD, dogs and therapy were used to effectively collect literature from each database. The keywords included were **"autism spectrum disorder", "ASD", "autism" "canine assisted therapy", "dog facilitated therapy", "animal assisted interventions", "service dog"** and **"pet intervention"**. To develop a more systematic and methodological approach, the researcher used the PEO template to insert each of the relevant search phrases (Table 1).

Table 1: PEO Inclusion and Exclusion Criteria

		Inclusion	Exclusion
Population	Children with a clinical diagnosis of ASD	Children from the age of 0 to 17 years Comorbidity	Children without a clinical diagnosis of ASD 18 years and older
Exposure	Canine Assisted Therapy	Trained Canine Must be an intervention Any breed of dog Any length of intervention	Animals other than canine Untrained Canines
Outcome	Social Behaviours	Interaction with dog (affection, pleasure, interest) Non-verbal behaviour (laughter, smiles, gesture) Verbal behaviour (speech to person, speech to dog)	Aggression Anxiety Challenging behaviour
	Types of Studies	Any study design including: Randomised Control Trials (RCT), Case Control Studies Quantitative Studies Qualitative Studies Mixed Methodology Studies	Any study designs including: Unpublished papers Editorials Commentaries Thesis or dissertations Book chapters Naturalistic Observation
	Language	Studies in English	Studies in a language except English
	Timeframe	Studies from 2011- 2021	Studies before 2011

Table 2: Database Results from Search String 1

#S1 Autistic disorder AND (autism or asd or autism spectrum disorder) AND 'canine therapy' or 'canine assisted therapy') OR (dog therapy or dog assisted or pet therapy) OR (animal therapy or animal assisted therapy or animal intervention or pet intervention				
Database	Results – No Limits	Date Accessed	Results with Generic Limits	Date Accessed
Cinahl Full Text	133	02/05/21	46	02/05/21
Total Articles	133	02/05/21	46	02/05/21

Selecting the Literature

The search strings as outlined in Table 2 were entered in each of the two databases. The terms **"Autistic disorder"** and **"autism spectrum disorders**" were interchanged as both of the databases differed in the recognition of the two specified terms. Both of the search strings resulted in a small volume of literature.

To eliminate irrelevant information and studies, certain criteria that included inclusions and exclusions had to be met (Table 1). The inclusion and exclusion criteria table was broken up into 6 sections: population, exposure, outcome, types of studies, language used and timeframe. This framework mirrored that of the PEO approach.[31] The population section described the age and specified diagnosis of the proposed sample, the exposure section described the type of intervention and type of animal present, the outcome section described the desired (interaction with dog, non-verbal and verbal behaviour) and non-desired (aggression, anxiety and challenging behaviour) outcomes. The types of studies section described the different forms of research (quantitative, qualitative, meta-analysis, random controlled trial etc.) that were included and excluded.

Quality Appraisal:

In order to determine whether the 16 selected articles were suitable and of good quality, a critical appraisal checklist, the Template for Intervention Description and Replication (TIDieR) Checklist, Joanna Briggs Institute (JBI) and Single Case Design[32] were used.

The TIDieR framework was used to summarise each of the selected article's methodology such as description of the

intervention, theoretical rationale, materials, and procedure used, the instigator of the intervention, location and length of the intervention and details of any specific tailoring or modification occurred (refer to Tables 3-10 *as per supplementary material available with online version*).

The JBI and Single Case Design (SCD) frameworks were used to summarise each of the selected studies, their design, methods and main findings to fully appraise the quality. The JBI framework included a quasi-experimental checklist, a randomised control trial (RCT) checklist and a qualitative checklist. The SCD checklist primarily focused on the articles that included a single case design methodology.

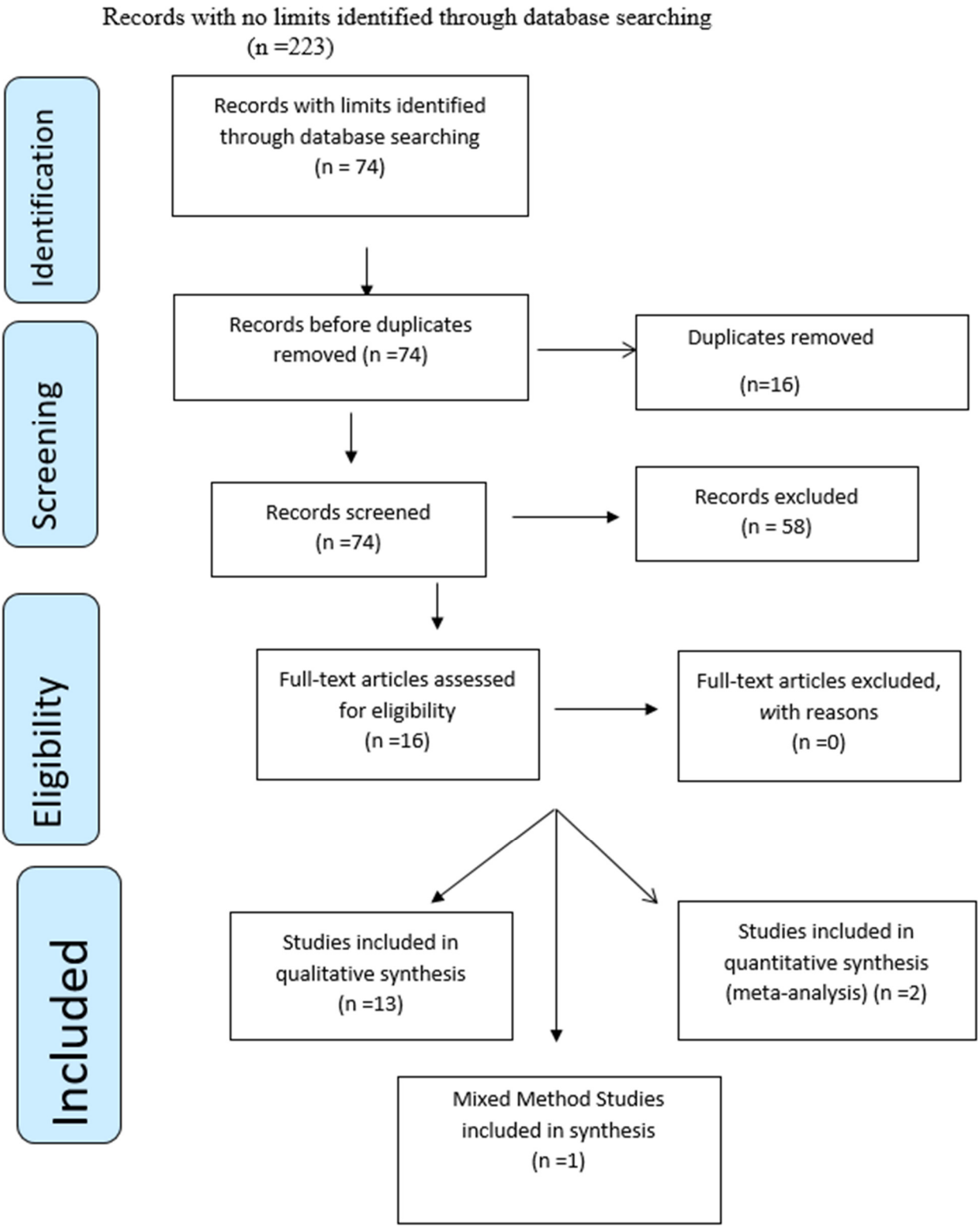


Figure 1: PRISMA Flow Diagram for Autistic Children and Canine Assisted Therapy

RESULTS

Selected Studies

See Figure 1. The selected articles ranged in time from 2011–2020. They comprised of 2 quasi-experimental studies (*n* = 2), 10 single case studies, (*n* = 10), 2 qualitative studies (*n* = 2) and 1 randomised controlled trial (RCT) (*n* = 1). The origin of these studies were as follows; 1 from Spain (*n* = 1), 1 from the Netherlands (*n* = 1), 1 from Romania (*n* = 1), 1 from Hong Kong (*n* = 1), 2 from Australia (*n* = 2), 4 from Portugal (*n* = 4), 4 from the USA (*n* = 4), 1 from Brazil (*n* = 1) and 1 from Japan (*n* = 1).

Participants

The selected participants ranged between 11 months and 11 years of age. The selected studies consisted of 112 participants (*N* = 112), 102 males (91.07%) and 10 females (8.93%). The selected participants contained either a preliminary or clinical diagnosis of ASD, however, one of the selected studies also included 5 participants with a clinical diagnosis of Down Syndrome (DS). The breed of canines utilised in the selected studies were as follows; 3 labrador retrievers (*n* = 3), 1 Galician shepherd (*n* = 1), 1 Spanish water dog (*n* = 1), 3 labradors (*n* = 3), 2 labradoodles (*n* = 2), 2 beagles (*n* = 2), 2 golden retriever (*n* = 2), 1 Saint Bernard (*n* = 1), 1 German shepherd/great Pyrenees mix (*n* = 1), 2 Australian shepherds (*n* = 2), 2 Welsh corgis (*n* = 2), 1 border collie/retriever mix (*n* = 1), 1 King Charles spaniel mix (*n* = 1), 1 labrador mix (*n* = 1), 1 pomeranian (*n* = 1), 1 Chihuahua (*n* = 1) and 1 dachshund (*n* = 1).

Interventions

The types of theoretical approaches used in the selected studies are; 3 Human Animal Interaction Theories (*n* = 3), 1 Dog Assisted Therapy (*n* = 1), 5 Occupational Therapies (*n* = 5), 2 Applied Behavioural Analysis (*n* = 2), 1 Complementary Therapy (*n* = 1), and 4 Animal Assisted Therapy (*n* = 4). The length of the interventions ranged from 1 day a week for 20 minutes to 10 weekly 30 minute sessions.

Measurement of Outcomes

The outcomes of the selected articles were measured as follows; 8 video analysis (*n* = 7), 1 ACIS 4.0 Assessment of Communication and Interaction Skills (*n* = 1), 1 semi structured interview (*n* = 1), 1 phone interview (*n* = 1), 1 Multiple Stimulus Without Replacement Preference Assessment (*n* = 1), 1 Autistic Behaviour

Assessing Questionnaire (CACS-27) (*n* = 1) and 2 ECG devices (*n* = 2).

Outcomes: Themes and Sub-themes

The three main themes that emerged from the selected articles were **Non-Verbal Behaviour, Verbal Behaviour** and **Social Communication Through Body Language.** These themes seemed to overlap or be reliant on one another. From the emerging themes, several sub-themes were identified.

Non-verbal Behaviour

One of the most common outcomes of canine-assisted intervention for ASD was the increase in non-verbal behaviour – in 7 of 16 articles. Non-verbal behaviours were defined as actions that were evident through non-verbal forms.[40] Subsequently, two main sub-themes; **Smiling** and **Eye Contact** were created from the main theme.

Smiling

In the presence of a canine, behaviours associated with being positive such as smiling and physical contact significantly increased, while behaviours deemed problematic significantly decreased.[33] For example, using EMG signals Funahashi et al.,[34] revealed a substantial difference in the artificial neural network output responsible for smiling in children with ASD. Due to the presence of the canine, smile responses increased dramatically from session 1 to session 4.[34] Similarly, Germone et al.,[35] reported a significant group difference. The group exposed to canine companionship reported a higher increase in facial expressions, smiling and laughing behaviours than the group that did not.[35]

Eye Contact

Studies such as Ávila-Álvarez et al.,[7] Silva et al.,[33] London et al.,[36] and Grigore et al.,[14] revealed how canine-assisted therapy significantly improved social skills such as eye contact. A selected study identified the social benefits of canine-assisted therapy, as the frequency of eye contact in children diagnosed with ASD increased.[7] Likewise, Grigore et al.,[14] reported similar findings suggesting the presence of a canine around children with ASD can have a positive effect on social skills including frequency of eye contact. A study conducted by London et al.,[36] reported that canines facilitated a child's interaction which in turn encouraged positive social behaviours such as

appropriate amounts of eye contact. Dogs were reported as being "more approachable" and "less threatening" than other children.[36] These factors created a suitable environment for the development of positive social skills.

Verbal Behaviour

Another common theme or outcome that presented itself was verbal behaviour – reported in six of 16 studies. Children with ASD often see a small, yet uneven, improvement in speech and language, however not to a typical level of competence.[4] Two main sub-themes; **Speech** and **Positive Statements** were identified.

Speech

Studies such as Fung et al.,[37]; Jorgenson et al.,[38] and London et al.,[36] demonstrated how canine-assisted therapy, had a significant impact on speech in children with ASD. Fung et al.,[37] discovered children exposed to canines experienced a dramatic increase in verbal social behaviour. The children engaged in speech such as "eat a strawberry" and "It's Charlie's turn." Similarly, participants' rate of verbal statements had the highest increase from the initial baseline assessment, during the canine intervention.[38] A study that was centred around parental insights reported the presence of the canine created an easier atmosphere for the child to engage in a conversation with the therapist,[36] with the canine acting as a "social catalyst"[46] or "social icebreaker".[39]

Positive Statements

A study by Germone et al.,[35] reported that children exposed to canines displayed more positive statements, than children who were not.[35] A statement such as "this is fun" was classed as a positive statement.[35] Similarly, positive greetings towards others and the canine increased dramatically during the animal-assisted experimental condition.[40] The children utilised appropriate greeting vocalisations such as "Hello" and "My name is …" towards the therapist and the canine itself.[40] Interestingly, stereotypical negative behaviours including negative vocalisations decreased as a result of canine exposure.[40]

Social Communication Through Body Language

Another strong theme that emerged was Social Communication Through Body Language –reported in 4 of 16 articles. Our knowledge of social circumstances is

greatly aided by our ability to read body language.[41] Gestures and posture changes which are among the most important nonverbal communication indicators, supply observers with useful information about other people's subjective and emotional states and intentions.[41] The two main sub-themes derived from the main theme are **Synchrony** and **Confidence**.

Synchrony

Behavioural synchrony, which is defined as "an observable pattern of dyadic interaction that is jointly regulated, reciprocal and harmonious," is an important aspect of social interaction.[42]

Studies such as Grioffen et al.,[43] and Funahashi et al.,[34] reported the benefits of canine-assisted interventions on the synchrony of a child with ASD, including higher proportions of synchrony between the first and last session of canine exposure[43]. Similarly, Funahashi et al.,[34] demonstrated the positive effect from interacting with a dog. Children who voluntarily held or touched the canine showed a significant increase in behaviour synchrony, which resulted in a higher occurrence of smiling.[34] By engaging in behavioural synchrony the children developed emotional reciprocity skills in an emotionally safe environment.[34]

Confidence

Studies such as Hill et al.,[44] and London et al.,[36] demonstrate how canine-assisted therapy can increase a child's confidence. Hill et al.,[44] discovered that the presence of a therapy canine created emotional safety for the child with ASD, encouraging pro-social behaviours. Evidence of emotional safety was reported by the children's parents,[44] with one reporting the canine eliminated pressure to perform on task procedures, resulting in the child's engagement in therapy increasing.[44] London et al.,[36] discovered the presence of a canine produced greater levels of comfort and confidence in children with ASD, than typical therapeutic interventions.[44] This increased confidence resulted in greater self-direction, allowing the child to take control of their therapeutic process.[44]

DISCUSSION

The purpose of this review was to provide a comprehensive analysis of the existing literature on the effects of canine-assisted therapies on the social behaviours of children clinically diagnosed with ASD.

Sixteen studies were identified as the most appropriate to answer the review question. Three main themes were identified: **Non-verbal Behaviour, Verbal Behaviour** and **Social Communication Through Body Language**. This resulted in the emergence of six main sub-themes, **Smiling, Eye Contact, Speech, Positive Statements, Synchrony** and **Confidence**.

This section discusses the key points that were identified from these three themes in light of the wider literature currently available nationally and internationally.

The result of the present investigation confirmed that in the studies reviewed, canine-assisted therapy had a positive effect on the social behaviours of children diagnosed with ASD. In terms of non-verbal behaviour, canine exposure resulted in a higher increase in facial expressions, smiling and laughing behaviours,[35] while eye contact significantly increased as a result of canine assisted therapy.[14] In terms of verbal behaviour, particular interventions appeared to have a positive effect on the development of speech and positive statements with each component being reported as increasing dramatically e.g. Fung et al.,[22]; Jorgenson et al.,[38] and London et al.,[36] However, more research is needed.

The effectiveness of canine-assisted intervention may result from a number of different factors. Firstly, therapy animals may enable treatment clients to be more sensitive to the therapist's interventions by creating a friendly, non-threatening environment in the therapy room, thus increasing therapy effectiveness.[19] This may be due to the canine diverting attention and eliminating embarrassment and stress.[45] Secondly, canines may provide multisensory stimulus such as touch, smell, sound and sight that results in lower sensory and emotional arousal levels in children with ASD.[46] Likewise, it has been argued that social avoidance towards others does not extend to animals.[47] Thirdly, canines are perceived as less threatening and easier to train than larger animals.[48]

Limitations

This study contained a number of limitations. Differing measures were used for outcomes in each article, which may have jeopardised the internal validity of the review. Studies often did not include a

control group, meaning change could result from history or maturational effects. The current study did not use a second independent rater when assessing the quality of the selected articles meaning bias may have been present. Results may have been biased by gender as there was only approximately nine percent of females within the studies reviewed, with the majority of studies focusing on male children with ASD. Finally, the majority of studies contained a small sample size.

Future Recommendations

Future researchers should include randomisation, wait list controls, larger sample sizes with a sample size statistic used to consider group sizes for comparison, control for gender and age, and to use measures with good internal and external validity and reliability.

CONCLUSION

The results indicate that non-verbal, verbal and synchrony behaviour may be positively improved by canine-assisted therapy. The quality and rigour of extant studies are poor, with inadequately powered sample sizes. This review helps summarise the current literature surrounding this topic. However, more extensive research is necessary for areas such as gender, age, and differences related to the efficacy of different types of canine-assisted therapy before more definitive conclusions can be drawn. Future research may benefit from controlling for the effect of canine breed and from giving greater consideration to the testing of different psychological theories on canine-assisted therapies.

REFERENCES

1. Fine AH. Handbook on animal-assisted therapy: foundations and guidelines for animal-assisted interventions. Amsterdam: Academic Press; 2019.
2. Hallyburton A, Hinton J. Canine-Assisted Therapies in Autism: A Systematic Review of Published Studies Relevant to Recreational Therapy. Therapeutic Recreation Journal. 2017;51(2):127–42.
3. Soares CB, Hoga LAK, Peduzzi M, Sangaleti C, Yonekura T, Silva DRAD. Integrative Review: Concepts And Methods Used In Nursing. Revista da Escola de Enfermagem da USP [Internet]. 2014 Apr;48(2):335–45. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0080-62342014000200335
4. National Institute on Deafness and Other Communication Disorders. Autism Spectrum Disorder: Communication Problems in Children [Internet]. NIDCD. 2020. Available from: https://www.nidcd.nih.gov/health/auti

sm-spectrum-disorder-communication-problems-children
5. Nichols CM, Ibañez LV, Foss-Feig JH, Stone WL. Social Smiling and Its Components in High-Risk Infant Siblings Without Later ASD Symptomatology. Journal of Autism and Developmental Disorders. 2013 Sep 21;44(4):894–902.
6. Swettenham J, Baron-Cohen S, Charman T, Cox A, Baird G, Drew A, et al. The Frequency and Distribution of Spontaneous Attention Shifts between Social and Nonsocial Stimuli in Autistic, Typically Developing, and Nonautistic Developmentally Delayed Infants. Journal of Child Psychology and Psychiatry. 1998 Jul;39(5):747–53.
7. Alvari G, Furlanello C, Venuti P. Is Smiling the Key? Machine Learning Analytics Detect Subtle Patterns in Micro-Expressions of Infants with ASD. Journal of Clinical Medicine. 2021 Apr 19;10(8):1776.
8. Kleinke CL. Gaze and eye contact: A research review. Psychological Bulletin. 1986;100(1):78–100.
9. Osterling J, Dawson G. Early recognition of children with autism: A study of first birthday home videotapes. Journal of Autism and Developmental Disorders. 1994 Jun;24(3):247–57.
10. Ingvarsson ET, Hollobaugh T. ACQUISITION OF INTRAVERBAL BEHAVIOR: TEACHING CHILDREN WITH AUTISM TO MAND FOR ANSWERS TO QUESTIONS. Thompson R, editor. Journal of Applied Behavior Analysis [Internet]. 2010;43(1):1–17. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2831436/
11. Bacon EC, Osuna S, Courchesne E, Pierce K. Naturalistic language sampling to characterize the language abilities of 3-year-olds with autism spectrum disorder. Autism. 2018 May 14;23(3):699–712.
12. Tager-Flusberg H, Kasari C. Minimally Verbal School-Aged Children with Autism Spectrum Disorder: The Neglected End of the Spectrum. Autism Research. 2013 Oct 7;6(6):468–78.
13. Scattone D. Social skills interventions for children with autism. Psychology in the Schools. 2007;44(7):717–26.
14. Grigore AA, Rusu AS. Interaction with a Therapy Dog Enhances the Effects of Social Story Method in Autistic Children. Society & Animals. 2014 Apr 22;22(3):241–61.
15. Matson JL, Nebel-Schwalm MS. Comorbid psychopathology with autism spectrum disorder in children: An overview. Research in Developmental Disabilities. 2007 Jul;28(4):341–52.
16. Leyfer OT, Folstein SE, Susan A, Ae B, Davis NO, Dinh E, et al. Comorbid Psychiatric Disorders in Children with Autism: Interview Development and Rates of Disorders. Journal of Autism and Developmental Disorders [Internet]. 2006;36(7). Available from: http://www.bu.edu/autism/files/2010/03/2006-Leyfer-et-al-comorbid-disorders1.pdf
17. Gargaro BA, Rinehart NJ, Bradshaw JL, Tonge BJ, Sheppard DM. Autism and ADHD: How far have we come in the comorbidity debate? Neuroscience & Biobehavioral Reviews [Internet]. 2011 Apr;35(5):1081–8. Available from: https://www.sciencedirect.com/science/article/pii/S0149763410001831
18. Davis TN, Scalzo R, Butler E, Stauffer M, Farah YN, Perez S, et al. Animal Assisted Interventions for Children with Autism Spectrum Disorder: A Systematic Review. Education and training in autism and developmental disabilities. 2015 Sep 1;50(3):316–29.

19. Hardy KK, Weston RN. Canine-Assisted Therapy for Children with Autism Spectrum Disorder: a Systematic Review. Review Journal of Autism and Developmental Disorders. 2019 Dec 6;7(2).
20. Serpall JA. Animal-Assisted Interventions in Historical Perspective. In. A. H. Fine (ED.), Handbook on Animal-Assisted Therapy: Theoretical Foundations and Guidelines for Practice. 3rd ed. ELsevier; 2010.
21. Solomon O. What a Dog Can Do: Children with Autism and Therapy Dogs in Social Interaction. Ethos. 2010 Mar;38(1):143–66.
22. Fung S, Leung AS. Pilot Study Investigating the Role of Therapy Dogs in Facilitating Social Interaction among Children with Autism. Journal of Contemporary Psychotherapy. 2014 Jul 8;44(4):253–62.
23. Bell A, Palace K, Allen M, Nelson R. Using Martial Arts to Address Social and Behavioral Functioning in Children and Adolescents With Autism Spectrum Disorder. Therapeutic Recreation Journal. 2016;50(2).
24. Hawkins BL, Ryan JB, A Lynne Cory, Donaldson MC. Effects of Equine-Assisted Therapy on Gross Motor Skills of Two Children with Autism Spectrum Disorder: A Single-Subject Research Study. Therapeutic recreation journal. 2014 Apr 10;48(2):135–49.
25. Stuhl A, Potter H. Riding the Waves: Therapeutic Surfing to Improve Social Skills for Children with Autism. Therapeutic Recreation Journal. 2015;49(3):253–6.
26. Hare B, Tomasello M. Human-Like Social Skills in Dogs? Trends in Cognitive Science. 2005;9(9):439–44.
27. Miklósi Á, Topál J. What does it take to become “best friends”? Evolutionary changes in canine social competence. Trends in Cognitive Sciences. 2013 Jun;17(6):287–94.
28. Jegatheesan B. THE IAHAIO Definitions for Animal Assisted Intervention and Guidelines for Wellness of Animals Involved. IAHAIO WHITE PAPER; 2014 p. 1–10.
29. Carlisle GK. Pet Dog Ownership Decisions for Parents of Children With Autism Spectrum Disorder. Journal of Paediatric Nursing. 2014 Mar;29(2):114–23.
30. Berry A, Borgi M, Francia N, Alleva E, Cirulli F. Use of Assistance and Therapy Dogs for Children with Autism Spectrum Disorders: A Critical Review of the Current Evidence. The Journal of Alternative and Complementary Medicine. 2013 Feb;19(2):73–80.
31. Bettany-Saltikov J, McSherry R. How to Do a Systematic Literature Review in Nursing: a step-by-step Guide. 2nd ed. London: Open University Press; 2016.
32. Butler A, Hall H, Copnell B. A Guide to Writing a Qualitative Systematic Review Protocol to Enhance Evidence-Based Practice in Nursing and Health Care. Worldviews on Evidence-Based Nursing. 2016 Jan 20;13(3):241–9.
33. Silva K, Correia R, Lima M, Magalhães A, de Sousa L. Can Dogs Prime Autistic Children for Therapy? Evidence from a Single Case Study. The Journal of Alternative and Complementary Medicine. 2011 Jul;17(7):655–9.
34. Funahashi A, Gruebler A, Aoki T, Kadone H, Suzuki K. Brief Report: The Smiles of a Child with Autism Spectrum Disorder During an Animal-assisted Activity May Facilitate Social Positive Behaviors—Quantitative Analysis with Smile-detecting Interface. Journal of Autism and Developmental Disorders. 2013 Jul 27;44(3):685–93.

35. Germone MM, Gabriels RL, Guérin NA, Pan Z, Banks T, O'Haire ME. Animal-assisted activity improves social behaviors in psychiatrically hospitalized youth with autism. Autism. 2019 Feb 28;23(7):136236131982741.
36. London MD, Mackenzie L, Lovarini M, Dickson C, Alvarez-Campos A. Animal Assisted Therapy for Children and Adolescents with Autism Spectrum Disorder: Parent perspectives. Journal of Autism and Developmental Disorders. 2020 Apr 24;50(12).
37. Fung S, Leung AS. Pilot Study Investigating the Role of Therapy Dogs in Facilitating Social Interaction among Children with Autism. Journal of Contemporary Psychotherapy. 2014 Jul 8;44(4):253–62.
38. Jorgenson CD, Clay CJ, Kahng S. Evaluating preference for and reinforcing efficacy of a therapy dog to increase verbal statements. Journal of Applied Behavior Analysis. 2019 Dec 19;53(3):1419–31.
39. Chandler CK. Animal-assisted therapy in counselling. New York London Routledge, Taylor & Francis Group; 2017.
40. Protopopova A, Matter AL, Harris BN, Wiskow KM, Donaldson JM. Comparison of contingent and noncontingent access to therapy dogs during academic tasks in children with autism spectrum disorder. Journal of Applied Behavior Analysis. 2019 Aug 4;53(2).
41. Centelles L, Assaiante C, Etchegoyhen K, Bouvard M, Schmitz C. From Action to Interaction: Exploring the Contribution of Body Motion Cues to Social Understanding in Typical Development and in Autism Spectrum Disorders. Journal of Autism and Developmental Disorders. 2012 Sep 25;43(5):1140–50.
42. Harrist AW, Waugh RM. Dyadic synchrony: Its structure and function in children's development. Developmental Review. 2002 Dec;22(4):555–92.
43. Griffioen RE, Steen S, Verheggen T, Enders-Slegers M, Cox R. Changes in behavioural synchrony during dog-assisted therapy for children with autism spectrum disorder and children with Down syndrome. Journal of Applied Research in Intellectual Disabilities. 2019 Dec 6;33(3).
44. Hill JR, Ziviani J, Driscoll C. Canine-assisted occupational therapy for children on the autism spectrum: Parents' perspectives. Australian Occupational Therapy Journal. 2020 Mar 22;67(5).
45. Burrows KE, Adams CL. Challenges of Service-Dog Ownership for Families with Autistic Children: Lessons for Veterinary Practitioners. Journal of Veterinary Medical Education. 2008 Dec;35(4):559–66.
46. Redefer LA, Goodman JF. Brief report: Pet-facilitated therapy with autistic children. Journal of Autism and Developmental Disorders [Internet]. 1989 Sep;19(3):461–7. Available from: https://link.springer.com/article/10.1007/BF02212943
47. Johnson SC. Detecting agents. Frith CD, Wolpert DM, editors. Philosophical Transactions of the Royal Society of London Series B: Biological Sciences. 2003 Feb 21;358(1431):549–59.
48. Nimer J, Lundahl B. Animal-Assisted Therapy: A Meta-Analysis. Anthrozoös. 2007 Sep;20(3):225–38.
49. Silva K, Lima M, Santos-Magalhães A, Fafiães C, de Sousa L. Living and Robotic Dogs as Elicitors of Social Communication Behavior and Regulated Emotional Responding in

Individuals with Autism and Severe Language Delay: A Preliminary Comparative Study. Anthrozoös. 2019 Jan 2;32(1):23–33.
50. Silva K, Lima M, Fafiães C, Sinval J, de Sousa L. Preliminary Test of the Potential of Contact With Dogs to Elicit Spontaneous Imitation in Children and Adults With Severe Autism Spectrum Disorder. The American Journal of Occupational Therapy. 2019 Dec 5;74(1):7401205070p1-7401205070p8.
51. Michelotto ALL, Anater A, Guebert MCC, Borges TD, Michelotto PV, Pimpão CT. Animal-Assisted Activity for Children with Autism Spectrum Disorder: Parents' and Therapists' Perception. The Journal of Alternative and Complementary Medicine. 2019 Sep 1;25(9):928–9.

SUPPLEMENTARY MATERIAL TABLES: 3-10

Table 3: Articles 1-4: Section 1

Title	Year	Authors	Sample Size	Study Type	Intervention Length	Intervention Theory	Outcome Measured
Improving social participation of children with autism spectrum disorder: Pilot testing of an early animal-assisted intervention in Spain	2020	Ávila-Álvarez, Adriana; Alonso-Bidegain, Miguel; De-Rosende-Celeiro, Iván; Vizcaíno-Cela, Mirian; Larrañeta-Alcalde, Lestonnac; Torres-Tobío, Gabriel	19	Quasi experimental longitudinal design	1 day a week for 20 mins	Human Animal Interaction Theory (HAI Theory)	Communication/Social Skills observable actions used to express intentions or needs and to interact successfully with other people in occupations and social contexts
Changes in behavioural synchrony during dog-assisted therapy for children with autism spectrum disorder and children with Down syndrome	2020	Griffioen, Richard Eric; Steen, Steffie; Verheggen, Theo; Enders-Slegers, Marie-Jose; Cox, Ralf	10	Single subject design	6 weekly sessions for 30 mins	Dog Assisted Therapy	Rhythmic patterns of synchronous movement
Animal assisted therapy for children and adolescents with autism spectrum disorder: Parent perspectives	2020	London, Maeve Doyle; Mackenzie, Lynette; Lovarini, Meryl; Dickson, Claire; Alvarez-Campos, Alberto	17	Qualitative	Once a week for 5 weeks	Occupational Therapy	Engagement/enjoyment/motivation
Canine assisted occupational therapy for children on the autism spectrum: A pilot randomised control trial	2020	Hill, Jessica; Ziviani, Jenny; Driscoll, Carlie; Teoh, Ai Lin; Chua, Jia Min; Cawdell-Smith, Judy	22	Pilot randomised controlled trial. JBI tool for RCTs probably okay to use	7 weekly 1 hour sessions	Occupational Therapy	Therapist qualities/goal-directed therapy/emotional safety/therapy engagement

Table 4: Articles 1-4: Section 2

How it was measured	Child's Age	Diagnosis	Dog Breed	Who delivered outcome	Gender	Limitations	Key Findings	Country	Location of Intervention
ACIS 4.0 Assessment of Communication and Interaction Skills/Animal Therapy Flow Sheet	30 months - 6 years	ASD/ADHD	Labrador Retrievers/ Galician Shepperd Dog/ Spanish Water dog	Specialised Therapist	19 Male	No control group/ severity of diagnosis/ inclusion of children with probable diagnosis	Improvement in eye/verbal and physical contact with dog/increased participation in activities involving dog	Spain	Spanish Therapeutic Unit
Child Behaviour Checklist, video, using a HD camcorder, Panasonic type HC-V750	N/A	ASD/DS	Labrador/ Labradoodle	Therapist	8 Male 2 Female	Number of participants	Increased synchrony between child and dog	Holland	N/A
Semi structured interview	4-19 years	ASD	N/A	Occupational therapist	16 Male 1 Female	Not generalisable, inaccuracies	Presence of the dog valuable for addressing communication and behavioural regulation	Australia	N/A
Phone interviews, video footage	11 months /4-6 years	ASD	Labradoodle	Therapist	Mixed	Conducted by a single person/diagnosis of level one were only included	Presence of dog was not sufficient in engaging child in goal directed activities	Australia	Animal Assisted Psychology Practice

Table 5: Articles 5-8: Section 1

Title	Year	Authors	Sample Size	Study Type	Intervention Length	Intervention Theory	Outcome Measured
Can dogs prime autistic children for therapy? Evidence from a single case study	2011	Silva, Karine; Correia, Rita; Lima, Mariely; Magalhães, Ana; de Sousa, Liliana	1	N/S	N/S	Occupational Therapy	Child's behaviour with and without the presence of the dog when engaging in activities with the therapist
Evaluating preference for and reinforcing efficacy of a therapy dog to increase verbal statements	2020	Jorgenson, Courtney D.; Clay, Casey J.; Kahng, SungWoo	5	Single subject design	3-7 sessions per day, 1 to 2 days each week, 30 min to 1 hr	Applied Behavioural Analysis	Rate of verbal statements
Living and robotic dogs as elicitors of social communication behavior and regulated emotional responding in individuals with autism and severe language delay: A preliminary comparative study	2019	Silva, Karine; Lima, Mariely; Santos-Magalhães, André; Fafiães, Carla; de Sousa, Liliana	10	Single subject design	N/A	Human Animal Interaction Theory (HAI Theory)	Social Communication/ appropriate responses/ heart rate
Animal-assisted activity for children with autism spectrum disorder: Parents' and therapists' perception	2019	Michelotto, Ana L. L.; Anater, Amanda; Guebert, Mirian C. C.; Borges, Tâmara D.; Michelotto, Pedro V. Jr.; Pimpão, Cláudia T.	15	Single subject design	10 weekly 30 minute sessions	Complementary Therapy	Uses positive gestures or facial expression in dogs' presence, Unquiet or excited in dogs' presence

Table 6: Articles 5-8: Section 2

How it was measured	Child's Age	Diagnosis	Dog Breed	Who delivered outcome	Gender	Limitations	Key Findings	Country	Location of Intervention
Video recording of sessions	12	ASD	Labrador Retriever	Therapist	1 Male	Small sample size, not generalisable, results may be due to a natural phenomenon	The participant exhibited more frequent and longer durations of positive behaviour. less frequent and shorter durations of negative behaviours	Portugal	Portuguese Association for Developmental Disorders and Autism Centre
Multiple Stimulus Without Replacement Preference Assessment (MSWO) and video recording of the event	4-8 years	ASD	Labrador	Therapist	4 Male 1 Female	Measurement of a single social skill/tokens present	Noncontingent access to the therapy dog slightly increased verbal statements for 1 participant. Contingent access to the therapy dog increased social interactions.	USA	Outpatient Clinic
Video recording/ECG monitoring device/HRV	5-10 years	ASD	Beagle	Therapist	10 Male	Did not allow for clinical significance and replication	When comparing the dog and the robot conditions, only children showed a more positive pattern of behaviour in the presence of the living dog.	Portugal	Home or Day Centre
Autistic Behaviour Assessing Questionnaire (CACS-27)	5.6 +- 1.6	ASD	Golden Retriever, Saint Bernard, Beagle	Therapist	14 Male 1 Female	Small sample size,	Increased positive gestures and facial expression in children and improved peer interaction, improvement in speech communication and creativity.	Brazil	Specialised Therapeutic Centre

Table 7: Articles 9-12: Section 1

Title	Year	Authors	Sample Size	Study Type	Intervention Length	Intervention Theory	Outcome Measured
Pilot study investigating the role of therapy dogs in facilitating social interaction among children with autism	2014	Fung, Suk-chun; Leung, Alvin Seung-ming	10	Comparison group. Use JBI Quasi-experimental checklist.	7 weeks, 3 20-minute sessions	Animal Assisted Therapy	Social Behaviours, Non-Social Behaviours
Preliminary test of the potential of contact with dogs to elicit spontaneous imitation in children and adults with severe autism spectrum disorder	2020	Silva, Karine; Lima, Mariely; Fafiães, Carla; Sinval, Jorge; de Sousa, Liliana	10	Single subject design.	N/S	Occupational Therapy	Imitation ratio, imitation accuracy, and indicators of social motivation.
Interaction with a therapy dog enhances the effects of social story method in autistic children	2014	Grigore, Andreea A.; Rusu, Alina S.	3	Single subject design.	15 min per day	Animal Assisted Therapy	Frequency of the appropriate social interactions relevant to the target social skill, social response/frequency of social initiations.
Comparison of contingent and noncontingent access to therapy dogs during academic tasks in children with autism spectrum disorder	2020	Protopopova, Alexandra; Matter, Ashley L.; Harris, Breanna N.; Wiskow, Katie M.; Donaldson, Jeanne M.	30-min sessions with each participant once per day, 2 to 3 days per week	Single subject design.	30-min sessions with each participant once per day, 2 to 3 days per week,	Applied Behavioural Analysis	Preference ranking from each preference assessment, correct responses per minute on an academic task, engagement with the academic task, the alternative task, and with the therapy dog team, problematic behaviour, stereotypy, positive affect, and social behaviour during academic sessions, and salivary cortisol concentration before and after each academic session.

Table 8: Articles 9-12: Section 2

How it was measured	Child's Age	Diagnosis	Dog Breed	Who delivered outcome	Gender	Limitations	Key Findings	Country	Location of Intervention
Video analysis	7-10 years	ASD	Golden Retrievers	Therapist	8 Male 2 Female	Small sample size,	Increases in the verbal social behaviour. Significantly more verbal social behaviours after intervention	Hong Kong	School
Video analysis,	5-8 years	ASD	Labrador Retriever	Therapist	10 Male	Only tested short term effects	Children appeared more motivated and engaged more frequently in spontaneous imitation in the live dog condition than in the other conditions.	Portugal	Home or Day Centre
Video analysis	7-8 years	ASD	Labrador	Graduate students	2 Male 1 Female	Did not include condition for dog presence alone	Statistically significant increase in the frequency of the appropriate social interactions	Romania	Romanian Therapy Centre for Children
Video analysis, saliva samples	7-11 years	ASD	German Shepherd/Great Pyrenees Mix, Australian Shepherd, Welsh Corgi,	Experimenter	4 Male 1 Female	Inability to separate the effects of the dog handler from the therapy dog	Higher correct response and academic behaviour when dog was presented contingently. While social and affiliative behaviour was highest in the noncontingent dog condition.	USA	University

Table 9: Articles 13-16: Section 1

Title	Year	Authors	Sample Size	Study Type	Intervention Length	Intervention Theory	Outcome Measured
Animal-assisted activity improves social behaviours in psychiatrically hospitalized youth with autism	2019	Germone, Monique M.; Gabriels, Robin L.; Guérin, Noémie A.; Pan, Zhaoxing; Banks, Tiffany; O'Haire, Marguerite E.	47	Single subject design.	10-minute sessions	Human Animal Interaction Theory (HAI Theory)	Social communication and interaction,
Brief report: The smiles of a child with autism spectrum disorder during an animal-assisted activity may facilitate social positive behaviours—Quantitative analysis with smile-detecting interface	2014	Funahashi, Atsushi; Gruebler, Anna; Aoki, Takeshi; Kadone, Hideki; Suzuki, Kenji	2	Single subject design.	1 session, 30 - 40 mins	Animal Assisted Therapy	Smile Evaluation. Positive and Negative Social Behaviours
Can dogs assist children with severe autism spectrum disorder in complying with challenging demands?	2018	Silva, Karine; Lima, Mariely; Santos-Magalhães, André; Fafiães, Carla; de Sousa, Liliana	10	Single subject design (within subjects)	N/S	Animal Assisted Therapy	Participants' emotional expressions, latency to distress, compliance levels, and behaviours, cardiovascular reactivity
Canine-assisted occupational therapy for children on the autism spectrum: Parents' perspectives.	2020	Hill, Jessica Rachel; Ziviani, Jenny; Driscoll, Carlie;	10	Qualitative. Use JBI tool for qualitative studies.	7 weekly 1 hour sessions	Occupational Therapy	Experience of Canine Assisted Occupational Therapy

Table 10: Articles 13-16: Section 2

How it was measured	Child's Age	Diagnosis	Dog Breed	Who delivered outcome	Gender	Limitations	Key Findings	Country	Location of Intervention
Video analysis, saliva samples	7-11 years	ASD	German Shepherd/Great Pyrenees Mix, Australian Shepherd, Welsh Corgi,	Experimenter	4 Male 1 Female	Inability to separate the effects of the dog handler from the therapy dog	Higher correct response rate and academic behaviour when the dog was presented contingently rather than noncontingently. noncontingent dog condition.	USA	University
Social Communication Questionnaire ; Autism Diagnostic Observation Schedule, Video	6-8 years	ASD	Border Collie/Retriever Mix, King Charles Spaniel Mix, Labrador Mix	Dog Handler	Mixed	Participants were not randomized, into experimental or control condition	Increased social and communicative behaviours of talking, use of gestures, and socially directed in the AAA experimental condition.	USA	Specialised Psychiatric Unit
Wearable device ECG levels, video analysis	10 years	ASD	Pomeranians, Chihuahuas, Dachshund	Dog Handler	1 Male	Small sample size,	Improvement in quality and social meaning of eye contact	Japan	N/S
Wearable device ECG levels, video analysis	6-9 years	ASD	N/S	N/S	Male	N/S	Dog produced a calming effect on the participants.	Portugal	Home

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