



behavioral sciences

Special Issue Reprint

Animal-Assisted Interventions for Neurodivergent Individuals

Advancing Research, Practice, and Well-Being

Edited by
Nikolaos Kargas, Ana Maria Barcelos and Stamatina Tsiora

mdpi.com/journal/behavsci



Animal-Assisted Interventions for Neurodivergent Individuals: Advancing Research, Practice, and Well-Being

Animal-Assisted Interventions for Neurodivergent Individuals: Advancing Research, Practice, and Well-Being

Guest Editors

Nikolaos Kargas

Ana Maria Barcelos

Stamatina Tsiora



Basel • Beijing • Wuhan • Barcelona • Belgrade • Novi Sad • Cluj • Manchester

Guest Editors

Nikolaos Kargas
Department of Cognitive
Sciences
United Arab Emirates
University
Al Ain
United Arab Emirates

Ana Maria Barcelos
School of Natural Sciences
University of Lincoln
Lincoln
UK

Stamatina Tsiora
Autism Research Innovation
Centre
University of Lincoln
Lincoln
UK

Editorial Office

MDPI AG
Grosspeteranlage 5
4052 Basel, Switzerland

This is a reprint of the Special Issue, published open access by the journal *Behavioral Sciences* (ISSN 2076-328X), freely accessible at: https://www.mdpi.com/journal/behavsci/special_issues/U953Y6M3IS.

For citation purposes, cite each article independently as indicated on the article page online and as indicated below:

Lastname, A.A.; Lastname, B.B. Article Title. <i>Journal Name</i> Year , Volume Number, Page Range.
--

ISBN 978-3-7258-8751-4 (Hbk)

ISBN 978-3-7258-8752-1 (PDF)

<https://doi.org/10.3390/books978-3-7258-8752-1>

Contents

About the Editors	vii
Preface	ix
Niko Kargas, Ana Maria Barcelos and Stamatina Tsiora	
Animal-Assisted Interventions for Neurodivergent Individuals: Advancing Research, Practice, and Well-Being	
Reprinted from: <i>Behav. Sci.</i> 2026 , <i>16</i> , 820, https://doi.org/10.3390/bs16050820	1
Francisco González-Sala, Karel Llopiz-Guerra, Ainhoa Ferri and Manuel Martí-Vilar	
Parents' Perspectives on the Benefits of Animal-Assisted Intervention: A Systematic Review	
Reprinted from: <i>Behav. Sci.</i> 2025 , <i>15</i> , 1663, https://doi.org/10.3390/bs15121663	8
Candela Jasmin Hüsgen, Nienke Peters-Scheffer and Robert Didden	
Exploring Interaction Dynamics in Dog-Assisted Therapy: An Observational Study	
Reprinted from: <i>Behav. Sci.</i> 2025 , <i>15</i> , 1115, https://doi.org/10.3390/bs15081115	31
Manon Toutain, Salomé Paris, Solyane Lefranc, Laurence Henry and Marine Grandgeorge	
From Gaze to Interaction: Links Between Visual Attention, Facial Expression Identification, and Behavior of Children Diagnosed with ASD or Typically Developing Children with an Assistance Dog	
Reprinted from: <i>Behav. Sci.</i> 2025 , <i>15</i> , 674, https://doi.org/10.3390/bs15050674	45
Lily Widdison, Ana Maria Barcelos, Stamatina Tsiora, Andrei Zarie, Daniel S. Mills and Niko Kargas	
Exploring Cat-Human Interaction as a Psychosocial Resource in Autism and ADHD: Risks, Engagement, and Well-Being	
Reprinted from: <i>Behav. Sci.</i> 2026 , <i>16</i> , 162, https://doi.org/10.3390/bs16020162	71
Claire Wilson, Carrie Ballantyne and Roxanne D. Hawkins	
'He's Practising His Learned Social Skills on the Cat': A Mixed-Methods Investigation of Parental Perspectives of the Role of Pets in Autistic Children's Social Skills and Wellbeing	
Reprinted from: <i>Behav. Sci.</i> 2025 , <i>15</i> , 419, https://doi.org/10.3390/bs15040419	94
Emily Shoesmith, Heidi Stevens, Selina Gibsone, Cari Miles, Hannah Beal, Kelly Jennings and Elena Ratschen	
Supporting Families to 'Make the Most' of the Relationship Between Their Companion Dogs and Their Children with Autism Spectrum Condition: A Qualitative Exploration of the 'Family Dog Service'	
Reprinted from: <i>Behav. Sci.</i> 2025 , <i>15</i> , 162, https://doi.org/10.3390/bs15020162	115
Mirena Dimolareva, Ella Doolan-Dransfield, Jenny Duckworth, Victoria L. Brelsford, Kerstin Meints and Nancy R. Gee	
Pawsitive Impact: Measuring the Dog Mentor's Effect in Neurodivergent Students	
Reprinted from: <i>Behav. Sci.</i> 2026 , <i>16</i> , 323, https://doi.org/10.3390/bs16030323	136
Jacqueline M. Browne, Sarah Jean Reega, Ellen M. Rankins, Arlene A. Schmid and B. Caitlin Peters	
The Acceptability of Occupational Therapy Using Zones of Regulation™ Concepts in an Equine Environment to Autistic Children	
Reprinted from: <i>Behav. Sci.</i> 2025 , <i>15</i> , 495, https://doi.org/10.3390/bs15040495	147

Hannah Louise Brumpton and Niko Kargas

Perceived Benefits and Barriers for Autistic Adults Accessing Therapeutic Horse Riding for Mental Health

Reprinted from: *Behav. Sci.* **2026**, *16*, 84, <https://doi.org/10.3390/bs16010084> **169**

Cheryl A. Krause-Parello, Erika Friedmann, Deborah Taber, Haidong Zhu, Alejandra Quintero and Rick Yount

Veterans Training Service Dogs for Other Veterans: An Animal-Assisted Intervention for Post-Traumatic Stress Disorder

Reprinted from: *Behav. Sci.* **2025**, *15*, 1180, <https://doi.org/10.3390/bs15091180> **196**

About the Editors

Nikolaos Kargas

Nikolaos Kargas is an Associate Professor in the Department of Cognitive Sciences at the United Arab Emirates University and an Honorary Senior Research Fellow at the Autism Research Innovation Centre, University of Lincoln, United Kingdom. His research focuses on autism and mental health across the lifespan, clinical audit and service evaluation, human–animal interaction and animal-assisted interventions, educational technologies, and language and communication in neurodivergent populations. He has led and contributed to interdisciplinary and community-based projects examining psychosocial well-being, resilience, and inclusive support, including recent empirical studies on therapeutic horse riding for autistic adults and on pet–human interaction and well-being in autistic individuals and those with ADHD. His work has been published in high-impact international journals, and he is actively involved in translating research into practice through collaboration with education, health, and third-sector organisations. He is a Guest Editor of this Reprint.

Ana Maria Barcelos

Ana Maria Barcelos is affiliated with the School of Life Sciences, University of Lincoln, United Kingdom. Her work focuses on human–animal interaction and its implications for health and well-being, such as the impacts of dog and cat ownership on mental health and the psychosocial role of human–animal interaction in autism and ADHD. Currently, Ana is also a cat welfare scientist in a large UK charity (i.e., Cats Protection), where she is co-developing tools to assess and improve the welfare of shelter, unowned free-living and home cats. Her multi-faceted work supports interdisciplinary and evidence-informed approaches to animal-assisted research and practice.

Stamatina Tsiora

Stamatina Tsiora is an Honorary Fellow, and a member of the Autism Research Innovation Centre at the University of Lincoln, United Kingdom. Her research interests include cognitive neuropsychology, sleep, mental health, and animal-assisted interventions for neurodivergent populations. She has contributed to recent research on cat–human interaction and well-being in autism and ADHD and supports interdisciplinary work at the intersection of neurodivergence, cognition, and mental health.

Preface

This Reprint was developed to bring together a growing body of work on how relationships with animals, and structured animal-assisted interventions, may support neurodivergent individuals and others with complex mental health needs. Interest in this area continues to expand across psychology, education, occupational therapy, and community practice, yet the evidence base remains uneven and context-sensitive. The contributions presented here reflect both the opportunities and the challenges of the field. They address mechanisms of interaction, lived experience, family perspectives, feasibility, acceptability, and implementation across dogs, cats, and horses. We hope this Reprint will be useful to researchers, clinicians, educators, students, and practitioners who are working to develop ethical, accessible, and evidence-informed approaches that promote well-being.

Nikolaos Kargas, Ana Maria Barcelos, and Stamatina Tsiora

Guest Editors



Animal-Assisted Interventions for Neurodivergent Individuals: Advancing Research, Practice, and Well-Being

Niko Kargas ^{1,*}, Ana Maria Barcelos ² and Stamatina Tsiora ³

¹ Department of Cognitive Sciences, United Arab Emirates University, Al Ain P.O. Box 15551, United Arab Emirates

² School of Natural Sciences, University of Lincoln, Lincoln LN6 7TS, UK; abarcelos@lincoln.ac.uk

³ School of Psychology, Sport Science and Wellbeing, University of Lincoln, Lincoln LN6 7TS, UK; mtsiora@lincoln.ac.uk

* Correspondence: nkargas@uaeu.ac.ae

1. Introduction

Within contemporary clinical, educational, and psychosocial research, animal-assisted interventions (AIs) occupy a distinctive and empirically contested position. Enthusiasm for the field has grown rapidly, driven by accounts of improved regulation, social engagement, confidence, and well-being across diverse populations. Yet the evidence base remains uneven in its terminology, methods, outcome frameworks, and explanatory models, and implementation in practice has frequently advanced ahead of the conceptual and methodological precision needed to support cumulative science (Beetz et al., 2012; Dimolareva & Dunn, 2021; Gee et al., 2021; Green et al., 2024; Kerulo et al., 2020; O'Haire, 2013, 2017; Rodriguez et al., 2021; Santaniello et al., 2020). This tension is especially visible in research involving neurodivergent populations, where interest in humane, relational, and non-stigmatising forms of support is high, and where outcomes, mechanisms, acceptability, and access cannot be assumed. Neurodevelopmental conditions are heterogeneous by definition (Thapar et al., 2017), and the neurodiversity framework usefully reminds us that such heterogeneity is not reducible to deficit alone but reflects variation in minds and nervous systems situated within social and environmental contexts (Chapman, 2020; Dwyer, 2022). This framing is particularly relevant here because, while autism and Attention-Deficit/Hyperactivity Disorder (ADHD) are paradigmatic neurodevelopmental forms of neurodivergence, the inclusion of Post-Traumatic Stress Disorder (PTSD) in this Reprint reflects an intentionally expansive and pragmatic use of the term. The scope of neurodivergence remains contested; however, trauma research demonstrates that PTSD is associated with enduring alterations in brain structure and function, alongside marked difficulties in emotion regulation and social functioning, domains that overlap meaningfully with those examined across autism and ADHD scholarship (Beheshti et al., 2020; Conti et al., 2023; McDonald et al., 2024; Pitman et al., 2012; Scoglio et al., 2022). Similarly, “animal-assisted intervention” is an umbrella term rather than a single modality, and the mere presence of an animal is not, in itself, a mechanism of therapeutic benefit (Kerulo et al., 2020; Santaniello et al., 2020). The central scholarly value of this Reprint lies precisely in how clearly it confronts that complexity.

2. Scope of the Special Issue

The ten contributions assembled in this Reprint comprise nine empirical studies and one systematic review. Across dogs, cats, and horses; across home, school, therapeutic, clinical, and community settings; and across autistic children, autistic adults, individuals

with ADHD or co-occurring autism and ADHD, and veterans with PTSD, the Reprint moves beyond the simplistic question of whether animals “help” and towards more analytically productive questions: what kinds of human–animal relationships matter, for whom, in which contexts, by what processes, and under what practical, ethical, and methodological conditions (Browne et al., 2025; Brumpton & Kargas, 2026; Dimolareva et al., 2026; González-Sala et al., 2025; Hüsken et al., 2025; Krause-Parello et al., 2025; Shoesmith et al., 2025; Toutain et al., 2025; Widdison et al., 2026; Wilson et al., 2025). Rather than serving as a simple catalogue of positive outcomes, the collection foregrounds important distinctions between intervention types, analytic levels, relational contexts, and forms of evidence, reflecting an important maturation in the field.

3. An Overview of the Published Articles

One of the clearest themes emerging across the collection is that the meaningful unit of analysis is not simply the animal, but the relational ecology in which human–animal contact is embedded. González-Sala et al.’s (2025) systematic review of 23 studies, conducted with PRISMA guidelines, anchors this point by showing that parents tend to perceive benefits of AAI at physical, social, and emotional levels, while also identifying family-level effects including reduced parental stress and improved family functioning. Yet this Reprint demonstrates consistently that such outcomes are shaped by far more than animal presence alone. Shoesmith et al. (2025), in a qualitative study of the Family Dog Service, found that parents described companion dogs as sources of enhanced attention, reduced loneliness and anxiety-based behaviour, and improved family well-being, but emphasised that these benefits were inseparable from tailored guidance, long-term support, and deliberate attention to sensory fit, dog selection, and relationship-building over time. Wilson et al. (2025) similarly showed that among autistic children, positive behaviour toward a pet predicted prosocial behaviour, while qualitative accounts highlighted emotion regulation, improved sleep, comfort, and expanded social opportunity alongside pet-related anxieties and welfare concerns. Widdison et al. (2026) extend this picture further by examining cat–human interaction in autistic and ADHD adults, showing that companion-animal relationships can also involve burden: anxious cat behaviour, poorer cat health, close proximity, and perceived inability to provide adequate care for the animal were each associated with poorer well-being outcomes. Taken together, these studies challenge the still-common assumption that pet ownership or animal contact is inherently salutogenic. The more defensible conclusion is that human–animal relationships can function as psychosocial resources, but only under specific relational, practical, and ethical conditions (Atherton et al., 2023; Barcelos et al., 2021; Hall et al., 2016; O’Haire, 2013).

A second major contribution of this Reprint is its attention to mechanism and process, addressing a recurring weakness in AAI scholarship: the tendency to report outcomes without adequately explaining how they arise (Nieforth et al., 2021; Rodriguez et al., 2021). Several papers directly confront this gap. Hüsken et al. (2025), using behavioural observation and an ethogram across repeated dog-assisted therapy sessions, found partial support for the “icebreaker” account: participant–dog interaction tended to decrease over time while participant–therapist engagement increased, suggesting that the dog may initially facilitate rapport rather than remaining the central relational focus throughout therapy. Toutain et al. (2025) add a further layer of analytical sophistication by combining eye-tracking, ethological observation, and facial expression identification tasks. Their findings demonstrate that visual attention is context dependent: children diagnosed with autism paid less attention to faces and more attention to the broader environment than their typically developing peers, yet behavioural patterns during free interaction with an assistance dog were similar across groups, and within-group associations linked gaze

allocation to interaction style and expression-recognition performance. Wilson et al. (2025) further bridge process and outcome by suggesting that prosocial development may be linked less to attachment in the abstract than to the quality of enacted behaviour toward the pet. Across these papers, animals are not treated as quasi-magical therapeutic agents but as participants in dynamic, situated systems of attention, arousal, co-regulation, and relational learning, a position that is consistent with broader biopsychosocial accounts of human–animal interaction (Beetz et al., 2012; Gee et al., 2021; O’Haire et al., 2015).

The equine-focused contributions press the field towards greater precision in intervention design. Browne et al. (2025) examine the acceptability of Occupational Therapy Using Zones of RegulationTM concepts in an equine environment for autistic children, making a particularly valuable methodological and ethical contribution by centring the perspectives of the children themselves. Their findings are instructive: the intervention was generally acceptable, horse riding was clearly meaningful and enjoyable, yet some components of the Zones of RegulationTM curriculum were experienced as less acceptable, illustrating that promising interventions may still require adaptation in delivery, pacing, or content to align with participant preferences and capacities. Additionally, Brumpton and Kargas (2026) conducted a qualitative study of therapeutic horse riding for autistic adults, showcasing positive outcomes such as enjoyment, calm, self-efficacy, authenticity in relationships, and benefits that extended into daily life beyond the riding arena, while also highlighting the structural barriers (i.e., cost, transport, limited facilities, limited specialist staff) that determine who can actually participate. Together, these papers support the broader equine-assisted services literature while pressing it in a more differentiated direction: away from generic claims about horses as therapeutic and toward a more empirically grounded account of equine-assisted services as embodied, relational, structured, and access-dependent forms of support (Gabriels et al., 2015; McDaniel Peters & Wood, 2017; Wood et al., 2021).

This Reprint is equally notable for situating the benefits of canine-assisted interventions in different settings. Dimolareva et al. (2026) analysed handler and teacher reports from 58 schools participating in The Dog Mentor programme, showing how school-based dog support is perceived to create calmer environments, promote engagement, reduce barriers to learning, and support self- and emotion regulation. Importantly, this study highlights that flexibility may not be merely a methodological concession but a feature that makes school-based AAI workable in practice. Shoesmith et al.’s (2025) findings indicated that companion dogs could have similar benefits to those reported for assistance dogs for autistic children, but also emphasised the importance of practical scaffolding in decision making with respect to selecting and training a dog. Krause-Parello et al.’s (2025) randomised study of female veterans with PTSD participating in a service dog training programme highlighted its positive effects on a number of biological and psychological indicators of stress, whereas combat exposure moderated these changes. This is a valuable reminder that the effects of animal-assisted programmes may be multidimensional, non-linear, and context sensitive.

4. Methodological and Conceptual Considerations

Methodologically, this Reprint is stronger than much of the preceding literature. Its contributions include a PRISMA-guided systematic review with a registered protocol, qualitative interview studies with parents and autistic adults, mixed-methods research, content analysis, observational coding of therapeutic triads, eye-tracking, and biomarker assessment. This diversity is a genuine strength, and it also exposes a number of limitations. Samples are often small; participant groups are sometimes internally heterogeneous; direct participant voice remains less common than proxy report; and outcome frameworks remain

difficult to compare across studies. These challenges are not unique to AAI research, but they are particularly consequential in a field characterised by substantial variability in species, training, setting, handler expertise, participant preference, and programme aims (O’Haire, 2017; Rodriguez et al., 2021). What emerges from the Reprint is not a call for rigid standardisation at the expense of person-centred practice, but for sharper and more transparent reporting, clearer conceptual boundaries, and more explicit theory of change. The field needs frameworks that can accommodate both benefit and burden, symptom change and positive well-being, and human outcomes and animal welfare. Widdison et al.’s (2026) use of a pet–human-related factors framework is instructive in this respect, capturing both the positive as well as cumbersome aspects of cat ownership rather than assuming that closeness is uniformly beneficial (see also Barcelos et al., 2021).

A further scholarly strength of this Reprint is its alignment with neurodiversity-affirming priorities, even where the underlying literature reflects mixed terminology and divergent conceptual traditions. Several papers explicitly treat lived experience as a primary source of knowledge rather than a supplement to clinician- or caregiver-generated data. Browne et al. (2025) centre autistic children’s accounts of intervention acceptability. Brumpton and Kargas (2026) foreground autistic adults’ own accounts of meaning, access, and psychological change. Wilson et al. (2025) and Shoesmith et al. (2025) take family perspectives seriously without reducing children’s experiences to parental interpretation. This represents an important corrective in a field that has historically spoken about neurodivergent people more readily than with them. More broadly, the Reprint models a shift in autism and neurodiversity research: from deficit-framed, externally defined notions of “improvement” towards more situated questions about fit, safety, communication, agency, and quality of life (Atherton et al., 2023; Botha & Cage, 2022). At the same time, the inclusion of veterans with PTSD within the Reprint’s scope invites productive conceptual reflection. It signals an intentionally expansive understanding of neurodivergence organised less by diagnostic purity and more by shared concerns around regulation, relational safety, mental health, and access to supportive environments. Whether all such conditions are best grouped under a common conceptual umbrella remains open to debate, but the Reprint demonstrates that this boundary question can be intellectually productive rather than merely terminological.

5. Practical Implications and Future Directions

The practical implications of this body of work are substantial. For clinicians, this Reprint suggests that animal-assisted work should be treated neither as an all-purpose adjunct nor as a niche novelty, but as a set of structured relational options whose appropriateness depends on the person, animal, context, goals, and available support infrastructure. For educators and school leaders, the school-based studies point to the importance of staff training, whole-setting planning, and animal welfare safeguards rather than ad hoc or unstructured use. For service providers, the collection foregrounds access and equity as central rather than secondary concerns: cost, transport, waiting times, staffing, and local availability all determine who benefits from promising programmes. For researchers, the Reprint underscores the need for comparative work across intervention types, longitudinal follow-up, more precise moderator analyses, economic and implementation evaluation, and co-produced designs that take neurodivergent priorities seriously from the outset. Such priorities are not incidental to scientific progress; they are necessary if the field is to move from pockets of encouraging evidence to genuinely evidence-based, ethically defensible, and scalable practice.

6. Conclusions

What, finally, does this Reprint contribute to the wider field? Its greatest contribution may be that it resists simplification. It does not present AAIs as universally effective, inherently benign, or conceptually settled, nor does it dismiss the field on account of its methodological heterogeneity. Instead, it shows a field in the midst of methodological and theoretical consolidation. Animals in these studies appear as companions, co-regulators, catalysts for social contact, partners in embodied activity, and, at times, sources of obligation or strain. Neurodivergent participants are not treated as passive recipients of benefit, but as individuals whose sensory profiles, communicative styles, preferences, histories, and material circumstances shape what any intervention can become. In this sense, the Reprint advances research, practice, and well-being not by closing debate, but by improving its quality: making it more precise, more critical, more ethically alert, and more responsive to lived experience.

Acknowledgments: The Guest Editors would like to express their sincere gratitude to all authors and research teams whose scholarship has contributed to this Special Issue and its Reprint. We are equally grateful to the participants, families, caregivers, practitioners, educators, and community partners whose time, trust, and engagement made the studies included in this Reprint possible. Their contributions are essential to advancing research, practice, and well-being in the field of animal-assisted interventions for neurodivergent individuals. We also thank the reviewers for their thoughtful and constructive feedback, which helped strengthen the quality of the published work. Finally, we warmly acknowledge the Behavioral Sciences Editorial Office, together with the journal's administrative and technical staff, for their professional guidance, coordination, and support throughout the editorial and production process. The authors have reviewed and edited the final text and take full responsibility for the content of this publication.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AAIs	Animal-Assisted Interventions
ADHD	Attention-Deficit/Hyperactivity Disorder
PTSD	Post-Traumatic Stress Disorder

List of Contributions:

1. Browne, J. M., Reega, S. J., Rankins, E. M., Schmid, A. A., & Peters, B. C. (2025). The acceptability of occupational therapy using zones of regulationTM concepts in an equine environment to autistic children. *Behavioral Sciences*, 15(4), 495. <https://doi.org/10.3390/bs15040495>.
2. Brumpton, H. L., & Kargas, N. (2026). Perceived benefits and barriers for autistic adults accessing therapeutic horse riding for mental health. *Behavioral Sciences*, 16(1), 84. <https://doi.org/10.3390/bs16010084>.
3. Dimolareva, M., Doolan-Dransfield, E., Duckworth, J., Brelsford, V. L., Meints, K., & Gee, N. R. (2026). Pawsitive impact: Measuring the dog mentor's effect in neurodivergent students. *Behavioral Sciences*, 16(3), 323. <https://doi.org/10.3390/bs16030323>.
4. González-Sala, F., Llopiz-Guerra, K., Ferri, A., & Martí-Vilar, M. (2025). Parents' perspectives on the benefits of animal-assisted intervention: A systematic review. *Behavioral Sciences*, 15(12), 1663. <https://doi.org/10.3390/bs15121663>.
5. Hüsken, C. J., Peters-Scheffer, N., & Didden, R. (2025). Exploring Interaction dynamics in dog-assisted therapy: An observational study. *Behavioral Sciences*, 15(8), 1115. <https://doi.org/10.3390/bs15081115>.
6. Krause-Parello, C. A., Friedmann, E., Taber, D., Zhu, H., Quintero, A., & Yount, R. (2025). Veterans training service dogs for other veterans: An animal-assisted intervention for post-traumatic stress disorder. *Behavioral Sciences*, 15(9), 1180. <https://doi.org/10.3390/bs15091180>.

7. Shoesmith, E., Stevens, H., Gibsone, S., Miles, C., Beal, H., Jennings, K., & Ratschen, E. (2025). Supporting families to 'make the most' of the relationship between their companion dogs and their children with autism spectrum condition: A qualitative exploration of the 'family dog service'. *Behavioral Sciences*, 15(2), 162. <https://doi.org/10.3390/bs15020162>.
8. Toutain, M., Paris, S., Lefranc, S., Henry, L., & Grandgeorge, M. (2025). From gaze to interaction: Links between visual attention, facial expression identification, and behavior of children diagnosed with ASD or typically developing children with an assistance dog. *Behavioral Sciences*, 15(5), 674. <https://doi.org/10.3390/bs15050674>.
9. Widdison, L., Barcelos, A. M., Tsiora, S., Zarie, A., Mills, D. S., & Kargas, N. (2026). Exploring cat-human interaction as a psychosocial resource in autism and ADHD: Risks, engagement, and well-being. *Behavioral Sciences*, 16(2), 162. <https://doi.org/10.3390/bs16020162>.
10. Wilson, C., Ballantyne, C., & Hawkins, R. D. (2025). 'He's practising his learned social skills on the cat': A mixed-methods investigation of parental perspectives of the role of pets in autistic children's social skills and wellbeing. *Behavioral Sciences*, 15(4), 419. <https://doi.org/10.3390/bs15040419>.

References

- Atherton, G., Edisbury, E., Piovesan, A., & Cross, L. (2023). 'They ask no questions and pass no criticism': A mixed-methods study exploring pet ownership in autism. *Journal of Autism and Developmental Disorders*, 53(8), 3280–3294. [CrossRef]
- Barcelos, A. M., Kargas, N., Packham, C., & Mills, D. S. (2021). Understanding the impact of dog ownership on autistic adults: Implications for mental health and suicide prevention. *Scientific Reports*, 11(1), 23655. [CrossRef]
- Beetz, A., Uvnäs-Moberg, K., Julius, H., & Kotrschal, K. (2012). Psychosocial and psychophysiological effects of human-animal interactions: The possible role of oxytocin. *Frontiers in Psychology*, 3, 234. [CrossRef]
- Beheshti, A., Chavanon, M.-L., & Christiansen, H. (2020). Emotion dysregulation in adults with attention deficit hyperactivity disorder: A meta-analysis. *BMC Psychiatry*, 20, 120. [CrossRef] [PubMed]
- Botha, M., & Cage, E. (2022). "Autism research is in crisis": A mixed method study of researchers' constructions of autistic people and autism research. *Frontiers in Psychology*, 13, 1050897. [CrossRef] [PubMed]
- Chapman, R. (2020). Defining neurodiversity for research and practice. In H. Bertilsson Rosqvist, N. Chown, & A. Stenning (Eds.), *Neurodiversity studies: A new critical paradigm* (pp. 218–220). Routledge. [CrossRef]
- Conti, L., Fantasia, S., Violi, M., Dell'Oste, V., Pedrinelli, V., & Carmassi, C. (2023). Emotional dysregulation and post-traumatic stress symptoms: Which interaction in adolescents and young adults? A systematic review. *Brain Sciences*, 13(12), 1730. [CrossRef] [PubMed]
- Dimolareva, M., & Dunn, T. J. (2021). Animal-assisted interventions for school-aged children with autism spectrum disorder: A meta-analysis. *Journal of Autism and Developmental Disorders*, 51(7), 2436–2449. [CrossRef]
- Dwyer, P. (2022). The neurodiversity approach(es): What are they and what do they mean for researchers? *Human Development*, 66(2), 73–92. [CrossRef]
- Gabriels, R. L., Pan, Z., Dechant, B., Agnew, J. A., Brim, N., & Mesibov, G. (2015). Randomized controlled trial of therapeutic horseback riding in children and adolescents with autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 54(7), 541–549. [CrossRef]
- Gee, N. R., Rodriguez, K. E., Fine, A. H., & Trammell, J. P. (2021). Dogs supporting human health and well-being: A biopsychosocial approach. *Frontiers in Veterinary Science*, 8, 630465. [CrossRef]
- Green, F. L., Dahlman, M. L., Lomness, A., & Binfet, J.-T. (2024). For the love of acronyms: An analysis of terminology and acronyms used in AAI research 2013–2023. *Human-Animal Interactions*, 12, 1–10. [CrossRef]
- Hall, S. S., Wright, H. F., & Mills, D. S. (2016). What factors are associated with positive effects of dog ownership in families with children with autism spectrum disorder? The development of the Lincoln autism pet dog impact scale. *PLoS ONE*, 11(2), e0149736. [CrossRef]
- Kerulo, G., Kargas, N., Mills, D. S., Law, G., VanFleet, R., Faa-Thompson, T., & Winkle, M. Y. (2020). Animal-assisted interventions: Relationship between standards and qualifications. *People and Animals: The International Journal of Research and Practice*, 3(1), 4. [CrossRef]
- McDaniel Peters, B. C., & Wood, W. (2017). Autism and equine-assisted interventions: A systematic mapping review. *Journal of Autism and Developmental Disorders*, 47(10), 3220–3242. [CrossRef] [PubMed]
- McDonald, R. G., Cargill, M. I., Khawar, S., & Kang, E. (2024). Emotion dysregulation in autism: A meta-analysis. *Autism*, 28(12), 2986–3001. [CrossRef]

- Nieforth, L. O., Schwichtenberg, A., & O'Haire, M. E. (2021). Animal-assisted interventions for autism spectrum disorder: A systematic review of the literature from 2016 to 2020. *Review Journal of Autism and Developmental Disorders*, 10, 255–280. [CrossRef]
- O'Haire, M. E. (2013). Animal-assisted intervention for autism spectrum disorder: A systematic literature review. *Journal of Autism and Developmental Disorders*, 43, 1606–1622. [CrossRef] [PubMed]
- O'Haire, M. E. (2017). Research on animal-assisted intervention and autism spectrum disorder, 2012–2015. *Applied Developmental Science*, 21(3), 200–216. [CrossRef]
- O'Haire, M. E., McKenzie, S. J., Beck, A. M., & Slaughter, V. (2015). Animals may act as social buffers: Skin conductance arousal in children with autism spectrum disorder in a social context. *Developmental Psychobiology*, 57, 584–595. [CrossRef] [PubMed]
- Pitman, R. K., Rasmusson, A. M., Koenen, K. C., Shin, L. M., Orr, S. P., Gilbertson, M. W., Milad, M. R., & Liberzon, I. (2012). Biological studies of post-traumatic stress disorder. *Nature Reviews Neuroscience*, 13(11), 769–787. [CrossRef]
- Rodriguez, K. E., Herzog, H., & Gee, N. R. (2021). Variability in human-animal interaction research. *Frontiers in Veterinary Science*, 7, 619600. [CrossRef]
- Santaniello, A., Dicé, F., Carratú, R. C., Amato, A., Fioretti, A., & Menna, L. F. (2020). Methodological and terminological issues in animal-assisted interventions: An umbrella review of systematic reviews. *Animals*, 10(5), 759. [CrossRef] [PubMed]
- Scoglio, A. A. J., Reilly, E. D., Girouard, C., Quigley, K. S., Carnes, S., & Kelly, M. M. (2022). Social functioning in individuals with post-traumatic stress disorder: A systematic review. *Trauma, Violence, & Abuse*, 23(2), 356–371. [CrossRef]
- Thapar, A., Cooper, M., & Rutter, M. (2017). Neurodevelopmental disorders. *Lancet Psychiatry*, 4(4), 339–346. [CrossRef] [PubMed]
- Wood, W., Alm, K., Benjamin, J., Thomas, L., Anderson, D., Pohl, L., & Kane, M. (2021). Optimal terminology for services in the United States that incorporate horses to benefit people: A consensus document. *The Journal of Alternative and Complementary Medicine*, 27(1), 88–95. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Review

Parents' Perspectives on the Benefits of Animal-Assisted Intervention: A Systematic Review

Francisco González-Sala ¹, Karel Llopiz-Guerra ², Ainhoa Ferri ³ and Manuel Martí-Vilar ^{4,*}

¹ Department of Developmental and Educational Psychology, Universitat de València, 46010 Valencia, Spain; francisco.gonzalea-sala@uv.es

² Department of Special Education, Universidad Central “Marta Abreu” de las Villas, Carretera de Camajuaní Km 5 1/2, Santa Clara 50100, Villa Clara, Cuba; karelllopizguerra@gmail.com

³ Fundació Mira'M, Carrer de Rugat, 4-6, Camins al Grau, 46021 Valencia, Spain; ainhoa.ferri@fundaciomiram.org

⁴ Department of Basic Psychology, Universitat de València, 46010 Valencia, Spain

* Correspondence: manuel.marti-vilar@uv.es

Abstract

Animal-assisted intervention is widely used in children and adolescents with neurodevelopmental disorders. The aim of this review is to understand the perceptions of parents of children with neurodevelopmental disorders, regarding the benefits of their children's participation in animal-assisted intervention. Using the PRISMA methodology, a search was conducted in the Web of Science and ProQuest Central databases. The number of articles included in the review was 23 after applying the selection criteria. The results indicate that in all interventions carried out with children with neurodevelopmental disorders, parents perceive improvements in their children mainly at the physical, social and emotional levels. In addition, they identify positive aspects that influence family functioning. It can be concluded that these types of interventions, regardless of the type of animal or activity, are a beneficial tool when addressing different symptoms associated with neurodevelopmental disorders, having an impact not only on the child or adolescent, but also on parents or caregivers.

Keywords: animal-assisted intervention; neurodevelopmental disorders; parents; systematic review

1. Introduction

Neurodevelopmental disorders are characterised by the presence of a delay or impairment that hinders or prevents the acquisition of a whole range of skills related to different areas of development (Thapar et al., 2017), encompassing a wide variety of disorders, including intellectual disability, Attention Deficit Hyperactivity Disorder, Communication Disorders, Motor Disorders, Specific Learning Disorders and Autism Spectrum Disorder (APA, 2013), among others.

The IAHAIO (2018) defines Animal-Assisted Interventions (AAIs) as organised interventions that intentionally incorporate animals in various settings, such as health, education and public services. These interventions pursue specific objectives with the aim of improving people's quality of life and achieving therapeutic benefits.

AAI is known in the health field as Animal-Assisted Therapy (AAT), a term coined by Levinson (1969). This is considered the starting point in the development of AAI programmes. Likewise, in 1977, several psychiatrists, veterinarians, and doctors created the

Delta Foundation in Portland, United States. This organisation served to create the Delta Society (now Pet Partners) in 1981, considered the global pioneer in the development of research and working protocols for AAI (Martos-Montes et al., 2015). Taking the Delta Society's definitions (Fredrickson, 1992) as a reference, AAI is divided into different modalities according to the purpose of the intervention and the type of professionals involved: Animal-Assisted Activities (AAAs) are interventions carried out by a human–animal team in contexts covered by non-formal education. These interventions pursue recreational, motivational and educational goals, emphasising the spontaneous interactions that may occur between the animal and the participants in the activity, without having any specific objectives (IAHAIO, 2018). Animal-Assisted Education (AAE) as a pedagogical resource and Animal-Assisted Therapy (AAT) have a clearly therapeutic objective directed towards the person. In line with these views, Lasa et al. (2011) classify three types of actions in relation to animal-assisted interventions (AAIs), namely service animal programmes, animal-assisted activities and animal-assisted therapies. According to Delgado et al. (2017), AAI focuses mainly on four areas or domains of development: psychomotor skills, cognitive skills, socio-emotional skills and language and communication skills, with the latter two areas being related to social development and sociability.

The Fundación Affinity (2023) details the various benefits that people who participate in AAI obtain. These include an increased desire and willingness to engage in group activities and teamwork, increased self-esteem (Arkow, 2010; Parra, 2016), as well as increased sense of responsibility (Fundación Affinity, 2009; Jacobsen, 1997). It also helps reduce anxiety and/or feelings of loneliness (Levinson, 1995; Signes & Rodrigo, 2010), opens up space for the expression of affection and feelings (Poresky, 1996; Fundación Affinity, 2009), increases levels of attention and concentration (Beetz, 2013; Parra, 2016), helps to overcome fears, improves physical condition, moderates anxiety levels, provides stress relief and physical benefits such as reduced heart rate and reduced blood pressure (Morrison, 2007). Focusing on neurodevelopmental disorders, there are various studies that show benefits in children after their participation in an AAI, such as Ávila-Álvarez et al. (2022), Chadwick et al. (2022) or Narvekar and Krishnan (2024). In the specific case of Hippotherapy, a form of horse-assisted therapy that focuses on neurological functioning and sensory processing (Koca & Ataseven, 2015), studies such as those conducted by Ajzenman et al. (2013), Muñoz-Lasa et al. (2011) and Snider et al. (2007) have found positive effects in children with ASD and cerebral palsy, while Silkwood-Sherer et al. (2012) obtained positive results with the implementation of this kind of therapy in children with Down syndrome.

Therapies that use dogs, both assistance dogs, which are trained for the purpose of specialised intervention with a specific group of individuals, and companion dogs, which are trained by the parents themselves or by private trainers, also report positive psychosocial outcomes in children with autism (Fung, 2017; Grandgeorge et al., 2012; Hardy & Weston, 2020; Guay et al., 2022; Hellings et al., 2022; Tseng, 2023), among others. These benefits are reflected in the regulation of emotional state and increase in social skills, along with the reduction in stress and anxiety levels, which can be high in children with ASD, contributing to calm children in the presence of and in contact with the dog (Appleby et al., 2022; Burgoyne et al., 2014; Carlisle et al., 2018; Hallyburton & Hinton, 2017; Narvekar & Narvekar, 2022; Viau et al., 2010).

The benefits of AAI also extend to parents or primary caregivers, as pointed out by Bibbo et al. (2019), Brown (2017) and Fecteau et al. (2017), reducing stress levels in parents and improving life quality.

The overall objective of this review is to conduct a systematic review of the scientific literature in order to understand the perceptions of parents of children with neurodevelopmental disorders, regarding the impact of AAI on their children and on family functioning.

Based on this general objective, the following specific objectives and corresponding hypotheses are proposed:

- To understand parents' perceptions of the impact of AAI on their children in relation to social, emotional and motor skills, among others. In this regard, it is expected that parents identify benefits associated with AAI, mainly in psychosocial development (Hypothesis 1).
- To understand the effects that AAI may have on variables related to family functioning in general and on parents in particular, such as stress and anxiety, satisfaction or well-being. In this regard, it is expected that AAI will have positive effects on different aspects of family functioning according to parents' perceptions (Hypothesis 2).

2. Materials and Methods

2.1. Search Strategy

For the correct preparation of the systematic review, a research question was formulated in PICO format, which was as follows: What impact does AAI have on parents of children and adolescents with neurodevelopmental disorders who participate in this type of intervention, and what are their perspectives on the therapy? The guidelines proposed in the PRISMA 2020 Statement (Page et al., 2021) were followed while preparing this review. The analysis process to determine whether the articles were appropriate for the research objective was carried out independently by two researchers acting as 'blind' evaluators. The COVidence programme was used for this purpose, which increased inter-rater reliability, obtaining a reliability of 0.91. In cases of disagreement, a third reviewer was responsible for evaluating the article. After this process, a discussion was held to decide whether to include the study in the review or not.

This study includes a systematic review of the scientific literature related to AAI aimed at children with neurodevelopmental disorders. The review protocol was registered in PROSPERO with the following registration number: CRD42023446582.

The search was conducted in the Web of Science Core Collection and ProQuest databases in July 2025, including all works published up to 2024. The search equation used was in the Topic field: animal-assisted intervention* OR animal-assisted therapy OR animal-assisted education OR animal-assisted activities AND neurodevelopmental disorder* OR ASD OR Autism OR Asperger OR ADHD OR Attention deficit disorder and hyperactivity OR learning disorders OR Down Syndrome.

2.2. Selection Criterion

The following inclusion criteria were selected: quantitative and qualitative empirical studies addressing parents' perceptions of the effect of AAI; published and peer-reviewed; written in English or Spanish; focusing on children and adolescents with neurodevelopmental disorders; published up to July 2025. The exclusion criteria were as follows: review studies or meta-analyses; theoretical articles; other types of documents such as books, book chapters, conference proceedings or doctoral theses; studies that do not address parents' perceptions of the effects of AAI in their results; those using samples of adults and/or children and adolescents with mental or physical health problems, acquired brain damage or traumatic experiences.

2.3. Procedure

The total number of papers analysed was 278, of which 154 were found in WoS, 121 in ProQuest, and 3 articles were manually included when reviewing the references. After removing duplicate articles in both databases ($n = 34$), the titles and abstracts of a total of 244 articles were read, and a total of 213 studies were excluded for various reasons: not focusing on parents' perceptions ($n = 168$), not focusing on samples with neurodevelopmental disorders ($n = 10$), the intervention was performed by a robot ($n = 4$), because they were theoretical articles ($n = 9$), because they were review articles or meta-analyses ($n = 11$), because they focused on therapists' perceptions ($n = 5$), and because they focused on samples of people over 18 years old ($n = 15$). After this, a total of 31 articles were read in full, eliminating one study for not including children or adolescents with neurodevelopmental disorders and seven for not including parents' perceptions in accordance with the object of study of this review. The number of articles included in this review was 23. This process is shown in Figure 1.

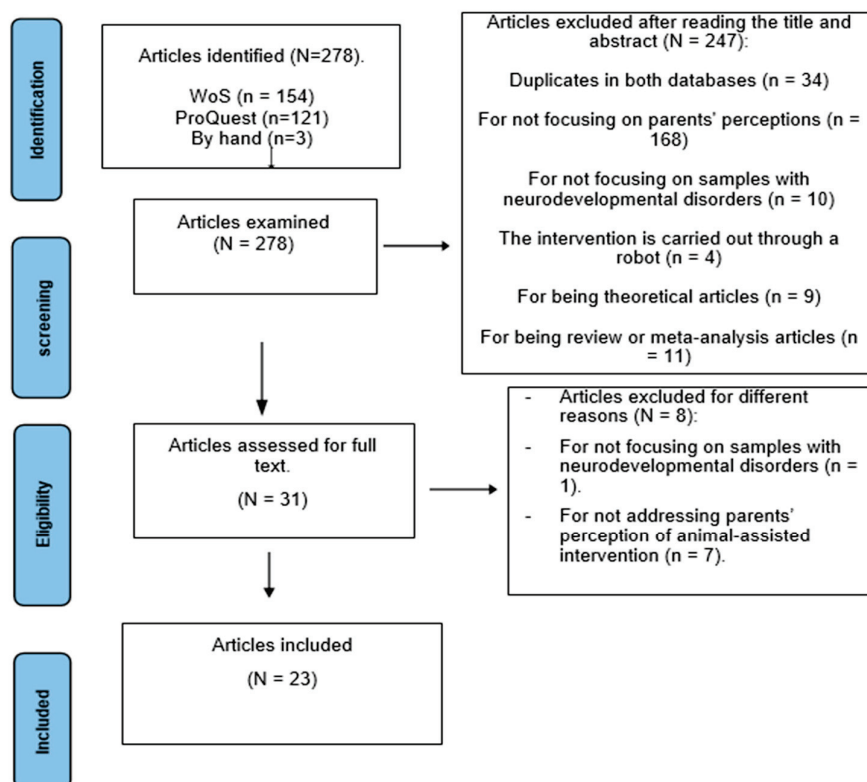


Figure 1. Flowchart of the different phases carried out in the review.

2.4. Methodological Quality of the Selected Articles

Two of the authors of this study reviewed the quality of the articles included in the review, based on the Standards for Quality Improvement Reporting Excellence 2.0 (QUIRE 2.0) scale by (Ogrinc et al., 2016). To this end, the 18 indicators included in the scale were selected, relating to the sections title and abstract, introduction, method, results, discussion and other information, classifying the articles into three categories: high quality (when between 12 and 18 indicators were met), medium quality (between 11 and 6 indicators) and low quality (5 or fewer indicators). After application, all articles were assessed as high quality, although the indicator referring to the description of the intervention was the one with the most shortcomings, as some articles did not fully describe the methodology used in the AAI programmes. The inter-rater agreement between the two reviewers, according

to Cohen's Kappa coefficient (Orwin, 2018), was 0.88, indicating very good agreement between the reviewers (Hernández-Nieto, 2002).

3. Results

Table 1 summarizes the main characteristics of the 23 studies included in this structured review in chronological and alphabetical order.

3.1. Characteristics of the Samples and Type of AAI

Considering the type of population targeted by the interventions, it should be noted that in the vast majority of cases, 20 studies (86.9%), these interventions were aimed at children with ASD, with three studies, Boyd and Le Roux (2017), Scotland-Coogan et al. (2021) and Stumpf and Breitenbach (2014), including children with other types of disorders and disabilities in addition to this type of disorder.

Regarding the origin of the samples, these are distributed across a total of nine countries. Specifically, eight studies were conducted in Australia, five in the United States, three in the United Kingdom, two in Ireland, one in Canada (Guay et al., 2024), one in South Africa (Boyd & Le Roux, 2017), one in the Netherlands (van der Steen et al., 2019), one in Germany (Stumpf & Breitenbach, 2014), and one in Brazil (Michelotto et al., 2019).

Depending on the type of AAI, 15 studies (65.2%) use dogs in two different ways: either through occupational therapy or assistance dogs or through pet dogs. The use of horses in therapy is present in six studies (20.1%), one of which specifies Hippotherapy as the type of intervention (Scotland-Coogan et al., 2021). Finally, one study uses dolphins (Stumpf & Breitenbach, 2014), and another uses farm animals (Dolecheck et al., 2024).

3.2. Benefits of AAI in Children with Neurodevelopmental Disorders, as Perceived by Their Parents or Caregivers

Depending on the type of therapy, the studies included in this review point out benefits to children in different areas of development, according to their parents.

In relation to the use of therapy involving horses, parents perceive benefits in the physical and motor domain, with improvements in body posture (Boyd & Le Roux, 2017), stability and balance (Boyd & Le Roux, 2017; Scotland-Coogan et al., 2021; Cleary et al., 2024), increased strength and fine/gross motor skills (Scotland-Coogan et al., 2021). All these findings show an impact on greater autonomy in actions or tasks such as walking, dressing and showering.

In studies that use horses in therapy, parents perceive improvement at the social level: Boyd and Le Roux (2017), Malcolm et al. (2018), Tan and Simmonds (2018), van der Steen et al. (2019), Kalmbach et al. (2020), Scotland-Coogan et al. (2021) and Cleary et al. (2024). These benefits include greater confidence and interest in social relationships, with participants becoming more communicative, more aware of others and experiencing fewer relationship problems. These benefits are also linked with language improvement, in speech and receptive language (Boyd & Le Roux, 2017; Scotland-Coogan et al., 2021) and language acquisition (Scotland-Coogan et al., 2021). Emotionally, parents perceive their children to be in a better mood (Tan & Simmonds, 2018; Kalmbach et al., 2020), with greater feelings of joy and happiness (Boyd & Le Roux, 2017; Tan & Simmonds, 2018; Kalmbach et al., 2020; Cleary et al., 2024), greater emotional regulation, appearing calmer and more relaxed (Boyd & Le Roux, 2017; Malcolm et al., 2018; Tan & Simmonds, 2018; van der Steen et al., 2019; Kalmbach et al., 2020; Scotland-Coogan et al., 2021; Cleary et al., 2024), which lead parents to perceive a decrease in emotional problems (van der Steen et al., 2019) and improved self-esteem (Boyd & Le Roux, 2017; Tan & Simmonds, 2018).

Table 1. Main characteristics and results found through the systematic review.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Burgoyne et al. (2014)	Parents' perspective on the impact of the assistance dog on children with ASD.	Ireland Experimental group: n = 134 parents/guardians with an assistance dog. Control group: n = 87 parents of children on the waiting list were surveyed.	Quantitative and qualitative design. A cross-sectional study. Perceived Competence Scales (PCS) (Williams et al., 1998). Caregiver Strain Questionnaire (CGSQ) (Brannan et al., 1997). In addition, questions about parents' perception of safety and a section on benefits and limitations are included.	Assistance dog.	The experimental group reported greater perceptions of safety regarding environmental risks ($M = 32.43$; $p < 0.001$) compared to the control group ($M = 22.97$), especially in cases where children were enrolled in special education schools (Mdif. = 6.62; 95% CI 0.639 to 12.61), with no differences observed for children attending regular schools. At the social level, parents in the experimental group perceive that people respond more respectfully and responsibly to their children in public places ($M = 15.87$; $p < 0.001$) compared to the control group ($M = 10.67$). This perception is higher and significant among parents of children enrolled in special education schools (Mdif. = 6.65; 95% CI 3.79 to 9.51) and among those in mainstream schools with special education classrooms (Mdif. = 7.01; 95% CI 2.88 to 11.13) compared to children in regular mainstream schools. Parents in the experimental group perceive greater competence in managing their children ($M = 19.75$, $p < 0.023$) compared to the control group ($M = 17.91$). Qualitatively, parents from both groups identify safety-related benefits, especially when they are occupied with other tasks. Relationally, they highlight the friendship bond formed between the child and the dog and the child's acquisition of responsibilities in caring for the dog. The experimental group notes increased social visibility and awareness of ASD, while the control group emphasizes greater sociability of the child through the dog both inside and outside the home and a reduction in the child's anxiety. Concerns mostly relate to caring for the dog and the connection between the child and the dog if such a bond does not form.

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Carlisle (2014)	Examine the decision-making process and parents' perception of the benefits of having pet dogs in homes with children with autism.	United States Seventy parents (61 females, 8 males) of children with autism aged between 8 and 18 years participated. Among them, 47 belonged to the dog group and 23 to the non-dog group.	Cross-sectional descriptive design. Telephone interview. Sociodemographic data and open-ended questions about decision-making.	Pet Dog Ownership.	The reasons parents decide on pet dog ownership were "Always had a dog," grew up with dogs (51.1%), parents like/love dogs (38.3%), teach children responsibility (31.9%), good for children (31.9%), children wanted a dog (27.6%), companion for children (27.6%), good for children with ASD (25.5%) and teach compassion/calm the child (19.1%). Parents in the dog group identified benefits such as teaching responsibility (51.1%), companionship (46.8%), calming/stress relief (29.8%), entertainment/happiness (34%), unconditional love (25.5%), promotion of social interaction (14.9%), teaching empathy/tolerance (14.9%) and protection/safety (14.9%). Regarding burdens, they noted the cost and time of care and travel limitations.
Stumpf and Breitenbach (2014)	Parents' perspectives on the impact of Animal-Assisted Therapy (AAT) on their children and on the parents' quality of life.	Germany N = 47 parents of children with disabilities between 5 and 10 years. Experimental group (n = 31) new dolphin-assisted therapy program—Down syndrome (n = 5), physical (n = 11) and mental retardation (n = 15), of which 54.8% are males. Control group (n = 16) non-treatment—Down syndrome (n = 4), physical (n = 5) and mental retardation (n = 7), of which 62.5% are males.	Pre-test/post-test design with control and experimental group. Interview families. Questionnaire about Child's Social-Emotional Behaviour (Breitenbach et al., 2009); Questionnaire about Parental Quality of Life (Averbeek et al., 1997).	Dolphin-Assisted Therapy. Ten days. (First day diagnostic interviews; 4 days interaction with the dolphins in sessions lasting between 25 and 30 min. Sixth day recreation and group discussion. From day 7 to 10, parents are included in the sessions with the dolphins).	The experimental group reports improvements in communicative skills both short- and long-term in verbal communication (d = 0.76 and d = 0.81), non-verbal communication (d = 0.90), and self-initiated non-verbal communication (d = 0.54 and d = 0.61). When comparing groups, improvements remain significant short-term (p = 0.04, d = 0.84) and long-term (p = 0.03, d = 0.84) in the factor of non-verbal communication. For other factors, improvements are maintained short-term in verbal communication (p = 0.03, d = 0.82) and self-initiated non-verbal communication (p = 0.02, d = 0.52). Parents report improvements in social-emotional skills both short-term and long-term (p = 0.08, d = 0.63; p = 0.01; d = 0.99), self-confidence skills (p = 0.06, d = 0.60; p = 0.01, d = 0.58), and in sociability long-term (p = 0.04, d = 0.29). In parental quality of life, benefits are perceived in prevailing mood (F = 3.76, df = 34, p = 0.03) both short-term (d = 0.49) and long-term (d = 0.40), and in view of life (F = 3.42, df = 32, p = 0.05) short-term (d = 0.80), although this significant effect does not remain when using paired samples.

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Hall et al. (2016)	Study the long-term effects on the family after acquiring a dog.	United Kingdom N = 37 parents of children with autism aged between 3 and 16 years. Experimental group: n = 22. Control group: n = 15.	Family functioning (Brief FAM-III-General Scale) (Skinner et al., 1995). Parenting Stress Index-Short Form (PSI-SF) (Abidin, 1995). Attachment to the dog: Lexington Attachment to Pets Scale (LAPS; Johnson et al., 1992).	Pet dog.	The experimental group shows a decrease in difficulties and an increase in family strengths, which leads to better family functioning compared to the control group ($F(1, 32) = 4.71, p = 0.037, \eta^2 = 0.125$). The experimental group reports fewer family difficulties between time 1 and time 2 of the evaluation ($t(21) = 2.69, p = 0.01$). No significant differences are observed in the control group ($t(13) = 0.34, p = 0.73$). Although parental stress decreases in both groups, this reduction is greater in the experimental group, where 20% of parents move from a clinical level to a normal level of stress ($\chi^2(1, 34) = 3.17, p = 0.07$). The largest differences occur in the total stress factor between the two evaluation points, with a difference of 10.9 points in the experimental group compared to 4.43 points in the control group. The experimental group also shows a decrease in dysfunctional interactions between parents and children.
Boyd and Le Roux (2017)	To know the perceptions of parents with children with disabilities about therapeutic horseback riding.	South Africa Twelve parents (11 females, 1 male) of children with disabilities aged between 6 and 12 years.	Exploratory qualitative research. Parent interviews (six questions) related to experiences in the program and its benefits and limitations.	Therapeutic horseback riding.	Positive psychosocial effects include increased confidence and independence as children feel they have control over the horse, feelings of pride and enhanced self-esteem, and feelings of joy and happiness. Cognitively, there is improved concentration, which allows better academic performance, and language improvements that boost social confidence and the ability to interact with others. Physically, there are improvements in posture, stability, muscle tone and rigidity, which facilitate walking in children. Additionally, parents report that their children are calmer and more relaxed, especially parents of children with ASD, ADHD and sensory issues. Some parents believe these benefits are directly related to their children's participation in the intervention, while others cannot confirm this relationship.

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Malcolm et al. (2018)	To understand the perceptions of professionals and parents of children with autism regarding the benefits and limitations of equine therapy.	United Kingdom Nine interviews were conducted with therapists, volunteers, teachers and parents of children with ASD.	Malcolm's 'observant participation' (Moeran, 2009).	Horse-assisted therapy involved various games with the horse while therapists encouraged the child's verbal communication toward the horse.	Parents reported improvements in social functioning, noticing their children becoming more communicative, increasing their comprehension, demonstrating better communication skills and becoming more aware of themselves and others.
Tan and Simmonds (2018)	Parents' perceptions of the psychosocial impact of equine-assisted interventions on their children.	Australia Parents of six children (five girls and one boy) with ASD aged between 3 and 14 years old.	Qualitative research Semi-structured interview with related questions about the psychosocial benefits observed in their children and how they are aware of these benefits.	Equine-assisted interventions.	Parents perceive improvements in their children's self-concept and emotional well-being, mainly in mood and self-regulation skills, with children appearing calmer and more relaxed and exhibiting improved behaviour. On a social level, parents perceive improvements in the quality of interactions and in their motivation to engage in them. They also point to the positive social climate of the intervention as having an effect on their well-being. They perceive benefits in discovering how their children enjoy themselves and appear happier, have less difficulty managing their behaviour, and generalise the skills learned to other contexts. It should be noted that some of these benefits are mainly perceived on the days when the children have sessions.
Harwood et al. (2019)	Explore the impact of companion canines on children with ASD.	Australia Eleven mothers of children with ASD aged between 5 and 12 years (7 males, 6 females).	Semi-structured interview about the child's relationship with the dog and whether the dog influences the child emotionally and behaviourally.	Canine companion.	Ten of the eleven mothers describe the child's relationship with the dog as positive. Nine mothers report that children show greater calm in stressful situations, which occurs through sensory experiences, such as touching the dog. In other cases, the dog is a distracting element that has a calming effect on the child. They report greater social connection through increased opportunities for communication related to the dog. They also associate the dog's company with a positive effect on social skills, empathy and the ability to interpret non-verbal language. As negative aspects, they point out that in some cases children may behave inappropriately towards dogs.

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Hill et al. (2020)	Knowing the parents' perspective on animal-assisted occupational therapy intervention.	Australia Ten parents (nine mothers, one father) of children with ASD aged between 4 and 6 years and 11 months. Five parents formed the experimental group and five the control group.	Qualitative interpretive description design. Semi-structured interview.	Canine-assisted occupational therapy. Seven weekly sessions of 1 h duration (Hill et al., 2020).	The dog provides greater emotional security for the child, which facilitates the relationship between the child and the therapist. Parents indicate that the interaction with the dog helped their child to calm down and feel more comfortable during the session. These self-regulation skills generalize to other contexts. Additionally, they perceive an increased number of social behaviours directed towards the dog and the therapist, viewing this relationship with the dog as a friendship. All of this generates a greater sense of acceptance in the child and increased motivation to participate, even when activities were more challenging, paying more attention. They identify feelings of pride in their children when they perceive that goals set in the sessions have been achieved.
Michelotto et al. (2019)	Parents' and therapists' perception of the impact of animal-assisted activities (AAA) on their children's behaviour.	Brazil Fifteen children with ASD. Fourteen boys and one girl. Aged 5.6 + / − 1.6 years.	The Autistic Behaviour Assessing Questionnaire (CACS-27) (Moraes, 1998).	AAA with dogs. Minimum of 10 weeks with 30 min sessions. Children interact freely with the dogs and other children in groups of 11.2 + / − 2.2 children per session.	Parents report a reduction in self-aggression and repetitive stereotyped movements, as well as positive effects on speech communication and creativity.
van der Steen et al. (2019)	Evaluate the effects of equine-assisted intervention in children with autism.	The Netherlands Mother (41 years old) and father (45 years old) of an 8-year-old girl with autism.	Semi-structured interview. Scale for Emotional Development—Revised (SED-R) (Vandevelde et al., 2015). Strengths and Difficulties Questionnaire (SDQ) Subscale (Parents) (Goodman, 1997). Video observations of the sessions.	Equine-assisted intervention. Five sessions, one per week, lasting between 90 and 120 min.	Regarding emotional development, the parents report significant positive changes between the pre-test and post-test in abilities associated with the following factors: Deal with her own body (Pre-test level 1; Post-test level 4), Emotion differentiation (Pre-test level 2; Post-test level 4) and Emotion regulation (Pre-test level 2; Post-test level 4). Concerning the SDQ, the mother reports a decrease in problems from pre-test to post-test in the factors (Total difficulties score 24–16; Emotional symptoms 8–4; Peer relationship problems 8–5), and an increase in Prosocial behaviour (5–8). For the father, the scores were (Total difficulties score 19–14; Peer relationship problems 8–4).

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Kalmbach et al. (2020)	Describe the perceptions of parents of children with autism regarding occupational therapy in an equine environment.	United States Four mothers and one father of children with ASD aged between 8 and 13 years, all of whom are boys.	Qualitative descriptive research. Semi-structured interviews with the parents at 4–6 weeks and at 6 months after the intervention about their children's experience and the impact on the child and family at the domestic, school, and community levels.	Occupational therapy in an equine environment. Sessions lasting between 45 and 60 min, once a week for 10 weeks.	Parental perspectives on the child's experience: Importance of the horse and the therapist, such as physical contact with the horse, riding, children's motivation, therapists' knowledge of autism. Children's positive emotions regarding their participation, such as excitement or enjoyment. Parental perspectives on the intervention in the daily lives of children and families: Positive impact on mood and social skills with parents and other family members. Reduction in hyperactivity or irritability and violent behaviour. All of this leads to greater satisfaction in the relationship with their children and greater self-control in parents.
London et al. (2020)	Parents' perspectives on the impact of AAT on their children.	Australia Seventeen parents (3 males and 14 females) of children with ASD aged between 4 and 19 years, of whom 16 (94.1%) are boys.	Qualitative phenomenological study design. Semi-structured interview about decision-making, the child's experience after the intervention and its effects.	AAT occupational therapy program with dogs. Five sessions, one per week for five weeks.	Mainly, parents decide to participate thinking about the achievements the child can reach with the intervention. Parents give positive evaluations regarding the fulfilment of objectives related to non-verbal communication and engagement and interaction (17, 100%), play and enjoyment (16, 94.1%), community participation (14, 82.4%), motivation (13, 76.5%), emotional regulation (12, 70.6%) and improving communication (12, 70.6%).

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Scotland-Coogan et al. (2021)	To understand parents' perceptions of the benefits of hippootherapy in children with disorders.	United States Eleven caregivers of 12 children with different disabilities (four females, eight males).	Qualitative multiple case study design. Semi-structured interviews (Stake, 1995).	Hippootherapy (equine-assisted treatment).	Caregivers report improvements in the following areas: Physical level—increased strength and flexibility, as well as enhanced skills related to fine and gross motor abilities, which make it easier for children to perform more tasks, such as dressing themselves. Improvements in balance and greater autonomy when walking. Language level—improvements in speech, receptive language, and increased communicative intentions. Psychology level—lower levels of frustration. Many parents note improvements associated with hippootherapy compared to other types of therapies they have experienced. Regarding quality of life, they highlight greater confidence and independence in their children when performing daily tasks on their own, which positively impacts the parents as they perceive their children are less dependent on them.
Ang and MacDougall (2022)	To know the perceptions of parents and therapists about the choice of AAT.	Parents of children with ASD (three males and one female) aged between 3 and 21 years and three therapists.	Qualitative phenomenological design. Semi-structured interviews with parents and therapists about their experiences and opinions of AAT.	Dogs.	Benefits of AAT according to parents. Physical: parents perceive the environment as safe and positive, which facilitates the child being more participative and receptive. Emotional: parents report a feeling of well-being as their child feels accepted, increased self-confidence, better impulse control (allowing the child to be less challenging), with benefits.

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Appleby et al. (2022)	Parents of children with autism who own assistance dogs report numerous positive experiences.	Australia Eight mothers and fathers with children with autism aged between 7 and 12 years.	Qualitative descriptive design. Occupational mapping (Huot & Rudman, 2015). Semi-structured interviews about their experiences related to Autism Assistance Dogs.	Autism assistance dog.	Parents report that children gain freedom of movement, which in turn allows them to build strength for walking in a straight line and helps stretch the calf muscles. They feel safer when walking on the street because the children understand the dog's signals related to traffic rules. Parents gain freedom to talk with others and feel more relaxed. Isolation is reduced as they can go to more places, spending more time outside the home. They perceive that others recognise the child's behaviours as a result of their disorder, rather than a lack of discipline. The children appear calmer, with fewer and less severe behavioural crises related to stress. Additionally, the dog provides security and calmness to the child in stressful or difficult situations. Parents note that children form friendships with their dogs, sometimes even considering them confidants. They see benefits in language stimulation, the acquisition of social skills, and even an increase in empathy.
Richardson et al. (2022)	Parents' perspectives on the impact of Animal Assisted Therapy (AAT) in their children are highlighted.	Australia Parents (n = 4) and mothers (n = 13) of children and adolescents with autism (3 girls and 13 boys) aged between 5 and 19 years.	Qualitative study. Semi-structured interview with 12 questions about parents' perspectives on the Animal Assisted Therapy occupational program.	AAT occupational therapy program (Groenewald, 2004) with dogs. Five sessions, one per week for five weeks. First session 90 min, four sessions 60 min.	Parents report positive effects in the following areas: stress management in children, participation and engagement, and social communication skills during the sessions. They also observe maintenance of self-care skills at 3, 6 and 9 months after the intervention.

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Adkins et al. (2023)	To explore parents' perceptions of how pet dogs in households can promote healthy nutrition and physical activity in children with ASD.	Australia Ten mother–child dyads of children with autism aged between 8 and 18 years.	Qualitative research. Semi-structured interviews conducted to understand the impact of pet dogs on the family and children with ASD.	Pet dogs.	Parents report feeling that their children are happier when playing with their dog, creating a bond between the child and the animal. They mention fewer effects related directly to autism symptoms, although some parents report increased verbal language use. Some negative aspects related to playing with the dog and behavioural issues associated with autism in interactions with the dog are mentioned to a lesser extent. They also note that the dog's arrival helped introduce care routines in which the children participate and that they spend more time outside the home. Parents report increased awareness in their children about healthy nutrition and physical activity for both the child and the dog, although they note that the children do not enjoy physical activity much. Regarding nutrition, while children are more aware of healthy eating, they do not enjoy eating this type of food. However, the healthy diet has allowed the introduction of different foods and new textures.
Morgan and O'Byrne (2023)	To understand the experiences of parents of children with ASD, canine handlers, and teachers regarding assistance canines	Ireland Four parents of children with autism, three canine handlers, two teachers.	Qualitative research. Semi-structured interviews with parents about the relationship between the child and the dog and the benefits and limitations.	Assistance Canines.	Parents emphasize the importance of the bond formed between the child and the dog. They attribute positive aspects to this relationship, such as increased social interaction, greater confidence when doing things independently, companionship and improvements in language development, as well as a reduction in behavioural problems. At the family level, parents report an increase in activities outside the home and a reduction in stress levels related to caregiving.
Cleary et al. (2024)	To know the experiences of parents and the benefits after their children's participation in horse-based therapies.	Australia Four mothers and two fathers of three boys and one girl with ASD. Eight staff members of equine therapy.	Qualitative research. Semi-structured interviews about the impact on their children related to their participation in horse riding.	Horse-based therapies.	Parents focus the impact of the therapy on the following: Physical and social benefits: an increase in the child's sense of responsibility. Improvements in balance, communication skills, social skills and socialization; as a protective factor for mental health: learning to manage anxiety, increased resilience, better self-regulation, greater happiness and an increased sense of social support.

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Dolecheck et al. (2024)	Parents' perspectives on the benefits of farm-based Animal Assisted Therapy (AAT) for their children highlight several key points.	United States Five parents of children with autism.	Exploratory sequential design. Semi-structured interview.	Farm Animal-Assisted Therapy (cows, sheep, goats, horses and pigs).	Increases in social behaviours, regulation of behaviours and a sense of normalcy for the children.
Guay et al. (2024)	Parent perceptions about the acceptability and effects of having either an assistance dog or a companion dog for their children include several key insights.	Canada First phase: 85 parents (assistance dogs group $n = 57$; companion dogs group $n = 28$) of children with autism aged between 3 and 17 years ($M = 10.37$, $SD = 3.67$), of which 98.8% were mothers. Second phase: $N = 17$ (assistance dogs $n = 14$, companion dogs $n = 3$).	Explanatory sequential design. French version of the Treatment Acceptability Rating Form—Revised (TARF-R) (Reimers et al., 1992). Semi-structured interview questionnaire about the benefits for the child and the family.	Assistance or companion dogs.	Parents in the assistance dog group report greater satisfaction with the treatment ($M = 5.60$, $SD = 0.76$) than the comparison group ($M = 5.24$, $SD = 0.68$), with these differences being significant ($t(83) = -2.12$, $p = 0.037$, $d = 0.49$). Satisfaction with the presence of a dog is higher among families with another child with a disorder, regardless of the group ($t(83) = -2.26$, $p = 0.026$, $d = 0.49$); within this, parents of children with ADHD are the least satisfied ($t(83) = 2.46$, $p = 0.016$, $d = 0.53$), with significant differences in the assistance dog group ($t(55) = 2.16$, $p = 0.036$, $d = 0.57$). Families with assistance dogs report lower satisfaction when there is comorbidity with a behavioural disorder ($t(55) = 2.09$, $p = 0.041$, $d = 1.09$). Both types of families (assistance and companion) perceive positive effects in their children related to better emotional regulation, specifically in managing anger and anxiety when doing activities with the dog, with a reduction in the frequency and intensity of emotional outbursts, and faster decreases in tantrums and aggression. These effects are also observed in other contexts. They report increased communication and social interactions mainly related to issues concerning the dog, which helps expand the child's social network and reduce social isolation. Additionally, they note benefits in autonomy, routines and responsibilities acquisition. Other benefits extend to other family members, such as an increased number, duration and frequency of activities outside the home, which contributes to

Table 1. Cont.

Study	Aim	Country/Sample	Design/Instruments	AAT Program or Action	Parents' Perceptions: Main Outcomes
Guay et al. (2024)	Parent perceptions about the acceptability and effects of having either an assistance dog or a companion dog for their children include several key insights.	Canada First phase: 85 parents (assistance group $n = 57$; companion dogs group $n = 28$) of children with autism aged between 3 and 17 years ($M = 10.37$, $SD = 3.67$), of which 98.8% were mothers. Second phase: $N = 17$ (assistance dogs $n = 14$, companion dogs $n = 3$).	Explanatory sequential design. French version of the Treatment Acceptability Rating Form—Revised (TARF-R) (Reimers et al., 1992). Semi-structured interview questionnaire about the benefits for the child and the family.	Assistance or companion dogs.	reduced stress among other family members. Families report happier moments of interaction with the dog, spending more time together, especially among siblings. There are benefits in the couple's relationship, allowing them to sleep together again, which grants them higher quality time for themselves. The burdens associated with having the dog mainly relate to caregiving responsibilities.
Rodriguez et al. (2024)	Evaluate the effect of service dogs on children with autism and their parents.	United States A total of 75 families of children with autism (39 in the service dog group; 36 in the comparison group).	Cross-sectional design. Instruments: Child: SCQ; CSHQ; ABC; BASC-3; PRPP. Parents: CGSQ; PROMIS [®] ; PHQ-9; PedsQL TM ; FIMFFS. Animal-human bond: MDORS (Monash Dog Owner Relationship Scale) and IOS (Inclusion of Other in the Self).	Service dogs	Regarding parent-related variables, there are no statistically significant differences between the experimental group and the control group in any of the analysed variables (Caregiver Strain Questionnaire, PROMIS Sleep Disturbance, Patient Health Questionnaire, PedsQL Family Impact—Daily Activities, and PedsQL Family Impact—Family Relationships). In terms of children's scores, there are significant differences in the Children's Sleep Habit Questionnaire ($p = 0.038$), Sleep Initiation and Duration ($p = 0.005$), and Sleep Anxiety/Co-Sleeping ($p = 0.026$), with lower mean scores in the experimental group. There is no relationship between having a dog and benefits in emotional self-control, withdrawal, irritability, or hyperactivity.

AAA (Animal-Assisted Activity). AAT (Animal-Assisted Therapy). D = effect size. SCQ (Social Communication Questionnaire). CSHQ (The Children's Sleep Habit Questionnaire). ABC (Aberrant Behaviour Checklist). BASC-3 (The Behaviour Assessment Scale for Children 3rd edition). PRPP (Peer Relationships Paediatric Parent-Proxy Short Form (7-A v2.0)). CGSQ (The Caregiver Strain Questionnaire). PROMIS (The PROMIS[®] Sleep Disturbance Short Form 6-A). PHQ-9 (The Patient Health Questionnaire-9). PedsQLTM (Paediatric Quality of Life Inventory). FIMFFS (Family Impact Module Family Functioning Scale). MDORS (The Monash Dog-Owner Relationship Scale). IOS (The Inclusion of Other in Self scale). TARF-R (Treatment Acceptability Rating Form—Revised).

In cases where dogs are part of the intervention, either in therapy or as companions, parents perceive benefits mainly in two areas: social and emotional. In the social sphere, they report greater sociability and social interaction (Burgoyne et al., 2014; London et al., 2020; Morgan & O’Byrne, 2023; Guay et al., 2024), which in turn can be linked to another aspect highlighted by parents, namely greater opportunities for communication and social participation (Harwood et al., 2019; Hill et al., 2020; London et al., 2020; Guay et al., 2024). The bond of friendship that develops with the dog has been noted in five of the studies (Burgoyne et al., 2014; Harwood et al., 2019; Appleby et al., 2022; Adkins et al., 2023; Morgan & O’Byrne, 2023), offering the child plenty of companionship (Carlisle, 2014), which helps combat the loneliness experienced by many children with ASD. Other aspects include an increase in social skills (Harwood et al., 2019) Appleby et al., 2022; Richardson et al., 2022) and empathy (Harwood et al., 2019; Appleby et al., 2022). On an emotional level, Burgoyne et al. (2014), Carlisle (2014), Harwood et al. (2019), Hill et al. (2020), London et al. (2020), Ang and MacDougall (2022), Appleby et al. (2022), Richardson et al. (2022) and Guay et al. (2024) report that parents perceive a decrease in anxiety in their children, which appears to be related to a decrease in behavioural problems (Appleby et al., 2022) and could be related to a decrease in self-harm and stereotypical movements typical of children with ASD (Michelotto et al., 2019). The increase in the sense of responsibility and commitment, mainly in caring for the dog, has also been noted by Burgoyne et al. (2014), Carlisle (2014), Richardson et al. (2022) and Guay et al. (2024), which allows children to establish more routines in their daily lives (Adkins et al., 2023; Guay et al., 2024). Interaction with dogs, according to parents’ perceptions, has also been associated with more positive emotional states, such as improved well-being, greater enjoyment of playing with the dog, increased emotional security and self-confidence, and a greater sense of pride (Hill et al., 2020; London et al., 2020; Ang & MacDougall, 2022). With regard to language development, the studies reviewed reported that parents perceived improvements in oral communication (Michelotto et al., 2019; Adkins et al., 2023) and in the interpretation of non-verbal language (Harwood et al., 2019; London et al., 2020). For Appleby et al. (2022) and Morgan and O’Byrne (2023), interaction with the dog stimulated the children’s language. Other benefits reported by parents included increased strength and greater freedom of movement (Appleby et al., 2022), improved sleep habits (Rodriguez et al., 2024), greater knowledge about healthy nutrition and the introduction of new foods into their children’s diets (Adkins et al., 2023), which occurs when children are involved in caring for the dog, including not only physical exercise but also the importance of healthy eating for the dog and for the child, with this involvement providing an opportunity for children to learn about healthy nutrition.

Other less frequent interventions that also reported positive perceptions by parents were those related to dolphin-assisted therapy (Stumpf & Breitenbach, 2014) and farm animal-assisted therapy (Dolecheck et al., 2024). Both types of intervention noted benefits in emotional regulation, social interaction, and verbal/non-verbal communication; the latter being mainly with dolphin therapy.

3.3. Benefits of AAI for Families of Children with Neurodevelopmental Disorders, as Perceived by Parents or Caregivers

At the family level, parents perceive a greater reduction in parental stress (Hall et al., 2016; Appleby et al., 2022; Morgan & O’Byrne, 2023; Guay et al., 2024). This can be linked to a reduction in problems in their relationship with their children (Hall et al., 2016; Guay et al., 2024), lessening of behavioural problems (Morgan & O’Byrne, 2023) and an increase in the sense of parental competence (Burgoyne et al., 2014) in families where the programme involved the participation of a dog. The presence of the dog also meant spending more time outdoors (Adkins et al., 2023; Morgan & O’Byrne, 2023; Guay et al., 2024). In addition,

Guay et al. (2024) point out benefits in the couple's relationship, as the child's increased autonomy and the security provided by the dog allow them to spend more time together, while Appleby et al. (2022) highlight the value parents place on the freedom to talk to other people inside and outside home.

In the case of therapies that use horses, only two studies have reported benefits perceived by parents in terms of family functioning. Kalmbach et al. (2020) indicate greater parental satisfaction in terms of their relationship with their children and increased self-control, while Scotland-Coogan et al. (2021) refer to an increase in family life quality, related to greater autonomy and independence of their children when performing different tasks or activities.

4. Discussion and Conclusions

The aim of this review was to ascertain parents' perceptions of the benefits in different areas of development in their children with neurodevelopmental disorders, after participating in some type of intervention or programme involving animals. All studies included in this review indicate that parents perceive benefits in different areas of development, mainly at the physical, social, language development and emotional levels, thus confirming the first hypothesis of this review. Specifically, one of the aspects most frequently mentioned by parents was improved emotional regulation, with parents reporting that their children appear calmer and more relaxed and showing less anxiety, regardless of the type of intervention or animal (Boyd & Le Roux, 2017; Malcolm et al., 2018; Tan & Simmonds, 2018; van der Steen et al., 2019; Kalmbach et al., 2020; Scotland-Coogan et al., 2021; Cleary et al., 2024; Burgoyne et al., 2014; Carlisle, 2014; Harwood et al., 2019; Hill et al., 2020; London et al., 2020; Ang & MacDougall, 2022; Appleby et al., 2022; Richardson et al., 2022; Guay et al., 2024; Dolecheck et al., 2024). In this regard, Solomon (2012) points out that in the case of children with ASD, interacting with an animal is easier because the person does not need to interpret what the animal is thinking, so the social communication difficulties experienced by children with ASD are diluted when they interact with animals, making interaction with animals easier than with humans (Grandin et al., 2015). This relationship, interpreted by parents as one of friendship and security, has been documented in the works of Burgoyne et al. (2014), Harwood et al. (2019), Appleby et al. (2022), Adkins et al. (2023) and Morgan and O'Byrne (2023), which may explain the large number of studies in this review where the intervention has been aimed at children with ASD.

Depending on the type of animal used, it should be noted that parents believe that interventions with horses have a greater physical and motor impact by increasing strength, improving posture and balance, if we take into account the number of studies that report these types of benefits (Boyd & Le Roux, 2017; Scotland-Coogan et al., 2021; Cleary et al., 2024), while in the case of dogs, only the study by Appleby et al. (2022) shows benefits in this regard. This is perfectly understandable when one considers that horse riding is a physical activity that requires a range of skills at this level.

These benefits are perceived not only in relation to the child or adolescent but also in relation to personal aspects of the parents and family functioning, regardless of the type of intervention (Burgoyne et al., 2014; Hall et al., 2016; Appleby et al., 2022; Adkins et al., 2023; Kalmbach et al., 2020; Scotland-Coogan et al., 2021; Morgan & O'Byrne, 2023; Guay et al., 2024), thus confirming the second of the hypotheses proposed.

These results are consistent with a large number of studies that point to psychosocial and health benefits for children and adolescents who have participated in activities or therapies with animals (Fundación Affinity, 2023; Ajzenman et al., 2013; Muñoz-Lasa et al., 2011; Snider et al., 2007; Silkwood-Sherer et al., 2012; Fung, 2017; Grandgeorge et al., 2012; Hardy & Weston, 2020; Guay et al., 2022; Hellings et al., 2022; Sissons et al., 2022; Rehn

et al., 2023; Tseng, 2023; Appleby et al., 2022; Burgoyne et al., 2014; Carlisle et al., 2018; Hallyburton & Hinton, 2017; Narvekar & Narvekar, 2022; Viau et al., 2010), although a number of issues need to be taken into account in relation to the results obtained from parents' perceptions.

In this regard, most studies employ a qualitative descriptive methodology, which, as Sandelowski (2000, 2009) points out, is an appropriate methodology for describing events, phenomena or experiences, such as the perceptions of parents of children who have directly or indirectly participated in an animal-related programme or therapy. In this regard, limitations related to qualitative studies using small sample sizes (Guay et al., 2024) should be taken into account, as well as the use of self-report measures, in which responses may be influenced by parents' expectations and memory biases (Burgoyne et al., 2014).

It should also be noted that few of the studies included in this review used any type of objective to measure the benefits of the intervention; specifically, only eight studies did (Burgoyne et al., 2014; Stumpf & Breitenbach, 2014; Hall et al., 2016; Michelotto et al., 2019; van der Steen et al., 2019; Appleby et al., 2022; Guay et al., 2024; Rodriguez et al., 2024), which may be consistent with or differ from parents' perceptions. Sample size may be a limitation, as pointed out by various studies (Cleary et al., 2024); although, as Braun and Clarke (2021) indicate, this does not necessarily mean that the results are not rigorous, as sample size may be determined by the relevance of the topic to the research question itself, meaning that small samples may also be perfectly valid. In this regard, various studies point to small sample sizes as one of the limitations that explain why some effects are not maintained in matched samples, as is the case in the study by Stumpf and Breitenbach (2014) on socio-emotional skills in children in the short term or on mood and outlook on life in parents six months after the intervention. Rodriguez et al. (2024) also attribute to sample size and sample heterogeneity, by not taking into account the different phenotypes of autism, the failure to find significant differences between matched samples in some of the variables assessed in children, such as withdrawal, negative emotionality, emotional self-control, hyperactivity, irritability and lethargy. In the case of parents' perceptions of caregiver strain, there were no differences between the control group and the experimental group, which may be due to the increased level of stress associated with caring for the dog. Other factors in which there were no differences between groups were sleep disturbance, depression or family daily activities according to the severity of autism, which is attributed to aspects related to the type of instruments used to measure parents' perceptions, as well as the high rates of sleep disorders in the matched samples or the bond established between the caregiver and the dog (Rodriguez et al., 2024).

Regarding the studies included in this review, in the case of the study by Stumpf and Breitenbach (2014), which includes dolphins in the IAA, in addition to the limitations the authors may point out in their study, it is important to consider a whole series of unethical aspects associated with captive breeding and the exploitation of dolphins, as well as the ineffectiveness of this type of intervention, as noted by Whale and Dolphin Conservation (2021). Specifically, in the Stumpf and Breitenbach (2014) study, the authors themselves indicate that the study was conducted following the review and evaluation of dolphin living conditions carried out by the European Association for Zoos and Aquariums. Considering other ethical aspects when animals are used in this type of intervention, it is worth highlighting the concerns expressed by parents about certain inappropriate behaviours of children towards animals, impacting animal welfare, as reported in studies by Burgoyne et al. (2014), Carlisle (2014) and Harwood et al. (2019).

Based on the results obtained, it can be concluded that AAIs are perceived by parents of children with neurodevelopmental disorders as beneficial when considering their effects

on different areas of development. These benefits also extend to the family environment, as positive changes in children and adolescents have an impact on parents' well-being.

Author Contributions: Conceptualization, M.M.-V. and F.G.-S.; methodology, F.G.-S. and K.L.-G.; software, A.F. and K.L.-G.; investigation, K.L.-G., F.G.-S., M.M.-V. and A.F.; writing—original draft preparation, K.L.-G. and F.G.-S.; writing—review and editing, F.G.-S., M.M.-V. and K.L.-G.; supervision, F.G.-S., M.M.-V. and K.L.-G.; project administration, F.G.-S. and M.M.-V. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- Abidin, R. (1995). *Parenting stress index manual* (3rd ed.). Psychological Assessment Resources.
- Adkins, J. R., Mulé, C. M., Linder, D. E., Must, A., Cash, S. B., & Folta, S. C. (2023). Exploring health behaviors and the role of pet dogs in households with autistic children: The DANE study. *Frontiers in Pediatrics*, 11, 1153124. [CrossRef]
- 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. *The American Journal of Occupational Therapy*, 67(6), 653–663. [CrossRef] [PubMed]
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.
- Ang, C. S., & MacDougall, F. A. (2022). An evaluation of animal-assisted therapy for autism spectrum disorders: Therapist and parent perspectives. *Psychological Studies (Mysore)*, 67(1), 72–81. [CrossRef] [PubMed]
- Appleby, R., Wright, S., Williams, L., & Stanley, M. (2022). Australian parents' experiences of owning an autism assistance dog. *Health & Social Care in the Community*, 30(6), e4113–e4121. [CrossRef]
- Arkow, P. (2010). Animal-assisted interventions and human education: Opportunities for a more targeted focus. In H. A. Fine (Ed.), *Handbook on animal-assisted therapy: Theoretical foundations and guidelines for practice* (pp. 457–480). Academic Press. [CrossRef]
- Averbeek, M., Leiberich, P., Grote-Kusch, M. T., Olbrich, E., Schröder, A., Brieger, M., & Schumacher, K. (1997). *Skalen zur erfassung der lebensqualität (SEL)*. Swets & Zeitlinger B.V., Swets Test Service.
- Ávila-Álvarez, A., Alonso-Bidegain, M., Ramos-Veiguela, D., Iglesias-Jove, E., & De Rosende-Celeiro, I. (2022). Changes in social functioning and engagement during canine-assisted intervention for children with neurodevelopmental disorders in the context of an early intervention service. *Research in Developmental Disabilities*, 124, 104216. [CrossRef]
- Beetz, A. (2013). Socio-emotional correlates of a schooldog-teacher-team in the classroom. *Frontiers in Psychology*, 4, 886. [CrossRef]
- Bibbo, J., Rodriguez, K. E., & O'Haire, M. E. (2019). Impact of service dogs on family members' psychosocial functioning. *The American Journal of Occupational Therapy*, 73(3), 7303205120p1–7303205120p11. [CrossRef] [PubMed]
- Boyd, L., & Le Roux, M. (2017). 'When he's up there he's just happy and content': Parents' perceptions of therapeutic horseback riding. *African Journal of Disability*, 26(6), 307. [CrossRef]
- Brannan, A. M., Heflinger, C. A., & Bickman, L. (1997). The caregiver strain questionnaire: Measuring the impact on the family of living with a child with serious emotional problems. *Journal of Emotional and Behavioral Disorders*, 5, 212–222. [CrossRef]
- Braun, V., & Clarke, V. (2021). To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qualitative Research in Sport, Exercise and Health*, 13(2), 201–216. [CrossRef]
- Breitenbach, E., Stumpf, E., Fersen, L. V., & Ebert, H. (2009). Dolphin-assisted therapy: Changes in interaction and communication between children with severe disabilities and their caregivers. *Anthrozoös*, 22, 227–289. [CrossRef]
- Brown, S. X. (2017). *Service dogs for children with autism: A parent's perspective* [Doctoral dissertation, Chestnut Hill College].
- Burgoyne, L., Dowling, L., Fitzgerald, A., Connolly, M., Browne, J. P., & Perry, I. J. (2014). Parents' perspectives on the value of assistance dogs for children with autism spectrum disorder: A cross-sectional study. *BMJ Open*, 24, e004786. [CrossRef]
- Carlisle, G. K. (2014). Pet dog ownership decisions for parents of children with Autism Spectrum Disorder. *Journal of Pediatric Nursing*, 29, 114–123. [CrossRef]
- Carlisle, G. K., Johnson, R. A., Mazurek, M., Bibbo, J. L., Tocco, F., & Cameron, G. T. (2018). Companion animals in families of children with autism spectrum disorder: Lessons learned from caregivers. *Journal of Family Social Work*, 21(4–5), 294–312. [CrossRef]

- Chadwick, Z., Edmondson, A., & McDonald, S. (2022). Engaging with animal-assisted interventions (AAls): Exploring the experiences of young people with ASD/ADHD diagnoses. *Support for Learning*, 37(1), 44–61. [CrossRef]
- Cleary, M., West, S., Kornhaber, R., Johnston-Devin, C., Thapa, D. K., McLean, L., & Hungerford, C. (2024). ‘The Horse Weaves Magic’: Parents and service providers on the benefits of horse-based therapies for autistic children-an Australian qualitative study. *Issues in Mental Health Nursing*, 45(11), 1201–1209. [CrossRef] [PubMed]
- Delgado, R., Amor, A., Barranco, M. M., Barranco, P., & Sánchez, A. P. (2017). Terapia asistida por animales [Animal-supported therapy]. *Revista Española de Comunicación en Salud*, 8(2), 254–271. [CrossRef]
- Dolecheck, M., Autry, C. E., Eldridge, L. A., Loy, D. P., & Watts, C. E. (2024). Farm animal-assisted therapy using farm animals for individuals with Autism Spectrum Disorder. *Therapeutic Recreation Journal*, 58(3), 272. [CrossRef]
- Fecteau, S.-M., Boivin, L., Trudel, M., Corbett, B. A., Harrell, F. E., Jr., Viau, R., Champagne, N., & Picard, F. (2017). Parenting stress and salivary cortisol in parents of children with autism spectrum disorder: Longitudinal variations in the context of a service dog’s presence in the family. *Biological Psychology*, 123, 187–195. [CrossRef]
- Fredrickson, M. (1992). *Handbook for animal-assisted activities and animal-assisted therapy*. Delta Society.
- Fundación Affinity. (2009). *Los animales de compañía aumentan la autoestima, disminuyen la ansiedad y la agresividad*. Available online: <http://www.terapiaconanimales.com/congresos.html> (accessed on 15 April 2023).
- Fundación Affinity. (2023). *Qué son las terapias asistidas con animales*. Available online: <https://www.fundacion-affinity.org/la-fundacion/accion-social/que-son-las-terapias-asistidas-con-animales#programas> (accessed on 15 April 2023).
- Fung, S. C. (2017). An observational study on canine-assisted play therapy for children with autism: Move towards the phrase of manualization and protocol development. *Global Journal of Health Science*, 9(7), 67–86. [CrossRef]
- Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 38, 581–586. [CrossRef]
- Grandgeorge, M., Tordjman, S., Lazartigues, A., Lemonnier, E., Deleau, M., & Hausberger, M. (2012). Does pet arrival trigger prosocial behaviors in individuals with autism? *PLoS ONE*, 7(8), e41739. [CrossRef] [PubMed]
- Grandin, T., Fine, A. H., O’Haire, M. E., Carlisle, G., & Bowers, C. M. (2015). The roles of animals for individuals with autism spectrum disorder. In A. Fine (Ed.), *Handbook on animal-assisted therapy: Foundations and guidelines for animal-assisted interventions* (4th ed., pp. 225–236). Elsevier Academic Press.
- Groenewald, T. (2004). A phenomenological research design illustrated. *International Journal of Qualitative Methods*, 3(1), 42–55. [CrossRef]
- Guay, C., Abouzeid, N., Forget, J., & Boulé, M. (2024). Acceptability and effects of acquiring an assistance or companion dog for families of children on the autism spectrum. *Disability and Rehabilitation. Assistive Technology*, 19(4), 1687–1699. [CrossRef]
- Guay, C., Forget, J., & Abouzeid, N. (2022). Assessing effects of an assistance dog on social communication and interaction of a child with autism spectrum disorder and his family: An exploratory single-case study. *Child Family & Behavior Therapy*, 44(4), 323–348. [CrossRef]
- Hall, S. S., Wright, H. F., Hames, A., PAWS Team & Mills, D. S. (2016). The long-term benefits of dog ownership in families with children with autism. *Journal of Veterinary Behavior*, 13, 46–54. [CrossRef]
- Hallyburton, A., & Hinton, J. (2017). Canine-assisted therapies in autism: A systematic review of published studies relevant to recreational therapy. *Therapeutic Recreation Journal*, 51(2), 127–142. [CrossRef]
- Hardy, K. K., & Weston, R. N. (2020). Canine-assisted therapy for children with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 7(2), 197–204. [CrossRef]
- Harwood, C., Kaczmarek, E., & Drake, D. (2019). Parental perceptions of the nature of the relationship children with Autism Spectrum Disorders share with their canine companion. *Journal of Autism Developmental Disorders*, 49(1), 248–259. [CrossRef]
- Hellings, D., Joosten, A., Hatfield, M., & Netto, J. (2022). Benefits and challenges of assistance dogs for families of children on the autism spectrum: Mothers’ perspectives. *Qualitative Health Research*, 32(11), 1648–1656. [CrossRef]
- Hernández-Nieto, R. A. (2002). *Contributions to statistical analysis: The coefficients of proportional variance, content validity and kappa*. CreateSpace Independent Publishing Platform.
- Hill, J. R., Ziviani, J., & Driscoll, C. (2020). Canine-assisted occupational therapy for children on the autism spectrum: Parents’ perspectives. *Australian Occupational Therapy Journal*, 67(5), 427–436. [CrossRef] [PubMed]
- Huot, S., & Rudman, D. L. (2015). Extending beyond qualitative interviewing to illuminate the tacit nature of everyday occupation: Occupational mapping and participatory occupation methods. *OTJR: Occupation, Participation and Health*, 35(3), 142–150. [CrossRef]
- IAHAIO. (2018). *IAHAIO white paper: The IAHAIO definitions for animal assisted intervention and guidelines for wellness of animals involved in AAI*. Available online: <https://iahaio.org/wp/wp-content/uploads/2019/06/iahaio-white-paper-spanish.pdf> (accessed on 10 April 2023).
- Jacobsen, J. J. (1997). *Pet therapy: A study of the use of companion animals in select therapies*. Pikes Peak, Colorado Spring, Colorado.

- Johnson, T. P., Garrity, T. F., & Stallones, L. (1992). Psychometric evaluation of the Lexington attachment to pets scale (LAPS). *Anthrozoös*, 5, 160–175. [CrossRef]
- Kalmbach, D., Wood, W., & Caitlin Peters, B. (2020). Parental perspectives of occupational therapy in an equine environment for children with Autism Spectrum Disorder. *Occupational Therapy in Health Care*, 34(3), 230–252. [CrossRef]
- Koca, T. T., & Ataseven, H. (2015). What is hippotherapy? The indications and effectiveness of hippotherapy. *Northern Clinics of Istanbul*, 2(3), 247–252. [CrossRef]
- Lasa, S. M., Ferriero, G., Brigatti, E., Valero, R., & Franchignoni, F. (2011). Animal-assisted interventions in internal and rehabilitation medicine: A review of the recent literature. *Panminerva Mededica*, 53, 129–136.
- Levinson, B. M. (1969). *Psicoterapia infantil asistida con animales*. Fundación Affinity.
- Levinson, B. M. (1995). *Psicoterapia infantil asistida por animales*. Fundación Purina.
- London, M. D., Mackenzie, L., Lovarini, M., Dikson, C., & Alvarez-Campos, A. (2020). Animal assisted therapy for children and adolescents with Autism Spectrum Disorder: Parent perspectives. *Journal of Autism and Developmental Disorders*, 50, 4492–4503. [CrossRef]
- Malcolm, R., Ecks, S., & Pickersgill, M. (2018). ‘It just opens up their world’: Autism, empathy, and the therapeutic effects of equine interactions. *Anthropol Medical*, 25(2), 220–234. [CrossRef] [PubMed]
- Martos-Montes, R., Ordóñez-Pérez, D., Martos-Luque, R., & García-Viedma, M. (2015). Intervención asistida con animales (IAA): Análisis de la situación en España. *Escritos de Psicología*, 8(3), 1–10. [CrossRef]
- Michelotto, A. L. L., Anater, A., Guebert, M. C. C., Borges, T. D., Michelotto, P. V., Jr., & Pimpão, C. T. (2019). Animal-assisted activity for children with Autism Spectrum Disorder: Parents’ and therapists’ perception. *Journal of Alternative and Complementary Medicine*, 25(9), 928–929. [CrossRef] [PubMed]
- Moeran, B. (2009). From participant observation to observant participation. In S. Ybema, D. Yanow, H. Wells, & F. Kamsteeg (Eds.), *Organizational ethnography: Studying the complexities of everyday life* (pp. 139–156). Sage.
- Moraes, C. (1998). Autistic behavior assessment questionnaire. *Revista de Ciencias Médicas (PUCCAMP)*, 8, 103.
- Morgan, S., & O’Byrne, D. A. (2023). How autism assistance canines enhance the lives of autistic children. *Inquiry*, 60, 00469580231195029. [CrossRef]
- Morrison, M. L. (2007). Health benefits of animal-assisted interventions. *Complementary Health Practice Review*, 12(1), 51–62. [CrossRef]
- Muñoz-Lasa, S., Ferriero, G., Valero, R., Gomez-Muñiz, F., Rabini, A., & Varela, E. (2011). Effect of therapeutic horseback riding on balance and gait of people with multiple sclerosis. *Giornale Italiano di Medicina del Lavoro ed Ergonomia*, 33(4), 462–467. [PubMed]
- Narvekar, H. N., & Krishnan, U. (2024). Animal-assisted therapy for children and adolescents with neurodevelopmental disorders: A review. In S. K. Gupta (Ed.), *Handbook of research on child and adolescent psychology practices and interventions* (pp. 324–340). IGI Global Scientific Publishing. [CrossRef]
- Narvekar, H. N., & Narvekar, H. N. (2022). Canine-assisted therapy in neurodevelopmental disorders: A scoping review. *European Journal of Integrative Medicine*, 26(8), 1947–1958. [CrossRef]
- Ogrinc, G., Davies, L., Goodman, D., Batalden, P., Davidoff, F., & Stevens, D. (2016). Standards for QUality improvement reporting Excellence 2.0: Revised publication guidelines from a detailed consensus process. *Journal of Nursing Care Quality*, 200, 676–682. [CrossRef]
- Orwin, R. G. (2018). Evaluating coding decisions. In *The handbook of research synthesis* (pp. 95–107). Russell Sage Foundation.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffman, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement an updated guideline for reporting systematic reviews. *BMJ*, 372, n71. [CrossRef]
- Parra, S. (2016). *Terapia y educación asistida con animales para colectivos infantiles en riesgo o con necesidades educativas especiales* (Trabajo Fin de Grado). Universidad de Granada.
- Poresky, R. H. (1996). Companion animals and other factors affecting young children’s development. *Anthrozoös*, 9, 159–168. [CrossRef]
- Rehn, A. K., Caruso, V. R., & Kumar, S. (2023). The effectiveness of animal-assisted therapy for children and adolescents with autism spectrum disorder: A systematic review. *Complementary Therapies in Clinical Practice*, 50, 101719. [CrossRef]
- Reimers, T. M., Wacker, D. P., Cooper, L. J., & de Raad, A. (1992). Acceptability of behavioral treatments for children: Analog and naturalistic evaluations by parents. *School Psychology Review*, 21(4), 628–643.
- Richardson, K., Mackenzie, L., Lovarini, M., & Dickson, C. (2022). Occupational therapy incorporating dogs for autistic children and young people: Parent perspectives. *British Journal of Occupational Therapy*, 85(11), 859–868. [CrossRef]
- Rodriguez, K. E., Rispoli, M., Kelleher, B. L., MacLean, E. L., & O’Haire, M. E. (2024). The effects of service dogs for children with autism spectrum disorder and their caregivers: A cross-sectional study. *Frontiers in Psychiatry*, 15, 1355970. [CrossRef]
- Sandelowski, M. (2000). Whatever happened to qualitative description? *Research in Nursing & Health*, 23(4), 334–340. [PubMed]
- Sandelowski, M. (2009). What’s in a name? Qualitative description revisited. *Research in Nursing & Health*, 33, 77–84. [CrossRef]

- Scotland-Coogan, D., Whitworth, J. D., & O'Brien, C. N. (2021). Caregiver perceptions of the benefits of hippotherapy for children with various disorders, disabilities, and medical conditions. *Journal of Human Behavior in the Social Environment*, 31(8), 1054–1076. [CrossRef]
- Signes, M. A., & Rodrigo, M. (2010). Animales de compañía y niños: Una relación educativa y terapéutica. *Indivisa: Boletín de Estudios e Investigación*, 1(1), 117–144.
- Silkwood-Sherer, D. J., Killian, C. B., Long, T. M., & Martin, K. S. (2012). Hippotherapy—An intervention to habilitate balance deficits in children with movement disorders: A clinical trial. *Physical Therapy*, 92(5), 707–717. [CrossRef]
- Sissons, J. H., Blakemore, E., Shafi, H., Skotny, N., & Lloyd, D. M. (2022). Calm with horses? A systematic review of animal-assisted interventions for improving social functioning in children with autism. *Autism*, 26(6), 1320–1340. [CrossRef]
- Skinner, H. A., Steinhauer, P. D., & Santa-Barbara, J. (1995). *FAM-iii: Family assessment measure III*. Multi-Health Systems.
- Snider, L., Korner-Bitensky, N., Kammann, C., Warner, S., & Saleh, M. (2007). Horseback riding as therapy for children with cerebral palsy: Is there evidence of its effectiveness? *Physical & Occupational Therapy in Pediatrics*, 27(2), 5–23. [CrossRef]
- Solomon, O. (2012). Doing, being and becoming: The sociality of children with autism in activities with therapy dogs and other people. *Cambridge Anthropology*, 30, 109–126. [CrossRef]
- Stake, R. E. (1995). *The art of case study research*. Sage Publishing.
- Stumpf, E., & Breitenbach, E. (2014). Dolphin-assisted therapy with parental involvement for children with severe disabilities: Further evidence for a family-centered theory for effectiveness. *Anthrozoös*, 27(1), 95–109. [CrossRef]
- Tan, V. X. L., & Simmonds, J. G. (2018). Parent perceptions of psychosocial outcomes of equine-assisted interventions for children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 48, 759–769. [CrossRef]
- Thapar, A., Cooper, M., & Rutter, M. (2017). Neurodevelopmental disorders. *Lancet Psychiatry*, 4(4), 339–346. [CrossRef]
- Tseng, A. (2023). Brief report: Above and beyond safety: Psychosocial and biobehavioral impact of autism-assistance dogs on autistic children and their families. *Journal of Autism and Developmental Disorders*, 53(1), 468–483. [CrossRef]
- van der Steen, S., Heineman, M. M. P., & Ernst, M. J. A. (2019). Evaluating animal-assisted interventions: An empirical illustration of differences between outcome measures. *Animals*, 9(9), 645. [CrossRef]
- Vandeveld, S., Morisse, F., Došen, A., Poppe, L., Jonckheere, B., van Hove, G., Maes, B., van Loon, J., & Claes, C. (2015). The scale for emotional development-revised (SED-R) for persons with intellectual disabilities and mental health problems: Development, description, and reliability. *International Journal of Developmental Disabilities*, 62, 11–23. [CrossRef]
- Viau, R., Arsenault-Lapierre, G., Fecteau, S., Champagne, N., Walker, C. D., & Lupien, S. (2010). Effect of service dogs on salivary cortisol secretion in autistic children. *Psychoneuroendocrinology*, 35(8), 1187–1193. [CrossRef]
- Whale and Dolphin Conservation. (2021). *Still no evidence dolphins cure human health issues says review*. Available online: <https://uk.whales.org/2021/01/29/still-no-evidence-dolphins-cure-human-health-issues-says-review/> (accessed on 18 November 2025).
- Williams, G. C., Freedman, Z. R., & Deci, E. L. (1998). Supporting autonomy to motivate glucose control in patients with diabetes. *Diabetes Care*, 21, 1644–1651. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

Exploring Interaction Dynamics in Dog-Assisted Therapy: An Observational Study

Candela Jasmin Hüsgen ^{1,2,*}, Nienke Peters-Scheffer ¹ and Robert Didden ^{1,3}

¹ Behavioural Science Institute, Radboud University, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands; nienke.peters-scheffer@ru.nl (N.P.-S.); robert.didden@ru.nl (R.D.)

² Hulphond, P.O. Box 24, 5373 ZG Herpen, The Netherlands

³ Trajectum, Dokter Stolteweg 17, 8025 AV Zwolle, The Netherlands

* Correspondence: candela.huesgen@ru.nl

Abstract

(1) Background: Dog-assisted therapy (DAT) integrates dogs into therapeutic sessions to enhance participants' physical, emotional, and social well-being. Despite its growing popularity, little is known about the interaction dynamics between the dog, participant, and therapist during sessions. (2) Methods: This study examined these dynamics, focusing on active participation, focus direction, joint focus, and physical contact. Video data from sessions 1, 5, and 9 of 10 individual therapy sessions with five participants were analysed using behavioural observations and an ethogram. (3) Results: Results indicated that therapists' active participation increased over time while participants' activity levels remained stable. Dogs were most active during the initial and final sessions. Participants' focus on therapists remained consistent, but their focus on the dog stabilised after an initial decline. Dogs are primarily focused on their surroundings. The joint focus between participants and therapists increased, and physical contact with dogs varied significantly among participants and dogs. (4) Conclusions: The findings partially support the "icebreaker" theory, whereby dogs help establish initial rapport. However, the trend was not consistent across all participants. Therapist–dog interactions remained low and stable. Differences in dog characteristics (e.g., breed and fur type) and participant needs may explain variation in physical contact. These findings underline the complexity of DAT and highlight the need for further research into interaction patterns relate to participants and dog characteristics.

Keywords: dog-assisted therapy (DAT); animal assisted therapy; human–animal interaction; behavioural observation; dog behaviour

1. Introduction

Although research on dog-assisted therapy (DAT) has promising outcomes, little is known about the interactions between dogs, therapists, and children within DAT and how these interactions relate to the context and goals of the intervention (Binfet et al., 2021; Jones et al., 2019). Current studies suggest DATs potentially enhance participants' physical, emotional, and social well-being (Grové et al., 2021; Guzmán et al., 2022; Lavín-Pérez et al., 2021). Research highlights that the presence of dogs during therapy can reduce anxiety, elevate mood, and foster social interactions, positioning DAT as a valuable supplement to traditional therapeutic approaches (Grajfoner et al., 2017; Van Schooten et al., 2024; Wu & Wei, 2023). However, existing studies focused on outcomes, often overlooking how the interactions between the child, dog and therapist drive these results (Hüsgen et al.,

2022; Wagner et al., 2022). Understanding these interactions is crucial for explaining DAT's effectiveness and optimising therapeutic outcomes (De Santis et al., 2024).

In human–animal interactions, the triadic relationship between the dog, the participant, and the therapist provides the setting in which the participant is learning. The triadic relationship between the therapist, participant, and dog distinguishes DAT from many other therapies, which typically involve a dyadic relationship between the participant and therapist. Observable interactions, such as movements, focus, and physical contact, are presumably distributed differently in this triadic dynamic, creating a therapeutic setting with both advantages and challenges (Glenk & Foltin, 2021; IAHAIO, 2018; Roma et al., 2021; ISAAT, 2024; Voutilainen & Peräkylä, 2016). A challenge, for example, is that according to the One Health concept, the therapist in Dog-Assisted Therapy (DAT) holds responsibility not only for the client's well-being but also for their own welfare and that of the dog (IAHAIO, 2018). The pre-established relationship between the therapist and the dog plays a crucial role in modelling a secure and trusting bond for the participant, facilitating the therapeutic alliance (A.MOET A. ERBIJ? Fine, 2018). It can be an advantage of the setting. Unlike other therapeutic alliances, the therapist and dog enter this process with a relationship built before the therapy session, outside the therapeutic context. This relationship, grounded in training and mutual understanding, includes the therapist's responsibility for the dog's actions and welfare (ISAAT, 2024; IDEM). While the therapist–participant relationship is developed during the session, the therapist–dog relationship serves as a model of safety and trust for the participant.

Observations can be used to analyse interactions in therapy by recording actions such as movement, physical contact, and the direction of participants' focus (Binfet et al., 2021; Ramseyer & Tschacher, 2011). DAT often involves active engagement, including movement and physical contact, particularly in sessions encouraging interaction between the dog and the participant (Abadi et al., 2022; Wohlfarth et al., 2013). Examples include agility exercises, obedience training, or simply taking a walk together. These movements are comparable to those in psychomotor therapy, where integrating movement into therapy can support emotional processing, enhance emotional resilience, aid motor function recovery, and foster creativity and exploration (Bergland et al., 2018). This approach encourages experiential learning through shared reflection on the experiences. Another interaction in DAT is petting the dog, which introduces physical contact (Beetz et al., 2012). Studies suggest that such actions may influence participants' emotional states by fostering attachment and a sense of safety, potentially enhancing openness to therapy. Despite these insights, little is known about the specific frequencies of these interactions during sessions, which this study aims to address.

This study aims to determine the extent to which observable interactions in DAT, such as movements, focus, joint focus, and physical contact, occur during therapy sessions. Physical contact has been shown to provide therapeutic benefits. Similarly, moments of joint focus between the participant, therapist, and dog create opportunities for engagement and interaction within the triadic relationship. These interactions are believed to enhance the therapeutic process. To better understand these dynamics and their contribution to the effectiveness of DAT, this study seeks to answer the following research question: What are the frequencies of movement, physical contact, and focus in DAT sessions, and can patterns of these interactions be identified?

2. Materials and Methods

2.1. Participants and Setting

Participant recruitment was conducted through social media, a local child and family service centre, and participant-to-participant conversations. The inclusion criteria were

as follows: (1) children aged 10–18 years; (2) a treatment goal related to social-emotional challenges, focus, and/or impulse control; and (3) the ability to attend therapy once a week. Exclusion criteria included (1) allergies to dogs, (2) aggression towards humans or animals, and (3) a fear of dogs. In total, five adolescents participated as follows: two boys aged 12 and 15 years, and three girls aged 13, 18, and 18. The participants were coping with challenges such as emotional regulation, Autism Spectrum Disorder (ASD), performance anxiety, perfectionism, distractibility, and Attention-Deficit/Hyperactivity Disorder (ADHD). Only the 15-year-old boy had a dog at home. Each participant attended ten weekly sessions over a 12-week period. Four therapists provided the interventions. All had completed in-company Dog-Assisted Therapy (DAT) training at Hulphond Nederland, a foundation specialised in training assistance dogs and providing a wide range of animal-assisted interventions in the Netherlands. The therapists had between one and three years of experience in delivering DAT. Three dogs participated in the study—a black male Labrador (8 years old), a white male Poodle (5 years old), and a blond male Golden Retriever (4 years old). All dogs began their training at approximately eight weeks of age and started working in therapy between 20 and 24 months. They worked two days per week in therapeutic settings and had each been active in DAT for at least one year. Each dog was paired with a specific therapist, and the dog–therapist teams had developed a working relationship before the study’s start, as they had worked together for at least a year, ensuring consistency and trust within the sessions. Additional dogs and therapists had been at the research location several times before the research began to become familiar with the room, smells, and overall environment.

2.2. Therapy Sessions

Therapy sessions were held in a controlled environment conducive to therapy and dog interactions at Radboud University’s Baby and Child Laboratory. The guidelines outlined in the IAHAIO whitepaper for integrating dogs into therapy settings were followed during all sessions. Ethical considerations were paramount in the study. Informed consent was obtained from all participants and their legal guardians, and the anonymity and confidentiality of the participants were maintained throughout the study. The institutional ethics committee review board of the Radboud University approved the study (ECSW-2022-022), adhering to ethical guidelines for research involving minors and animals.

Video footage was systematically recorded using high-definition cameras from HikVision (DS-2CD2183G2-I), placed unobtrusively in the therapy room to ensure that all interactions were captured without disrupting the therapy sessions. Two cameras were placed in the two corners of the room at a height of 2.3 m to view the participants from multiple angles. The therapy room measures 5 by 7 m (see Figure 1). On one side of the room, double doors provide access. A large window directly opposite allows natural light to enter. The floor is covered with carpet, which offers grip for the dog. Additionally, a resting area for the dog was included with a dog bed and a water bowl. The room is furnished with two tables (each measuring approximately 140 × 80 cm) and two chairs, as well as a storage cabinet (100 × 50 cm). The two cameras are installed in the top-right and bottom-right corners of the room. During sessions, the therapist, client, and dog were in the room.

A researcher who observed the video recordings in real time adjusted the cameras during the sessions as necessary. Additionally, the therapy room contained two tables and four chairs, a cupboard with dog toys, agility materials such as a tunnel and cones, and treats for the dog.

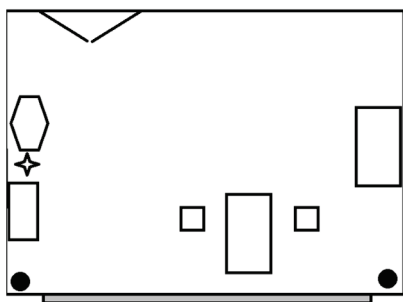


Figure 1. Floor plan of the therapy room. Including double doors, two tables, two chairs, a storage cabinet, a dog bed (hexagon), a dog water bowl (star), and two cameras (black circles).

Each therapy session followed a consistent structure, beginning with an introduction or welcome, during which participants discussed their daily life issues and feelings. This was followed by a warm-up exercise, which remained the same across all sessions, helping the participant to establish familiarity with the therapist and the dog. For example, the warming-up could be a small sequence in which the client gives the dog simple commands such as “sit”, “down”, and “shake hands” to initiate contact and build engagement. After the warm-up exercise, the participant engaged in an individualised exercise tailored to their therapeutic goals, such as a personalised obstacle course, adapted to the client’s therapeutic goals and the dog’s abilities. This was followed by a reflective conversation with the therapist and the participant to encourage personal insights and reinforce learning. Next, a second exercise was introduced. Sometimes, this exercise built upon the previous exercise to deepen engagement; in other sessions, a new exercise was introduced. This second activity followed a reflective conversation, allowing participants to process and internalise their experiences. Each session concluded with a dog puzzle activity, in which the dog was given a puzzle task. This final exercise provided a light-hearted end to the session. It allowed participants to observe the dog’s problem-solving abilities, creating a positive and relaxed atmosphere as the session unfolded.

2.3. Measures

The entire sessions, each lasting between 40 and 60 min, were video recorded and used for analysis. Recordings from the first, fifth, and ninth sessions of each participant were included in full and divided into 30 s segments. Each session was scored with an ethogram developed for this study. Momentary time sampling was employed to record behaviour at specific predetermined moments (Harrop & Daniels, 1986). This approach ensures a systematic and consistent method for recording and analysing the interactions within the sessions. The ethogram comprised 25 categories, divided into ten for the dog, eight for the participant, and eight for the therapist (Appendix A). The ethogram was based on the literature and the principles of Behavioural Observation (Ramachandran, 2012) commonly applied in psychotherapy evaluations. Table 1 describes the observed behaviours and interactions categorised into movements, focus direction, joint focus and physical contact. The category of movements is divided into passive and active actions, distinguishing between stationary behaviours, such as sitting, standing, or lying down, and dynamic behaviours, such as walking.

Table 1. The therapist focuses on the participant, the dog, and other aspects of each session.

Focus Direction	Towards Participant			Towards Dog			Other		
Session	1	5	9	1	5	9	1	5	9
Participant 1	51%	65%	44%	21%	12%	37%	28%	24%	20%
Participant 2	61%	70%	69%	27%	16%	10%	12%	14%	21%
Participant 3	41%	64%	51%	43%	24%	36%	16%	12%	13%
Participant 4	62%	67%	66%	20%	14%	12%	18%	19%	20%
Participant 5	47%	57%	54%	38%	34%	42%	15%	9%	5%
Average	53%	64%	57%	30%	20%	27%	18%	16%	16%

2.4. Data Processing and Analysis

First, the data were standardised by adjusting the frequency of observations based on session length, ensuring comparability across all sessions despite differences in duration. Initially, the active and passive behaviours of the dog, participant, and therapist were analysed. First, the active and passive behaviour scores were calculated by recording movement observations into two categories—active and passive. Behaviours are classified as active, walking and moving, or passive, such as sitting, standing, or lying down. Then, cross-tabulations were used to identify patterns and frequencies. This provided an overview of how much time each participant spent engaging in active versus passive behaviours during the therapy sessions. Second, the focus direction of each participant was examined, categorising where the focus was directed—whether toward the participant, the therapist, the dog, or something else. This analysis helped reveal shifts in focus and moments of joint focus. Subsequently, the joint focus was analysed to capture instances where two participants were simultaneously focused. Physical contact between the dog and the participant or therapist was recorded, capturing all forms of touch, including petting and other types of physical interaction.

3. Results

3.1. Frequencies of Active and Passive Participation During Therapy Sessions

The participation levels of the dogs fluctuated across the sessions as follows: 37.9% of the intervals in Session 1, 21.4% of the intervals in Session 5, and 40.7% of the intervals in Session 9, where the dog was active. In contrast, participant participation remained relatively stable (34% in Session 1, 30.6% in Session 5, and 35.4% in Session 9). Therapists demonstrated increasing participation rates from 28.1% in Session 1 to 33.7% in Session 5 and 38.2% in Session 9. The level of participant participation was consistent across all sessions, reflecting the structured nature of the therapy. Therapists started with a low level of active engagement in Session 1 (28.1%), which gradually increased in subsequent sessions. Dogs exhibited more dynamic levels of participation, with a noticeable decline in Session 5, followed by an increase in Session 9. The trend for participant participation remained stable across all sessions, indicating consistent involvement in the therapy process. Therapists displayed an upward trend in participation over time, suggesting increasing activity as sessions progressed. The trend for dogs was more irregular, with no clear directional pattern, highlighting fluctuations in their engagement throughout the sessions. Figure 2 provides a detailed view of individual participant trends. Participant 3 exhibited the highest initial participation but steadily declined over the sessions. In contrast, Participant 5 demonstrated an upward trend, with significant growth in active engagement. The remaining participants displayed stable patterns or slight fluctuations in their participation levels over time.

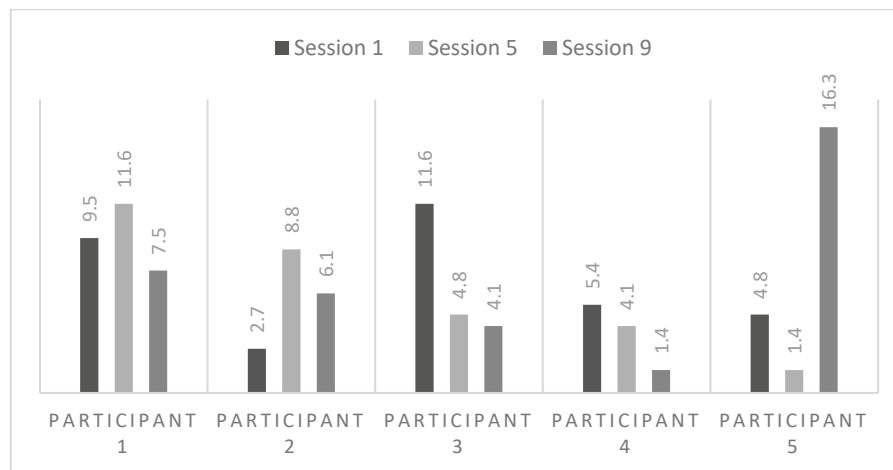


Figure 2. Participants' active participation across three therapy sessions is displayed in percentage.

3.2. Frequencies of Focus Direction During Therapy Sessions

Table 1 displays therapists' focus direction during sessions involving participants and dogs, categorised into three areas as follows: focus direction towards the participant, towards the dog, and others. Data from the three sessions and average values for each session are presented in Table 1. In terms of focus direction from the therapist towards the participant, therapists showed an increase from Session 1 (53%) to Session 5 (64%), followed by a slight decrease in Session 9 (57%). The focus of the therapist on the dog was initially high in Session 1 (30%), dropped in Session 5 (20%), and rose again in Session 9 (27%). Focus directed towards other aspects stayed stable from Session 1 (18%) to Session 5 (16%) and in Session 9 (16%). While a pattern emerged in the therapist's focus direction toward the participant, and no consistent pattern was found in the therapist's focus on the dog. Therapists demonstrated the highest focus on the participant during Session 2, whereas their focus on the dog varied, with noticeable differences between individual therapists.

Table 2 provides insights into participants' focus direction during therapy sessions, categorised into the following three areas: towards the therapist, towards the dog, and others. Data from Session 1, Session 5, and Session 9 for five participants and average values are presented. The average focus on the therapist stayed stable from 44% in Session 1 to 47% in Session 5, and then to 45% in Session 9. Notable individual variation is observed, with some participants increasing their focus on the therapist. Initially, participants' focus on the dog was 37% in Session 1, dropping to 26% in Session 5 and then rising again to 33% in Session 9. Participants' focus on other factors increased from 20% in Session 1 to 27% in Session 5, then decreased slightly to 23% in Session 9.

Table 2. The participant's focus direction toward the therapist, dog, and other aspects varies for each participant and each session in percentage.

Focus Direction	Towards Therapist			Towards Dog			Other		
	1	5	9	1	5	9	1	5	9
Participant 1	13%	13%	24%	36%	20%	48%	51%	67%	28%
Participant 2	38%	41%	60%	43%	23%	16%	19%	36%	25%
Participant 3	47%	63%	28%	40%	33%	49%	13%	4%	23%
Participant 4	70%	63%	72%	21%	21%	19%	9%	16%	9%
Participant 5	50%	55%	42%	42%	33%	31%	8%	12%	27%
Average	44%	47%	45%	37%	26%	33%	20%	27%	23%

Table 3 presents data on dogs' focus direction during therapy sessions, categorised into three areas as follows: towards the therapist, towards the participant, and others.

Data from three sessions for five participants are provided, along with average values. Regarding the focus on the therapist, the dogs showed an average of 12% in Session 1, which slightly decreased to 10% in Session 5 and further decreased to 6% in Session 9. When focusing on the participant, the dogs' focus direction was 25% in Session 1, increased to 28% in Session 5, and slightly decreased to 24% in Session 9. The dog's most measured focus direction was categorised as "other". The average focus on other factors was 63% in Session 1, stayed stable at 62% in Session 5, but then rose to 71% in Session 9. The data indicate that dogs in therapy sessions have a fluctuating focus direction span, with the most consistent focus being on factors other than the therapist or participant. Their focus direction towards the therapist decreased over time, while their focus on the participant showed some variability.

Table 3. The dog's focus direction towards the therapist, participant, and other aspects varies for each participant and each session in percentage.

Focus Direction	Towards Therapist			Towards Participant			Other		
Session	1	5	9	1	5	9	1	5	9
Participant 1	11%	16%	5%	24%	17%	5%	65%	67%	91%
Participant 2	8%	2%	5%	26%	17%	10%	66%	81%	85%
Participant 3	21%	13%	8%	16%	43%	50%	63%	44%	42%
Participant 4	4%	11%	8%	27%	26%	17%	69%	63%	74%
Participant 5	15%	8%	3%	33%	37%	36%	52%	55%	61%
Average	12%	10%	6%	25%	28%	24%	63%	62%	71%

3.3. Frequencies of Joint Focus During Therapy Sessions

Based on the focus direction coding, the proportion of time during which joint focus occurred was calculated, as shown in Table 4. Joint focus was defined as moments when two of the three individuals involved simultaneously directed their attention toward each other. For each session, the percentage of joint focus was computed for the following three dyads: participant–dog, therapist–dog, and participant–therapist. The results indicate that joint focus between the participant and the dog decreases over time, from an average of 18% in session 1 to 15% in session 9. Notably, individual variation is considerable as follows: some participants maintain a relatively high level of shared attention with the dog in session 5, whereas for others, this declines more rapidly. Joint focus between therapist and dog remains consistently low across all three sessions, averaging 3% in session 1 and approximately 2% in sessions 5 and 9. In contrast, joint focus between participant and therapist increases over time. In session 1, an average of 34% of the session involved joint focus, which rises to 43.1% in session 5 and remains at 41.3% in session 9.

Table 4. Joint focus during therapy sessions for each participant and each session is displayed in percentages.

	Participant–Dog Dyad			Therapist–Dog Dyad			Participant–Therapist Dyad		
Session	1	5	9	1	5	9	1	5	9
Participant 1	15%	4%	5%	3%	1%	1%	7%	12%	22%
Participant 2	21%	14%	6%	0%	1%	2%	32%	37%	55%
Participant 3	13%	28%	28%	4%	3%	2%	33%	55%	26%
Participant 4	14%	12%	12%	0%	2%	1%	56%	61%	64%
Participant 5	24%	28%	22%	6%	0%	2%	44%	51%	40%
Average	18%	17%	15%	3%	2%	2%	34%	43%	41%

3.4. Frequencies of Physical Contact During DAT Sessions

Figure 3 illustrates the percentage of time each participant spent petting the dog during the three therapy sessions. It shows the varying levels of physical contact between the participants and their dogs. Participant 1 displayed consistent behaviour across the sessions, spending 2.8%, 1.3%, and 3.5% of the time in contact with his dog during Sessions 1, 5, and 9. This indicates relatively low and stable physical contact. In contrast, Participant 2, a boy interacting with a Labrador, showed a peak of physical contact during Session 1, where 10.3% of the session was spent petting the dog. However, this interaction dropped to 5% in Session 5 and 1% in Session 9, showing decreased physical engagement. On the other hand, Participant 3, a 18-year-old girl interacting with a Poodle, demonstrated increasing engagement across the sessions. She began with 18.7% in Session 1, increased to 21.3% in Session 5, and saw a substantial rise to 45.3% in Session 9. Similarly, Participant 4, an 18-year-old girl interacting with a Poodle, displayed dynamic interaction patterns. She spent 37.8% of the time petting her dog in Session 1, which increased to 57.1% in Session 5 before slightly dropping to 36% in Session 9. These two participants, who worked with Poodles that also tend to seek physical contact on their own, displayed the highest levels of physical engagement, likely influenced by the dogs' preference for this type of interaction. Lastly, Participant 5, a 13-year-old girl interacting with a Labrador, showed minimal engagement, petting her dog 4.5% of the time in Session 1. Interestingly, she had no recorded physical contact in Session 5 but increased to 9% in Session 9, indicating some variability in her interaction levels. The analysis of physical contact between participants and their dogs reveals distinct trends. Participants interacting with Poodles (P3 and P4) showed the highest and increasing levels of physical contact over time. In contrast, Participants 1 and 5, interacting with a Golden Retriever and a Labrador, exhibited consistently low and stable physical contact throughout the sessions. Participant 2, also with a Labrador, initially had higher contact but showed a notable decrease over time.

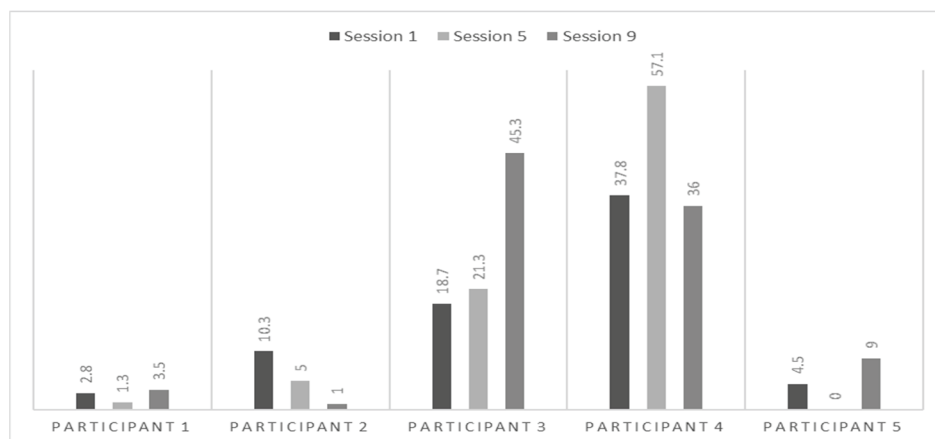


Figure 3. Percentage of time participants spent petting their dogs during therapy sessions.

4. Discussion

This study explored the interactions within DAT sessions by examining active and passive participation, focus direction, joint focus, and physical contact among the dog, participant, and therapist. Analysis of their involvement during the therapy sessions showed that participants remained actively involved at similar levels across all sessions, while therapists exhibited a slight increase in activity over time. The dogs showed the most variation in participation, with their activity levels fluctuating throughout the sessions, being more active at sessions one and nine than during Session 5. Further analysis showed that therapists primarily focused on the participants, and participants' focus on the thera-

pists increased slightly across the sessions. At the same time, participants' focus towards the dogs decreased. However, this trend was not consistent across all participants. Joint focus analyses revealed that engagement between participants and dogs slightly decreased, while joint focus between participants and therapists increased in most cases. Physical contact between the participant and the dog varied significantly, with the Poodle exhibiting considerably more physical contact with participants than the other dogs. Breed characteristics and fur type could explain this observation, as well as variations in participants' characteristics or needs. Overall, these results offer insight into the changes in engagement among participants, therapists, and dogs throughout DAT sessions.

The analysis of the focus direction indicates that most participants in this study initially focused on the dog, which may help ease them into the therapeutic process by providing emotional comfort (Coakley et al., 2020). Early research describes this as the "Icebreaker Effect" of the dog, making it easier for the therapist and participant to come into contact and create a safe atmosphere (Meixner & Kotrschal, 2022). Over time, the participants' focus shifts toward the therapist, with a balance between the therapist, the dog, and the environment emerging by Session 5. By Session 9, the participant's focus direction stabilises on the therapist, which fits with the dog's role as a bridge to build trust, as A.IDEM Fine (2018) described. Joint focus patterns also show that participant-therapist engagement seems to increase in most cases, while participant-dog interaction slightly decreases. This transition highlights the evolving dynamic, where the dog facilitates early engagement, but the therapist becomes central for achieving therapeutic goals. However, this is not found for all participants. Interestingly, the focus between therapists and dogs remained stable, with only short moments of joint focus observed. This lack of joint focus between the therapist and the dog challenges assumptions about the dog-therapist dynamic (Mignot et al., 2022). At the same time, the therapist frequently observed the dog, with an average of 26% per session, indicating that the dog's well-being was being monitored. This suggests that while there was limited collaboration between the therapist and the dog during the sessions, attention to the dog was present. Still, this raises questions about the exact nature and necessity of therapist-dog interaction as described by Glenk and Foltin (2021). Additionally, while the dogs' well-being was safeguarded through recommended session durations, the lack of comparison with non-DAT sessions limits conclusions about DAT's unique effects. Future studies should explore how different types of therapist-dog interaction might influence therapy.

It should be noted, however, that the therapist and the dog did observe each other more frequently than they jointly focused on a shared activity. This suggests that although there was limited joint focus—understood here as engaging together in a shared task—the therapist still monitored the dog, and the dog paid attention to the therapist. The distinction between joint focus and focus on each other is therefore not always clear-cut. Moreover, the less collaborative role of the therapist and dog during sessions may partially explain the low levels of joint engagement.

The literature suggests that DAT participants value its active nature and reduced focus on verbal interaction (Van Schooten et al., 2024). However, the results of our study indicate that participants could have been more active during the sessions, with participants actively participating only about one-third of the time, and this level of participation slightly declined from Session 1 to Session 9. Therapists demonstrated a similar trend, with their active involvement decreasing notably by Session 9. This could be attributed to the structured nature of the sessions, while one therapist had more experience, the others had less than two years of experience, which may have led to a closer adherence to the therapy protocol. This observation aligns with Aubrey Fine's Handbook on animal-assisted therapy, which emphasises the importance of tailoring the structure of the sessions

to meet therapeutic goals. The moderate to high levels of structure in this study may have limited unplanned interactions, while these unplanned, spontaneous interactions can encourage engagement between the participant and the dog. For future research, adopting a less rigid session structure to encourage more spontaneous participant–dog interactions could potentially provide richer data on the dynamics of DAT. Moreover, shorter observation intervals and a closer examination of the dog’s evolving role during different stages of therapy could yield additional insights into how these interactions contribute to the therapeutic process.

The analysis of physical contact between the participant and the dog revealed notable differences. While these data must be interpreted cautiously, examining the differences between these outcomes seems important. The literature shows that physical contact between participants and dogs can affect the neurobiological systems, influencing oxytocin levels, heart rate, and bonding behaviour (Beetz et al., 2012). These are critical factors that can shape the therapeutic process and contribute to building a strong alliance. Based on the literature, having physical contact appears beneficial for participants and dogs. Our data indicate that participants who worked with the Poodle had significantly more physical contact. Possible explanations include (1) the dog’s temperament and natural need for affection and (2) the dog’s coat type, as Poodles have softer, non-greasy, and non-shedding fur (Udvarhelyi-Tóth et al., 2024). Given the numerous positive effects of physical contact, further research is needed to investigate these interactions and determine whether physical contact correlates with other therapeutic outcomes. Dogs with more affectionate personalities or softer coats may naturally foster more participant engagement, potentially enhancing the therapeutic experience. Exploring how these factors impact participant–dog interaction will provide valuable insights into how dogs affect the therapeutic process and could help to create a guideline to match the dogs with participants to maximise therapeutic effectiveness.

In addition to the dog’s physical characteristics regarding contact, an alternative explanation may lie in the type of participant. Research by Nagasawa et al. (2015) demonstrates that women tend to have a stronger inclination for closeness with dogs, linked to oxytocin-mediated bonding. Notably, the two participants who interacted with the more “cuddly” dog in our study were both older adolescent girls. Their choice of this particular dog may reflect a greater need or preference for physical closeness and affectionate moments compared to the younger participants. This interplay between participant characteristics and dog selection could have influenced the observed frequency of physical contact. On the other hand, other research indicates that men may engage in more physical contact with unfamiliar dogs in therapeutic or structured settings, where the dog is not their own (Shih et al., 2020). Given these mixed findings, it remains unclear to what extent participant gender or preferences influence physical contact with dogs, highlighting the need for further research to clarify this relationship.

Two challenges of this study were the use of a low-frequency behaviour analysis approach and the heterogeneity of the participant group. The low-frequency behaviour analysis method provided a broad overview of the movement and focus direction towards the therapist, participant, and dog. It is inappropriate to capture brief yet meaningful interactions, such as short “check-in moments” between the therapist and dog (looking at each other) or short physical contact between the participant and the dog. The 30 s recording intervals excluded high-frequency behaviours and subtle nuances of the therapeutic process. Future research could address this limitation by implementing shorter intervals, such as 5 s, and focusing on key exercises or meaningful moments rather than entire sessions. This adjustment would allow for a more precise and detailed analysis of behaviours while managing data complexity effectively. The second challenge was the heterogeneity of

the participant group. The wide age range (12 to 18 years) introduces developmental differences in maturity, attention span, and emotional regulation, potentially affecting consistency of engagement, which makes comparison and generalisation difficult. While all participants faced social–emotional or focus-related challenges, the specific nature of these issues differed, influencing how they interacted with the dog, therapist, and therapy process. This variability complicated the analysis of participation and focus patterns, as observed behaviours could reflect individual differences rather than therapy effects. To address this, future research should consider more narrowly defined inclusion criteria to create a more homogeneous group.

5. Conclusions

This study examined interactions in DAT sessions, revealing a general trend toward increased participant–therapist engagement over time, while participant–dog interaction tended to decrease. This partially supports the “icebreaker” theory, which suggests that the dog initially facilitates rapport between the participant and therapist, after which the therapist–participant relationship becomes more prominent. However, this trend was not consistent across all participants. Similarly, therapist–dog interactions remained low throughout and varied only minimally. These individual differences underline the importance of further investigating the dynamics.

Author Contributions: Conceptualization, C.J.H., N.P.-S. and R.D.; methodology, C.J.H., N.P.-S. and R.D.; validation, C.J.H. and N.P.-S.; formal analysis, C.J.H.; investigation, C.J.H. and N.P.-S.; data curation, C.J.H.; writing—original draft preparation, C.J.H.; writing—review and editing, C.J.H. and N.P.-S.; visualisation, C.J.H.; supervision, R.D.; project administration, C.J.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Foundation Hulphond Netherlands.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Committee of Radboud University (protocol code ECSW-2022-022; date of approval: 24 June 2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets generated for this study are available on request to the corresponding author.

Conflicts of Interest: C.J.H. is employed by the funding organisation Foundation Hulphond Netherlands in a capacity unrelated to the current research. The funding organisation had no role in the design, execution, analysis, or interpretation of the study. The other authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

ADHD	Attention-Deficit Hyperactivity Disorder
ASD	Autism Spectrum Disorder
BSI	Behavioural Science Institute, Radboud University
DAT	Dog Assisted Therapy
ECSW	Ethics Committee of the Faculty of Social Sciences, Radboud University
IAHAIO	International Association of Human–Animal Interaction Organizations

Appendix A

Appendix A.1. Ethogram

Behavioural observations are essential for systematically assessing interactions between dogs, clients, and therapists during animal-assisted interventions. An ethogram, which includes clearly defined behavioural categories, is used to ensure reliability and objectivity. This study will analyse video recordings of therapy sessions by pausing the video every 30 s to record observed behaviours. This sequential recording method allows for structured and comparable data collection.

Operational Definitions

1. Dog Behaviours:

- Dog lying: The dog rests on the ground with its body wholly or partially in contact with the floor.
- Dog sitting: The dog is seated with its hindquarters on the floor and front legs extended.
- Dog standing: The dog is on all four legs without movement.
- Dog walking: The dog moves forward or changes position using all four legs.
- Attention client: The dog is visibly oriented towards the client, with its head or body directed towards them.
- Attention therapist: The dog is visibly oriented towards the therapist, with its head or body directed towards it.
- Attention other: The dog is visibly oriented towards another individual or object in the environment.
- Dog makes physical contact: The dog initiates direct physical contact with the client, therapist, or another individual (e.g., nudging, leaning, pawing).
- Other: Any behaviour the client displays that does not fit the above categories.

2. Client Behaviours:

- Client sitting: The client is seated on a chair, bench, or the floor.
- Client standing: The client is upright and stationary.
- Client walking: The client is moving from one location to another.
- Attention dog: The client is visibly oriented towards the dog, with eye contact or body direction.
- Attention therapist: The client is visibly oriented towards the therapist, with eye contact or body direction.
- Attention other: The client is oriented towards another individual or object in the environment.
- Petting dog: The client physically touches or stroking the dog with their hands.
- Other: Any behaviour the client displays that does not fit the above categories.

3. Therapist Behaviours:

- Therapist sitting: The therapist is seated on a chair, bench, or the floor.
- Therapist standing: The therapist is upright and stationary.
- Therapist walking: The therapist is moving from one location to another.
- Attention dog: The therapist is visibly oriented towards the dog, with eye contact or body direction.
- Attention client: The therapist is visibly oriented towards the client, with eye contact or body direction.
- Attention other: The therapist is oriented towards another individual or object in the environment.
- Petting dog: The therapist physically touches or stroking the dog with their hands.

- Other: Any behaviour the therapist displays that does not fit into the above categories.

References

- Abadi, M. R. H., Hase, B., Dell, C., Johnston, J. D., & Kontulainen, S. (2022). Dog-assisted physical activity intervention in children with autism spectrum disorder: A feasibility and efficacy exploratory study. *Anthrozoös*, 35(4), 601–612. [CrossRef]
- Beetz, A., Uvnäs-Moberg, K., Julius, H., & Kotrschal, K. (2012). Psychosocial and psychophysiological effects of human-animal interactions: The possible role of oxytocin. *Frontiers in Psychology*, 3, 234. [CrossRef]
- Bergland, A., Olsen, C. F., & Ekerholt, K. (2018). The effect of psychomotor physical therapy on health-related quality of life, pain, coping, self-esteem, and social support. *Physiotherapy Research International*, 23(4), e1723. [CrossRef] [PubMed]
- Binfet, J., Green, F. L. L., & Draper, Z. A. (2021). The importance of client–canine contact in canine-assisted interventions: A randomised controlled trial. *Anthrozoös*, 35(1), 1–22. [CrossRef]
- Coakley, A. B., Annesse, C. D., Empoliti, J. H., & Flanagan, J. M. (2020). The experience of animal assisted therapy on patients in an acute care setting. *Clinical Nursing Research*, 30(4), 401–405. [CrossRef] [PubMed]
- De Santis, M., Filugelli, L., Mair, A., Normando, S., Mutinelli, F., & Contalbrigo, L. (2024). How to measure human-dog interaction in dog-assisted interventions? A scoping review. *Animals*, 14(3), 410. [CrossRef]
- Fine, A. (2018). The use of the relationship with animals vicariously—Role modelling. In *Animal assisted therapy* (4th ed., p. 146). Academic Press.
- Glenk, L. M., & Foltin, S. (2021). Therapy dog welfare revisited: A review of the literature. *Veterinary Sciences*, 8(10), 226. [CrossRef]
- Grajfoner, D., Harte, E., Potter, L., & McGuigan, N. (2017). The effect of dog-assisted intervention on student well-being, mood, and anxiety. *International Journal of Environmental Research and Public Health*, 14(5), 483. [CrossRef]
- Grové, C., Henderson, L., Lee, F., & Wardlaw, P. (2021). Therapy dogs in educational settings: Guidelines and recommendations for implementation. *Frontiers in Veterinary Science*, 8, 655104. [CrossRef] [PubMed]
- Guzmán, E. G., Rodríguez, L. S., Santamarina-Perez, P., Barros, L. H., Giral, M. G., Elizalde, E. D., Ubach, F. R., Gonzalez, M. R., Yuste, Y. P., Téllez, C. D., Cela, S. R., Gisbert, L. R., Medina, M. S., Ballesteros-Urpi, A., & Liñan, A. M. (2022). The benefits of dog-assisted therapy as complementary treatment in a children’s mental health day hospital. *Animals*, 12(20), 2841. [CrossRef] [PubMed]
- Harrop, A., & Daniels, M. (1986). Methods of time sampling: A reappraisal of momentary time sampling and partial interval recording. *Journal of Applied Behaviour Analysis*, 19(1), 73–77. [CrossRef] [PubMed]
- Hüsken, C. J., Peters-Scheffer, N. C., & Didden, R. (2022). A systematic review of dog-assisted therapy in children with behavioural and developmental disorders. *Advances in Neurodevelopmental Disorders*, 6(1), 1–10. [CrossRef]
- IAHAIO. (2018). *White paper on animal-assisted interventions*. IAHAIO. Available online: <https://iahaio.org/best-practice/white-paper-on-animal-assisted-interventions/> (accessed on 7 April 2025).
- ISAAT. (2024). *STANDARDS*. Available online: <https://isaat.org/standards/> (accessed on 7 April 2025).
- Jones, M. G., Rice, S. M., & Cotton, S. M. (2019). Incorporating animal-assisted therapy in mental health treatments for adolescents: A systematic review of canine-assisted psychotherapy. *PLoS ONE*, 14(1), e0210761. [CrossRef] [PubMed]
- Lavín-Pérez, A. M., Martín-Sánchez, C., Martínez-Núñez, B., Lobato-Rincón, L. L., Villafaina, S., González-García, I., Mata-Cantero, A., Graell, M., Merellano-Navarro, E., & Collado-Mateo, D. (2021). Effects of dog-assisted therapy in adolescents with eating disorders: A study protocol for a pilot controlled Trial. *Animals*, 11(10), 2784. [CrossRef]
- Meixner, J., & Kotrschal, K. (2022). Animal-assisted interventions with dogs in special education—A systematic review. *Frontiers in Psychology*, 13, 876290. [CrossRef] [PubMed]
- Mignot, A., De Luca, K., Servais, V., & Leboucher, G. (2022). Handlers’ representations on therapy dogs’ welfare. *Animals*, 12(5), 580. [CrossRef]
- Nagasawa, M., Mitsui, S., En, S., Ohtani, N., Ohta, M., Sakuma, Y., Onaka, T., Mogi, K., & Kikusui, T. (2015). Oxytocin-gaze positive loop and the coevolution of human-dog bonds. *Science*, 348(6232), 333–336. [CrossRef] [PubMed]
- Ramachandran, V. S. (2012). *Encyclopedia of human behavior*. Elsevier eBooks. [CrossRef]
- Ramseyer, F., & Tschacher, W. (2011). Nonverbal synchrony in psychotherapy: Coordinated body movement reflects relationship quality and outcome. *Journal of Consulting and Clinical Psychology*, 79(3), 284–295. [CrossRef]
- Roma, R. P. S., Tardif-Williams, C. Y., Moore, S. A., & Bosacki, S. L. (2021). A transdisciplinary perspective on dog-handler-participant interactions in animal assisted activities for children, youth and young adults. *Human-Animal Interaction Bulletin*, 9, 62–91. [CrossRef]
- Shih, H., Paterson, M. B. A., Georgiou, F., Pachana, N. A., & Phillips, C. J. C. (2020). Who is pulling the leash? Effects of human gender and dog sex on human–dog dyads when walking on-leash. *Animals*, 10(10), 1894. [CrossRef]

- Udvarhelyi-Tóth, K. M., Iotchev, I. B., Kubinyi, E., & Turcsán, B. (2024). Why do people choose a particular dog? A mixed-methods analysis of factors owners consider important when acquiring a dog, on a convenience sample of austrian pet dog owners. *Animals*, 14(18), 2634. [CrossRef] [PubMed]
- Van Schooten, A., Peters-Scheffer, N., Enders-Slegers, M., Verhagen, I., & Didden, R. (2024). Dog-assisted therapy in mental health care: A qualitative study on the experiences of patients with intellectual disabilities. *European Journal of Investigation in Health, Psychology and Education*, 14(3), 540–553. [CrossRef] [PubMed]
- Voutilainen, L., & Peräkylä, A. (2016). Interactional practices of psychotherapy. In *Palgrave macmillan UK eBooks* (pp. 540–557). Palgrave Macmillan. [CrossRef]
- Wagner, C., Grob, C., & Hediger, K. (2022). Specific and non-specific factors of animal-assisted interventions considered in research: A systematic review. *Frontiers in Psychology*, 13, 931347. [CrossRef]
- Wohlfarth, R., Mutschler, B., Beetz, A., Kreuser, F., & Korsten-Reck, U. (2013). Dogs motivate obese children for physical activity: Key elements of a motivational theory of animal-assisted interventions. *Frontiers in Psychology*, 4, 796. [CrossRef]
- Wu, A., & Wei, R. (2023). The benefits of dog-assisted therapy for children with anxiety. *Psychotherapy and Counselling Journal of Australia*, 11(2), 1–17. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

From Gaze to Interaction: Links Between Visual Attention, Facial Expression Identification, and Behavior of Children Diagnosed with ASD or Typically Developing Children with an Assistance Dog

Manon Toutain ^{1,*}, Salomé Paris ², Solyane Lefranc ², Laurence Henry ² and Marine Grandgeorge ²

¹ UMR 8002 Integrative Neuroscience and Cognition Center, CNRS, Université Paris-Cité, 75006 Paris, France

² CNRS, EthoS (Éthologie Animale et Humaine)—UMR 6552, University Rennes, Normandie University, 35000 Rennes, France; salomeeparis@gmail.com (S.P.); solyane.lefranc@gmail.com (S.L.); laurence.henry@univ-rennes.fr (L.H.); marine.grandgeorge@univ-rennes.fr (M.G.)

* Correspondence: manon-toutain@laposte.net

Abstract: Understanding how children engage with others is crucial for improving social interactions, especially when one of the partners is an animal. We investigated relationships between interaction strategies, visual attention, and facial expression identification of children interacting with an assistance dog, and evaluated the effects of a neurodevelopmental disorder (Autism Spectrum Disorder (ASD)) on these elements. Thus 20 children (7 with ASD, 13 with typical development or TD) participated in three experimental tasks: (1) face-to-face encounters with the assistance dog while wearing eye-tracking glasses to analyze visual exploration patterns; (2) free interactions with the assistance dog, assessed using ethological methods and (3) a computerized task evaluating human and canine facial expression identification. The results revealed that (1) visual exploration patterns varied depending on task instructions: ASD children paid less attention to faces and more to the environment than TD children; (2) both groups displayed similar behavioral patterns during free interactions with the assistance dog; (3) facial expression identification data did not differ between groups; and (4) within-group associations emerged between visual attention, spontaneous interaction behaviors, and facial expression identification abilities. These findings highlighted the complex interplay between visual attention, facial expression identification, and social behavior of children, emphasizing the importance of context in shaping interaction strategies.

Keywords: visual attention; assistance dog; autism; ethology; human-animal interaction

1. Introduction

1.1. Humans' Visual Attention and Its Importance in Social Interactions

Attention is a cognitive process that allows the selection, processing, and filtering of relevant information or stimuli from the many that reach us (Posner & Rothbart, 2007). Visual attention plays a crucial role in social interactions as it enables individuals to gather information and cues from their partners, such as postures, gestures, facial expressions, or gaze direction (Langton et al., 2008). These signals help individuals infer the intentions and mental states of their communication partners (e.g., mutual gaze, joint attention; Emery, 2000), allowing them to adapt and adjust their behavior, thus facilitating smooth communication and mutual understanding (Chokron et al., 2014).

Infants exhibit early visual attention to faces, which is essential for detecting potential danger and recognizing signs of rejection, fear, acceptance, or affection (Chokron et al., 2014). This visual attention system plays a key adaptive role in ensuring the proper development of processes essential for social interactions (Nelson, 2001; Gillet & Barthélémy, 2011). Evaluation of visual attention is therefore a major methodological challenge. Data in the literature is traditionally based on visual search tasks (Gerhardstein & Rovee-Collier, 2002), target detection tasks (Johnstone et al., 2007), and reaction time tasks to visual stimuli (Posner, 1980). More recently, many studies have adopted eye-tracking techniques to record eye movements, providing a precise and non-invasive method to infer individuals' visual attention (Valtakari et al., 2021; Thorsson et al., 2024).

1.2. Social Visual Attention in Autistic Spectrum Disorder (ASD)

Social visual attention of individuals with a neurodevelopmental disorder such as ASD can be different or even disrupted, leading to a so-called neuro-atypical cognitive profile. ASD is a neurodevelopmental disorder that manifests early in childhood and is characterized by a dyad of impairments: (1) deficits in communication and social interaction, including difficulties in both verbal (e.g., echolalia, language delay) and nonverbal communication (e.g., gestures, facial expressions), as well as challenges in initiating and maintaining interactions while adhering to social norms; (2) the presence of restricted and repetitive behaviors, interests and activities, including verbal and motor stereotypies (DSM-5; APA, 2013). Additionally, sensory processing difficulties are commonly observed, manifesting as hypo- or hyper-reactivity to sensory stimuli. Furthermore, the sex ratio in ASD is approximately three males for every female (Loomes et al., 2017).

Visual attention is one of the avenues explored to understand the social differences of ASD children (Courchesne et al., 1994; Chokron et al., 2014). For example, ASD children exhibit deficits in orienting their attention towards social stimuli such as faces and tend to focus more on objects compared to typically developing (TD) children (Klin et al., 2002; Riby & Hancock, 2008; Gillet & Barthélémy, 2011). Indeed, they display an atypical pattern of facial exploration, spending more time looking at a mouth and less time at the eye region compared to TD children (Klin et al., 2002; Nakano et al., 2010; Spezio et al., 2007; Grandgeorge et al., 2016; Valiyamattam et al., 2020; Dollion et al., 2021; Toutain et al., 2024). As a result, insufficient gaze toward faces and atypical exploration patterns can interfere with the processing and recognition of facial expressions. Studies show that ASD children do worse in emotion recognition tasks or facial expression identification tasks than their TD peers (Dyck et al., 2001; Bölte & Poustka, 2003; Harms et al., 2010; Black et al., 2017). Consequently, impairments in these abilities may lead to difficulties in assimilating and understanding social signals and contexts.

1.3. ASD Children's Visual Attention During Interspecific Interactions

Reports increasingly stress the benefits of human-animal interactions for ASD children and a widespread approach is based on animal-assisted interventions (O'Haire et al., 2013; Davis et al., 2015). These children can be accompanied in their daily lives by several pets as well as by an assistance dog that provides multiple benefits (Dollion & Grandgeorge, 2022). This daily presence could improve their communication skills (Grandgeorge et al., 2012b; Erbacher & Bördlein, 2025). Moreover, the facial exploration strategies of ASD children improved in the presence of an assistance dog than those of ASD children living without one (Dollion et al., 2022). A recent study showed that after one school year, the presence of an assistance dog had helped adolescents with cognitive function disorders (including ASD) to identify human and dog facial expressions better (Toutain et al., 2025). To explain such benefits, the authors explore the role of visual attention. Indeed, unlike human faces,

animals represent visually attractive stimuli for ASD children. These children look more at pictures of animals than at pictures of humans or objects (Celani, 2002). This preference is also observed in real-life settings with a dog (Prothmann et al., 2009; Dollion et al., 2021). These children may therefore find it easier to engage in and maintain interactions with animals rather than with other humans. More precisely, both ASD children and TD children exhibit similar visual attention patterns towards their household cats and dogs in daily life interactions (e.g., glances, gaze; Grandgeorge et al., 2020). Other reports, based on eye tracking technologies, showed that ASD children display a facial exploration pattern similar to that of TD children when looking at animal faces, with a particular interest in the eye region, that was not observed when they explore human faces (Grandgeorge et al., 2016; Valiyamattam et al., 2020; Toutain et al., 2024). This more typical exploration pattern of animal faces may enable ASD children to extract information efficiently from an animal's face, thereby facilitating interaction regulation (Dollion et al., 2021).

Building on previous literature, we aimed to investigate the visual attention and interaction strategies of ASD children and typically developing (TD) children during real-life, unguided interactions with an assistance dog (i.e., without guidance or intervention from a referent). We also explored potential associations between their interaction strategies, visual attention patterns, and their ability to identify facial expressions. Thus our research included three sub-studies: (Study 1) characterization of facial exploration patterns (i.e., human and dog) of ASD children or TD children using a head-mounted eye-tracking approach during a real encounter; (Study 2) a behavioral analysis of these children during spontaneous interactions with the same assistance dog; (Study 3) assessment of children's ability to identify human and canine facial expressions based on photographs. Finally, we examined the relationships between visual attention (Study 1) and (a) the interaction strategies adopted during spontaneous interactions with the assistance dog (Study 2), as well as (b) the ability to identify human and canine facial expressions (Study 3). In Study 1, we expected both groups of children (those with ASD and those with TD) to display similar visual attention patterns when observing an assistance dog, but to differ in their visual attention toward a human. In Study 2, we anticipated no significant difference between the groups in terms of spontaneous interactions with the assistance dog. In Study 3, similar to Study 1, we expected comparable performance between the groups in recognizing canine facial expressions. However, we anticipated that ASD children would perform more poorly when interpreting human facial expressions. Furthermore, we hypothesized that visual attention directed toward the assistance dog will be associated with spontaneous engagement behaviors during interactions, with longer fixation durations on the assistance dog corresponding to increased interactive behaviors. Finally, we expected visual attention toward the assistance dog to be positively correlated with performance in recognizing facial expressions, with greater attention to the assistance dog enhancing the ability to identify the emotions expressed. This study should be considered as a preliminary investigation, given its sample size limitations.

2. General Materials and Methods

2.1. Ethics

The present research was non-invasive and did not involve any pharmacological intervention. Parents provided written informed consent, and the assent of the children was obtained both orally and in writing. This study was approved by the Sud Méditerranéen III ethics committee on 5 September 2022, [N°2022.06.09 bis_22.02106.000105].

Regarding ethical considerations for the assistance dogs, the experiments were conducted in accordance with Directive 2010/63/EU of the European Parliament and of the Council on the protection of animals used for scientific purposes. They complied with

current French legislation on animal experimentation (Decree No. 2013-118 of 1 February 2013) and its five implementing orders (JO 7 February 2013), integrated into the Rural and Maritime Fishing Code (Articles R.214-87 to R.214-137). The procedures fell outside the scope of the European Directive, as they involved only behavioral observations and non-invasive interactions. In accordance with French regulations, no ethical authorization was required. The assistance dogs involved were not research animals; their care and housing were entirely managed by the professional trainers of the Handi'Chiens association. They were accustomed to human interaction, and each participated in a maximum of five sessions per day, with a minimum of 30 min of rest between each 10-min session. All sessions took place on the association's premises, in a familiar environment located approximately 100 m from the assistance dogs' living area, eliminating the need for transport.

2.2. Participants

Humans. The inclusion criteria in our study were being between 6 and 17 years old and having ASD or typical development. The exclusion criteria were having epilepsy, having a significant intellectual disability making it too difficult to understand our instructions, or requiring strong visual correction (an informal visual acuity test was conducted beforehand by the experimenter). Thus, twenty French children (11 girls and 9 boys) between 6 and 16 years old (mean $\pm$ SD: 9.7 ± 2.6 years old) participated in this study. Seven of them were diagnosed with ASD (7 boys; 10.6 ± 3.0 years old), and thirteen had typical development (11 girls and 2 boys; 9.3 ± 2.0 years old) (for details, see Table 1). Ages did not differ significantly between the two groups (Mann-Whitney test, $W = 55.5$, $p = 0.4452$). In the informational questionnaire completed by the parents, only one parent of a typically developing child mentioned that their child could be afraid of unfamiliar dogs.

Table 1. Characteristics of the study subjects (TD: typical development, ASD: Autism Spectrum Disorder; NA: not available). *: At least one animal is present in the household at the time of the study. Social Communication Questionnaire (SCQ): a score above 15 indicates a probable ASD diagnosis. Dunn's Sensory Profile: a score between 38 and 122 indicates a significant sensory sensitivity difference compared to a group of TD children; a score between 123 and 149 indicates a probable sensory sensitivity difference compared to the same group; a score between 150 and 190 represents typical performance.

Participants Number	Group	Sex	Age (yo)	SCQ Score	Dunn Score	Presence of an Animal at Home *	Vision's Particularities	Studies in Which the Participant Took Part
1	ASD	M	11	29	127	YES	NO	1, 2, 3
2	ASD	M	11	21	114	YES	NA	1, 2, 3
3	ASD	M	13	23	111	YES	NO	1, 2, 3
4	ASD	M	9	19	123	YES	NA	1, 2, 3
5	ASD	M	8	28	120	YES	NO	2, 3
6	ASD	M	16	22	NA	YES	Myopia	1, 2, 3
7	ASD	M	6	31	89	YES	Hyperopic	1, 2, 3
8	TD	M	8	0	180	YES	NO	1, 2, 3
9	TD	F	11	1	179	YES	Myopia	1, 2, 3
10	TD	F	13	4	190	YES	NO	1, 2, 3
11	TD	F	6	8	117	YES	Strabismus	2, 3
12	TD	F	11	0	178	YES	NA	1, 2, 3
13	TD	M	9	3	156	NO	NO	1, 2, 3
14	TD	F	9	1	162	YES	NA	1, 2, 3
15	TD	F	8	1	155	YES	Hyperopic	2, 3
16	TD	F	12	1	162	YES	NO	1, 2, 3
17	TD	F	9	1	158	YES	NO	1, 2, 3
18	TD	F	7	5	169	YES	NO	1, 2, 3
19	TD	F	11	0	182	YES	NO	1, 2, 3
20	TD	F	7	0	141	YES	NA	1, 2, 3

The parents of all the children fulfilled two questionnaires. First, the Social Communication Questionnaire (SCQ, a 40-item parent-report screening questionnaire for ASD, Rutter et al., 2003). We used the SCQ French version (Kruck et al., 2013). Items on the SCQ correspond to criteria used to diagnose the core features of ASD (i.e., communication, reciprocal social interactions, and repetitive behaviors and interests). This autism screening questionnaire is the best researched and validated parent-report screening tool for ASD (Norris & Lecavalier, 2010) as it shows strong discrimination between ASD and non-ASD cases as well as good reliability and validity (Witwer & Lecavalier, 2007). The lifetime version was used in our research. Each item on the SCQ is rated as “yes” or “no” and assigned a 0–1 point rating (0 = absence of abnormal behavior, 1 = presence of abnormal behavior). Items address both current and past behavior. The possible range of scores for nonverbal children is 0–33 and for verbal children is 0–39. In the French version, the cut-off score used for ASD screening purposes is 15 (Kruck et al., 2013). Second, we also used the short version of the Dunn Sensory Profile (Dunn, 2010) designed for 3 to 10-year-old and 11-month-old children. This questionnaire assesses a child’s sensory sensitivity. A score between 38 and 122 indicates a significant sensory difference compared to a group of typically developing (TD) children. A score between 123 and 149 suggests a probable sensory difference, while a score between 150 and 190 corresponds to typical performance.

Dogs. Five assistance dogs (all Golden Retrievers, 1 female, and 4 males; 3.2 ± 2.1 years old), trained by the Handi’chiens association, participated in the study. Each child was randomly assigned an assistance dog.

2.3. Study Context

The study took place at the Handi’Chiens training center in Alençon, France, within the “Autism” building. A dedicated room was provided for the study, equipped with a desk, chairs, a sofa, a bed, a carpet, and a coffee table with objects belonging to the assistance dog (i.e., a knotted rope, an intelligence toy for dogs (plastic platform with compartments to hide treats, specially designed for dogs), a toy veterinary kit (composed entirely of wooden objects mimicking real medical instruments used for care, such as a toy stethoscope and a toy syringe, all neatly packaged in a small fabric bag), and a brush). Additionally, a watering can be filled with water and a food bowl was placed near the bed. A parent was present throughout the session but remained non-intervening. The room was equipped with three Sony Camcorder FDR-AX43A Black, Full HD cameras.

2.4. Methodology

Each participant completed the three studies consecutively, always in the same order, during a single appointment. Details of the studies are given below.

2.5. Statistical Analyses

All statistical analyses were conducted using RStudio software version 2023.09.0. The significance threshold was set at 0.05, and non-parametric statistics were used. Detailed information about statistical analyses is provided in each of the following subparts.

3. Study 1: Characterization of ASD Children and TD Children’s Visual Exploration Pattern

3.1. Methods

3.1.1. Participants

Seventeen of the twenty children in the research participated in this study (9 girls and 8 boys). Among them, 6 boys were diagnosed with ASD and 11 had typical development

(9 girls and 2 boys). Their mean age was 10.2 ± 2.6 years. Ages did not differ significantly between the two groups (Mann-Whitney test, $W = 41$, $p = 0.4419$).

3.1.2. Procedure

Eye fixations were collected and recorded using Tobii Glasses Pro 2 eye-tracking glasses (Appendix A). The glasses were connected to a power unit, which transmitted real-time data to a computer. Data recording was performed using the Tobii Pro Glasses Controller software (version 1.1 4.20033). The procedure followed a standardized scenario, as described below. The child sat on a carpet on the floor. The experimenter fitted the glasses and performed a single-point calibration. Eye-tracking measures are detailed in Table 2 (total average data collection time: mean $\pm$ SD: 26.1 ± 5.1 s).

Table 2. Definitions of Areas of Interest (AOIs), description of their application and pictures for example.

AOI Details	Experimenter	Assistance Dog
	Head (circle with a maximum tolerance margin of half a hand around the head)	Head (circle around the head with a maximum tolerance margin of a quarter of a paw)
	Eyes (oval including both eyes when the head is facing forward, limited to the base of the nostrils)	Eyes (oval including both eyes when the head is facing forward, and only one eye when the head is in profile, as soon as the second eye is no longer visible)
	Nose-mouth (circle including the base of the nostrils, the mouth, and the base of the chin)	Muzzle (circle including the entire muzzle)
	Ears (not included due to technical challenge, small size, and limited visibility)	Ears (custom shape including the ear up to its lower insertion)
	Other (included the entire scene except the AOIs Head, Eyes, and Lower face)	Other (included the entire scene except the AOIs Head, Eyes, Lower face, and Ears)
Example		

Phase 1. Assistance dog presentation (8.3 ± 1.1 s)¹. The experimenter entered the room with an assistance dog on a leash and instructed the dog to lie down or sit. Then, she introduced the dog, providing its name, age, breed, and color. Eye-tracking coding started when the experimenter said “Let me introduce you to” and ended 20 s later.

Phase 2. Questions about assistance dogs (9.1 ± 2.3 s). The experimenter asked the child two questions about the assistance dog: “What do you think of it?” and “How do you think it feels?” Eye-tracking coding started when the first question was asked and ended after the child’s final response.

Phase 3. Gaze fixation on the experimenter (4.1 ± 1.2 s) *and the assistance dog* (4.6 ± 0.5 s). The experimenter asked the child to fixate on her for 10 s and then to fixate on the dog for another 10 s. Only the first 5 s were coded. This duration was chosen based on previous eye-tracking studies using similar protocols for animal face presentation on a screen, typically

lasting 5 s (Muszkat et al., 2015; Grandgeorge et al., 2016; Valiyamattam et al., 2020). For both fixation tasks, eye-tracking coding started when the experimenter began counting aloud from “1” and ended before the number “6” was spoken. Given the time-consuming nature of manual coding and the standard presentation times observed in eye-tracking studies on screens (typically between 3 and 5 s), this duration was deemed appropriate.

3.1.3. Data Collection and Statistical Analyses

The collected data corresponded to the fixation time on different areas of interest (AOIs) of an assistance dog’s face (i.e., AOIs: head, eyes, muzzle, ears) and the experimenter’s face (i.e., AOIs: head, eyes, nose-mouth), as well as “other” AOI encompassing the entire visual scene (Table 2). AOIs were manually adjusted to accommodate changes in the configuration of the faces in the scene (e.g., when an assistance dog was in profile). Since the amount of usable data varied between participants, fixation times were converted into percentages to allow comparisons.

Mean comparison tests (i.e., Friedman test, Wilcoxon test with “FDR” correction, and Mann-Whitney test) compared facial exploration pattern data between the two groups of children and within each group.

3.2. Results

3.2.1. Visual Exploration of ASD Children

The data are represented in Figure 1A (see Appendix B for details in percent).

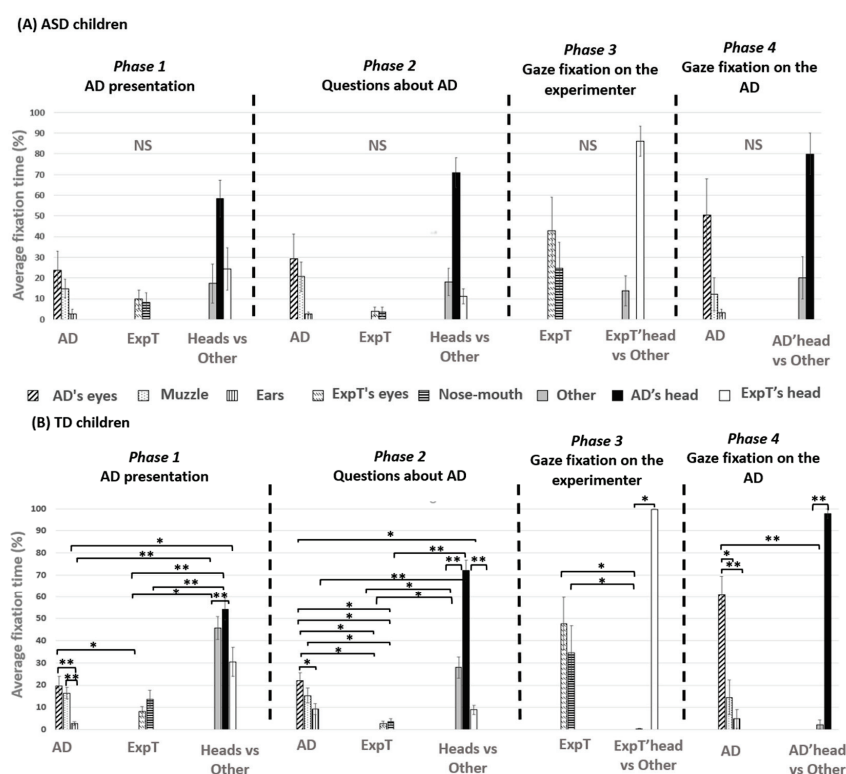


Figure 1. Fixation times (mean $\pm$ S.E.) for the different Areas Of Interest (AOIs) during the different phases (A) for ASD children and (B) and TD children. AD: Assistance Dog, ExpT: Experimenter. *: $p < 0.05$, **: $p < 0.01$, NS: Non-significant. Wilcoxon tests.

Phase 1. Presentation of an assistance dog. ASD children did not seem to spend the same amount of time on each AOI ($X^2 = 18.7$; $df = 7$; $p = 0.009$). However, pairwise comparisons could not reveal any significant differences between AOIs (all $p > 0.05$). Nevertheless, the

longest fixation time percentage ($58.32 \pm 21.75\%$) was for an assistance dog's head, while the shortest was for a dog's ears ($2.75 \pm 5.77\%$).

Phase 2. Questions about the assistance dog. ASD children did not seem to spend the same amount of time on each AOI ($X^2 = 22.7$; $df = 7$; $p = 0.002$). However, pairwise comparisons could not reveal any significant differences between AOIs (all $p > 0.05$). During this phase, the fixation time percentage was the highest for an assistance dog's head ($70.80 \pm 17.75\%$), and the lowest percentage was for an assistance dog's ears ($2.71 \pm 1.84\%$).

Phase 3. Gaze fixation on the experimenter. ASD children did not seem to spend the same amount of time on each AOI ($X^2 = 9.9$; $df = 3$; $p = 0.019$). However, pairwise comparisons could not reveal any significant differences between AOIs (all $p > 0.05$). During this phase, the highest fixation time percentage was for the experimenter's head ($86.0 \pm 17.78\%$), and the lowest percentage was for AOI "other" ($14.0 \pm 17.78\%$).

Phase 4. Gaze fixation on an assistance dog. ASD children did not seem to spend the same amount of time on each AOI ($X^2 = 14.6$; $df = 5$; $p = 0.006$). However, pairwise comparisons could not reveal any significant differences between AOIs (all $p > 0.05$). During this phase, the highest fixation time percentage was for a dog's head ($79.95 \pm 24.81\%$), and the lowest percentage was for AOI "other" ($20.05 \pm 24.81\%$).

3.2.2. Visual Exploration of TD Children

The corresponding data are represented in Figure 1B (see Appendix B for percentage details).

Phase 1. Assistance dog presentation. TD children did not spend the same amount of time on each AOI ($X^2 = 45.3$; $df = 7$; $p < 0.001$). They gazed more at an assistance dog's head than at the "other" AOI, the experimenter's eyes, and the experimenter's nose-mouth region (respectively, $W = 2$; $p = 0.008$; $W = 66$; $p = 0.003$; $W = 66$; $p = 0.003$). They gazed less at an assistance dog's ears than at the human's head, the assistance dog's head, the assistance dog's muzzle, and the "other" AOI (respectively: $W = 63$; $p = 0.01$; for the other three: $W = 66$; $p = 0.003$). They gazed less at the experimenter's eyes than at the "other" AOI and the assistance dog's eyes (for both: $W = 61$; $p = 0.02$).

Phase 2. Questions about the assistance dog. TD children did not spend the same amount of time on each AOI ($X^2 = 41.6$; $df = 7$; $p < 0.001$). They gazed more at an assistance dog's head than at the following AOIs: the "other" AOI, the human's head, the human's eyes, and the human's mouth (respectively: $W = 0$; $p = 0.008$; for the next three: $W = 55$; $p = 0.008$). Then, they gazed more at an assistance dog's eyes than at the human's head, nose-mouth region, eyes, and the assistance dog's ears (respectively: $W = 49$; $p = 0.04$; $W = 54$; $p = 0.01$; $W = 54$; $p = 0.01$; $W = 51$; $p = 0.02$). They gazed more at an assistance dog's muzzle than at the human's nose-mouth region and eyes (respectively: $W = 54$; $p = 0.01$; $W = 52$; $p = 0.02$). Finally, they gazed more at "other" AOI than at the human's nose-mouth region and eyes (respectively: $W = 50$; $p = 0.03$; $W = 53$; $p = 0.01$).

Phase 3. Gaze fixation on the experimenter. TD children did not spend the same amount of time on each AOI ($X^2 = 23.5$; $df = 3$; $p < 0.001$). They gazed more at the experimenter's head than at the "other" AOI ($W = 0$; $p = 0.01$). They gazed more at the experimenter's eyes and nose-mouth AOI than at the "other" AOI ($W = 0$; $p = 0.02$; $W = 0$; $p = 0.04$). No significant differences were evidenced between fixation times for the eyes and the nose-mouth AOIs ($p > 0.05$).

Phase 4. Gaze fixation on the assistance dog. TD children did not spend the same amount of time on each AOI ($X^2 = 36.4$; $df = 4$; $p < 0.001$). They spent more time looking at a dog's head than at the "other" AOI ($W = 0$; $p = 0.005$). They looked more at a dog's eyes than at its muzzle, ears, and the "other" AOI ($W = 9$; $p = 0.04$; $W = 64$; $p = 0.005$; $W = 0$; $p = 0.003$).

3.3. Comparisons Between ASD Children and TD Children

No significant differences could be evidenced for gaze times for the different AOIs between the two groups during the presentation phase (Phase 1) or the question phase (Phase 2) (all $p > 0.05$).

During the experimenter fixation phase (Phase 3), ASD children tended to fixate more on the AOI “other” than did TD children ($W = 43.5$; $p = 0.064$) (Figure 2). ASD children tended to look less at the experimenter’s face than did TD children ($W = 16.5$; $p = 0.064$). During the assistance dog fixation phase (Phase 4), TD children looked more at a dog’s face than ASD children ($W = 15$; $p = 0.039$). ASD children looked more at the “other” AOI than did TD children ($W = 51$; $p = 0.039$).

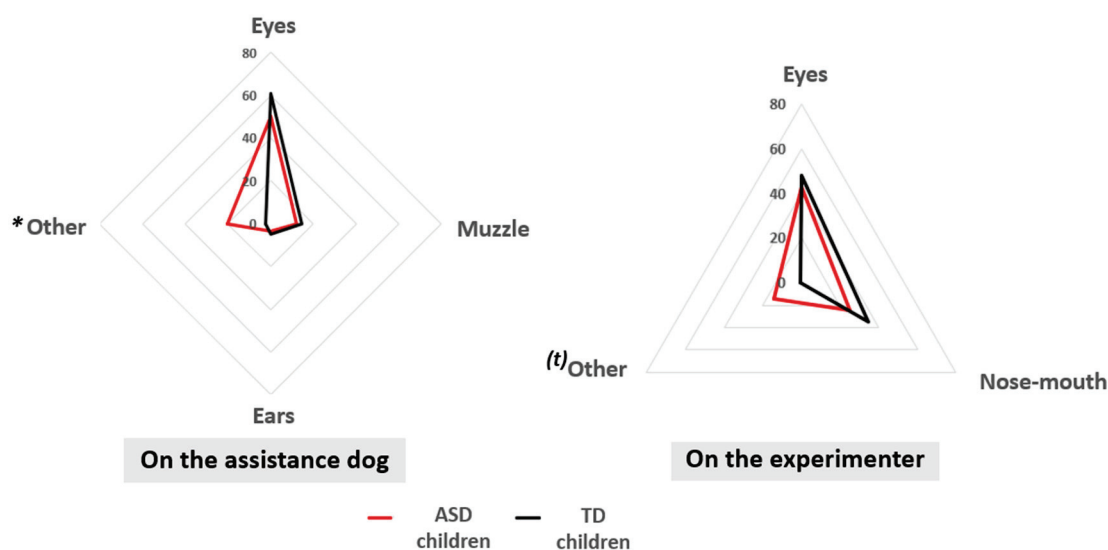


Figure 2. Fixation times (mean) on different areas during the fixation phases on the assistance dog (left) and the experimenter (right) for ASD children (red) and TD children (black). *: $p < 0.05$, (t): $p < 0.10$. Mann-Whitney test.

4. Study 2: Spontaneous Interactions Between Children and Assistance Dogs

4.1. Participants

All the children participated in this study ($n = 20$). For a detailed description of the population, see Table 1. Ages did not differ significantly between the two groups (Mann-Whitney test, $W = 55.5$, $p = 0.4452$).

4.2. Procedure

The protocol for Study 2 followed a standardized scenario, described below (Table 2). Only one parent was present in the room, seated in the same location against a wall. They were instructed to not interfere in the interactions between the child and the dog, except in a dangerous situation requiring intervention (which did not occur). If a child sought their attention, they were allowed to respond.

Phase 1. Explanation (2 to 5 min). The experimenter presented various objects (i.e., the puzzle game, the toy veterinary kit, the brush, the knotted rope, the watering can, and the water bowl) to the child and explained what the child could do with each one. The experimenter then left the room, brought the assistance dog in on a leash, and then released the assistance dog. She placed the leash with the other dog’s objects and told the child she would return in 10 min. The time was indicated by a timer visible to the child.

Phase 2. Spontaneous interaction (10 min 28 ± 27 s). The child interacted freely with the assistance dog for 10 min. The behavioral coding phase began when the experimenter left the room, closed the door, and the door handle no longer moved. It ended when the timer went off, signaling the end of the 10 min.

Note that throughout the spontaneous interaction phase, the experimenter was in the next room, monitoring the interactions between the child and the assistance dog through a one-way mirror. If necessary, the experimenter could intervene at any time if either the child or the assistance dog was in difficulty. However, this never occurred during our study.

4.3. Data Collection and Statistical Analyses

The videos were converted using the ShotCut application and then coded with The Observer software (Version XT 16). The behaviors recorded are described in Table 3. Scan sampling (Altmann, 1974) was used at a rate of one scan every 5 s to collect distances, the presence or absence of play, and a child's visual attention. Focus sampling (Altmann, 1974) was used to record the occurrences of contacts, locomotor behaviors, care behaviors, verbalizations, onomatopoeias, laughter and smiles, joint attention, self-centered behaviors, and finally, verbal and motor stereotypes. Durations were only collected for physical contact.

Table 3. Behavioural repertoire.

Behavioural Category	Definition	Subtypes and Behaviours
Distance between child and assistance dog	Distance between the area of the child's body closest to the assistance dog.	Direct contact, <1 arm, 1 to 2 arms, >2 arms, further away.
Distance between child and parent	Distance between the area of the child's body closest to the parent.	Direct contact, <1 arm, 1 to 2 arms, >2 arms, further away.
Play behaviours	The child engages spontaneously with a dog in a playful activity.	Types of games: toy veterinary kit, rope, intelligence toy, chase, other (e.g., hold on to the lead, child lies down and strokes the dog while laughing, child throws another object at the assistance dog).
Gaze orientation of child	Global orientation of head and gaze.	Targets: assistance dog, parent, assistance dog-related object, self-centred, environment, undetermined.
Distance modulation with the assistance dog	The child approaches or backs away from the dog with both feet.	Types: approaching the assistance dog, backing away from an assistance dog.
Child's contact with assistance dog	The child had a part of her/his body in physical contact with assistance dog's body.	Type of contact: active (voluntary, involves movement) or passive (involuntary, does not involve movement).
Care behaviour by child	The child's behaviour to care for the assistance dog or meet its needs.	The child brushes the assistance dog, gives it water or a kibble.
Vocalisation of child directed to assistance dog	The child used some vocalisation directed to assistance dog	Type of verbalisation: encourages interaction, neutral, stops interaction.
Vocalisation of child directed to parent	The child used some vocalisation directed to parent.	Nature of comments: about the assistance dog, other.
Other type of vocalisations	The child gives non-vocal vocal cues when interacting with the assistance dog.	Types: onomatopoeia (sounds, cries, noises to call the dog), laughter, smiles.
Joint attention	The child shares a moment of visual attention with the dog after following its gaze.	NA
Self-centred behaviour	The child's behaviour or action is self-centred.	NA

NA: not available.

Our statistical analyses involved the fact that the total durations of the videos as well as the durations and occurrences of the variables were standardized to 10 min (range: 9 min 0 s to 10 min 6 s). Mean comparison tests were performed using Friedman tests, Wilcoxon tests with “FDR” correction, and Mann-Whitney tests.

4.4. Results

General Description for ASD Children and TD Children

Time budget for interpersonal distances between children and an assistance dog (Table 4).

Table 4. Times (mean percentage) spent at different distances from an assistance dog and their parent. Friedman test. $p > 0.05$.

Distance from	Assistance Dog		Parent	
	ASD	TD	ASD	TD
	Mean $\pm$ SD (%)	Mean $\pm$ SD (%)	Mean $\pm$ SD (%)	Mean $\pm$ SD (%)
Direct contact	32.78 $\pm$ 21.00	34.46 $\pm$ 23.56	0.45 $\pm$ 0.89	0.25 $\pm$ 0.51
<1 arm	37.93 $\pm$ 8.71	44.80 $\pm$ 16.93	4.55 $\pm$ 9.43	0.68 $\pm$ 1.37
1 to 2 arms	11.88 $\pm$ 10.12	12.15 $\pm$ 7.51	2.28 $\pm$ 2.40	9.43 $\pm$ 11.61
>2 arms	17.17 $\pm$ 14.07	8.59 $\pm$ 5.48	92.72 $\pm$ 11.25	89.64 $\pm$ 11.92
Statistics	$X^2 = 19.8; p < 0.001$	$X^2 = 42.9; p < 0.001$	$X^2 = 22.8; p < 0.001$	$X^2 = 43.8; p < 0.001$

Children did not spend the same amount of time at different distances from the assistance dog (ASD: $X^2 = 19.8$, $df = 4$, $p < 0.001$; TD: $X^2 = 42.9$, $df = 4$, $p < 0.001$). TD children interacted significantly more often at less than one arm’s length from the assistance dog than at 1–2 arms ($W = 91$, $p < 0.001$) or beyond 2 arms ($W = 91$, $p < 0.001$). Physical contact with an assistance dog was significantly more frequent than interactions at 1–2 arms ($W = 81$, $p = 0.013$) or beyond 2 arms ($W = 87$, $p = 0.002$). In contrast, the positions of ASD children in relation to dogs were less pronounced. The contacts of these children with an assistance dog did not differ significantly in relation to distance (less than one arm, 1–2 arms, and more than 2 arms, $p > 0.05$). However, contacts with the assistance dog were more frequent than interactions at 1–2 arms ($W = 28$, $p = 0.031$), and the distance of less than one arm was observed more frequently than beyond 2 arms ($W = 28$, $p = 0.031$).

Time budgets of interpersonal distances between children and their parents (Table 4).

Distances between a child and his/her parent varied significantly (ASD: $X^2 = 22.8$; $df = 4$; $p < 0.001$; TD: $X^2 = 43.8$; $df = 4$; $p < 0.001$). However, ASD children tended to be farther from the parent (i.e., more than 2 arms versus contact, less than one arm, and between 1 and 2 arms; for all, $W = 0$, $p = 0.055$). TD children were significantly more often observed at a distance of 2 arms from the parent compared to contact ($W = 0$, $p = 0.004$), less than one arm ($W = 0$, $p = 0.004$), and between one and two arms ($W = 0$, $p = 0.013$). Additionally, TD children spent less time at a distance of less than one arm from their parent than at a distance of one to two arms ($W = 0$, $p = 0.013$).

No significant differences could be evidenced between the two groups regarding distances from the dog or parent (all $p > 0.05$).

Time budgets for activities (play/non-play) with an assistance dog (Table 5). Children did not spend the same amounts of time in different activities with a dog (ASD: $X^2 = 17.7$; $df = 5$; $p = 0.003$; TD: $X^2 = 37$; $df = 5$; $p < 0.001$). TD children spent more time “non-playing” than playing, whatever the type of play ($W = 0$, $p < 0.001$). Additionally, TD children played significantly more with the rope than played with the toy veterinary kit ($W = 10$, $p = 0.048$). No other significant differences could be evidenced (all $p > 0.05$). No significant differences could be evidenced between ASD children’s different play activities (all $p > 0.05$). Finally,

intergroup comparisons (ASD vs. TD) could not reveal any differences between types of play (all $p > 0.05$).

Table 5. Times (mean percentage) spent performing different types of play for ASD children and TD groups. Friedman test: $p < 0.05$.

	ASD	TD
	Mean $\pm$ SD (%)	Mean $\pm$ SD (%)
Other play	5.41 $\pm$ 8.22	7.77 $\pm$ 11.38
Toy veterinary kit	12.83 $\pm$ 14.69	4.95 $\pm$ 5.91
Rope play	19.94 $\pm$ 22.04	13.21 $\pm$ 9.98
Running with the dog	2.44 $\pm$ 6.46	0.62 $\pm$ 1.53
Intelligent toy	4.22 $\pm$ 5.75	5.98 $\pm$ 4.57
Not playing	55.15 $\pm$ 24.99	67.46 $\pm$ 14.49
Statistics	$\chi^2 = 17.7$; df = 5; $p = 0.003$	$\chi^2 = 37$; df = 5; $p < 0.001$

Time budgets of children's visual attention (Table 6). Children did not spend the same amounts of time observing the different targets (ASD: $\chi^2 = 26$; df = 5; $p = 0.003$; TD: $\chi^2 = 54.7$; df = 5; $p < 0.001$). TD children spent more time looking at their assistance dog than at their parent ($W = 91$, $p < 0.001$), an assistance dog's objects ($W = 91$, $p < 0.001$), or the environment ($W = 91$, $p < 0.001$). ASD children spent more time looking at an assistance dog than at their parent ($W = 28$, $p = 0.033$) and tended to look at the assistance dog's objects more than at the other targets ($W = 27$, $p = 0.052$). Intergroup comparisons revealed that TD children tended to look at the assistance dog more than ASD children ($W = 20.5$; $p = 0.052$).

Table 6. Visual attention (mean percentage) for both groups. Friedman test, $p < 0.05$.

	ASD	TD
	Mean $\pm$ SD (%)	Mean $\pm$ SD (%)
Assistance dog	51.13 $\pm$ 16.94	66.59 $\pm$ 10.15
Assistance dog's objects	22.30 $\pm$ 10.18	16.42 $\pm$ 8.25
Environment	13.29 $\pm$ 8.59	8.99 $\pm$ 4.21
Parent	6.20 $\pm$ 6.74	5.20 $\pm$ 2.65
Self-centered	1.99 $\pm$ 1.84	0.85 $\pm$ 0.60
Indeterminate	5.09 $\pm$ 5.40	1.95 $\pm$ 2.44
Statistics	$\chi^2 = 26$; df = 5; $p = 0.003$	$\chi^2 = 54.7$; df = 5; $p < 0.001$

Nature of contact with an assistance dog (Table 7). TD children's active contacts with a dog were longer than their passive contacts ($W = 82$; $p = 0.008$). Additionally, they made active contact more frequently than passive contact ($W = 85$, $p = 0.007$). In contrast, no such differences could be evidenced for ASD children (occurrence and duration; $p > 0.05$). Similarly, the intergroup comparison did not reveal any significant differences concerning the type of contact (all $p > 0.05$).

Vocalizations directed to a dog and parent (Table 8). Type of vocalizations to a dog varied (ASD: $\chi^2 = 9.55$, df = 2, $p = 0.008$; TD: $\chi^2 = 19.86$, df = 2, $p < 0.001$). ASD children tended to encourage interactions vocally more than interrupt them ($W = 21$, $p = 0.054$). ASD children also emitted more neutral vocalizations directed to a dog aimed at interrupting an interaction ($W = 28$, $p = 0.047$). Types of vocalization directed to the parent by ASD children did not differ significantly ($p > 0.05$). TD children emitted vocalizations that encouraged interaction with a dog more than vocalizations aimed at interrupting an interaction ($W = 91$, $p = 0.0004$). Similarly, TD children emitted more neutral vocalizations towards a dog than

vocalizations aimed at stopping an interaction ($W = 91, p = 0.0004$). TD children were more likely to talk about the dog with their parents than to talk about other things ($W = 68, p = 0.025$). Intergroup comparisons could not reveal any significant differences regarding the different vocalizations (all $p > 0.05$).

Table 7. Time spent (mean duration and average percentage) engaging in relation to contact type with a dog by ASD children and TD children. Wilcoxon test: $p < 0.05$.

	ASD	TD
	Mean $\pm$ SD Duration (s)	Mean $\pm$ SD Duration (s)
Active contact (duration)	57.95 $\pm$ 49.12	137.98 $\pm$ 116.61
Passive contact (duration)	109.21 $\pm$ 82.60	52.78 $\pm$ 41.34
Statistics	$W = 5, p = 0.30$	$W = 82, p = 0.008$
	Mean $\pm$ SD (%)	Mean $\pm$ SD (%)
Active contact (occurrences)	11.15 $\pm$	16.04 $\pm$ 6.44
Passive contact (occurrences)	15.97 $\pm$	9.24 $\pm$ 4.76
Statistics	$W = 7, p = 0.3$	$W = 85, p = 0.007$

Table 8. Vocalizations (mean percentage) directed towards dogs or parents by ASD children and TD children. Friedman Test and Wilcoxon test: $p < 0.05$.

	ASD	TD
	Mean $\pm$ SD (%)	Mean $\pm$ SD (%)
Encourage interaction with the assistance dog	14.89 $\pm$ 9.94	21.98 $\pm$ 11.22
Stop interaction with the assistance dog	1.37 $\pm$ 3.20	0.07 $\pm$ 0.26
Neutral verbalization towards the assistance dog	18.78 $\pm$ 17.14	16.82 $\pm$ 7.51
Statistics (Friedman test)	$\chi^2 = 9.55, p = 0.008$	$\chi^2 = 19.86, p < 0.001$
Talks about the assistance dog with the parent	7.21 $\pm$ 10.69	9.40 $\pm$ 5.71
Talks about something other than the assistance dog with the parent	6.36 $\pm$ 7.72	5.28 $\pm$ 3.74
Statistics (Wilcoxon test)	$W = 11, p = 0.690$	$W = 68, p = 0.025$

5. Study 3: Facial Expression Identification Skills

5.1. Participants

All children participated ($n = 20$) in this study. For the description of the population see Table 1. Ages did not differ significantly between the two groups (Mann-Whitney test, $W = 55.5, p = 0.4452$).

5.2. Procedure

The protocol for study 3 followed a previously used standardized scenario (Toutain et al., 2025) based on the presentation of visual stimuli on a 13-inch computer screen (Dell, Latitude 5420).

Phase 1. Definition of facial expressions. Before starting, a child was asked to define five facial expressions: sadness, joy, fear, anger, and neutral, and then the experimenter provided a definition without giving any configurational details.

Phase 2. Instructions given to child. Once a child was seated in front of the computer, the experimenter gave the instructions: “I will now show you a series of photos of human and animal faces. For each face, you must tell me which emotion² best matches the face you see. To help you, I’ve placed the names of the possible emotions in front of you.” Five rectangular labels with the five facial expressions written on them were placed in front of the child. The experimenter reassured the child by explaining that there were no right or wrong answers and that only their opinion mattered.

Phase 3. Testing phase. The stimuli were presented in blocks, with each block corresponding to a species: either human or dog. There were two pictures per facial expression of each species, meaning there were 10 faces per block. The two blocks were presented consecutively in a random order. The subject had to name the facial expression on each of the 20 stimuli, either by saying it aloud or by pointing to the corresponding label. This task was not subject to a time constraint.

5.3. Visual Stimuli

Two categories of photographs were used: dog faces and human faces. The dog photographs included five images of the same golden retriever (the same breed as the assistance dog), each showing a different facial expression (i.e., sadness, joy, fear, neutral, anger), and five images of different dogs of various breeds, each showing a different facial expression. The human photographs included five women and five men, also showing five different facial expressions. The photographs of dogs were sourced from Bloom and Friedman (2013); Borgi et al. (2014), Inès Sauvage, Pxhere, Kaggle, and authors' personal sources. The photographs of humans were extracted from the FACES databases. These pictures were previously used for a similar protocol (Toutain et al., 2025), although here, we focused only on dog and human pictures. Thus, our full test set consisted of 20 photographs of two species, each showing five different facial expressions (i.e., sadness, joy, fear, neutral, anger), with two examples of each expression. The backgrounds of all the photographs were standardized: the background was removed from all the dog photographs and all the human photographs a given a uniform light grey background. All photographs showed individuals facing the camera. The dog photographs measured $10.3 \pm 1 \times 9.9 \pm 0.67$ cm, and the human photographs measured 19×15.2 cm.

5.4. Data Collection and Statistical Analyses

The experimenter recorded immediately the subject's responses for each stimulus on paper, and these responses were later scored on a binary scale (i.e., 1 = success and 0 = failure). For this study, multivariate analyses were conducted using binomial Generalized Linear Mixed Models (GLMMs) built using the GLMER function in R ("lme4" package), followed by a type II ANOVA ("Anova" function in R-"car" package) on the models to assess the influence of various factors on children's ability to identify facial expressions. To assess differences between the levels of a variable (e.g., facial expression) in the model, we computed a post hoc analysis using the "glht" function in R using the Tukey method. Additionally, Mann-Whitney mean comparison tests compared the two groups of children.

5.5. Results

5.5.1. Both Groups of Children

The diagnosis did not influence success rates significantly in the identification of facial expressions of dog or human stimuli, nor overall results (all $p > 0.05$).

General results. The GLMM model $\text{Result} \sim \text{Diagnosis} + \text{Facial Expression} + \text{Species} + \text{Age} + (1 \mid \text{Individual})$ was used. The results were influenced by facial expression ($X^2 = 27.7$; $df = 4$; $p < 0.001$), species (human, dog) ($X^2 = 43.3$; $df = 1$; $p < 0.001$), and child's age ($X^2 = 26.3$; $df = 7$; $p < 0.001$). Older children performed better than younger ones. Human facial expressions were identified better than dog facial expressions ($Z = 6.5$; $p < 0.001$). Children identified anger better than fear ($Z = -4.2$; $p < 0.001$), sadness ($Z = -4.7$; $p < 0.001$), and neutral expression ($Z = -3.5$; $p = 0.003$). They identified joy better than sadness ($Z = -3.2$; $p = 0.01$).

Results for dog stimuli (Figure 3). The GLMM model $\text{ResultDog} \sim \text{Diagnostic} + \text{Facial Expression} + \text{Age} + (1 \mid \text{Individual})$ was used. Facial expression ($X^2 = 28.9$; $df = 4$; $p < 0.001$) and age ($X^2 = 22.2$; $df = 7$; $p = 0.002$) influenced facial expression identification results

for dogs. Again, older children had better results than younger ones ($X^2 = 22.2$; $df = 7$; $p = 0.002$). They tended to identify anger better than the neutral expression ($Z = -2.7$; $p = 0.053$) and identified significantly better anger than sadness ($Z = -4.9$; $p < 0.001$) and fear ($Z = -3.8$; $p = 0.001$). They identified joy better than sadness ($Z = -3.4$; $p = 0.005$), and the neutral expression better than sadness ($Z = -3.05$; $p = 0.02$).

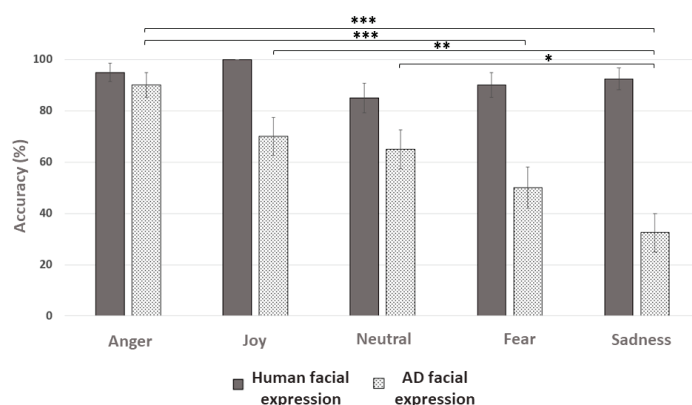


Figure 3. Success rates (mean percentage) of all children for human (grey) and canine (dashed) facial expressions, AD: Assistance Dog. *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$. Post hoc analysis using the “glht” function in R with the Tukey method.

Results for human stimuli (Figure 3). The GLMM model $\text{ResultHuman} \sim \text{Diagnostic} + \text{Facial Expression} + \text{Age} + (1 \mid \text{Individual})$ was used. No variable significantly influenced the facial expression identification results for the human species ($p > 0.05$).

5.5.2. ASD Children

General results. The GLMM model $\text{ResultASD} \sim \text{Facial Expression} + \text{Species} + \text{Age} + (1 \mid \text{Individual})$ was used. Species ($X^2 = 17$; $df = 1$; $p < 0.001$) and child’s age ($X^2 = 17.3$; $df = 5$; $p = 0.004$) influenced their overall results. ASD children identified human facial expressions better than dog facial expressions ($Z = 4.1$; $p < 0.001$), and older children also obtained better results.

Results for dog stimuli. The GLMM model $\text{ResultASDDog} \sim \text{Facial Expression} + \text{Age} + (1 \mid \text{Individual})$ was used. Facial expression tended to influence ($X^2 = 8.5$; $df = 4$; $p = 0.07$), and age significantly influenced ($X^2 = 15.4$; $df = 5$; $p = 0.008$) their results. Older children performed better than younger ones ($X^2 = 15.38$; $df = 5$; $p = 0.008$), and children identified anger better than sadness ($Z = -2.8$; $p = 0.032$).

Results for human stimuli. The GLMM model $\text{ResultASDHuman} \sim \text{Facial Expression} + \text{Age} + (1 \mid \text{Individual})$ was used. No significant variables were found (all $p > 0.05$).

5.5.3. TD Children

General results. The GLMM model $\text{ResultTD} \sim \text{Facial Expression} + \text{Species} + \text{Age} + (1 \mid \text{Individual})$ was used. Species ($X^2 = 27.5$; $df = 1$; $p < 0.001$) and facial expression ($X^2 = 25.8$; $df = 4$; $p < 0.001$) influenced their results, as well as age ($X^2 = 16.7$; $df = 6$; $p = 0.01$). TD children identified human facial expressions better than dog expressions ($Z = 5.2$; $p < 0.001$). They identified anger better than fear ($Z = -4$; $p < 0.001$), sadness ($Z = -4.2$; $p < 0.001$), and the neutral expression ($Z = -2.9$; $p = 0.027$). They identified joy better than fear ($Z = -3$; $p = 0.021$) and sadness ($Z = -3.1$; $p = 0.01$). Younger children obtained poorer results than older ones.

Results for dog stimuli. The GLMM model $\text{ResultTDDog} \sim \text{Facial Expression} + \text{Age} + (1 \mid \text{Individual})$ was used. Facial expression influenced their results ($X^2 = 22.6$; $df = 4$; $p < 0.001$). TD children identified anger better than fear ($Z = -3.4$; $p = 0.005$) and sadness

($Z = -3.9$; $p < 0.001$). They identified joy better than sadness ($Z = -3.3$; $p = 0.009$) and the neutral expression better than sadness ($Z = -2.8$; $p = 0.043$).

Results for human stimuli. The GLMM model ResultTDHuman ~ Facial Expression + Age + (1 | Individual) was used. No significant variables were found (all $p > 0.05$).

6. Interactions Between the Results of Study 1 and 2, and Study 1 and 3

To explore the relationships between the different studies, correlation tests (i.e., Spearman's test) were conducted.

6.1. Correlations Between Visual Attention and Spontaneous Interaction

ASD children, for all phases. For all phases of study 1, the average duration of fixation on the assistance dog's head was correlated positively with time spent looking at the dog during an interaction ($R = 0.94$; $p = 0.005$), time spent in contact with the dog ($R = 0.83$; $p = 0.042$), duration of passive contacts ($R = 0.83$; $p = 0.042$), and playing with the intelligence toy ($R = 0.93$; $p = 0.005$). Negative correlations were also found between the average fixation duration of the AOI "other" and time spent looking at the dog during an interaction, time spent in contact with it, and duration of passive contacts (for all three variables: $R = -0.83$; $p = 0.042$). Average fixation time on a dog's head was correlated negatively with the number of vocalizations to their parent about something other than the dog ($R = -0.83$; $p = 0.042$) and time spent within 1 to 2 arms of their parent ($R = 0.83$; $p = 0.042$).

TD Children for all phases. For all phases of study 1, average fixation duration on a dog's head was correlated positively with time spent playing with the rope ($R = 0.63$; $p = 0.039$) but correlated negatively with time spent looking at their parent ($R = -0.64$; $p = 0.033$). Average fixation duration on a dog's eyes was correlated negatively with time spent more than two arms away from the dog ($R = -0.65$; $p = 0.032$).

6.2. Correlations Between Visual Attention and Facial Expression Identification Ability

ASD children for all phases. For all phases of study 1, a positive correlation was found between average fixation duration on a dog's eyes and facial expression identification scores for dog stimuli ($R = 0.93$; $p = 0.008$), human stimuli ($R = 0.88$; $p = 0.021$), and overall scores ($R = 0.93$; $p = 0.008$). Conversely, average fixation duration on a dog's snout was correlated negatively with facial expression identification scores for dog stimuli ($R = -0.9$; $p = 0.015$) and overall scores ($R = -0.9$; $p = 0.015$). Similarly, average fixation duration on the AOI "other" was correlated negatively with facial expression identification scores for dog stimuli ($R = -0.81$; $p = 0.049$), human stimuli ($R = -0.88$; $p = 0.021$), and overall scores ($R = -0.81$; $p = 0.049$).

TD Children for all phases. For all phases of study 1, the average fixation duration on a dog's eyes was correlated positively with facial expression identification scores for dog stimuli ($R = 0.64$; $p = 0.034$). Average fixation duration on a dog's head was correlated positively with overall facial expression identification scores ($R = 0.61$; $p = 0.046$) and identification scores for human stimuli ($R = 0.77$; $p = 0.006$). Average fixation duration on the experimenter's eyes tended to be correlated negatively with success in identifying human facial expressions ($R = -0.6$; $p = 0.052$).

7. Discussion

Our research is based on the characterization of visual attention, facial expression identification, and behaviors of ASD children or typical development with an assistance dog, and the identification of possible links between these factors. Through the integration of findings from three studies, we could highlight several key findings: (1) context influenced

visual patterns, differences depending on instructions, particularly for children with typical development (TD), and divergences occurred between groups when the subjects were explicitly asked to look at their interaction partner (i.e., human or assistance dog). ASD children paid less attention to faces and focused more on the environment; (2) behaviors of the two groups observed during spontaneous interaction with the assistance dog were similar; (3) performances for the facial expression identification tasks were comparable between groups; as well as (4) within each group, links were established between visual attention, certain spontaneous behaviors during interactions, and their ability to identify facial expressions.

7.1. Convergences in Interaction with Assistance Dog

During interactions with an assistance dog, all children, both ASD and TD, displayed similar behaviors. However, visual attention varied during spontaneous interactions: whereas a dog was the preferred target for all children, ASD children looked at the dog less than TD children. Additionally, TD children looked at the dog more than at any other target (i.e., environment, dog-related objects, parent), whereas ASD children only looked at the dog more than at their parent.

During the eye-tracking phases when they were instructed to fixate on the experimenter and then the dog, ASD children observed the dog's head less and focused more on the environment, unlike TD children, who fixated more on faces. These results align with previous studies showing that ASD individuals focus less on human faces (Klin et al., 2002; Riby & Hancock, 2008; Jones & Klin, 2013; Vacas et al., 2021) and animal faces (Grandgeorge et al., 2016; Valiyamattam et al., 2020) than do TD individuals (i.e., control group). However, our study introduces gradation, as no such differences were found during the question and presentation phases. This suggests that these attentional differences may be exacerbated by the explicit instruction to look at interaction partners, whatever their species. Similar results were reported in a study using remote eye tracking during social interactions, divided into different contexts, involving adults with autistic traits (Thorsson et al., 2024). In situations where they were engaged in listening and guessing activities, the expression of their autistic traits was less pronounced regarding eye contact with the experimenter. This suggests that the interaction context, characterized by active engagement and the need to interpret verbal cues, might mitigate the effects of autistic traits on visual behaviors. However, when the task involved word description, participants tended to reduce their eye contact, which could be interpreted as a response to social pressure or cognitive overload related to expressing their own thoughts and feelings (Thorsson et al., 2024). Participants who experienced discomfort with eye contact exhibited a significant reduction in their gaze at the experimenter's eyes, indicating that the emotional and physical context of the interaction can modulate visual engagement ability. More broadly, context is crucial when evaluating behavioral expression related to ASD. For example, the imitation abilities of ASD individuals depend on the experimental context (Ingersoll, 2008), and their empathy capacity differs according to the emotional context (Hudry & Slaughter, 2009).

The different components of the interactions with assistance dogs measured here suggest convergences between the two groups of children. Firstly, both ASD children and TD children primarily interacted in close proximity to the dog while maintaining a greater distance from their parents. This finding aligns with Dollion et al. (2021, 2022), which identified different interaction profiles of ASD children with an assistance dog. Specifically, three distinct profiles have been described: the proximal-to-the-dog profile, the distal-to-the-dog profile, and the profile dependent on parental supervision (Dollion et al., 2021). The existence of different interaction profiles with an unfamiliar animal has also been documented

in the presence of a guinea pig (Grandgeorge et al., 2012a). In that study, ASD children were categorized into three groups: those attracted to the animal (“confident” profile), those engaging more with their parent despite their non-participation (“human-oriented” profile), and those who showed little interest in either the animal or the parent (“self-centered” profile). We did not observe the parental supervision profile in the present study, probably due to the instructions given to parents to refrain from intervening in the interactions between the child and the dog. Increasing the sample size would be valuable for exploring whether additional interaction profiles would emerge for the distal-to-the-dog profile, as observed for interactions with a guinea pig. Indeed, this unsupervised interaction-with-dogs context has not yet been documented in the literature, particularly in comparison with TD children. The TD children in our study also interacted in close proximity to the dog. This aligns with previous research indicating that physical contact between young children (under five years old) and their pet dogs is frequent (Filiâtre et al., 1986; Millot & Filiâtre, 1986). Given that tactile contact is a preferred modality of interaction between children and animals (Montagner, 2002), we can hypothesize that similar behaviors could be observed in older children. However, to our knowledge, no study has precisely reported interaction distances between typically developing children and an unfamiliar dog during their first encounter.

Another major convergence of the different components of interactions with assistance dogs concerns the vocalizations produced by both groups. All children used vocalizations to communicate with the unfamiliar dog, a strategy also used by some children interacting with unfamiliar cats (6–10 years old; Mertens & Turner, 1988) or an unfamiliar guinea pig (6–12 years old; Grandgeorge et al., 2015). Our study provided a more detailed analysis by considering the function of these vocalizations. It revealed that both ASD children and TD children primarily used vocalizations to encourage or neutrally engage in interaction more than to interrupt it. This suggests that both groups were motivated to interact with the assistance dog. Furthermore, when TD children addressed their parents, their conversations were more frequently centered on the assistance dog than on other topics. Our research illustrated the social catalyst role of animals (McNicholas & Collis, 2000), which provides opportunities for social interactions between humans, and in this case, between children and their parents. This phenomenon of motivation to interact with a dog also applies to ASD children, as observed in our study through vocalizations, but also through other communication channels in different contexts (e.g., visually and physically, with an unfamiliar dog; Prothmann et al., 2009).

7.2. *Convergences in the Identification Performance of Human and Canine Facial Expressions*

The similarities between the two groups of children also extend to their ability to identify human and canine facial expressions (i.e., similar performance levels). Overall, both ASD children and TD children were better at recognizing human facial expressions than those of dogs. This result aligns with the idea that humans are specialized in recognizing expressions from their own species. For instance, TD children recognize human emotions more accurately than those of dogs, with their abilities improving with age and experience (Eretová et al., 2020; Correia-Caeiro et al., 2022). However, humans often struggle to interpret facial signals from other species, as emotional signals have evolved primarily for intra-specific communication rather than inter-specific interactions (Hawkins et al., 2021). This distinction appears early in development, as the attraction to faces, with a specialization for processing human faces, emerges between 6 and 9 months (Pascalis et al., 2002).

However, this result for ASD children is surprising as it contradicts existing literature. Indeed, most studies agree that ASD children have difficulties identifying human facial expressions due to their atypical face exploration patterns (e.g., Bölte & Poustka, 2003; Harms et al., 2010). We cannot rule out the possibility that the specific cohort in this research (i.e.,

ASD children with no severe symptoms) influenced the results, as well as the experimental protocol. Since there was no time constraint, the children may have felt less stress during the task. Additionally, the facial expressions used in the photographs may have been particularly explicit, making them easier to recognize given the five provided labels. These factors may have contributed to the observed results, even if similar findings have been reported by other authors. Indeed, Toutain et al. (2025) used the same identification test with young individuals with various disorders, including those with ASD, and found that they performed better at recognizing human facial expressions compared to canine facial expressions during their first test. However, their overall performance (including the recognition of human, canine, and feline expressions—the latter not being included in our study) was lower than that of the control group (without disorders). Interestingly, this difference disappeared after one year of regular exposure to an assistance dog in their classroom, suggesting a potential impact of prolonged exposure to dogs on their ability to interpret canine facial expressions.

Our study highlighted better recognition of anger in dogs than of other facial expressions. Anger in dogs is particularly recognizable due to distinctive patterns, such as visible teeth and specific mouth positions (open or closed) (Siniscalchi et al., 2018). In contrast, positive expressions in dogs can be harder to perceive, as they lack human-like indicators of joy, such as Duchenne smiles (Girard et al., 2019). However, 5–6-year-old TD children can recognize accurately certain canine facial expressions, such as anger and joy, regardless of their prior experience with dogs (Amici et al., 2019). These differences could be explained by breed-related effects, as our study used images of Golden Retrievers, Malinois, and mixed-breed dogs, whereas Amici et al. (2019) focused on “wolf-like” breeds such as German Shepherds and Huskies. Another finding of this study is that fear and sadness were the most difficult facial expressions for participants to identify in dogs, a result also reported in a recent study by Toutain et al. (2025). Specifically, this study revealed confusion between the two groups (TD and children with TND) when distinguishing between neutral and sad expressions on the same dog stimuli. This may be due to the subtler nature of facial expressions of fear and sadness in dogs, compared to anger or joy, which makes them harder to recognize based solely on facial cues. Children may rely more on a combination of behaviors to identify fear and sadness. Supporting this idea, Lakestani et al. (2014) found that children aged 6, 8, and 10 were more successful in interpreting dogs’ emotions in defensive-aggressive contexts, achieving a high accuracy rate of 92%. However, they struggled more with recognizing fear, with an accuracy rate of only 41%. In contrast, they showed moderate success in identifying emotions in friendly conditions, with an accuracy rate of 57%.

7.3. Similarities and Differences in Face Exploration (Experimenter vs. Assistance Dog)

We revealed that, when observing the experimenter and the assistance dog with the eye-tracking device, TD children spent more time looking at the dog’s face than at the experimenter’s face or the rest of the scene regardless of the experimental phase or instructions. These observations aligned with previous studies showing that dogs are visually attractive stimuli (images: Celani, 2002; real dogs: Dollion et al., 2021).

At a finer level, an assistance dog’s eyes were the part of the face most frequently observed by both ASD children and TD children, especially when asked about the dog’s emotional state or their perception of the dog. These findings corroborate previous studies conducted with both TD and ASD children using photos of animals, which reported that an animal’s eyes are the most visually engaging region of the face (dog: Muszkat et al., 2015; Duarte-Gan et al., 2023; dog, cat: Borgi et al., 2014; dog, horse, cat: Grandgeorge et al., 2016; dog, cat, horse, cow: Valiyamattam et al., 2020). Moreover, our research showed

that TD children demonstrated the ability to adjust their visual attention to gather specific information based on questions about the dog's perception and emotional state, relying more on their eyes during their reasoning. They were also able to apply this strategy to human faces, spending different amounts of time on each facial area depending on the context. This allowed them to adjust their information intake according to instructions (e.g., spend less time looking at the experimenter's face during questions about the dog). This strategy is particularly efficient for dogs, as their eye region is crucial for recognizing their expressions (Siniscalchi et al., 2018). Furthermore, while the lower part of a dog's face is generally less observed than their eyes, it is particularly important for assessing potentially threatening facial expressions (Siniscalchi et al., 2018).

7.4. Do Facial Exploration Patterns Modulate Facial Expression Identification Performance?

Our eye-tracking observations of facial exploration patterns in real-life conditions clearly correlate with performance in facial expression identification tasks, both for ASD children and TD children. Indeed, the more children, regardless of their diagnosis, focused their attention on a dog's eye region, the better they identified the dog's facial expressions. This is especially crucial for ASD children, as increased attention to a dog's eyes during the eye-tracking phase was also associated with better results for the identification of human expressions. This suggests that children who can modulate their gaze, particularly by directing it toward the eyes, may find it easier to identify the facial expressions of both dogs and humans.

However, surprisingly, this link between preferential exploration of the experimenter's eye region and human facial expression identification was evidenced, neither for ASD children nor for TD children. Additionally, and logically, ASD children who spent more time looking at the dog's muzzle during eye-tracking recordings performed worse in facial expression identification (both for dogs and overall). This strategy may not be the most efficient, as although the lower part of a dog's face conveys essential information in threat contexts, eyes—especially of breeds with highly mobile eye muscles, such as those in our study—provide rich cues in other contexts (Siniscalchi et al., 2018). With domestication, dogs have developed facial muscles around the eyes (absent in wolves), increasing their expressiveness for humans (Kaminski et al., 2019).

Moreover, ASD children who paid more attention to elements other than faces during the eye-tracking phases also had the lowest performance in facial expression identification for all presented stimuli. This observation aligned with the idea that reduced time spent looking at a face diminishes the ability to extract relevant information, such as movements or facial expressions (Morrison & Bellack, 1981). A reciprocal trend was also observed in TD children, where greater attention to a dog's head during eye-tracking measurements was positively correlated with better performance in human facial expression identification tasks and overall results.

7.5. Do Facial Exploration Patterns Modulate Spontaneous Interaction with an Assistance Dog?

This ability to modulate attention was also reflected in spontaneous interactions with an assistance dog. Increased attention of ASD children to the dog's head during eye-tracking measurements was associated with greater engagement in spontaneous interactions with a dog (i.e., more frequent gazes at the dog, increased physical contact, and greater interest in an intelligence-based toy). Similarly, the more TD children observed the dog's head during the eye-tracking phase, the more they engaged in tug-of-war play. Conversely, when ASD children spent more time looking at elements other than faces during the eye-tracking phase, they engaged less in interaction (i.e., fewer gazes and fewer contacts with the dog). This link between visual attention and interaction is also supported

by Dollion et al. (2021) who reported that ASD children who paid more attention to human and dog heads during real-life encounters (measured via eye-tracking) were engaged more in subsequent interactions with a dog.

Our study highlighted all children's less interest in a dog's ears during the eye-tracking phase, consistent with observations based on 2D stimuli (i.e., photographs; Grandgeorge et al., 2016; Valiyamattam et al., 2020). However, in real-life encounters, ears represent an information area on a dog's head, particularly for communicating emotions (Siniscalchi et al., 2018). It would be interesting to further investigate this aspect in different contexts, such as in freer interactions between children and dogs.

7.6. Limits and Further Research

This study presents several limitations. First, the relatively small sample size limits the generalizability of the results and may have reduced the statistical power to detect significant effects. For the Chi-square tests, given the small sample size, we do not exclude the possibility of cumulative effects between specific pairs. Similarly, the lack of significant findings regarding factors influencing facial expression identification may be attributable to methodological limitations, such as a small sample size or insufficient statistical power to detect potential effects. A larger sample size could provide more robust evidence, and reveal effects that were not detectable in the current study. Second, it is important to note that the sex ratio in the sample is unbalanced, with a higher number of boys in the ASD group. This reflects the commonly observed prevalence of autism, which is more frequently diagnosed in boys. In contrast, the TD group is predominantly composed of girls, which may influence certain comparisons of results between the two groups. Thirdly, in Study 1 with eye-tracking measurements, particularly during fixation on the experimenter, the experimenter's speech may have redirected the children's attention towards her mouth rather than another facial feature. Nevertheless, the strength of this study lies in its ability to replicate conditions as close to real-life situations as possible. In everyday social interactions, it is common for one interlocutor to speak. It would be interesting to replicate this study using pre-recorded instructions delivered via a speaker rather than directly by the experimenter, to measure the potential impact of this variable.

Future research should investigate these links in interactions between children and their own pets (i.e., during daily interactions at home) using a longitudinal design to assess the impact of repeated exposure to dogs. Additionally, incorporating an interaction phase with a human partner (e.g., free interaction with another child) would help highlight the specificities of human-animal interactions and determine whether there is a connection between interactive behaviors, facial exploration strategies, and the ability to recognize others' facial expressions. Finally, future studies should consider and control for the potential influence of having pets on gaze behavior, facial recognition abilities, and interactions with the assistance dog, as this could not be explored in the present study—nearly all participants had at least one pet in their household.

8. Conclusions

To conclude, this research is particularly innovative because it combines different levels of social information processing from information intake (visual attention) during real interaction to the understanding of social cues (facial expression recognition) and finally to the behavioral responses in a real-life interaction. Notably, our findings reveal a clear link between facial exploration strategies, understanding others (through facial expression identification), and behavioral expressions during interactions. Overall, the results from the three sub-studies revealed few differences between ASD children and TD children, except for some variations in visual attention and a more pronounced intra-group

variability within the TD group than in the ASD group. To conclude, our research confirms the conclusions of a recent scoping review (Toutain et al., 2024) highlighting the fact that the visual attention of ASD individuals to animals differs from their visual attention to humans, being closer to that displayed by TD individuals. This particular visual attention may be one of the underlying mechanisms explaining the various benefits of human-animal interactions for people with ASD.

From an applied perspective, our results may help inform animal-assisted interventions by involving the animal as a support to draw analogies with humans, with dogs potentially serving as mediators in social contexts by helping children maintain their attention on a reassuring “social third party,” thereby facilitating interactions with others (adults or peers). For example, identifying parts of the dog’s face—often more attractive and engaging for children—can serve as a starting point to transfer attention to corresponding human facial features. However, it is essential to accompany these interventions with appropriate explanations, as simply directing attention to the correct area of the face does not in itself guarantee an accurate interpretation of the conveyed social or emotional information.

Author Contributions: Conceptualization, M.G., M.T. and L.H.; methodology, M.T.; validation, M.G., M.T., L.H., S.P. and S.L.; formal analysis, M.T., S.L. and S.P.; investigation, M.T.; resources, M.T., M.G. and L.H.; data curation, M.T.; writing—original draft preparation, M.T.; writing—review & editing, M.G., M.T., L.H. and S.P.; visualization, M.T.; supervision, M.G. and L.H.; project administration, M.G.; funding acquisition, M.G. All authors have read and agreed to the published version of the manuscript.

Funding: The material and logistical support was funded by the EthoS laboratory (France) and by the Adrienne and Pierre Sommer Foundation, while the salaries of the authors were funded by the University of Rennes.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Sud Méditerranéen III ethics committee in France on 5 September 2022 [N°2022.06.09 bis_22.02106.000105].

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data will be available upon the author’s request.

Acknowledgments: We would like to thank the association Handi’Chiens for welcoming us into their facilities and providing assistance dogs. We also extend our gratitude to all the participants and their families. Thanks to the EthoS laboratory and the University of Rennes for their logistical and material support as well as Adrienne and Pierre Sommer Foundation. Finally, we thank Ann Cloarec for her contribution to improving the language for publication in English.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Abbreviations

The following abbreviations are used in this manuscript:

ASD	Autism Spectrum Disorder
TD	Typical Development

Appendix A

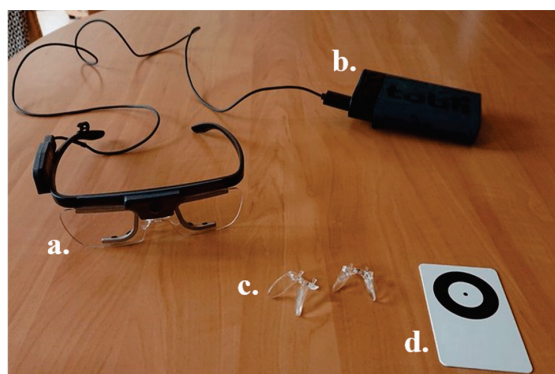


Figure A1. Eye-tracking glasses system—Tobii Glasses Pro 2 a. Glasses b. Power unit: A power box that supplies energy to the glasses, connected to the computer via Wi-Fi, enabling more freedom of movement while continuously recording eye data. c. Nose pads in various sizes: Adjustable nose pads that allow for a comfortable fit, especially for younger children, ensuring better accuracy and comfort during long sessions. d. 1-point calibration card: A tool used to calibrate the eye-tracking system at the start of the experiment, ensuring precise tracking based on the individual's eye movements and position.

Appendix B

Table A1. Mean percentage of eye-tracking measurements by phase (in seconds).

Variables		ASD		TD	
		Mean $\pm$ SD (%)	SD	Mean (%)	SD
Assistance dog presentation	Other	17.32 $\pm$ 23.00	23.00	20.22 $\pm$ 9.12	9.12
	Dog's head	58.32 $\pm$ 21.75	21.75	52.07 $\pm$ 18.13	18.13
	Muzzle	14.92 $\pm$ 10.89	10.89	15.43 $\pm$ 8.34	8.34
	Dog's eyes	23.86 $\pm$ 22.44	22.44	25.33 $\pm$ 20.45	20.45
	Experimenter's head	24.36 $\pm$ 24.81	24.81	27.71 $\pm$ 18.22	18.22
	Dog's ears	2.75 $\pm$ 5.77	5.77	2.55 $\pm$ 3.06	3.06
	Nose-mouth	8.33 $\pm$ 11.01	11.01	12.35 $\pm$ 12.19	12.19
	Experimenter's eyes	9.84 $\pm$ 10.89	10.89	8.24 $\pm$ 7.63	7.63
Questions about assistance dog	Other	18.01 $\pm$ 16.09	16.09	18.01 $\pm$ 13.29	13.29
	Dog's head	70.80 $\pm$ 17.75	17.75	72.28 $\pm$ 13.24	13.24
	Muzzle	20.71 $\pm$ 17.50	17.50	15.90 $\pm$ 10.38	10.38
	Dog's eyes	29.49 $\pm$ 28.94	28.94	22.07 $\pm$ 11.83	11.83
	Experimenter's head	11.19 $\pm$ 8.62	8.62	9.71 $\pm$ 7.77	7.77
	Dog's ears	2.71 $\pm$ 1.85	1.85	9.16 $\pm$ 8.04	8.04
	Nose-mouth	3.62 $\pm$ 5.92	5.92	3.72 $\pm$ 5.04	5.04
	Experimenter's eyes	3.88 $\pm$ 5.32	5.32	3.17 $\pm$ 3.09	3.09
Gaze fixation on the experimenter	Other	14.00 $\pm$ 17.78	17.78	0.22 $\pm$ 0.69	0.69
	Experimenter's head	86.00 $\pm$ 17.78	17.78	99.78 $\pm$ 0.69	0.69
	Nose-mouth	24.85 $\pm$ 30.65	30.65	34.62 $\pm$ 40.42	40.42
	Experimenter's eyes	42.99 $\pm$ 39.60	39.60	47.77 $\pm$ 39.31	39.31
Gaze fixation on the assistance dog	Other	20.05 $\pm$ 24.81	24.81	2.28 $\pm$ 7.11	7.11
	Dog's head	79.95 $\pm$ 24.81	24.81	97.72 $\pm$ 7.11	7.11
	Muzzle	12.14 $\pm$ 19.40	19.40	14.53 $\pm$ 25.85	25.85
	Dog's eyes	50.43 $\pm$ 43.14	43.14	60.80 $\pm$ 28.28	28.28
	Dog's ears	3.27 $\pm$ 3.91	3.91	4.77 $\pm$ 13.72	13.72

Notes

- ¹ A shorter measurement time than the total recording duration (20 s) was due to temporary loss of eye-tracking signal caused by participants' eye movements (e.g., looking too high or too low relative to the glasses' sensors, resulting in data loss). This presentation phase generated greater attentional shifts between the experimenter and an assistance dog, creating more signal interferences for some individuals.
- ² The term "emotion" was chosen over "facial expression" because it is better understood by children of the age group included in this study, especially by ASD children.

References

- Altmann, J. (1974). Observational study of behavior: Sampling methods. *Behaviour*, 49(3–4), 227–266. [CrossRef] [PubMed]
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.
- Amici, F., Waterman, J., Kellermann, C. M., Karimullah, K., & Bräuer, J. (2019). The ability to recognize dog emotions depends on the cultural milieu in which we grow up. *Scientific Reports*, 9(1), 16414. [CrossRef] [PubMed]
- Black, M. H., Chen, N. T. M., Iyer, K. K., Lipp, O. V., Bölte, S., Falkmer, M., Tan, T., & Girdler, S. (2017). Mechanisms of facial emotion recognition in autism spectrum disorders: Insights from eye tracking and electroencephalography. *Neuroscience & Biobehavioral Reviews*, 80, 488–515. [CrossRef]
- Bloom, T., & Friedman, H. (2013). Classifying dogs' (*Canis familiaris*) facial expressions from photographs. *Behavioural Processes*, 96, 1–10. [CrossRef] [PubMed]
- Borgi, M., Cogliati-Dezza, I., Brelsford, V., Meints, K., & Cirulli, F. (2014). Baby schema in human and animal faces induces cuteness perception and gaze allocation in children. *Frontiers in Psychology*, 5, 411. [CrossRef]
- Bölte, S., & Poustka, F. (2003). The recognition of facial affect in autistic and schizophrenic subjects and their first-degree relatives. *Psychological Medicine*, 33(5), 907–915. [CrossRef]
- Celani, G. (2002). Human beings, animals and inanimate objects: What do people with autism like? *Autism*, 6(1), 93–102. [CrossRef]
- Chokron, S., Pieron, M., & Zalla, T. (2014). Troubles du spectre de l'autisme et troubles de la fonction visuelle: Revue critique, implications théoriques et cliniques. *L'information Psychiatrique*, 90(10), 819–826. [CrossRef]
- Correia-Caeiro, C., Lawrence, A., Abdelrahman, A., Guo, K., & Mills, D. (2022). How do children view and categorise human and dog facial expressions? *Developmental Science*, 26(3), e13332. [CrossRef]
- Courchesne, E., Townsend, J., Akshoomoff, N. A., Saitoh, O., Yeung-Courchesne, R., Lincoln, A. J., James, H. E., Haas, R. H., Schreibman, L., & Lau, L. (1994). Impairment in shifting attention in autistic and cerebellar patients. *Behavioral Neuroscience*, 108(5), 848–865. [CrossRef]
- Davis, T. N., Scalzo, R., Butler, E., Stauffer, M., Farah, Y. N., Perez, S., Mainor, K., Clark, C., Miller, S., Kobylecky, A., & Coviello, L. (2015). Animal assisted interventions for children with autism spectrum disorder: A systematic review. *Education and Training in Autism and Developmental Disabilities*, 50(3), 316–329.
- Dollion, N., & Grandgeorge, M. (2022). The pet in the daily life of typical and atypical developing children and their families. *La Revue Internationale de L'education Familiale*, 50(1), 157–184. [CrossRef]
- Dollion, N., Herbin, A., Champagne, N., Plusquellec, P., & Grandgeorge, M. (2022). Characterization of children with autism spectrum disorder's interactions with a service dog during their first encounter. *Anthrozoos*, 35(6), 867–889. [CrossRef]
- Dollion, N., Toutain, M., François, N., Champagne, N., Plusquellec, P., & Grandgeorge, M. (2021). Visual exploration and observation of real-life interactions between ASD children and service dogs. *Journal of Autism and Developmental Disorders*, 51(11), 3785–3805. [CrossRef]
- Duarte-Gan, C., Martos-Montes, R., & Garcia-Linares, M. (2023). Visual processing of the faces of humans and dogs by children with autism spectrum disorder: An eye-tracking study. *Anthrozoos*, 36(4), 605–623. [CrossRef]
- Dunn, W. (2010). *Profil sensoriel, manuel—Winnie Dunn—ECPA, les Éd. Du Centre de psychologie appliquée (ECPA, les Éd. Du Centre de psychologie appliquée)*. ECPA, les Éd. du Centre de psychologie appliquée.
- Dyck, M. J., Ferguson, K., & Shochet, I. M. (2001). Do autism spectrum disorders differ from each other and from non-spectrum disorders on emotion recognition tests? *European Child & Adolescent Psychiatry*, 10(2), 105–116. [CrossRef]
- Emery, N. J. (2000). The eyes have it: The neuroethology, function and evolution of social gaze. *Neuroscience & Biobehavioral Reviews*, 24(6), 581–604. [CrossRef]
- Erbacher, J. C. E., & Bördlein, C. (2025). Dog-assisted interventions for children and adolescents with autism spectrum disorders. *Research on Social Work Practice*, 10497315241307636. [CrossRef]
- Eretová, P., Chaloupková, H., Hefferová, M., & Jozífková, E. (2020). Can children of different ages recognize dog communication signals in different situations? *International Journal of Environmental Research and Public Health*, 17(2), 506. [CrossRef]
- Filiâtre, J. C., Millot, J. L., & Montagner, H. (1986). New data on communication behaviour between the young child and his pet dog. *Behavioural Processes*, 12(1), 33–44. [CrossRef]

- Gerhardstein, P., & Rovee-Collier, C. (2002). The development of visual search in infants and very young children. *Journal of Experimental Child Psychology*, 81(2), 194–215. [CrossRef] [PubMed]
- Gillet, P., & Barthélémy, C. (2011). Développement de l'attention chez le petit enfant: Implications pour les troubles autistiques. *Développements*, 9(3), 17–25. [CrossRef]
- Girard, J. M., Shandar, G., Liu, Z., Cohn, J. F., Yin, L., & Morency, L.-P. (2019, September 3–6). *Reconsidering the duchenne smile: Indicator of positive emotion or artifact of smile intensity?* 2019 8th International Conference on Affective Computing and Intelligent Interaction (ACII) (pp. 594–599), Cambridge, UK. [CrossRef]
- Grandgeorge, M., Bourreau, Y., Alavi, Z., Lemonnier, E., Tordjman, S., Deleau, M., & Hausberger, M. (2015). Interest towards human, animal and object in children with autism spectrum disorders: An ethological approach at home. *European Child & Adolescent Psychiatry*, 24(1), 83–93. [CrossRef]
- Grandgeorge, M., Degrez, C., Alavi, Z., & Lemonnier, E. (2016). Face processing of animal and human static stimuli by children with autism spectrum disorder: A pilot study. *Human-Animal Interaction Bulletin*, 4(1), 39–53. [CrossRef]
- Grandgeorge, M., Deleau, M., Lemonnier, E., Tordjman, S., & Hausberger, M. (2012a). Children with autism encounter an unfamiliar pet: Application of the Strange Animal Situation test. *Interaction Studies*, 13(2), 165–188. [CrossRef]
- Grandgeorge, M., Gautier, Y., Bourreau, Y., Mossu, H., & Hausberger, M. (2020). Visual attention patterns differ in dog vs. cat interactions with children with typical development or autism spectrum disorders. *Frontiers in Psychology*, 11, 2047. [CrossRef]
- Grandgeorge, M., Tordjman, S., Lazartigues, A., Lemonnier, E., Deleau, M., & Hausberger, M. (2012b). Does pet arrival trigger prosocial behaviors in individuals with autism? *PLoS ONE*, 7(8), e41739. [CrossRef]
- Harms, M. B., Martin, A., & Wallace, G. L. (2010). Facial emotion recognition in autism spectrum disorders: A review of behavioral and neuroimaging studies. *Neuropsychology Review*, 20(3), 290–322. [CrossRef]
- Hawkins, R. D., Hatin, B. D. M., & Revesz, E. O. (2021). Accuracy of canine vs. human emotion identification: Impact of dog ownership and belief in animal mind. *Human-Animal Interaction Bulletin*, 12(2), 1–18. [CrossRef]
- Hudry, K., & Slaughter, V. (2009). Agent familiarity and emotional context influence the everyday empathic responding of young children with autism. *Research in Autism Spectrum Disorders*, 3(1), 74–85. [CrossRef]
- Ingersoll, B. (2008). The effect of context on imitation skills in children with autism. *Research in Autism Spectrum Disorders*, 2(2), 332–340. [CrossRef]
- Johnstone, S. J., Dimoska, A., Smith, J. L., Barry, R. J., Pleffer, C. B., Chiswick, D., & Clarke, A. R. (2007). The development of stop-signal and Go/Nogo response inhibition in children aged 7–12 years: Performance and event-related potential indices. *International Journal of Psychophysiology*, 63(1), 25–38. [CrossRef]
- Jones, W., & Klin, A. (2013). Attention to eyes is present but in decline in 2–6-month-old infants later diagnosed with autism. *Nature*, 504(7480), 427–431. [CrossRef] [PubMed]
- Kaminski, J., Waller, B. M., Diogo, R., Hartstone-Rose, A., & Burrows, A. M. (2019). Evolution of facial muscle anatomy in dogs. *Proceedings of the National Academy of Sciences*, 116(29), 14677–14681. [CrossRef]
- Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002). Visual fixation patterns during viewing of naturalistic social situations as predictors of social competence in individuals with autism. *Archives of General Psychiatry*, 59(9), 809–816. [CrossRef] [PubMed]
- Kruck, J., Baduel, S., & Roge, B. (2013). *Questionnaire de communication sociale pour le dépistage des troubles du spectre autistique. Adaptation française..* Hogrefe. Available online: <https://hal.science/hal-04138726> (accessed on 20 January 2025).
- Lakestani, N. N., Donaldson, M. L., & Waran, N. (2014). Interpretation of dog behavior by children and young adults. *Anthrozoos*, 27(1), 65–80. [CrossRef]
- Langton, S. R. H., Law, A. S., Burton, A. M., & Schweinberger, S. R. (2008). Attention capture by faces. *Cognition*, 107(1), 330–342. [CrossRef]
- Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, 56(6), 466–474. [CrossRef]
- McNicholas, J., & Collis, G. M. (2000). Dogs as catalysts for social interactions: Robustness of the effect. *British Journal of Psychology*, 91(1), 61–70. [CrossRef]
- Mertens, C., & Turner, D. C. (1988). Experimental analysis of human-cat interactions during first encounters. *Anthrozoös*, 2(2), 83–97. [CrossRef]
- Millot, J.-L., & Filiâtre, J.-C. (1986). The behavioural sequences in the communication system between the child and his pet dog. *Applied Animal Behaviour Science*, 16(4), 383–390. [CrossRef]
- Montagner, H. (2002). *L'enfant et l'animal: Les émotions qui libèrent l'intelligence*. Odile Jacob. Available online: https://books.google.com/books?hl=fr&lr=&id=WQM2AAAAQBAJ&oi=fnd&pg=PT6&dq=L'Enfant+et+l'Animal+:+Les+%C3%A9motions+qui+lib%C3%A8rent+l'intelligence+&ots=8NcGI0R-_0&sig=NraT_fAAxXtOADwGlyHUGDXt4x4 (accessed on 20 January 2025).
- Morrison, R. L., & Bellack, A. S. (1981). The role of social perception in social skill. *Behavior Therapy*, 12(1), 69–79. [CrossRef]
- Muszkát, M., de Mello, C., Munoz, P., Lucci, T., David, V., Siqueira, J., & Otta, E. (2015). Face scanning in autism spectrum disorder and attention deficit/hyperactivity disorder: Human versus dog face scanning. *Frontiers in Psychiatry*, 6, 150. [CrossRef]

- Nakano, T., Tanaka, K., Endo, Y., Yamane, Y., Yamamoto, T., Nakano, Y., Ohta, H., Kato, N., & Kitazawa, S. (2010). Atypical gaze patterns in children and adults with autism spectrum disorders dissociated from developmental changes in gaze behaviour. *Proceedings of the Royal Society B: Biological Sciences*, 277(1696), 2935–2943. [CrossRef] [PubMed]
- Nelson, C. A. (2001). The development and neural bases of face recognition. *Infant and Child Development*, 10(1–2), 3–18. [CrossRef]
- Norris, M., & Lecavalier, L. (2010). Screening accuracy of level 2 autism spectrum disorder rating scales: A review of selected instruments. *Autism*, 14(4), 263–284. [CrossRef]
- O’Haire, M., McKenzie, S., Beck, A., & Slaughter, V. (2013). social behaviors increase in children with autism in the presence of animals compared to toys. *PLoS ONE*, 8(2). [CrossRef]
- Pascalis, O., de Haan, M., & Nelson, C. A. (2002). Is face processing species-specific during the first year of life? *Science*, 296(5571), 1321–1323. [CrossRef]
- Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology*, 32(1), 3–25. [CrossRef]
- Posner, M. I., & Rothbart, M. K. (2007). Research on attention networks as a model for the integration of psychological science. *Annual Review of Psychology*, 58, 1–23. [CrossRef]
- Prothmann, A., Ettrich, C., & Prothmann, S. (2009). Preference for, and responsiveness to, people, dogs and objects in children with autism. *Anthrozoös*, 22(2), 161–171. [CrossRef]
- Riby, D. M., & Hancock, P. J. B. (2008). Viewing it differently: Social scene perception in williams syndrome and autism. *Neuropsychologia*, 46(11), 2855–2860. [CrossRef] [PubMed]
- Rutter, M., Bailey, A., & Lord, C. (2003). *SCQ. The social communication questionnaire* (p. 5). Western Psychological Services.
- Siniscalchi, M., D’Ingeo, S., Minunno, M., & Quaranta, A. (2018). Communication in dogs. *Animals*, 8(8), 131. [CrossRef]
- Spezio, M. L., Adolphs, R., Hurley, R. S. E., & Piven, J. (2007). Analysis of face gaze in autism using «Bubbles». *Neuropsychologia*, 45(1), 144–151. [CrossRef]
- Thorsson, M., Galazka, M. A., Åsberg Johnels, J., & Hadjikhani, N. (2024). Influence of autistic traits and communication role on eye contact behavior during face-to-face interaction. *Scientific Reports*, 14(1), 8162. [CrossRef] [PubMed]
- Toutain, M., Dollion, N., Henry, L., & Grandgeorge, M. (2024). How do children and adolescents with ASD look at animals? A scoping review. *Children*, 11(2), 211. [CrossRef]
- Toutain, M., Dollion, N., Henry, L., & Grandgeorge, M. (2025). Does a dog at school help identify human and animal facial expressions? A preliminary longitudinal study. *European Journal of Investigation in Health, Psychology and Education*, 15(2), 13. [CrossRef]
- Vacas, J., Antolí, A., Sánchez-Raya, A., Pérez-Dueñas, C., & Cuadrado, F. (2021). Visual preference for social vs. Non-social images in young children with autism spectrum disorders. An eye tracking study. *PLoS ONE*, 16(6), e0252795. [CrossRef] [PubMed]
- Valiyamattam, G. J., Katti, H., Chaganti, V. K., O’Haire, M. E., & Sachdeva, V. (2020). Do animals engage greater social attention in autism? An eye tracking analysis. *Frontiers in Psychology*, 11, 727. [CrossRef]
- Valtakari, N. V., Hooge, I. T. C., Viktorsson, C., Nyström, P., Falck-Ytter, T., & Hessels, R. S. (2021). Eye tracking in human interaction: Possibilities and limitations. *Behavior Research Methods*, 53(4), 1592–1608. [CrossRef]
- Witwer, A. N., & Lecavalier, L. (2007). Autism screening tools: An evaluation of the social communication questionnaire and the developmental behaviour checklist–Autism screening algorithm. *Journal of Intellectual & Developmental Disability*, 32(3), 179–187. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

Exploring Cat–Human Interaction as a Psychosocial Resource in Autism and ADHD: Risks, Engagement, and Well-Being

Lily Widdison ¹, Ana Maria Barcelos ², Stamatina Tsiora ^{1,*}, Andrei Zarie ³, Daniel S. Mills ² and Niko Kargas ^{4,*}

¹ School of Psychology, Sport Science and Wellbeing, University of Lincoln, Lincoln LN6 7TS, UK; lily.widdison@outlook.com

² School of Natural Sciences, University of Lincoln, Lincoln LN6 7TS, UK; abarcelos@lincoln.ac.uk (A.M.B.); dmills@lincoln.ac.uk (D.S.M.)

³ School of Social Sciences, Nottingham-Trent University, Nottingham NG1 4FQ, UK; andrei.zarie@ntu.ac.uk

⁴ Department of Cognitive Sciences, United Arab Emirates University, Al Ain P.O. Box 15551, United Arab Emirates

* Correspondence: mtsiora@lincoln.ac.uk (S.T.); nkargas@uaeu.ac.ae (N.K.)

Abstract

Animals may offer vital psychosocial support, particularly for neurodiverse individuals. However, evidence surrounding the effects of pet ownership remains equivocal, especially in relation to cat–human dynamics. This study explored the relationship between cat–human-related factors (CHRFs) and psychological well-being in a sample of 127 adults, including individuals formally diagnosed with autism (30), ADHD (15), and/or co-occurring autism and ADHD (AuADHD; 22). Participants completed measures assessing neurodiverse traits, CHRF engagement, and symptoms of anxiety, depression, and suicidality. Spearman’s correlations analysed the relationships between CHRFs, neurodiverse traits, and well-being. Kruskal–Wallis tests established group differences in well-being and engagement in CHRFs between individuals with and without neurodevelopmental differences. The findings confirmed that autistic and ADHD traits were positively associated with greater anxiety, depression, and suicidality. Autistic individuals reported significantly elevated anxiety and depression; co-occurring diagnoses (AuADHD) were associated with heightened anxiety. Neurodiverse and neurotypical individuals demonstrated similar patterns of CHRF engagement. Several CHRFs, such as anxious cat behaviour, inability to provide for the cat, poor cat health, and close proximity, were linked to negative well-being outcomes. These findings highlight the nuanced, bi-directional nature of cat–human interactions, underscoring the importance of mitigating negative relational factors to support mental health in neurodiverse populations.

Keywords: cat–human interaction; neurodiversity; autism; ADHD; mental health; pet–human relationships

1. Introduction

1.1. Psychosocial Benefits of Companion Animals

Human–animal relationships may have the potential to improve social, emotional, and physical well-being (Amiot & Bastian, 2015; Beetz et al., 2012; Gee et al., 2021). For instance, psychosocial benefits of companion animals, often referred to as the ‘pet effect’ (Allen, 2003; Smith, 2012), are well-documented in the literature (Barker & Wolen, 2008; Friedmann & Son, 2009). The presence of a companion animal has been associated with an increase in positive affect (Janssens et al., 2020) such as an enhancement in the owners’

self-esteem (McConnell et al., 2011), self-acceptance (Merkouri et al., 2022), self-confidence (Zilcha-Mano et al., 2012), quality of life (Hughes et al., 2020), and life-satisfaction (Bao & Schreer, 2016). Additionally, a companion animal's presence has been linked to a decrease in negative affect (Janssens et al., 2020), protecting against high levels of stress (Sugawara et al., 2012; Teo et al., 2022), anxiety (Ein et al., 2018), depression (Pereira & Fonte, 2018; Souter & Miller, 2007), and potentially suicidality (Hawkins et al., 2021; Love, 2021). These effects may have the ability to improve an individual's daily functioning by enhancing social-emotional skills (Li et al., 2023; Purewal et al., 2017), which could aid the management of various mental (Brooks et al., 2018; Wisdom et al., 2009) and physical health conditions (Carr et al., 2018; Janevic et al., 2019).

In this context, the present study focuses on adult cat owners with and without formal diagnoses of autism and/or ADHD. Building on pet-human-related factor frameworks that distinguish specific supportive and strain-related activities and circumstances (Barcelos et al., 2020, 2023a; Corrêa et al., 2021; Ravenscroft et al., 2021), we examine how everyday cat-human-related factors (CHRFs) over a seven-day period relate to symptoms of anxiety, depression and suicidality. We further investigate whether these associations differ between neurodivergent and non-neurodivergent adults, in light of robust evidence that autistic and ADHD adults experience elevated and often chronic levels of anxiety, depression, and suicidality (Capp et al., 2024; Hedley & Uljarević, 2018; Hollocks et al., 2019; Lai et al., 2019; Sun et al., 2024; Zahid & Uptegrove, 2017). By integrating the pet-human-related factors framework with the neurodiversity and mental health literature, this study aims to clarify when and for whom cat-human relationships may act as psychosocial resources versus sources of strain. To explain the potential beneficial effects of human-animal interactions, a variety of psychosocial theories have been proposed (Barcelos et al., 2023b; Serpell et al., 2017). For example, the biophilia hypothesis posits that human beings have an intrinsic attraction toward living and life-like beings (Wilson 1984, as cited in Gullone, 2000). This inherent predisposition is evidenced towards animals (DeLoache et al., 2011), and it is argued that the simultaneous increase in attention results in decreased physiological arousal, which may result in a sense of security and safety (Beetz, 2017; Julius et al., 2013). This hypothesis may explain the benefits of close proximity with companion animals (Barcelos et al., 2023b). By contrast, the social support hypothesis asserts that companion animals provide and facilitate various forms of social support (Barcelos et al., 2023b; O'Haire, 2010). This includes emotional support via emotional contagion (Van Bourg et al., 2020; Yong & Ruffman, 2014), instrumental support via physical and psychological assistance (Burrows & Adams, 2008; Schoenfeld-Tacher et al., 2017), and positive social interaction via companionship (Horowitz & Hecht, 2016) and engagement from other human beings (Wood et al., 2015). These hypotheses should be understood as complementary and are not exclusive, with little evidence available to tease out the relative importance of differing mechanisms in general or in different populations (Barcelos et al., 2023b).

1.2. Inconsistent Findings in the Pet-Human Literature

Although a greater amount of published research concludes a positive relationship between pet ownership and human well-being (Barker & Wolen, 2008; Friedmann & Son, 2009), the conclusions remain contested due to potential publication bias of positive results (Herzog, 2011) and less attention given to studies showing no evidence of an effect or negative effects on psychological well-being (Scoresby et al., 2021; Wells, 2019). Contradictory findings exist regarding the effects of companion animals on stress, anxiety, and depression (Barker et al., 2018; Bradley & Bennett, 2015). Due to the mixed findings, it is argued that the general claim that a pet will improve mental health is unjustified

(Herzog, 2011). There is undoubtedly a need for further research to strengthen any claims of psychosocial benefits, especially in specialist populations (Carr et al., 2020; Lisk et al., 2021). Variability in well-being outcomes in different populations is likely due to the complex and dynamic nature of human–animal interactions (Rodriguez et al., 2021). For example, it is argued that the notion of “pet ownership” effects is too nebulous, failing to recognise the heterogeneity of pet–human dyads (Barcelos et al., 2020), and features of pet–human relationships that may differentially influence well-being (Bao & Schreer, 2016; Janssens et al., 2020). There are also probably bi-directional effects, dependent on the context of the interaction (Barcelos et al., 2023a). Therefore, it is recommended that researchers adopt an approach that acknowledges the multifaceted nature of pet–human relationships (Gee & Mueller, 2019), instead of merely comparing pet owners with non-pet owners (Friedmann & Krause-Parello, 2018).

1.3. Pet–Human-Related Factors Framework

A framework of pet–human-related factors that define the nature of ownership has since been developed, encompassing a wide range of common activities and circumstances (Barcelos et al., 2023a) that may be direct or indirect, as well as active, passive, or neutral. This framework is based on initial qualitative research, across various samples, documenting how pet–human factors were reported to impact the well-being of owners (Barcelos et al., 2020, 2021a, 2021b; Corrêa et al., 2021; Ravenscroft et al., 2021). Greater eudaimonic and hedonic well-being have been reported by individuals who engage in general routine, shared outdoor activity and exercise, and tactile interactions with their dog (Barcelos et al., 2020, 2021a; Corrêa et al., 2021). However, only friendly conversations with others due to the dog and psychological closeness to the dog appear to be significantly associated with greater eudaimonic and hedonic well-being (Barcelos et al., 2021a, 2023a). Decreased eudaimonic and hedonic well-being have been consistently reported by individuals who experienced an inability to meet their dog’s needs, witnessed problematic dog behaviours, or had a dog of old age and poor health (Barcelos et al., 2020, 2023a, 2021a; Corrêa et al., 2021). Notably, failure to provide for the dog and problematic dog behaviour, such as displaying aggression and fear, have been associated with greater anxiety and depression (Barcelos et al., 2023a).

Although our understanding of the effects of dog–human-related factors is evolving, research investigating the effects of cat–human-related factors (CHRFs) on well-being is much more limited (Ravenscroft et al., 2021). The majority of research has failed to consider the relevance of the sort of factors identified in dogs on cat-owner well-being (e.g., Turner, 2017). For instance, cat owners are unlikely to relate to the psychosocial benefits associated with increased walking (Howell et al., 2017). The original qualitative framework by Barcelos et al. (2020) assessing the impact of dog–human-related activities was adapted for cat–human relationships by Ravenscroft et al. (2021). This qualitative study indicated that there may also be positive effects exclusive to cat–human relationships, such as a cat’s purring, which was reported to provide feelings of relaxation (Ravenscroft et al., 2021). An increase in eudaimonic and hedonic well-being has also been reported regarding feeding the cat, tactile interactions with the cat, and close proximity to the cat (Ravenscroft et al., 2021). On the other hand, problematic cat behaviour and poor cat health have been reported to decrease eudaimonic and hedonic well-being. Further empirical research is required to test the significance of these potential associations.

1.4. Neurodiversity and Well-Being

Autism spectrum disorder is characterised by atypical patterns of social communication and interaction across various contexts, as well as restricted and repetitive behaviours,

interests, and activities (APA, 2022). Identity-first language is used to refer to autistic individuals, as it is broadly favoured by this population (Kenny et al., 2016; Taboas et al., 2023). Despite the substantial growth in the prevalence of recognised autistic individuals over the past 30 years (Solmi et al., 2022), social awareness and acceptance of the condition remain lacking (Sasson et al., 2017). The support needs of individuals on the spectrum are often inadequately met, as a result (Griffith et al., 2011; Raymaker et al., 2017). Autistic traits have been associated with greater rates of anxiety (Jolliffe et al., 2023), depression (Rai et al., 2018), and suicidality (Cassidy et al., 2018). Furthermore, individuals with a diagnosis of autism experience significant psychosocial challenges in adulthood (Howlin & Magiati, 2017), such as elevated rates of co-occurring mental health conditions and psychiatric disorders, notably anxiety and depressive disorders (Hollocks et al., 2019; Lai et al., 2019) and suicidality (Hedley & Uljarević, 2018; Hirvikoski et al., 2016; Zahid & Upthegrove, 2017). Attention-deficit hyperactivity disorder (ADHD) is prevalent in a significant proportion of autistic individuals (Rong et al., 2021).

ADHD is marked by persistent patterns of inattention, hyperactivity, and impulsivity that are inappropriate to the developmental level and inhibit an individual's ability to function across multiple contexts (APA, 2022). These traits must have been present prior to age 12, and the majority of cases diagnosed in childhood persist into adulthood (Sibley et al., 2022). Adult ADHD has a diverse range of clinical presentations, with symptoms possibly going unrecognised (Song et al., 2021; Zalsman & Shilton, 2016). Additionally, due to a lack of recognition of ADHD as a lifelong disability, numerous individuals with ADHD do not receive the correct diagnosis or intervention (Kooij et al., 2018). Traits of ADHD have been associated with greater levels of anxiety and depression (Capp et al., 2024; Garcha & Smith, 2023) and suicidality (Sun et al., 2024). Furthermore, individuals with a diagnosis of ADHD experience a range of difficulties in psychosocial functioning (Agnew-Blais et al., 2018; Fayyad et al., 2016), for instance, increased rates of mental health conditions and co-occurring psychiatric disorders, especially anxiety and depressive disorders (Choi et al., 2022), as well as self-injurious behaviour and suicidality (Hinshaw et al., 2012; Septier et al., 2019).

Given the potential psychosocial benefits of pet ownership, pet–human relationships could provide an important source of support for neurodiverse individuals (Barcelos et al., 2021b). In autistic children, companion animals may improve social–emotional functioning (Byström & Persson, 2015; Carlisle et al., 2020; Harwood et al., 2019) and reduce levels of stress and anxiety (Carlisle, 2014; Wright et al., 2015). Although research into the effects of companion animals has overwhelmingly focused on autistic children, pet ownership has also been associated with enhanced mental well-being and social–emotional functioning in autistic adults (Atherton et al., 2023a; Barcelos et al., 2021b). The pet–human-related factors framework has previously been applied to autistic dog-owners (Barcelos et al., 2021b). In this case, individuals reported that close proximity with the dog and routine-like activities were beneficial for well-being and life functioning, protecting against suicidal tendencies in a sizeable minority (Barcelos et al., 2021b), whereas problematic dog behaviour, poor dog health, and obligations to the dog were reported to be detrimental to well-being. The effect of pet–human relationships on the well-being of ADHD individuals is much more limited by comparison (Schuck & Childress, 2023), although there is some evidence supporting the use of structured animal-assisted interventions in this population (Busch et al., 2016). Structured animal-assisted activities are typically goal-directed and designed to provide psychological support and enhance human well-being. Such interventions often involve trained and certified animals under the supervision of a professional handler (Kerulo et al., 2020). Further research is required to understand neurodiverse individuals' engagement in pet–human-related factors and effects on their well-being, especially regarding ADHD indi-

viduals. This understanding could be used to strengthen the use of companion animals as a psychosocial intervention to maximise the well-being of individuals (Barcelos et al., 2023a).

Together, these lines of evidence indicate that autistic and ADHD adults face a substantial and often chronic burden of co-occurring anxiety, depression, and suicidality (Capp et al., 2024; Hedley & Uljarević, 2018; Hollocks et al., 2019; Lai et al., 2019; Sun et al., 2024; Zahid & Upthegrove, 2017), while frequently encountering barriers to timely diagnosis and appropriate mental health care (Griffith et al., 2011; Kooij et al., 2018; Pilling et al., 2012; Raymaker et al., 2017). Pet–human relationships have been proposed as a potentially accessible form of psychosocial support for neurodiverse individuals (Atherton et al., 2023a; Barcelos et al., 2021b; Schuck & Childress, 2023), yet existing empirical work has concentrated largely on autistic children and dog–owner relationships (Byström & Persson, 2015; Carlisle et al., 2020; Wright et al., 2015). The pet–human-related factors framework provides a structured approach to capturing both supportive and burdensome dog-related activities and circumstances (Barcelos et al., 2020, 2023a; Corrêa et al., 2021), and qualitative work suggests that analogous cat–human-related factors may similarly influence eudaimonic and hedonic well-being, for example, through feeding, tactile interaction, and close proximity to the cat (Ravenscroft et al., 2021). However, quantitative applications of this framework to everyday cat–human interactions in autistic and ADHD adults are lacking. Addressing this gap, and clarifying whether specific cat–human-related factors (CHRFs) function as psychosocial resources or sources of strain for neurodivergent adults compared with non-neurodivergent cat owners, is therefore an important step towards understanding when and for whom companion animals may support mental health.

1.5. The Present Study: Research Questions and Hypotheses

Building on this literature, the present study focused on adult cat owners with and without formal diagnoses of autism and/or ADHD. We applied a cat-adapted pet–human-related factors framework (Barcelos et al., 2023a; Ravenscroft et al., 2021) to examine how everyday cat–human-related factors (CHRFs) are associated with anxiety, depression, and suicidality over a seven-day period in these groups. Our overarching research question was the following: How are autistic and ADHD traits, formal neurodevelopmental diagnoses, and specific cat–human-related factors associated with anxiety, depression, and suicidality in adult cat owners, and do these patterns differ between neurodivergent and non-neurodivergent adults? Prior work shows that both autistic and ADHD traits are associated with elevated anxiety, depression, and suicidality in community and clinical samples (Capp et al., 2024; Cassidy et al., 2018; Garcha & Smith, 2023; Jolliffe et al., 2023; Rai et al., 2018; Sun et al., 2024). On this basis, we formulated four hypotheses.

H1 (traits and well-being). *Higher autistic traits and higher ADHD traits will each be positively associated with anxiety, depression, and suicidality.*

H2 (diagnostic group differences in well-being). *Adults with a formal diagnosis of autism, ADHD, or co-occurring autism and ADHD (AuADHD) will report higher anxiety, depression, and suicidality than adults without a formal diagnosis, reflecting the elevated rates of mood and anxiety disorders and suicidal behaviour observed in these diagnostic groups (Choi et al., 2022; Hedley & Uljarević, 2018; Hinshaw et al., 2012; Hollocks et al., 2019; Lai et al., 2019; Septier et al., 2019; Zahid & Upthegrove, 2017).*

H3 (CHRFs and well-being). *In line with prior work applying the pet–human-related factors framework to dog–owner and cat–owner relationships, we predict that a perceived inability to provide for the cat and problematic cat behaviours (aggressive, anxious, and destructive) will be positively associated with anxiety, depression, and suicidality, and that poorer cat physical health*

will also be linked to poorer owner well-being (Barcelos et al., 2020, 2023a; Corrêa et al., 2021; Ravenscroft et al., 2021). We further anticipate that the strength of these associations may vary across diagnostic groups.

H4 (diagnostic group differences in CHRF engagement). *Given the heightened mental health burden reported in autistic and ADHD adults (Capp et al., 2024; Choi et al., 2022; Hollocks et al., 2019; Lai et al., 2019), and evidence that some neurodivergent individuals use relationships with companion animals as a form of psychosocial support (Atherton et al., 2023a; Barcelos et al., 2021b), we predict that adults with autism, ADHD, or AuADHD will report greater engagement than adults without a formal diagnosis in CHRFs involving close shared interaction with the cat (e.g., affectionate physical contact and close physical proximity).*

Because this study formed part of a wider umbrella project on pet–human relationships, some analyses of associations between CHRFs and autistic/ADHD traits were treated as exploratory and are interpreted with appropriate caution given the number of tests conducted (Greenland et al., 2016).

2. Materials and Methods

2.1. Participants

Participants were recruited using purposive sampling followed by snowball sampling techniques, utilising online platforms such as social media websites (e.g., Instagram, Facebook, LinkedIn). Inclusion criteria required participants to be 18 years or older, to currently own at least one cat, and to self-report either the presence or absence of a formal diagnosis of autism and/or ADHD. Eligibility further required that individuals could read the study materials, provide informed consent, and complete the online questionnaire independently. In total, 127 participants completed the study ($N = 127$). Most responses (70.1%; $n = 89$) were from within the UK. Participants were aged between 18 and 68 years ($Mdn = 28$, $IQR = 12$). The gender distribution was 76.4% female ($n = 97$), 14.2% male ($n = 18$), 6.3% non-binary ($n = 8$), 2.4% transgender ($n = 3$), and 0.8% unspecified ($n = 1$). Just under half of the sample (47.2%; $n = 60$) reported no formal diagnosis of a developmental condition. The remaining participants reported a formal diagnosis of autism (23.6%; $n = 30$), ADHD (11.8%; $n = 15$), or co-occurring autism and ADHD (AuADHD; 17.3%; $n = 22$). Including adults without a formal diagnosis provided a comparison group to determine whether patterns of well-being and engagement in cat–human-related factors are specific to neurodivergent adults or reflect broader trends among adult cat owners, in line with previous work emphasising the need to understand both shared and distinct aspects of pet–human relationships in autistic and non-autistic populations (Atherton et al., 2023a; Barcelos et al., 2021b).

2.2. Materials

The Dog–Human-Related Factors Questionnaire was adapted from Barcelos et al. (2023a) to reflect feline-specific behaviours and interaction patterns, with adaptations informed by Ravenscroft et al. (2021) to create a cat-specific version. For example, each original item was evaluated for applicability to cat–human interactions. Items referencing largely dog-specific activities (e.g., walking and running routines) were removed or rephrased to reflect typical feline behaviours. Language was adjusted to ensure species-appropriate terminology (e.g., barking vs. vocalisation episodes). Adaptations were reviewed by three researchers experienced in feline behaviour. This resulted in 11 items that were most relevant to cat owners. The large version developed by Ravenscroft et al. (2021) was not adopted, as the reduced item set was deemed more appropriate to prevent

participant fatigue/disengagement. The abbreviated version of this questionnaire was derived from the most frequently mentioned themes in Ravenscroft et al. (2021) that captured the frequency and nature of interactions and events between participants and their cat(s). Table 1 presents the positive and negative factors evaluated, along with their respective measurement scales. A similar scaling to that used by Barcelos et al. (2023a) was used, with most items assessed using a self-report frequency rating scale ranging from 0 to 35, over the preceding seven days (e.g., in the last seven days, how many times have you had friendly conversations with others due to the presence of your cat?). Exceptions included ‘close proximity to the cat,’ measured on a sliding scale (0–100%), and ‘physical health of the cat,’ assessed using a 7-point Likert scale ranging from ‘Excellent’ to ‘Extremely Poor.’ Internal consistency assessment produced a Cronbach’s alpha of $\alpha = 0.63$, which is considered “reliable”, but marginally so (Cohen et al., 2018, p. 744). This is consistent with the multidimensional and bi-directional nature of the cat–human interaction factors assessed; i.e., activities (items of the scale) are related to some extent but not highly so, since individuals vary in the emphasis they give to different aspects of their interactions with cats, and thus the nature of the relationship which emerges differs as a consequence (Ines et al., 2021).

Table 1. Eleven cat–human-related factors assessed for their occurrence/rating during the past 7 days.

Factor	Response Options
Friendly conversations with others due to the presence of your cat	Zero (0)–35 or more (35) times overall
Feeding your cat main meals	Zero (0)–35 or more (35) times overall
Aggressive behaviour displayed by your cat (e.g., biting, lunging)	Zero (0)–35 or more (35) times overall
An inability to provide for your cat (e.g., not able to be at home with or feed them)	Zero (0)–35 or more (35) times overall
Anxious behaviour displayed by your cat (e.g., fear of people, separation anxiety)	Zero (0)–35 or more (35) times overall
Vocalisation episodes displayed by your cat	Zero (0)–35 or more (35) times overall
Destructive behaviour displayed by your cat (e.g., chewed, scratched, stolen items)	Zero (0)–35 or more (35) times overall
Affectionate physical contact with your cat (e.g., petting, cuddling, kissing)	Zero (0)–35 or more (35) times per day in the last 7 days
House soiling by your cat with urine or faeces (e.g., on inappropriate surfaces)	Zero (0)–35 or more (35) times overall
Proportion of time awake in close proximity with your cat (e.g., in the same room or outside together)	0–100% times overall
Physical health of your cat (e.g., medical issues, sickness, injuries)	Excellent (7), Very good (6), Good (5), Neither good nor poor (4), Poor (3), Very poor (2), Extremely poor (1)

Note: adapted from Barcelos et al. (2023a) with modifications to ensure relevance to cat–human interactions, including removal of dog-specific items, rewording for species-appropriate behaviours, and consideration of relevant items identified in Ravenscroft et al. (2021).

The Autism Spectrum Quotient-10 (AQ-10; Allison et al., 2012) assesses the frequency of autistic traits in the individual across 5 domains: social skills difficulties, routine behaviour, attention switching, imagination, and attention to detail. It is a short-form version

of that of Baron-Cohen et al. (2001), revised to include 10 items rated on a 4-point Likert scale ('Definitely Disagree' to 'Definitely Agree'). For example, rating 'Agree' or 'Definitely Agree' in response to 'When I'm reading a story I find it difficult to work out the characters' intentions' scored 1 point. There is reverse coding for 6 of the items for instance, rating 'Definitely Disagree' or 'Disagree' on 'I find it easy to 'read between the lines' when someone is talking to me' scored 1 point. Scores range from 0 to 10, with each item scored as either 0 or 1. Higher total scores indicate a greater presence of autistic traits. A score of 6 or above, in individuals of typical intelligence, is considered indicative of a positive screening outcome and may warrant clinical referral for further assessment. A Cronbach's alpha of $\alpha = 0.76$ indicated the measure was reliable (Cohen et al., 2018, p. 744).

The Adult ADHD Self-Report Scale Screener (ASRS; Kessler et al., 2005) was employed to assess the frequency of ADHD-related traits over the preceding six months. Grounded in the diagnostic criteria outlined in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; APA, 1994), the ASRS evaluates symptomatology across three core domains: inattention, hyperactivity, and impulsivity. The first six items of the ASRS serve as a validated screening tool, demonstrating a high predictive accuracy (94.3%) for identifying individuals at risk for ADHD (Adler et al., 2006). These items are therefore considered effective for preliminary assessment. Higher total scores reflect a greater presence of ADHD traits, with a score of 4 or above indicating a positive screening outcome. An assessment of internal consistency produced a Cronbach's alpha of $\alpha = 0.69$, suggesting marginal reliability, just below the conventional preferred threshold of 0.70 for a scale measuring a unitary construct (Cohen et al., 2018, p. 744). This value may thus reflect the variability of presentation of signs of ADHD, hence the use of the scale as a preliminary screen, rather than diagnostic tool.

The Generalised Anxiety Disorder—7 (GAD-7; Spitzer et al., 2006) assessed the frequency of Generalised Anxiety Disorder (GAD) symptomatology during the past 2 weeks, based on DSM-IV criterion. It includes 7 items rated on a 4-point Likert scale, with a score calculated using scores of between 0 (not at all) and 3 (nearly every day) for each question. The greater the total score, the greater the severity of anxiety symptoms (5 = mild, 10 = moderate, and 15 = severe). A score of ≥ 10 was considered a positive screening for clinical levels of anxiety (Spitzer et al., 2006). A Cronbach's alpha of $\alpha = 0.87$ indicated the items being used to measure the construct of interest were highly reliable (Cohen et al., 2018, p. 744).

The Patient Health Questionnaire—9 (PHQ-9; Kroenke et al., 2001) assessed the frequency of depressive symptomatology during the past 2 weeks, based on the 9 DSM-IV criteria for depressive disorders. The short-form version is based on Spitzer et al. (1999), including 9 items rated on a 4-point Likert scale ('Not at all'—'Nearly every day'), which ask how often the participant has experienced a variety of problems. Response options range from 0 ('not at all') to 3 ('nearly every day'). Participants' total scores can range from 0 to 27. The greater the total score, the greater the severity of depressive symptoms (5 = mild, 10 = moderate, 15 = moderately severe, and 20 = severe). Hence, a score of ≥ 10 was considered a positive screening for clinical levels of depression. A Cronbach's alpha of $\alpha = 0.86$ indicated the scale content was highly reliable (Cohen et al., 2018, p. 744).

The Suicidal Behaviours Questionnaire—Revised (SBQ-R; Osman et al., 2001) was used to assess the frequency and nature of suicidality. The instrument comprises four items, each targeting a distinct dimension of suicidal behaviour: lifetime suicidal ideation and attempts, the frequency of suicidal thoughts over the past year, the threat of suicidal behaviour, and the perceived likelihood of a future suicide attempt. Together, these items provide a brief yet multidimensional measure of suicidality. The greater the total score, the greater the risk of suicidality (6 or lower = low risk, 7 to 10 = moderate risk, 11 or

higher = high risk.). In the general population, a score of ≥ 7 indicates a positive screening for risk of suicidality. A Cronbach's alpha of $\alpha = 0.79$ demonstrated the reliability of the content of this scale for this factor (Cohen et al., 2018, p. 744).

2.3. Procedure

This study received a favourable opinion by the University of Lincoln Ethics Committee (UoL 2024_16619). Data were gathered through the online platform QuestionPro, which participants accessed through their own computers. A link to the study was provided in the recruitment text stating the eligibility criteria (18+ years of age). The Participant Information Sheet stated the study aims, anonymous and secure storage of data, websites of support organisations, and email addresses of key researchers for any questions or concerns. Both resources provided content warnings relating to items concerning mental health issues and suicidality. Participants then had to provide fully informed consent to proceed. Demographic information included age, gender, country of residence, formal neurodevelopmental diagnoses, and a variety of cat ownership questions.

2.4. Data Analysis

This study was part of a wider umbrella study investigating the interplay of pet-human factor activities, mental health, personality, and neurodiversity. For the present report, we focused specifically on cat-human relationships, neurodiversity, and well-being. Given the non-parametric nature of the data, we used Spearman's rank-order correlations and Kruskal–Wallis tests with Bonferroni-corrected Dunn's post hoc tests, as appropriate. To test H1 (traits and well-being), we calculated Spearman's rho correlations between autistic traits (AQ-10), ADHD traits (ASRS), anxiety (GAD-7), depression (PHQ-9), and suicidality (SBQ-R).

To test H2 (diagnostic group differences in well-being), we conducted three Kruskal–Wallis tests comparing GAD-7, PHQ-9, and SBQ-R scores across the four diagnostic groups: Group 1—no formal diagnosis of autism or ADHD; Group 2—a formal diagnosis of autism; Group 3—a formal diagnosis of ADHD; and Group 4—co-occurring formal diagnoses of autism and ADHD (AuADHD). Significant omnibus effects were followed up with Bonferroni-corrected Dunn's post hoc comparisons.

To test H3 (CHRFs and well-being), we examined Spearman's rho correlations between each of the 11 CHRFs and the mental health measures (GAD-7, PHQ-9, SBQ-R). In addition, we explored associations between CHRFs and autistic/ADHD traits (AQ-10, ASRS) to characterise how patterns of interaction with cats relate to neurodiversity at a dimensional level. Given the number of CHRFs and outcomes examined, these analyses were considered partly exploratory, and *p*-values are interpreted with appropriate caution in line with recommendations concerning multiple testing and effect-size interpretation (Greenland et al., 2016).

To test H4 (diagnostic group differences in CHRF engagement), we ran 11 Kruskal–Wallis tests comparing engagement in each CHRF across the four diagnostic groups defined above, followed by Bonferroni-corrected Dunn's post hoc tests where applicable.

To evaluate the adequacy of the sample size for these analyses, we conducted power calculations in G*Power 3.1.9.7 (Faul et al., 2007). For the correlational analyses (H1 and exploratory correlations between CHRFs and autistic/ADHD traits), assuming a two-tailed $\alpha = 0.05$ and medium effect sizes ($\rho \approx 0.25$ – 0.30), the available sample ($N = 127$) afforded power greater than 0.80. For the Kruskal–Wallis tests comparing the four diagnostic groups (H2 and H4), the corresponding parametric one-way ANOVA model indicated adequate power to detect medium-high-sized omnibus effects but more limited power for small effects and for post hoc pairwise contrasts, particularly in the ADHD-only group ($n = 15$).

These considerations align with our emphasis on effect sizes and cautious interpretation of p -values in the Results and with the limitations noted in Section 4.5 (Greenland et al., 2016).

3. Results

Results are organised by the four hypotheses outlined in Section 1.5. Section 3.1 addresses H1 (traits and well-being), Section 3.2 addresses H2 (diagnostic group differences in well-being), Section 3.3 addresses H3 (CHRFs and well-being), and Section 3.4 addresses H4 (diagnostic group differences in CHRF engagement).

3.1. Neurodiverse Traits and Well-Being (H1)

In relation to the first hypothesis (H1), correlations between autistic traits (AQ-10), ADHD traits (ASRS), anxiety (GAD-7), depression (PHQ-9), and suicidality (SBQ-R) are presented in Table 2, along with the descriptive statistics. There were moderate positive correlations between autistic traits and ADHD traits, $r_s = 0.44$, $p < 0.001$, $n = 125$; autistic traits and anxiety, $r_s = 0.45$, $p < 0.001$, $n = 124$; and autistic traits and depression, $r_s = 0.41$, $p < 0.001$, $n = 126$. There was also a weak positive correlation between autistic traits and suicidality $r_s = 0.27$, $p < 0.001$, $n = 125$. Additionally, there were moderate positive correlations between ADHD traits and anxiety, $r_s = 0.47$, $p < 0.001$, $n = 124$, and ADHD traits and depression, $r_s = 0.49$, $p < 0.001$, $n = 125$. There was also a weak positive correlation between ADHD traits and suicidality, $r_s = 0.33$, $p < 0.001$, $n = 124$. Furthermore, there was a strong positive correlation between anxiety and depression, $r_s = 0.75$, $p < 0.001$, $n = 124$; a moderate positive correlation between anxiety and suicidality, $r_s = 0.54$, $p < 0.001$, $n = 124$; and a moderate positive correlation between depression and suicidality, $r_s = 0.54$, $p < 0.001$, $n = 125$. Overall, these findings support H1 and indicate that higher autistic and ADHD traits are associated with greater psychological distress in this sample.

Table 2. Descriptive statistics and correlations for autistic traits, ADHD traits, anxiety, depression, and suicidality.

	<i>n</i>	Mdn	IQR	Autistic Traits	ADHD Traits	Anxiety	Depression	Suicidality
Autistic Traits	127	5	4	–				
ADHD Traits	125	4	3	0.44 **	–			
Anxiety	124	7	7	0.45 **	0.47 **	–		
Depression	126	8	8	0.41 **	0.49 **	0.75 **	–	
Suicidality	125	6	5.5	0.27 **	0.33 **	0.54 **	0.54 **	–

Note: ** $p < 0.001$.

3.2. Neurodevelopmental Diagnoses and Well-Being (H2)

In relation to the second hypothesis (H2), group differences in GAD-7, PHQ-9, and SBQ-R scores across the four diagnostic groups (1—no formal diagnosis of autism or ADHD; 2—a formal diagnosis of autism; 3—a formal diagnosis of ADHD; 4—co-occurring formal diagnoses of autism and ADHD) are presented in Figure 1. In GAD-7, the differences between the mean ranks of 49.33 (Group 1, Mdn = 5.5), 76.30 (Group 2, Mdn = 9.5), 66.86 (Group 3, Mdn = 7), and 78.28 (Group 4, Mdn = 9) were significant, $H(3, n = 124) = 16.62$, $p < 0.001$. The mean rank of Group 2 was significantly higher than the mean rank of Group 1, $p = 0.005$. Furthermore, the mean rank for Group 4 was significantly higher than the mean rank for Group 1, $p = 0.011$. After adjustment for multiple testing, none of the other comparisons were significant.

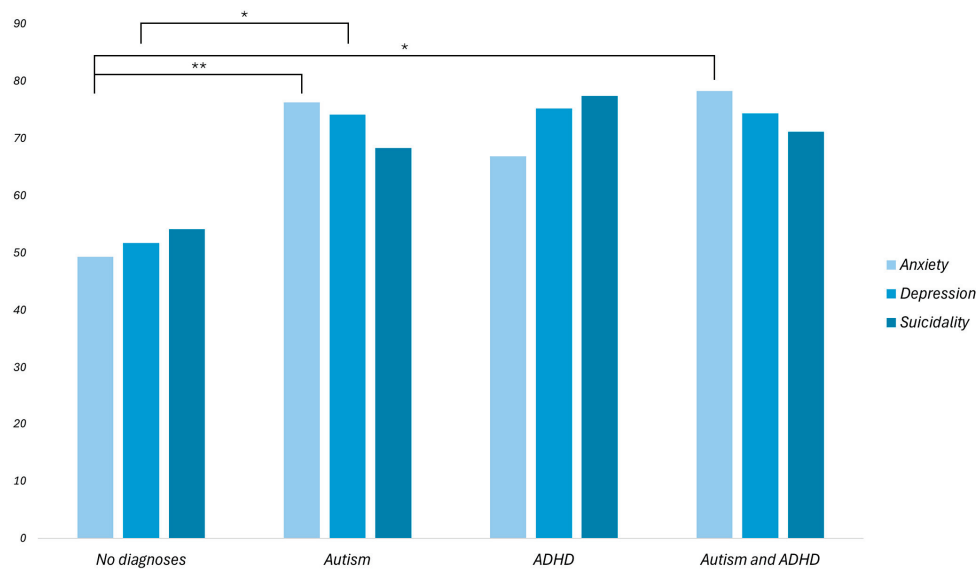


Figure 1. Mean ranks for anxiety, depression, and suicidality between individuals with and without formal diagnoses of autism and ADHD. Note: * $p < 0.05$. ** $p < 0.01$.

In PHQ-9, the difference between the mean ranks of 51.73 (Group 1, Mdn = 6), 74.15 (Group 2, Mdn = 9), 75.20 (Group 3, Mdn = 10), and 73.57 (Group 4, Mdn = 9) were significant, $H(3, n = 126) = 11.97, p = 0.007$. The PHQ-9 mean rank for Group 2 was significantly higher than the PHQ-9 mean rank for Group 1, $p = 0.036$, with no other pairwise comparisons reaching significance after adjustment.

In SBQ-R, the difference between the mean ranks of 54.13 (Group 1, Mdn = 5), 68.30 (Group 2, Mdn = 7.5), 77.39 (Group 3, Mdn = 7.5), and 71.17 (Group 4, Mdn = 7) were not significant, $H(3, n = 128) = 7.62, p = 0.054$.

Taken together, these results provide partial support for H2 as autistic participants and those with co-occurring AuADHD reported significantly higher anxiety than participants without a formal diagnosis, and autistic participants reported higher depression, whereas suicidality did not differ significantly between diagnostic groups in the present sample.

3.3. Cat-Human-Related Factors and Well-Being (H3)

In relation to H3 (CHRFs and well-being), four CHRFs demonstrated weak but statistically significant relationships with the mental health measures (Table 3). Firstly, there were positive correlations between an inability to provide for the cat and depression, $r_s = 0.20, p = 0.028, n = 126$, and an inability to provide for the cat and suicidality, $r_s = 0.19, p = 0.036, n = 125$. Additionally, there were positive correlations between anxious cat behaviour and anxiety, $r_s = 0.26, p = 0.003, n = 124$, and anxious cat behaviour and depression, $r_s = 0.25, p = 0.004, n = 126$. There was a positive correlation between close proximity to the cat and anxiety, $r_s = 0.22, p = 0.013, n = 124$. Finally, there was a positive correlation between poor physical health of the cat and depression, $r_s = 0.22, p = 0.015, n = 126$. The other six CHRFs did not yield significant correlations with anxiety, depression, or suicidality. These results therefore provide partial support for H3, indicating that a subset of hypothesised strain-related CHRFs are associated with poorer mental health, whereas most CHRFs were not reliably related to distress in this sample.

Table 3. Correlations between cat–human-related factors, anxiety, depression, and suicidality.

	Anxiety	Depression	Suicidality
Social interaction due to the cat	0.06	0.10	0.03
Feeding the cat	0.01	−0.04	0.07
Aggressive cat behaviour	0.04	−0.01	−0.02
Inability to provide for the cat	0.11	0.20 *	0.19 *
Anxious cat behaviour	0.26 **	0.25 **	0.11
Cat vocalisation episodes	0.05	−0.05	0.07
Destructive cat behaviour	0.05	0.12	0.10
Affectionate physical contact with the cat	0.10	−0.02	0.17
Cat soiling in the house	0.06	0.13	0.09
Close proximity to the cat	0.22 *	0.17	0.17
Physical health of the cat	0.16	0.22 *	−0.01

Note. * $p < 0.05$. ** $p < 0.01$.

3.4. Engagement in Cat–Human-Related Factors (H4)

In relation to H4 (diagnostic group differences in CHRF engagement), three CHRFs displayed significant differences in engagement between the four diagnostic groups. Firstly, for feeding the cat, the difference between the mean ranks of 61.11 (Group 1, Mdn = 9), 54.13 (Group 2, Mdn = 9), 84.83 (Group 3, Mdn = 16), and 71.14 (Group 4, Mdn = 12.5) were significant, $H(3, n = 127) = 8.28, p = 0.041$. The mean rank for Group 3 (ADHD) was significantly higher than the mean rank for Group 2 (autism), $p = 0.047$. None of the other comparisons were significant after adjustment for multiple testing. Secondly, for witnessing cat vocalisation episodes, the difference between the mean ranks of 58.13 (Group 1, Mdn = 12), 57.80 (Group 2, Mdn = 10.5), 76.03 (Group 3, Mdn = 32), and 80.25 (Group 4, Mdn = 24.5) were significant, $H(3, n = 127) = 8.42, p = 0.038$. However, post hoc pairwise comparisons using Dunn’s test with adjustment failed to identify specific significant pairwise contrasts. Finally, for affectionate physical contact with the cat, the difference between the mean ranks of 56.56 (Group 1, Mdn = 22), 63.95 (Group 2, Mdn = 32), 82.70 (Group 3, Mdn = 35), and 71.61 (Group 4, Mdn = 35) were significant, $H(3, n = 127) = 7.86, p = 0.049$, although again no individual pairwise comparisons remained significant following adjustment. The other eight CHRFs showed no significant differences in engagement between groups.

Overall, these findings indicate limited support for H4, as, although there were some group differences in feeding, vocalisation, and affectionate physical contact, engagement in most CHRFs did not differ significantly between neurodivergent and non-neurodivergent participants.

4. Discussion

The present study investigated the well-being of neurodivergent and non-neurodivergent adult cat owners in the context of everyday cat–human relationships over a seven-day period. In line with H1 and H2, higher autistic and ADHD traits were associated with greater anxiety, depression, and suicidality, and autistic and AuADHD groups reported elevated anxiety (and, for autistic adults, elevated depression) compared with adults without a formal diagnosis (Capp et al., 2024; Hedley & Uljarević, 2018; Hollocks et al., 2019; Lai et al., 2019; Zahid & Uptegrove, 2017). H3 received partial support as only a small subset of predominantly strain-related CHRFs (i.e., perceived inability to provide for the cat, anxious cat behaviour, close proximity to the cat, and poorer cat physical health) were associated with poorer mental health, whereas most CHRFs showed no reliable associations with distress (Barcelos et al., 2020, 2023a; Corrêa et al., 2021; Ravenscroft et al., 2021). H4 received

only limited support as there were some group differences in feeding, cat vocalisation episodes, and affectionate physical contact, but engagement in most CHRFS did not differ significantly between neurodivergent and non-neurodivergent participants. Overall, these findings suggest that both autistic/ADHD traits and diagnoses are meaningfully associated with mental health in adult cat owners and that specific high-burden CHRFS are linked to poorer well-being, while patterns of everyday cat engagement are broadly similar across groups.

4.1. Neurodiverse Traits and Well-Being

The results support H1, which predicted significant positive correlations between autistic traits, ADHD traits, and poorer well-being (i.e., anxiety, depression, and suicidality). Individuals with higher levels of autistic and ADHD traits reported greater rates of anxiety and depression and were at increased risk of suicidality, mirroring previous trait-based findings in community and clinical samples (Capp et al., 2024; Cassidy et al., 2018; Garcha & Smith, 2023; Jolliffe et al., 2023; Rai et al., 2018; Sun et al., 2024). These data reinforce the view that autistic and ADHD traits, conceptualised dimensionally rather than categorically, have meaningful implications for mental health. This dimensional pattern is important because many individuals with substantial autistic or ADHD traits experience barriers to timely diagnosis and tailored intervention, including under-recognition in some demographic groups and limited access to specialist assessment (Griffith et al., 2011; Kooij et al., 2018; Pilling et al., 2012; Raymaker et al., 2017; South et al., 2020). Our findings therefore support calls for mental health support to be sensitive to trait load and functional impact rather than restricted solely to those with confirmed diagnoses (Landry & Chouinard, 2019). They are also consistent with prior work documenting substantial overlap in autistic and ADHD traits and shared or interacting symptom profiles (Ghirardi et al., 2019; Mayes et al., 2012; Panagiotidi et al., 2019; Taylor et al., 2015), and with evidence that co-occurring autism and ADHD is common (Rong et al., 2021). Extending this literature to adult cat owners indicates that the presence of a companion animal does not eliminate underlying vulnerabilities, in line with research suggesting that pets can support but do not fully buffer mental health difficulties in neurodivergent and other clinical populations (Atherton et al., 2023a; Barcelos et al., 2021b; Brooks et al., 2018; Hawkins et al., 2021).

4.2. Formal Diagnoses and Well-Being

H2 predicted that adults with formal diagnoses of autism, ADHD, or co-occurring autism and ADHD would report poorer well-being than adults without a diagnosis. This was partially supported. Anxiety and depression were significantly higher in autistic adults than in adults without a diagnosis, and anxiety was elevated in the AuADHD group, consistent with meta-analytic evidence of high rates of anxiety and depressive disorders and complex psychiatric comorbidity in autistic adults (Hollocks et al., 2019; Hossain et al., 2020; Lai et al., 2019). These findings add to concerns that mental health provision for autistic adults remains limited or poorly tailored (Pilling et al., 2012) and underscore the need to identify factors that may support or undermine well-being, including pet–human relations (Barcelos et al., 2021b; Brumpton & Kargas, 2026; Howlin & Taylor, 2015; National Collaborating Centre for Mental Health, 2012; Segers & Rawana, 2014). In contrast, adults with ADHD alone did not report significantly higher anxiety or depression than adults without a diagnosis, despite prior evidence of elevated mood and anxiety disorders in this group (Agnew-Blais et al., 2018; Choi et al., 2022; Fayyad et al., 2016). This likely reflects limited power for subgroup comparisons, given the relatively small ADHD-only group ($n = 15$), as also noted in our power analysis and Limitations (Faul et al., 2007; Greenland et al., 2016). Suicidality did not differ significantly between diagnostic groups, although the

omnibus test approached significance, in line with broader work linking both autism and ADHD to elevated suicide risk (Hedley & Uljarević, 2018; Hinshaw et al., 2012; Septier et al., 2019; Zahid & Upthegrove, 2017). Overall, these findings indicate that poorer well-being in neurodivergent adults is not uniform across all diagnostic categories and all outcomes. Anxiety appears particularly elevated in autistic and AuADHD individuals, depression is especially elevated in autistic adults, and differences in suicidality may require larger samples to detect.

4.3. Cat–Human-Related Factors and Well-Being

Consistent with H3, a small number of cat–human-related factors were positively correlated with anxiety, depression, and suicidality. Perceived inability to provide for the cat was associated with greater depression and suicidality; anxious cat behaviour was associated with greater anxiety and depression; close proximity to the cat was associated with greater anxiety; and poorer cat physical health was associated with greater depression. These findings parallel dog-owner research using the pet–human-related factors framework, where caregiving strain, problematic animal behaviour, and concerns about the animal’s health have been linked to diminished well-being (Barcelos et al., 2020, 2021a, 2023a; Corrêa et al., 2021), and are consistent with evidence that chronic companion–animal health and behavioural problems can adversely affect owner affect and stress (Amat et al., 2016; Applebaum et al., 2020; Johnson et al., 2021; Ravenscroft et al., 2021). Although effect sizes were small, this pattern fits the expectation that everyday CHRfS make incremental contributions to mental health alongside many other psychosocial risk and protective factors (Greenland et al., 2016; Rodriguez et al., 2021). In contrast to some dog-owner studies, aggressive and destructive cat behaviours were not robustly associated with poorer well-being in the present sample (Barcelos et al., 2020, 2023a). Species-related differences may partly explain this discrepancy. For instance, companion dogs are more frequently referred for behavioural problems, and problematic feline behaviour often manifests as anxiety, withdrawal, and vocalisation rather than overt aggression (Denenberg et al., 2005; Howell et al., 2017). As such, caregiver strain in cat owners may arise more from managing ongoing anxiety-related issues and health concerns than from isolated incidents of aggression, in line with reports of owner stress associated with anxious or unwell cats (Amat et al., 2016; Applebaum et al., 2020; Johnson et al., 2021; Ravenscroft et al., 2021).

Notably, the positive association between close proximity to the cat and anxiety was unexpected given prior work indicating that psychological closeness and time spent in proximity to companion animals can support eudaimonic and hedonic well-being and buffer stress (Barcelos et al., 2021a; Ein et al., 2018; Ravenscroft et al., 2021; Sugawara et al., 2012; Teo et al., 2022). One plausible explanation is that more anxious owners may actively seek out physical closeness with their cat as a short-term regulatory strategy. Because our data are cross-sectional and rely on seven-day retrospective self-reports, we cannot determine directionality, that is, whether proximity increases anxiety or anxiety motivates proximity. Future longitudinal and experience-sampling designs will be needed to test these possibilities (Barcelos et al., 2023a).

Finally, the present study is, to our knowledge, the first to apply a pet–human-related factors framework quantitatively to cat–human relationships in a neurodiverse-inclusive adult sample (Barcelos et al., 2023a; Ravenscroft et al., 2021). In line with arguments from dog–human work, our findings suggest that intentionally reducing high-burden CHRfS, such as perceived inability to provide for the cat, or managing anxious or chronically unwell cats, may enhance the psychosocial benefits of cat ownership (Barcelos et al., 2021b). This has practical implications for collaborative work between mental health professionals and

animal behaviour and welfare specialists, particularly given evidence that autistic adults may perceive barriers to successful pet care (Atherton et al., 2023a; Barcelos et al., 2024).

4.4. Engagement in Cat–Human-Related Factors

H4 predicted that adults with formal diagnoses of autism, ADHD, or co-occurring autism and ADHD would report greater engagement in CHRFS involving shared interaction (e.g., affectionate physical contact and close physical proximity) than adults without a diagnosis, in line with evidence that neurodivergent individuals often experience elevated distress and may seek psychosocial support through relationships with companion animals (Atherton et al., 2023a; Barcelos et al., 2021b; Choi et al., 2022; Hollocks et al., 2019). This prediction received only limited support as, for most CHRFS, no significant group differences in engagement were observed, suggesting that neurodivergent and non-neurodivergent adults engaged with their cats in broadly similar ways in everyday life.

Three CHRFS showed significant omnibus group differences (i.e., feeding the cat, cat vocalisation episodes, and affectionate physical contact). Individuals in the ADHD group fed their cats more frequently than autistic individuals, and neurodivergent participants tended to report somewhat higher levels of affectionate physical contact than non-neurodivergent participants, although post hoc contrasts were modest and often did not survive adjustment. Feeding has been linked to improved eudaimonic and hedonic well-being in cat owners (Ravenscroft et al., 2021), and it is possible that some individuals engage more often in caregiving routines when seeking positive affective states, though empirical evidence on human–animal interactions in ADHD remains limited (Busch et al., 2016; Schuck & Childress, 2023). Taken together with the largely null findings for other CHRFS, these results suggest that relationships with cats, as with dogs, may offer broadly comparable forms of interaction across neurodivergent and non-neurodivergent adults (Atherton et al., 2023b; Barcelos et al., 2023a, 2021a). In combination with the CHRFS–well-being associations discussed above, this pattern implies that the quality and context of specific cat–human interactions may be more important for mental health than overall engagement frequency per se.

4.5. Limitations and Future Directions

Several limitations should be considered when interpreting these findings. First, formal diagnoses of autism, ADHD, and co-occurring autism and ADHD were self-reported and could not be independently verified. Although this approach is common in survey research, it introduces the possibility of misclassification and underscores the need for future work combining self-reports with clinical verification where feasible (Griffith et al., 2011; Pilling et al., 2012). Second, the ADHD-only group was relatively small ($n = 15$), which limited statistical power to detect between-group differences, particularly for depression and anxiety, and likely contributed to the near-significant omnibus effect for suicidality. Our power analysis indicated that the overall sample size was adequate for detecting medium-high-sized correlations and omnibus group effects, but not small effects or some subgroup contrasts (Faul et al., 2007; Greenland et al., 2016). Third, the sample was predominantly female and largely based in the UK, a pattern frequently observed in human–animal interaction research (Herzog, 2021) but one which limits the generalisability of the findings to more diverse populations. Fourth, all measures relied on self-reports of experiences over the past seven days. This permitted fine-grained, recent reflections on well-being and CHRFS but is inherently cross-sectional and retrospective, preventing strong inferences about temporal ordering and directionality (e.g., whether anxiety motivates increased proximity to the cat or vice versa). Future research should therefore apply this framework using longitudinal and experience-sampling designs and with larger, more

representative samples to test the robustness and temporal dynamics of the associations reported here (Barcelos et al., 2023a; Rodriguez et al., 2021). Fifth, we examined multiple CHRFS in relation to several mental health and neurodiversity indices. Although we used Bonferroni-corrected Dunn tests for group comparisons, we did not formally correct for multiple testing in the correlation analyses. In line with contemporary recommendations, we therefore emphasise the pattern and plausibility of effects rather than any single *p*-value or threshold (Greenland et al., 2016), and future work could use multivariate approaches or dimension-reduction techniques to summarise CHRFS. Future studies could also broaden the range of outcomes examined. In particular, assessing positive well-being indicators (e.g., life satisfaction, meaning in life, and social connectedness) alongside distress could deepen understanding of the complex and bi-directional nature of cat–human relationships (Barcelos et al., 2023a; Rodriguez et al., 2021). It will also be important to explore whether neurodivergent individuals show species-specific preferences or derive differential benefits from different companion animals, given emerging evidence that dog ownership can support mental health and buffer suicidality in autistic adults (Barcelos et al., 2021b). Finally, potential mediating and moderating factors such as personality, attachment to the pet, and social support (Atherton et al., 2023a; Bao & Schreer, 2016; Miltiades & Shearer, 2011) warrant investigation to clarify when and for whom cat–human relationships buffer or exacerbate psychological distress.

5. Conclusions

Pet–human-related factors frameworks provide a structured way to consider the bi-directional impact of specific pet–human activities and circumstances on human well-being (Barcelos et al., 2023a). Applying this sort of framework may help resolve inconsistencies in previous work on pet ownership and mental health by capturing both the supportive and the burdensome aspects of caregiving (Scoresby et al., 2021; Wells, 2019). The present study extended this framework to cat–human relationships in neurodiverse individuals, addressing a notable gap in the literature on both neurodiversity and companion animals (Atherton et al., 2023a; Ravenscroft et al., 2021).

In line with H1 and H2, we found that autistic and ADHD traits were associated with reduced well-being and that autistic and AuADHD adults, in particular, reported elevated anxiety (and, for autistic adults, elevated depression) compared with adults without a formal diagnosis, reinforcing evidence of heightened distress in neurodiverse populations (Capp et al., 2024; Hedley & Uljarević, 2018; Hollocks et al., 2019; Lai et al., 2019; Zahid & Upthegrove, 2017). These findings emphasise the necessity of improving mental health support for autistic and AuADHD adults (Pilling et al., 2012) and of considering both dimensional traits and diagnostic status when assessing risk.

Consistent with H3, four CHRFS (i.e., perceived inability to provide for the cat, anxious cat behaviour, close proximity to the cat, and poorer cat physical health) were associated with negative well-being outcomes, paralleling prior work on dog–human-related factors (Barcelos et al., 2020, 2021a; Corrêa et al., 2021). These findings reiterate the bi-directional nature of pet–human-related factors, which has rarely been quantified in cat–human relationships (Ravenscroft et al., 2021), and suggest that reducing high-burden CHRFS may be a pragmatic target for interventions aiming to support neurodivergent cat owners.

Finally, H4 received only limited support. Although there were some group differences in feeding, vocalisation, and affectionate physical contact, overall engagement in CHRFS did not differ substantially between neurodivergent and non-neurodivergent individuals. This pattern suggests that relationships with cats, as with dogs (Barcelos et al., 2023a, 2021a), may offer broadly comparable forms of interaction across groups, rather than reflecting a uniformly heightened reliance on cats for support in neurodivergent adults.

Taken together, these findings underscore the importance of considering both neurodiversity and specific cat–human-related factors when evaluating the mental health of adult cat owners. They also highlight the potential value of collaborative work between mental health professionals and animal behaviour/welfare specialists in identifying and mitigating high-burden CHRFS, with the aim of maximising the psychosocial benefits of cat–human relationships while minimising associated risks. Future research with larger and more representative samples, and with longitudinal designs, will be essential to test the robustness and causal direction of the associations reported here.

Author Contributions: Conceptualization, A.M.B., N.K. and D.S.M.; methodology, L.W., A.M.B., S.T., A.Z., D.S.M. and N.K.; validation, L.W., A.M.B., S.T., A.Z., D.S.M. and N.K.; formal analysis, L.W., A.Z.; investigation, L.W., A.M.B., S.T., A.Z., D.S.M. and N.K.; resources, N.K.; data curation, L.W., A.M.B., S.T., A.Z., D.S.M. and N.K.; writing—original draft preparation, L.W.; writing—review and editing, A.M.B., S.T., A.Z., D.S.M. and N.K.; visualisation, L.W.; supervision, N.K.; project administration, N.K. All authors contributed equally to this work. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of University of Lincoln (UoL 2024_16619 and 7 February 2024).

Informed Consent Statement: Informed consent was obtained from all the subjects involved in this study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: The authors would like to thank all participants for generously giving their time and for their invaluable contribution to this study.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

CHRFS	Cat–Human-Related Factors
APA	American Psychiatric Association
ADHD	Attention-Deficit Hyperactivity Disorder

References

- Adler, L. A., Spencer, T., Faraone, S. V., Kessler, R. C., Howes, M. J., Biederman, J., & Secnik, K. (2006). Validity of pilot adult ADHD self-report scale (ASRS) to rate adult ADHD symptoms. *Annals of Clinical Psychiatry*, 18(3), 145–148. [CrossRef] [PubMed]
- Agnew-Blais, J. C., Polanczyk, G. V., Danese, A., Wertz, J., Moffitt, T. E., & Arseneault, L. (2018). Young adult mental health and functional outcomes among individuals with remitted, persistent and late-onset ADHD. *The British Journal of Psychiatry*, 213(3), 526–534. [CrossRef]
- Allen, K. (2003). Are pets a healthy pleasure? The influence of pets on blood pressure. *Current Directions in Psychological Science*, 12(6), 236–239. [CrossRef]
- Allison, C., Auyeung, B., & Baron-Cohen, S. (2012). Toward brief “red flags” for autism screening: The short autism spectrum quotient and the short quantitative checklist in 1000 cases and 3000 controls. *Journal of the American Academy of Child & Adolescent Psychiatry*, 51(2), 202–212. [CrossRef]
- Amat, M., Camps, T., & Manteca, X. (2016). Stress in owned cats: Behavioural changes and welfare implications. *Journal of Feline Medicine and Surgery*, 18(8), 577–586. [CrossRef] [PubMed]
- American Psychiatric Association (APA). (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). American Psychiatric Association.

- American Psychiatric Association (APA). (2022). *Diagnostic and statistical manual of mental disorders* (5th ed., text rev.). American Psychiatric Association. [CrossRef]
- Amiot, C. E., & Bastian, B. (2015). Toward a psychology of human–Animal relations. *Psychological Bulletin*, 141(1), 6–47. [CrossRef] [PubMed]
- Applebaum, J. W., Tomlinson, C. A., Matijczak, A., McDonald, S. E., & Zsembik, B. A. (2020). The concerns, difficulties, and stressors of caring for pets during COVID-19: Results from a large survey of US pet owners. *Animals*, 10(10), 1882. [CrossRef]
- Atherton, G., Edisbury, E., Piovesan, A., & Cross, L. (2023a). ‘They ask no questions and pass no criticism’: A mixed-methods study exploring pet ownership in autism. *Journal of Autism and Developmental Disorders*, 53(8), 3280–3294. [CrossRef]
- Atherton, G., Piovesan, A., & Cross, L. (2023b). Autism, pets, and the importance of seeing human. *Autism Research*, 16(9), 1765–1774. [CrossRef]
- Bao, K. J., & Schreer, G. (2016). Pets and happiness: Examining the association between pet ownership and wellbeing. *Anthrozoös*, 29(2), 283–296. [CrossRef]
- Barcelos, A. M., Kargas, N., Assheton, P., Maltby, J., Hall, S., & Mills, D. S. (2023a). Dog owner mental health is associated with dog behavioural problems, dog care and dog-facilitated social interaction: A prospective cohort study. *Scientific Reports*, 13(1), 21734. [CrossRef]
- Barcelos, A. M., Kargas, N., Maltby, J., Hall, S., Assheton, P., & Mills, D. S. (2021a). Theoretical foundations to the impact of dog-related activities on human hedonic well-being, life satisfaction and eudaimonic well-being. *International Journal of Environmental Research and Public Health*, 18(23), 12382. [CrossRef]
- Barcelos, A. M., Kargas, N., Maltby, J., Hall, S., & Mills, D. S. (2020). A framework for understanding how activities associated with dog ownership relate to human well-being. *Scientific Reports*, 10(1), 11363. [CrossRef]
- Barcelos, A. M., Kargas, N., Maltby, J., & Mills, D. S. (2023b). Potential psychosocial explanations for the impact of pet ownership on human well-being: Evaluating and expanding current hypotheses. *Human-Animal Interactions*, 2023, 8. [CrossRef]
- Barcelos, A. M., Kargas, N., & Mills, D. (2024). The effects of dog behavioural problems on owner well-being: A review of the literature and future directions. *Pets*, 1(1), 53–69. [CrossRef]
- Barcelos, A. M., Kargas, N., Packham, C., & Mills, D. S. (2021b). Understanding the impact of dog ownership on autistic adults: Implications for mental health and suicide prevention. *Scientific Reports*, 11(1), 23655. [CrossRef]
- Barker, S. B., Schubert, C. M., Barker, R. T., Kuo, S. I. C., Kendler, K. S., & Dick, D. M. (2018). The relationship between pet ownership, social support, and internalizing symptoms in students from the first to fourth year of college. *Applied Developmental Science*, 24(3), 279–293. [CrossRef] [PubMed]
- Barker, S. B., & Wolen, A. R. (2008). The benefits of human–companion animal interaction: A review. *Journal of Veterinary Medical Education*, 35(4), 487–495. [CrossRef]
- Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders*, 31(1), 5–17. [CrossRef] [PubMed]
- Beetz, A. M. (2017). Theories and possible processes of action in animal assisted interventions. *Applied Developmental Science*, 21(2), 139–149. [CrossRef]
- Beetz, A. M., Uvnäs-Moberg, K., Julius, H., & Kotrschal, K. (2012). Psychosocial and psychophysiological effects of human-animal interactions: The possible role of oxytocin. *Frontiers in Psychology*, 3, 26183. [CrossRef]
- Bradley, L., & Bennett, P. C. (2015). Companion-animals’ effectiveness in managing chronic pain in adult community members. *Anthrozoös*, 28(4), 635–647. [CrossRef]
- Brooks, H. L., Rushton, K., Lovell, K., Bee, P., Walker, L., Grant, L., & Rogers, A. (2018). The power of support from companion animals for people living with mental health problems: A systematic review and narrative synthesis of the evidence. *BMC Psychiatry*, 18(1), 31. [CrossRef]
- Brumpton, H. L., & Kargas, N. (2026). Perceived benefits and barriers for autistic adults accessing therapeutic horse riding for mental health. *Behavioral Sciences*, 16(1), 84. [CrossRef]
- Burrows, K. E., & Adams, C. L. (2008). Challenges of service-dog ownership for families with autistic children: Lessons for veterinary practitioners. *Journal of Veterinary Medical Education*, 35(4), 559–566. [CrossRef]
- Busch, C., Tucha, L., Talarovicova, A., Fuermaier, A. B., Lewis-Evans, B., & Tucha, O. (2016). Animal-assisted interventions for children with attention deficit/hyperactivity disorder: A theoretical review and consideration of future research directions. *Psychological Reports*, 118(1), 292–331. [CrossRef] [PubMed]
- Byström, K. M., & Persson, C. A. L. (2015). The meaning of companion animals for children and adolescents with autism: The parents’ perspective. *Anthrozoös*, 28(2), 263–275. [CrossRef]
- Capp, S., De Burca, A., Aydin, Ü., Agnew-Blais, J., Lautarescu, A., Ronald, A., Happé, F., & McLoughlin, G. (2024). Depression and anxiety are increased in autism and ADHD: Evidence from a young adult community-based sample. *JCPP Advances*, 5, e70003. [CrossRef] [PubMed]

- Carlisle, G. K. (2014). Pet dog ownership decisions for parents of children with autism spectrum disorder. *Journal of Pediatric Nursing*, 29(2), 114–123. [CrossRef] [PubMed]
- Carlisle, G. K., Johnson, R. A., Wang, Z., Brosi, T. C., Rife, E. M., & Hutchison, A. (2020). Exploring human–Companion animal interaction in families of children with autism. *Journal of Autism and Developmental Disorders*, 50(8), 2793–2805. [CrossRef]
- Carr, E. C. J., Norris, J. M., Alix Hayden, K., Pater, R., & Wallace, J. E. (2020). A scoping review of the health and social benefits of dog ownership for people who have chronic pain. *Anthrozoös*, 33(2), 207–224. [CrossRef]
- Carr, E. C. J., Wallace, J. E., Onyewuchi, C., Hellyer, P. W., & Kogan, L. (2018). Exploring the meaning and experience of chronic pain with people who live with a dog: A qualitative study. *Anthrozoös*, 31(5), 551–565. [CrossRef]
- Cassidy, S., Bradley, L., Shaw, R., & Baron-Cohen, S. (2018). Risk markers for suicidality in autistic adults. *Molecular Autism*, 9, 42. [CrossRef]
- Choi, W., Woo, Y. S., Wang, S., Lim, H. K., & Bahk, W. (2022). The prevalence of psychiatric comorbidities in adult ADHD compared with non-ADHD populations: A systematic literature review. *PLoS ONE*, 17(11), e0277175. [CrossRef]
- Cohen, L., Manion, M., & Morrison, M. (2018). *Research methods in education* (8th ed.). Routledge. [CrossRef]
- Corrêa, G. F., Barcelos, A. M., & Mills, D. S. (2021). Dog-related activities and human well-being in Brazilian dog owners: A framework and cross-cultural comparison with a British study. *Science Progress*, 104(4), 368504211050277. [CrossRef] [PubMed]
- DeLoache, J. S., Pickard, M. B., & LoBue, V. (2011). How very young children think about animals. In P. McCardle, S. McCune, J. A. Griffin, & V. Maholmes (Eds.), *How animals affect us: Examining the influences of human–Animal interaction on child development and human health* (pp. 85–99). American Psychological Association. [CrossRef]
- Denenberg, S., Landsberg, G. M., Horwitz, D., & Seksel, K. (2005). A comparison of cases referred to behaviorists in three different countries. In *Current issues and research in veterinary behavioral medicine* (pp. 56–62). Purdue University Press. Available online: https://www.researchgate.net/profile/Greta-Berteselli/publication/281782239_Evaluation_of_immunological_stress_and_behavioural_parameters_in_dogs_canis_familiaris_with_anxiety-related_disordersProceedings_of_the_5th_International_Veterinary_Behavioural_Meeting_D_Mills_E_Levin/links/5ad5bb01458515c60f54c664/Evaluation-of-immunological-stress-and-behavioural-parameters-in-dogs-canis-familiaris-with-anxiety-related-disordersProceedings-of-the-5th-International-Veterinary-Behavioural-Meeting-D-Mills-E-L.pdf#page=75 (accessed on 15 December 2025).
- Ein, N., Li, L., & Vickers, K. (2018). The effect of pet therapy on the physiological and subjective stress response: A meta-analysis. *Stress and Health*, 34(4), 477–489. [CrossRef] [PubMed]
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39(2), 175–191. [CrossRef] [PubMed]
- Fayyad, J., Sampson, N. A., Hwang, I., Adamowski, T., Aguilar-Gaxiola, S., Al-Hamzawi, A., Andrade, L. H. S. G., Borges, G., de Girolamo, G., Florescu, S., Gureje, O., Haro, J. M., Hu, C., Karam, E. G., Lee, S., Navarro-Mateu, F., O'Neill, S., Pennell, B. E., Piazza, M., . . . Kessler, R. C. (2016). The descriptive epidemiology of DSM-IV adult ADHD in the world health organization world mental health surveys. *ADHD Attention Deficit and Hyperactivity Disorders*, 9, 47–65. [CrossRef]
- Friedmann, E., & Krause-Parello, C. A. (2018). Companion animals and human health: Benefits, challenges, and the road ahead for human-animal interaction. *Revue Scientifique et Technique (International Office of Epizootics)*, 37(1), 71–82. [CrossRef]
- Friedmann, E., & Son, H. (2009). The human–Companion animal bond: How humans benefit. *Veterinary Clinics of North America: Small Animal Practice*, 39(2), 293–326. [CrossRef]
- Garcha, J., & Smith, A. P. (2023). Associations between autistic and ADHD traits and the well-being and mental health of university students. *Healthcare*, 12(1), 14. [CrossRef]
- Gee, N. R., & Mueller, M. K. (2019). A systematic review of research on pet ownership and animal interactions among older adults. *Anthrozoös*, 32(2), 183–207. [CrossRef]
- Gee, N. R., Rodriguez, K. E., Fine, A. H., & Trammell, J. P. (2021). Dogs supporting human health and well-being: A biopsychosocial approach. *Frontiers in Veterinary Science*, 8, 630465. [CrossRef]
- Ghirardi, L., Pettersson, E., Taylor, M. J., Freitag, C. M., Franke, B., Asherson, P., Larsson, H., & Kuja-Halkola, R. (2019). Genetic and environmental contribution to the overlap between ADHD and ASD trait dimensions in young adults: A twin study. *Psychological Medicine*, 49(10), 1713–1721. [CrossRef] [PubMed]
- Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., & Altman, D. G. (2016). Statistical tests, P values, confidence intervals, and power: A guide to misinterpretations. *European Journal of Epidemiology*, 31(4), 337–350. [CrossRef]
- Griffith, G. M., Totsika, V., Nash, S., & Hastings, R. P. (2011). ‘I just don’t fit anywhere’: Support experiences and future support needs of individuals with Asperger syndrome in middle adulthood. *Autism*, 16(5), 532–546. [CrossRef] [PubMed]
- Gullone, E. (2000). The biophilia hypothesis and life in the 21st century: Increasing mental health or increasing pathology? *Journal of Happiness Studies*, 1(3), 293–322. [CrossRef]
- Harwood, C., Kaczmarek, E., & Drake, D. (2019). Parental perceptions of the nature of the relationship children with autism spectrum disorders share with their canine companion. *Journal of Autism and Developmental Disorders*, 49, 248–259. [CrossRef]

- Hawkins, R. D., Hawkins, E. L., & Tip, L. (2021). "I can't give up when I have them to care for": People's experiences of pets and their mental health. *Anthrozoös*, 34(4), 543–562. [CrossRef]
- Hedley, D., & Uljarević, M. (2018). Systematic review of suicide in autism spectrum disorder: Current trends and implications. *Current Developmental Disorders Reports*, 5, 65–76. [CrossRef]
- Herzog, H. (2011). The impact of pets on human health and psychological well-being: Fact, fiction, or hypothesis? *Current Directions in Psychological Science*, 20(4), 236–239. [CrossRef]
- Herzog, H. (2021, May 24). *Women dominate research on human-animal bond*. Psychology Today. Available online: <https://www.psychologytoday.com/us/blog/animals-and-us/202105/women-dominate-research-the-human-animal-bond> (accessed on 4 November 2025).
- Hinshaw, S. P., Owens, E. B., Zalecki, C., Huggins, S. P., Montenegro-Nevado, A. J., Schrodek, E., & Swanson, E. N. (2012). Prospective follow-up of girls with attention-deficit/hyperactivity disorder into early adulthood: Continuing impairment includes elevated risk for suicide attempts and self-injury. *Journal of Consulting and Clinical Psychology*, 80(6), 1041. [CrossRef]
- Hirvikoski, T., Mittendorfer-Rutz, E., Boman, M., Larsson, H., Lichtenstein, P., & Bölte, S. (2016). Premature mortality in autism spectrum disorder. *The British Journal of Psychiatry*, 208(3), 232–238. [CrossRef]
- Hollocks, M. J., Lerh, J. W., Magiati, I., Meiser-Stedman, R., & Brugha, T. S. (2019). Anxiety and depression in adults with autism spectrum disorder: A systematic review and meta-analysis. *Psychological Medicine*, 49(4), 559–572. [CrossRef]
- Horowitz, A., & Hecht, J. (2016). Examining dog-human play: The characteristics, affect, and vocalizations of a unique interspecific interaction. *Animal Cognition*, 19, 779–788. [CrossRef] [PubMed]
- Hossain, M. M., Khan, N., Sultana, A., Ma, P., McKyer, E. L. J., Ahmed, H. U., & Purohit, N. (2020). Prevalence of comorbid psychiatric disorders among people with autism spectrum disorder: An umbrella review of systematic reviews and meta-analyses. *Psychiatry Research*, 287, 112922. [CrossRef] [PubMed]
- Howell, T. J., Bowen, J., Fatjó, J., Calvo, P., Holloway, A., & Bennett, P. C. (2017). Development of the cat-owner relationship scale (CORS). *Behavioural Processes*, 141, 305–315. [CrossRef]
- Howlin, P., & Magiati, I. (2017). Autism spectrum disorder: Outcomes in adulthood. *Current Opinion in Psychiatry*, 30(2), 69–76. [CrossRef] [PubMed]
- Howlin, P., & Taylor, J. L. (2015). Addressing the need for high quality research on autism in adulthood: Autism in adulthood [Special issue]. *Autism*, 19(7), 771–773. [CrossRef]
- Hughes, M. J., Verreynne, M. L., Harpur, P., & Pachana, N. A. (2020). Companion animals and health in older populations: A systematic review. *Clinical Gerontologist*, 43(4), 365–377. [CrossRef]
- Ines, M., Ricci-Bonot, C., & Mills, D. S. (2021). My cat and me—A study of cat owner perceptions of their bond and relationship. *Animals*, 11(6), 1601. [CrossRef]
- Janevic, M. R., Shute, V., Connell, C. M., Piette, J. D., Goesling, J., & Fynke, J. (2019). The role of pets in supporting cognitive-behavioral chronic pain self-management: Perspectives of older adults. *Journal of Applied Gerontology*, 39(10), 1088–1096. [CrossRef] [PubMed]
- Janssens, M., Eshuis, J., Peeters, S., Lataster, J., Reijnders, J., Enders-Slegers, M., & Jacobs, N. (2020). The pet-effect in daily life: An experience sampling study on emotional wellbeing in pet owners. *Anthrozoös*, 33(4), 579–588. [CrossRef]
- Johnson, E. A., Portillo, A., Bennett, N. E., & Gray, P. B. (2021). Exploring women's oxytocin responses to interactions with their pet cats. *PeerJ: Life & Environment*, 9, e12393. [CrossRef]
- Jolliffe, R., Adams, D., & Simpson, K. (2023). Trait anxiety in individuals on the autism spectrum: A systematic review. *Review Journal of Autism and Developmental Disorders*, 10(3), 523–545. [CrossRef]
- Julius, H., Beetz, A., Kotrschal, K., Turner, D., & Uvnäs-Moberg, K. (2013). *Attachment to pets: An integrative view of human-animal relationships with implications for therapeutic practice*. Hogrefe Publishing.
- Kenny, L., Hattersley, C., Molins, B., Buckley, C., Povey, C., & Pellicano, E. (2016). Which terms should be used to describe autism? Perspectives from the UK autism community. *Autism*, 20(4), 442–462. [CrossRef]
- Kerulo, G., Kargas, N., Mills, D. S., Law, G., VanFleet, R., Faa-Thompson, T., & Winkle, M. Y. (2020). Animal-assisted interventions: Relationship between standards and qualifications. *People and Animals: The International Journal of Research and Practice*, 3(1), 4. [CrossRef]
- Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E., Howes, M. J., Jin, R., Secnik, K., & Spencer, T. (2005). The World Health Organization Adult ADHD Self-Report Scale (ASRS): A short screening scale for use in the general population. *Psychological Medicine*, 35(2), 245–256. [CrossRef]
- Kooij, J., Bijlenga, D., Salerno, L., Jaeschke, R., Bitter, I., Balazs, J., Thome, J., Dom, G., Kasper, S., & Filipe, C. N. (2018). Updated European Consensus Statement on diagnosis and treatment of adult ADHD. *European Psychiatry*, 56(1), 14–34. [CrossRef]
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606–613. [CrossRef]

- Lai, M., Kassee, C., Besney, R., Bonato, S., Hull, L., Mandy, W., Szatmari, P., & Ameis, S. H. (2019). Prevalence of co-occurring mental health diagnoses in the autism population: A systematic review and meta-analysis. *The Lancet Psychiatry*, 6(10), 819–829. [CrossRef]
- Landry, O., & Chouinard, P. A. (2019). Why we should study the broader autism phenotype in typically developing populations. In *Building bridges: Cognitive development in typical and atypical development* (pp. 36–47). Routledge. [CrossRef]
- Li, P., Yao, J., Xu, Y., & Zhou, F. (2023). Impact of pet companionship on student development: A meta-analysis. *Best Evidence in Chinese Education*, 14(1), 1727–1743. [CrossRef]
- Lisk, C., Lawson, L. M., & Vaduvathiriyar, P. (2021). The impact of animal exposure for children with ASD: A scoping review. *Review Journal of Autism and Developmental Disorders*, 8(4), 471–481. [CrossRef]
- Love, H. A. (2021). Best friends come in all breeds: The role of pets in suicidality. *Anthrozoös*, 34(2), 175–186. [CrossRef]
- Mayes, S. D., Calhoun, S. L., Mayes, R. D., & Molitoris, S. (2012). Autism and ADHD: Overlapping and discriminating symptoms. *Research in Autism Spectrum Disorders*, 6(1), 277–285. [CrossRef]
- McConnell, A. R., Brown, C. M., Shoda, T. M., Stayton, L. E., & Martin, C. E. (2011). Friends with benefits: On the positive consequences of pet ownership. *Journal of Personality and Social Psychology*, 101(6), 1239–1252. [CrossRef] [PubMed]
- Merkouri, A., Graham, T. M., O'Haire, M. E., Purewal, R., & Westgarth, C. (2022). Dogs and the good life: A cross-sectional study of the association between the dog-owner relationship and owner mental wellbeing. *Frontiers in Psychology*, 13, 903647. [CrossRef]
- Miltiades, H., & Shearer, J. (2011). Attachment to pet dogs and depression in rural older adults. *Anthrozoös*, 24(2), 147–154. [CrossRef]
- National Collaborating Centre for Mental Health. (2012). *Autism: Recognition, referral, diagnosis and management of adults on the autism spectrum*. British Psychological Society. Available online: <https://pubmed.ncbi.nlm.nih.gov/26065067/> (accessed on 8 November 2025).
- O'Haire, M. (2010). Companion animals and human health: Benefits, challenges, and the road ahead. *Journal of Veterinary Behavior*, 5(5), 226–234. [CrossRef]
- Osman, A., Bagge, C. L., Gutierrez, P. M., Konick, L. C., Kopper, B. A., & Barrios, F. X. (2001). The suicidal behaviors questionnaire-revised (SBQ-R): Validation with clinical and nonclinical samples. *Assessment*, 8(4), 443–454. [CrossRef]
- Panagiotidi, M., Overton, P. G., & Stafford, T. (2019). Co-occurrence of ASD and ADHD traits in an adult population. *Journal of Attention Disorders*, 23(12), 1407–1415. [CrossRef]
- Pereira, J. M., & Fonte, D. (2018). Pets enhance antidepressant pharmacotherapy effects in patients with treatment resistant major depressive disorder. *Journal of Psychiatric Research*, 104, 108–113. [CrossRef]
- Pilling, S., Baron-Cohen, S., Megnin-Viggars, O., Lee, R., & Taylor, C. (2012). Recognition, referral, diagnosis, and management of adults with autism: Summary of NICE guidance. *BMJ*, 344, e4082. [CrossRef]
- Purewal, R., Christley, R., Kordas, K., Joinson, C., Meints, K., Gee, N., & Westgarth, C. (2017). Companion animals and child/adolescent development: A systematic review of the evidence. *International Journal of Environmental Research and Public Health*, 14(3), 234. [CrossRef] [PubMed]
- Rai, D., Culpin, I., Heuvelman, H., Magnusson, C. M., Carpenter, P., Jones, H. J., Emond, A. M., Zammit, S., Golding, J., & Pearson, R. M. (2018). Association of autistic traits with depression from childhood to age 18 years. *JAMA Psychiatry*, 75(8), 835–843. [CrossRef]
- Ravenscroft, S. J., Barcelos, A. M., & Mills, D. S. (2021). Cat-human related activities associated with human well-being. *Human-Animal Interaction Bulletin*, 11(2), 79–95. [CrossRef]
- Raymaker, D. M., McDonald, K. E., Ashkenazy, E., Gerrity, M., Baggs, A. M., Kripke, C., Hourston, S., & Nicolaidis, C. (2017). Barriers to healthcare: Instrument development and comparison between autistic adults and adults with and without other disabilities. *Autism*, 21(8), 972–984. [CrossRef] [PubMed]
- Rodriguez, K. E., Herzog, H., & Gee, N. R. (2021). Variability in human-animal interaction research. *Frontiers in Veterinary Science*, 7, 619600. [CrossRef] [PubMed]
- Rong, Y., Yang, C. J., Jin, Y., & Wang, Y. (2021). Prevalence of attention-deficit/hyperactivity disorder in individuals with autism spectrum disorder: A meta-analysis. *Research in Autism Spectrum Disorders*, 83, 101759. [CrossRef]
- Sasson, N. J., Faso, D. J., Nugent, J., Lovell, S., Kennedy, D. P., & Grossman, R. B. (2017). Neurotypical peers are less willing to interact with those with autism based on thin slice judgments. *Scientific Reports*, 7(1), 0700. [CrossRef]
- Schoenfeld-Tacher, R., Hellyer, P., Cheung, L., & Kogan, L. (2017). Public perceptions of service dogs, emotional support dogs, and therapy dogs. *International Journal of Environmental Research and Public Health*, 14(6), 642. [CrossRef]
- Schuck, S. E. B., & Childress, A. (2023). Companion animals in the treatment of ADHD. In N. R. Gee, L. D. Townsend, & R. L. Findling (Eds.), *The Role of companion animals in the treatment of mental disorders*. American Psychiatric Association Publishing.
- Scoresby, K. J., Strand, E. B., Ng, Z., Brown, K. C., Stilz, C. R., Strobel, K., Barroso, C. S., & Souza, M. (2021). Pet ownership and quality of life: A systematic review of the literature. *Veterinary Sciences*, 8(12), 332. [CrossRef]
- Segers, M., & Rawana, J. (2014). What do we know about suicidality in autism spectrum disorders? A systematic review. *Autism Research*, 7(4), 507–521. [CrossRef]

- Septier, M., Stordeur, C., Zhang, J., Delorme, R., & Cortese, S. (2019). Association between suicidal spectrum behaviors and attention-deficit/hyperactivity disorder: A systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews*, 103, 109–118. [CrossRef]
- Serpell, J., McCune, S., Gee, N., & Griffin, J. A. (2017). Current challenges to research on animal-assisted interventions. *Applied Developmental Science*, 21(3), 223–233. [CrossRef]
- Sibley, M. H., Arnold, L. E., Swanson, J. M., Hechtman, L. T., Kennedy, T. M., Owens, E., Molina, B. S. G., Jensen, P. S., Hinshaw, S. P., Roy, A., Chronis-Tuscano, A., Newcorn, J. H., & Rohde, L. A. (2022). Variable patterns of remission from ADHD in the multimodal treatment study of ADHD. *American Journal of Psychiatry*, 179(2), 142–151. [CrossRef] [PubMed]
- Smith, B. (2012). The ‘pet effect’: Health related aspects of companion animal ownership. *Australian Family Physician*, 41(6), 439–442. Available online: <https://pubmed.ncbi.nlm.nih.gov/22675689/> (accessed on 4 November 2025). [PubMed]
- Solmi, M., Song, M., Yon, D. K., Lee, S. W., Fombonne, E., Kim, M. S., Park, S., Lee, M. H., Hwang, J., Keller, R., Koyanagi, A., Jacob, L., Dragioti, E., Smith, L., Correll, C. U., Fusar-Poli, P., Croatto, G., Carvalho, A. F., Oh, J. W., . . . Cortese, S. (2022). Incidence, prevalence, and global burden of autism spectrum disorder from 1990 to 2019 across 204 countries. *Molecular Psychiatry*, 27(10), 4172–4180. [CrossRef] [PubMed]
- Song, P., Zha, M., Yang, Q., Zhang, Y., Li, X., & Rudan, I. (2021). The prevalence of adult attention-deficit hyperactivity disorder: A global systematic review and meta-analysis. *Journal of Global Health*, 11, 04009. [CrossRef]
- Souter, M. A., & Miller, M. D. (2007). Do animal-assisted activities effectively treat depression? A meta-analysis. *Anthrozoös*, 20(2), 167–180. [CrossRef]
- South, M., Beck, J. S., Lundwall, R., Christensen, M., Cutrer, E. A., Gabrielsen, T. P., Cox, J. C., & Lundwall, R. A. (2020). Unrelenting depression and suicidality in women with autistic traits. *Journal of Autism and Developmental Disorders*, 50, 3606–3619. [CrossRef]
- Spitzer, R. L., Kroenke, K., & Williams, J. B. (1999). Validation and utility of a self-report version of PRIME-MD: The PHQ primary care study. *JAMA*, 282(18), 1737–1744. [CrossRef] [PubMed]
- Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, 166(10), 1092–1097. [CrossRef] [PubMed]
- Sugawara, A., Masud, M. M., Yokoyama, A., Mizutani, W., Watanuki, S., Yanai, K., Itoh, M., & Tashiro, M. (2012). Effects of presence of a familiar pet dog on regional cerebral activity in healthy volunteers: A positron emission tomography study. *Anthrozoös*, 25(1), 25–34. [CrossRef]
- Sun, Y., Huang, Z., Xu, S., Wang, Y., Wang, J., Lei, C., Li, W., Wang, Y., Qu, D., & Chen, R. (2024). Suicide risk with ASD traits or ADHD traits in non-clinical young adults. *Humanities and Social Sciences Communications*, 11(1), 1186. [CrossRef]
- Taboas, A., Doepke, K., & Zimmerman, C. (2023). Preferences for identity-first versus person-first language in a US sample of autism stakeholders. *Autism*, 27(2), 565–570. [CrossRef]
- Taylor, M. J., Charman, T., & Ronald, A. (2015). Where are the strongest associations between autistic traits and traits of ADHD? Evidence from a community-based twin study. *European Child & Adolescent Psychiatry*, 24, 1129–1138. [CrossRef]
- Teo, J. T., Johnstone, S. J., Römer, S. S., & Thomas, S. J. (2022). Psychophysiological mechanisms underlying the potential health benefits of human-dog interactions: A systematic literature review. *International Journal of Psychophysiology*, 180, 27–48. [CrossRef]
- Turner, D. C. (2017). A review of over three decades of research on cat-human and human-cat interactions and relationships. *Behavioural Processes*, 141, 297–304. [CrossRef]
- Van Bourg, J., Patterson, J. E., & Wynne, C. D. (2020). Pet dogs (*Canis lupus familiaris*) release their trapped and distressed owners: Individual variation and evidence of emotional contagion. *PLoS ONE*, 15(4), e0231742. [CrossRef] [PubMed]
- Wells, D. L. (2019). The state of research on human–animal relations: Implications for human health. *Anthrozoös*, 32(2), 169–181. [CrossRef]
- Wisdom, J. P., Saedi, G. A., & Green, C. A. (2009). Another breed of “service” animals: STARS study findings about pet ownership and recovery from serious mental illness. *American Journal of Orthopsychiatry*, 79(3), 430–436. [CrossRef]
- Wood, L., Martin, K., Christian, H., Nathan, A., Lauritsen, C., Houghton, S., Kawachi, S., & McCune, S. (2015). The pet factor-companion animals as a conduit for getting to know people, friendship formation and social support. *PLoS ONE*, 10(4), e0122085. [CrossRef] [PubMed]
- Wright, H., Hall, S., Hames, A., Hardiman, J., Mills, R., PAWS Project Team & Mills, D. (2015). Pet dogs improve family functioning and reduce anxiety in children with autism spectrum disorder. *Anthrozoös*, 28(4), 611–624. [CrossRef]
- Yong, M. H., & Ruffman, T. (2014). Emotional contagion: Dogs and humans show a similar physiological response to human infant crying. *Behavioural Processes*, 108, 155–165. [CrossRef] [PubMed]
- Zahid, S., & Upthegrove, R. (2017). Suicidality in autistic spectrum disorders. *Crisis*, 38(4), 237–246. [CrossRef]

- Zalsman, G., & Shilton, T. (2016). Adult ADHD: A new disease? *International Journal of Psychiatry in Clinical Practice*, 20(2), 70–76. [CrossRef]
- Zilcha-Mano, S., Mikulincer, M., & Shaver, P. R. (2012). Pets as safe havens and secure bases: The moderating role of pet attachment orientations. *Journal of Research in Personality*, 46(5), 571–580. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

'He's Practising His Learned Social Skills on the Cat': A Mixed-Methods Investigation of Parental Perspectives of the Role of Pets in Autistic Children's Social Skills and Wellbeing

Claire Wilson ^{1,*}, Carrie Ballantyne ¹ and Roxanne D. Hawkins ²

¹ Division of Psychology and Social Work, School of Education and Social Sciences, University of the West of Scotland, Paisley PA1 2BE, UK; carrie.ballantyne@uws.ac.uk

² Department of Clinical and Health Psychology, School of Health in Social Science, University of Edinburgh, Edinburgh EH8 9AG, UK; roxanne.hawkins@ed.ac.uk

* Correspondence: claire.wilson@uws.ac.uk

Abstract: Evidence suggests that autistic children spend less time engaging in social interactions than their neurotypical peers which can negatively impact their wellbeing. Researchers, educators, and parents must consider how we address this. A possible facilitator of autistic children's social skills and a protective factor for their psychological health is the role of pets and the human–pet bond. The study examined parental reports of autistic children's attachment to their pet (dog or cat), positive and negative behaviours with that pet, and how this relates to prosocial behaviour, peer problems, and psychological health (emotional difficulties, conduct problems, hyperactivity/inattention). Sixty-five parents with an autistic child completed quantitative measures to assess these variables. Participants also completed qualitative questions aimed at understanding their perceptions of the impact of pets on their child. A regression analysis showed that children's positive behaviour towards the pet predicted their prosocial behaviour ($\beta = 0.40$ $p = 0.006$). No other regression models were statistically significant. A thematic analysis of the qualitative responses highlighted four themes in relation to parents' perceptions of the positive impacts of pets on their child. These were (1) *Anxiety, Emotion Regulation, and Sleep*; (2) *Understanding of Self and Other*; (3) *Communication, Friendships, and Social Interactions*; and (4) *Comfort and Psychological Health*. One theme was identified in relation to the negative impact of pets: (5) *Pet-Related Anxiety and Concerns*. The findings have implications which can inform guidelines to help parents make decisions about pet ownership and how to foster meaningful relationships between autistic children and their pets.

Keywords: pets; autism; wellbeing; parental reports

1. Introduction

Autism is a form of neurodivergence that affects 1 in 100 children globally (World Health Organization, 2023). Although autism is heterogeneous in nature, it commonly includes differences in social communication and interaction; repetitive and restrictive behaviours; under- or over-sensitivity to sensory information; strict adherence to routines; highly focused interests; and high anxiety and emotional problems (American Psychiatric Association, 2013). Autistic children have the desire to participate in social interactions but can face difficulties in trying to do so (Frith, 2004). This may be explained by differences in communication styles, given that autistic individuals show highly successful nuanced socio-communicative abilities when among others of a similar neurotype (Crompton et al.,

2020). Thus, autistic individuals may be more socially comfortable with other autistic people rather than neurotypical people, and this can make the initiation and maintenance of social relationships with neurotypical children challenging. Autistic children often spend less time engaging in social interactions and are less likely to initiate social contact with peers (Y. Chen et al., 2021). This is problematic given that negative relationships with peers can impact upon depressive and anxiety symptoms among autistic children (Greenlee et al., 2020). Additionally, McKinlay et al. (2022) found that the perception of ‘not fitting in’ and lack of friendships between autistic children and their peers were related to poor wellbeing.

Research has shown that autistic children score higher on emotional symptoms, peer problems, conduct problems, and hyperactivity (Grasso et al., 2022; Russell et al., 2013; Salayev & Sanne, 2017) and lower on prosocial skills (Wang et al., 2022) than neurotypical children as measured via the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). Evidence has shown that autistic children commonly report feelings of isolation, loneliness, and social anxiety (Dean et al., 2023; Fuentes et al., 2023; Lasgaard et al., 2010). This has a cyclical effect, in that social exclusion leads to symptoms of anxiety and depression, which, in turn, influences the social interactions autistic children have with their peers. Psychosocial interventions, such as Cognitive Behavioural Therapy (Hillman et al., 2020; Kreslins et al., 2015; Spain et al., 2017) and social skills training (Factor et al., 2022; Schohl et al., 2014), have shown promise in breaking this cycle. However, more research is needed to consider how to enhance social relationships and wellbeing among autistic children who may not have access to such programmes. Given that there is increasing interest in home-based interventions in improving the lives of autistic individuals (e.g., Green et al., 2010; Mullan et al., 2021) and the importance of family relationships and the home environment, a possible facilitator of social skills and protective factor for wellbeing is the role of pets and the human–pet bond.

Human–animal interactions (HAIs) research has commonly involved the use of therapy animals, showing the benefit of such animals to autistic people. In experimental settings, HAIs have had positive impacts on autistic children, such as increasing social interactions, socioemotional abilities, communication skills, conversational engagement, eye gaze, and reduced sensory sensitivities and feelings of social isolation (Ang & MacDougall, 2022; Grigore & Bazgan, 2017; London et al., 2020; O’Haire, 2013). Further, Rehn et al. (2023) examined data from seven randomised controlled trials and found that participation in animal-assisted therapy (AAT) resulted in positive trends within cognitive, social, emotional, behavioural, and physical domains for children and adolescents. Such research is promising and shows the benefits of animals to autistic children. However, it should be noted that this work has focused only on therapy animals, with relatively less work examining the role of family pets. Not every family will have the resources or access to AAT programmes, but it is more likely that families have pets. In 2024, the PDSA found that, in the UK, 51% of UK households had pets (28% owned a dog; 24% owned a cat). Findings from the AAT literature may not translate to pets, given that animals involved in AAT are commonly highly trained and the animal is present during a therapeutic intervention only, and so a strong child–animal bond may not be present. There are marked differences between a highly trained therapy animal, in a controlled and predictable environment, and a family pet (Meehan et al., 2017).

Pets are an important part of family life, and children often develop strong bonds to their companion animals, which can facilitate positive developmental outcomes for young people (Goh et al., 2023; Hawkins et al., 2023; Lisk & Lawson, 2024; Mehrotra et al., 2024). Pets can also provide physical and emotional support to humans at times of need (see Shoesmith et al., 2021). Further, N. R. Y. Chen et al.’s (2024) meta-analysis found positive relationships between pet ownership and human pro-sociality. Another positive outcome

is the social-facilitating effects of pets. Pets may act as “social lubricant”, in that they provide a normalising effect and a safe topic of interest and conversation starter for autistic individuals (O’Haire, 2013). Some evidence suggests that parents report benefits of pets to their autistic child’s social skills, such as encouraging positive interactions with others and play behaviours (Carlisle, 2014; Carlisle et al., 2020). One such mechanism through which pets can facilitate socioemotional health benefits is through facilitating parent–child conversations about emotions and mental states (Reider et al., 2023). Byström and Persson (2015) argued that pets can expand social contacts, reduce anxiety, and facilitate learning among autistic children. Hawkins and Williams (2017) showed that pet attachment scores differed depending on pet type and child gender, but that an attachment to a pet can significantly increase the likelihood of increased prosocial behaviours among neurotypical children. Moreover, high-quality child–pet relationships can improve childhood developmental outcomes, including positive mental wellbeing (Kerns et al., 2023a, 2023b). However, it should be noted that research with an adult population has suggested a negative impact of pet attachment on wellbeing (e.g., Ellis et al., 2024b). Although these findings may not generalise to a child sample (for example, Scoresby et al.’s (2021) systematic review suggested a more positive impact of pets on wellbeing for children than adults), the work illustrates the importance of understanding the child–pet relationship and pet-related behaviours rather than simply ownership among autistic children. It should be noted that child–pet relationships should develop under adult supervision to ensure the animal’s needs are being met.

Pets do not automatically play an unequivocal role in every family and to every child. Having a family pet comes with increased costs and responsibilities to meet the animal’s needs. With certain pets, there is a risk of injury, such as dog bites (Schalamon et al., 2006). Children do not always engage in positive interactions with their pets (e.g., can display accidental and intentional harm); such interactions have been associated with poorer child–pet attachments and worse child outcomes, such as increased emotional and behavioural problems and poorer wellbeing (Hawkins et al., 2022, 2023; Wauthier et al., 2022). Further, such behaviours are also likely to have a negative impact on the animal’s physical and psychological wellbeing, which is problematic. It is important to examine the types of interactions that exist between autistic children and their pets due to the possible impact on both the child–pet relationship and child outcomes. Further, studies have focused predominantly on dog ownership, yet cats are the second most common pet within UK families, and emerging research has suggested that high-quality relationships may exist within child–cat dyads (Bould et al., 2018; Muldoon et al., 2019). Thus, it is important to consider children’s relationships and interactions with both dogs and cats to understand how pets may impact upon social outcomes and psychological health for autistic children.

This study examined parental reports of autistic children’s attachment to their pet (dog or cat), positive and negative behaviours with that pet, and how this relates to prosocial behaviour, peer problems, and psychological health (emotional difficulties, conduct problems, hyperactivity/inattention), controlling for sensory sensitivities, through standardised quantitative measures. We hypothesised that parental reports of child–pet attachment and positive child–pet behaviour would be positively related to prosocial behaviour and negatively related to peer problems, emotional symptoms, conduct problems, and hyperactivity. We also expected that parental reports of negative child–pet behaviour would be negatively related to prosocial behaviour and positively related to peer problems, emotional symptoms, conduct problems, and hyperactivity/inattention. This study also aimed to examine qualitative parental responses to understand lived experience of the positive and negative impacts of the child–pet relationship and child–pet interactions for autistic children. This study has significant importance in providing families with valuable insights

into the potential effects of children's relationships with family pets. The findings have implications for developing materials that will equip parents with practical guidelines on fostering meaningful and safe relationships between autistic children and their pets, which could ultimately improve child outcomes while ensuring pet welfare.

2. Method

2.1. Design and Participants

The current study employed a mixed-method, cross-sectional design using an online survey with parent-report-standardised quantitative measures and open-ended questions to collect qualitative responses. Purposive sampling was used, whereby parents with autistic children were recruited through online advertisements on social media, such as posting a flyer and link to the study on Facebook groups for parents with autistic children and groups for pet owners and advertising on X (formerly known as Twitter) with retweets from autism organisations and human–animal research groups. Parents were therefore self-selected and chose themselves whether to participate.

Following data cleaning and the removal of missing data ($n = 18$), the final sample included 65 parents of autistic children. This sample size was appropriate for the intended analyses based on priori power analysis using G* Power (Faul et al., 2009). Parents were aged between 31 and 53 years; the majority ($n = 45$) were married, were from the UK ($n = 55$), and were White/Caucasian ($n = 58$). Children were aged between 5 and 15 years (mean age = 11 years 7 months), and there were 32 girls, 32 boys, and 1 parent chose not to provide this information. Most children ($n = 34$) had one sibling, but some had two ($n = 12$) or more than two ($n = 9$). All but five children had a confirmed autism diagnosis. The age at diagnosis ranged from 3 years to 12 years ($M = 6$ years 9 months). Boys received a diagnosis at a lower average age ($M = 5$ years 9 months) than girls ($M = 7$ years 2 months). Most children ($n = 40$) had received some sort of support or intervention, such as school support, speech and language therapy, or art or play therapy. None of the parents mentioned animal-assisted therapy (AAT) or classroom support dogs.

Most children had an additional clinical diagnosis or difficulty as identified by parents, these included ADHD ($n = 11$), Tourette's ($n = 4$), dyslexia ($n = 4$) and other learning disabilities ($n = 2$), anxiety ($n = 9$), depression ($n = 2$), obsessive–compulsive disorder (OCD) ($n = 3$), post-traumatic stress disorder (PTSD) ($n = 1$), sensory-processing disorders, such as Irlen syndrome, or sensitivities ($n = 8$), development coordination disorders, including dyspraxia ($n = 5$) and cerebral palsy ($n = 1$), fine motor skill issues ($n = 1$), hypermobility ($n = 1$), macrocephaly and demand avoidance ($n = 1$), and attachment issues ($n = 1$).

Dog ownership numbers included one dog ($n = 34$), two dogs ($n = 10$), and four dogs ($n = 1$). Cat ownership numbers included one ($n = 21$), two ($n = 18$), three, or more cats ($n = 2$). A total of 12 children had other types of pets, such as rabbits. If children had both dogs and cats or multiple pets ($n = 41$), they were asked to answer the survey questions based on one pet dog or cat. They were asked to "please select ONE pet to base the rest of your answers on. You may wish to choose the pet that your child is most bonded to, or spends the most time with, or has had the longest". A total of 38 parents based their answers on a child's pet dog, and 27 based their answers on a child's pet cat. The age of pets ranged from 9 months to 18 years. The average age of the child when their parent acquired the pet was 6 years 7 months, with seven children being under 1 year, or the pet was in the family prior to the child's birth. Given the possible impact on pet attachment, 36 parents reported that their child helped to choose the pet, 31 children believed the pet was their own, and 27 parents reported that their child helped to name the pet.

2.2. Procedure

This study was conducted according to British Psychological Society's (BPS) ethical guidance and the Data Protection Act (2018) and was approved by the institutional ethics committee of the host university (approval number: 16542:13819). It is also important to note that the research team was experienced in collecting data from neurotypical samples and was therefore confident in data handling. The online survey was hosted on QuestionPro. At the start of the survey, parents viewed a lay summary of the project and an information sheet before deciding whether to participate. Parents then provided informed consent through an online consent form before being directed to the survey questions. The survey took approximately 20 min to complete. At the end of the survey, parents viewed a debrief form and could opt into a prize draw to win a £20 Amazon voucher.

2.3. Measures

Demographics: Basic demographics of the parent were collected, including age and gender identity, relationship status, country of residence, and race. Basic demographics of the child included child gender and age, number of siblings, autism diagnosis and any other existing clinical diagnosis, age at time of diagnosis, and whether child was/had received any intervention for their autism.

Pet ownership: Basic questions relating to the pet included number of pets, types of pets, pet size (dogs only), pet breed (if known), age of pets, the age of the child during pet acquisition, whether the child helped choose or name the pet, whether the child believed their pet belongs to them, whether the child sleeps with the pet at night time, the amount of time spent with the pet during weekdays and weekends, whether the pet had ever injured the child, and the reason for pet acquisition. Parents were also asked whether their child was responsible for any care-taking duties of the pet (e.g., walking, feeding, grooming, cleaning up after).

Child behaviour toward the pet dog: Parents were asked to report on the observed frequency of their child's behaviour toward their pet. This measure has 29 items with 13 items relating to positive/benign behaviours and 16 items relating to negative behaviours (Arhant et al., 2017; Hawkins et al., 2022). Example items from the positive behaviour subscale are 'speak to the pet', 'leave the pet alone when it is resting', and 'feed the pet'. The negative behaviour subscale includes items for both intentional harm (e.g., 'inflict pain deliberately on the dog'), and unintentional harm (e.g., 'inflict pain accidentally on the pet, e.g., stepping on'). Other example items include 'verbally scold the pet', 'throw objects at the pet', and 'wake the pet when sleeping'. Each item is rated from 1 'never' to 6 'very often', and the average frequency of behaviours for each subscale was calculated with higher scores reflecting more of that behaviour. We found good internal consistency for both the positive ($\alpha = 0.82$) and negative behaviour subscales ($\alpha = 0.81$).

Child-pet attachment: The CENSHARE Pet Attachment Survey (CENSHARE-PAS; Holcomb et al., 1985) is a child self-report measure and so was adapted to be suitable for parents to report on their child's relationship to their pet for the current study. The measure was adapted through minor wording adjustments, such as changing "you talk to your pet as a friend" to 'your child talks to your pet as a friend'. The original measure contains 27 items rated on a 4-point Likert scale from 1 'almost always' to 4 'almost never'. Additional items have been added in recent studies (Hawkins et al., 2022, 2023) to capture missed fundamental aspects of pet attachment, including pets as a safe-haven and pets as a safe-base (e.g., 'your pet helps your child to enjoy exploring new places') and so were also included in the current study. Mean attachment scores are calculated, with higher scores indicating greater attachment. This is a widely used measure for pet attachment that

is suitable for the age range tested. This measure has demonstrated strong psychometric properties and validity. We found high internal consistency of the scale ($\alpha = 0.93$).

Strengths and Difficulties: The SDQ (Goodman, 1997) is a 25-item scale that measures a child's internalising and externalising problems based on children's behaviour and feelings over the past six months and is commonly used as a wellbeing indicator (Goodman et al., 2000). The measure has five subscales: emotional symptoms, conduct problems, hyperactivity, peer problems, and prosocial behaviour. Example items from the emotional symptoms scale are 'Often unhappy, downhearted' and 'Many worries, often seems worried' ($\alpha = 0.83$). Example items for the conduct problems subscale include 'Often has temper tantrums or hot tempers' and 'Often lies or cheats' ($\alpha = 0.62$). Hyperactivity is assessed with items such as 'constantly fidgeting or squirming' and 'easily distracted, concentration wanders' ($\alpha = 0.66$). The peer problem subscale items include 'rather solitary, tends to play alone' and 'has at least one good friend' ($\alpha = 0.56$). Finally, the example items from the prosocial behaviour subscale include 'considerate of other people's feelings' and 'shares readily with other children' ($\alpha = 0.82$). Each item is rated as either 0 'not true', 1 'somewhat true' or 2 'certainly true' (some items are reverse scored), and total scores for each subscale were calculated.

Sensory sensitivities: The Parent-completed Glasgow Sensory Questionnaire (rGSQ-P; Smees et al., 2023) has 24 items that are equally distributed across seven sense domains (visual, auditory, gustatory, olfactory, tactile, vestibular, proprioception). Example items include 'ever complain of bright lights hurting his/her eyes or causing a headache?', 'dislike loud noises?', and 'complain about the labels in clothes and ask for them to be taken out?'. Items are rated from 0 to 4: 'never' to 'always' ($\alpha = 0.92$).

Open-ended questions: Qualitative questions were included for parents to provide more details about their child's relationship and interactions with the pet. These questions focused on the perceived positive and negative impacts of the child–pet relationship. Parents were asked, 'Do you think that your pet dog or cat has had any positive impacts on your child, particularly in relation to their autism?' and 'Do you feel that your pet dog or cat has had any negative impacts on your child, particularly in relation to their autism?'.

2.4. Data Analysis

Frequencies were calculated to explore children's pet responsibilities, co-sleeping behaviour, and pet-related injuries. A Multiple Analysis of Variance (MANOVA) was then conducted to determine mean differences in scores for pet-positive and -negative behaviours, pet attachment, and each subscale of the SDQ as a result of dog or cat ownership. A correlational analysis was conducted to understand relationships between the study variables. Based on these correlations, hierarchical multiple regression analysis was then carried out to examine predictive validity of (1) pet-positive behaviour on children's prosocial behaviour while controlling for the child's age, gender, and sensory sensitivity and (2) pet attachment and positive pet behaviour on children's emotional problems while controlling for the child's age, gender, and sensory sensitivity. All assumptions of regression were met.

Finally, Braun and Clarke's (2006, 2013) process of thematic analysis was used to analyse the responses to the open-text questions. This approach involves (1) familiarisation of the data through reading and re-reading the data; (2) producing initial codes; (3) searching for themes in the codes; (4) reviewing and editing themes; (5) naming and defining 'themes' into easily understood concepts; (6) reporting data. Themes were identified based on their relevance to the research questions and if they occurred commonly across all participants.

3. Results

3.1. Descriptive Statistics for Pet Responsibilities, Co-Sleeping, and Pet-Related Injuries

The majority of parents reported that children were responsible for some of the caregiving duties of their pet (see Table 1).

Table 1. Frequencies for children’s pet responsibilities split by pet type.

Responsibilities	Walking	Feeding	Grooming	Clean Up After	All Duties	Most Duties	Some Duties	None
Dog owners (n = 38)	14	13	9	7	0	4	28	6
Cat owners (n = 27)	n/a	9	2	1	0	1	17	9

Sleeping with the pet overnight: Five parents reported that their child slept with their pet dog every night, and some reported that the dog slept on the bed most (n = 5) or some of the time (n = 11). Four parents reported that their child slept with their pet cat every night, and some reported that the cat slept on the child’s bed most (n = 5) or some (n = 12) of the time.

Pet injuries to child: Five parents reported that their pet dog had previously injured the child. Details provided highlighted that these incidents were mostly puppy bites or scratches or were accidents such as when playing. One parent mentioned their dog gave their child ‘a warning nip’, one mentioned that the dog was ‘too rough’ and ‘over excited’ with the child, and one parent mentioned that their dog had ‘snapped’ at their child. Six parents reported that their pet cat had previously injured their child. Details provided highlighted that these injuries were mostly scratches and bites; one parent reported that their cat ‘lashes out’ when over petted or handled by the child.

3.2. Differences in Variables According to Pet Type

The MANOVA was conducted to determine whether scores on pet attachment, pet-positive and -negative behaviour, social inclusion variables (peer problems and prosocial behaviour), and psychological health (emotional symptoms, conduct problems, hyperactivity/inattention) differed as a result of owning a pet cat or dog. Results showed that mean scores were not significantly different as a result of pet type ($F(14, 39) = 1.56, p = 0.131$, Wilks’ $\Lambda = 0.64$). We therefore chose not to separate the data by pet type during further analysis.

3.3. Descriptive Statistics and Correlations Between Pet Attachment, Child–Pet Behaviour, and Child Outcomes

Means, standard deviations, and bivariate correlation coefficients for the scales used in the study are presented in Table 2. Pet attachment was positively correlated with positive (large effect) and negative child–pet behaviours (small effect); the more attached the child was to the pet, the more likely they were to engage in both positive and negative behaviours with the pet. Pet attachment was also positively correlated with emotional problems (medium effect) and sensory sensitivities (medium effect); children with higher pet attachment were more likely to have more emotional problems and sensory sensitivity. Pet attachment was also correlated with gender (small effect). Given the way this variable was coded, this result suggests that girls had higher attachment to their pet than boys. Positive pet behaviour was positively correlated with prosocial behaviour (medium effect) and emotional problems (small effect); children who engaged in positive behaviours with their pet scored higher in prosocial behaviour but also higher in emotional problems. Negative pet behaviour was only positively correlated with sensory sensitivity (medium effect), suggesting that children with higher sensory sensitivities also exhibited more negative behaviours towards their pet. No other significant correlations were found in relation to

pet attachment, pet behaviours, and internalising and externalising symptoms. It should be noted though that sensory sensitivity was positively correlated with hyperactivity (medium effect), conduct problems (medium effect), and emotional problems (medium effect). Based on these findings, regressions were carried out to further examine predictors of prosocial behaviour and emotional symptoms, given that these variables show relationships with certain pet-related variables.

Table 2. Mean (and standard deviation) scores for measured variables.

	Attch	Pet_p	Pet_n	Proso	Peer	Hyper	Emot	Cond	Sens	Age	Gend	Mean	SD
Attch		0.77 ***	0.27 *	0.17	0.13	−0.07	0.31 *	0.17	0.38 **	0.03	−0.27 *	123.77	28.42
Pet_p			0.39 **	0.31 *	0.11	0.03	0.29 *	0.12	0.24	−0.08	−0.22	53.60	11.42
Pet_n				−0.01	0.17	0.09	0.03	0.14	0.37 **	−0.18	−0.24	27.95	9.13
Proso					0.04	−0.34 *	0.06	−0.20	−0.13	−0.15	0.12	10.48	2.70
Peer						−0.11	0.20	0.07	0.16	−0.01	−0.14	10.42	1.55
Hyper							0.00	0.33 *	0.31 *	0.10	−0.20	11.76	2.30
Emot								0.10	0.31 *	−0.09	−0.19	11.31	1.97
Cond									0.46 ***	0.14	0.16	8.19	1.47
Sens										−0.07	−0.18	67.78	12.54
Age											0.19	11.79	7.75
Gend													

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; Age = child's age; Gend = child's gender; Attch = pet attachment; Pet_p = pet-positive behaviour; Pet_n = pet-negative behaviour; Proso = prosocial behaviour; Peer = peer problems; Hyper = hyperactivity; Emot = emotional problems; Cond = conduct problems; Sens = sensory sensitivity.

3.4. The Predictive Role of Positive Child–Pet Behaviour on Children's Prosocial Behaviour

Hierarchical multiple regression was used to examine the predictive role of positive child–pet behaviour on children's prosocial behaviour while controlling for the child's age, gender, and sensory sensitivity. Age, gender, and sensory sensitivity were added at Step 1. Pet-positive behaviour was then added at Step 2.

The model was not significant at Step 1 ($R^2 = 0.06$ $p = 0.415$), suggesting that age, gender, and sensory sensitivity were not predictive of the child's prosocial behaviour. Despite this, the model becomes significant at Step 2 with the inclusion of pet-positive behaviour ($R^2 = 0.202$ $R^2_{\text{Change}} = 0.14$ $p = 0.006$). Pet-positive behaviour was a significant predictor of prosocial behaviour ($\beta = 0.40$ $p = 0.006$). Children who engaged in more positive behaviour with their pet were more likely to demonstrate more prosocial behaviour, as reported by their parents. See Table 3.

Table 3. Pet-positive behaviour as a predictor of prosocial behaviour.

Step and Predictors	R^2	R^2_{Change}	F_{Change}	β	p
Step 1	0.06	0.06	0.97		
Age				−0.20	0.187
Gender				0.16	0.277
Sensory				−0.07	0.611
Step 2	0.20	0.14	8.30 **		
Age				−0.19	0.170
Gender				0.24	0.096
Sensory				−0.15	0.287
Pet_P				0.40 **	0.006

** $p < 0.01$; Pet_P = pet-positive behaviour.

3.5. The Predictive Role of Positive Child–Pet Behaviour and Pet Attachment on Children's Emotional Problems

Hierarchical multiple regression was next used to examine the predictive role of positive child–pet behaviour and pet attachment on children's emotional problems while

controlling for the child's age, gender, and sensory sensitivity. Age, gender, and sensory sensitivity were added at Step 1. Pet-positive behaviour and pet attachment were then added at Step 2.

The model was not significant at Step 1 ($R^2 = 0.12$ $p = 0.104$) or Step 2 ($R^2 = 0.17$ $p = 0.302$), suggesting that pet-positive behaviour and pet attachment were not predictive of children's emotional problems, as reported by their parents. See Table 4.

Table 4. Pet-positive behaviour and attachment as predictors of emotional problems.

Step and Predictors	R^2	R^2_{Change}	F_{Change}	β	p
Step 1	0.12	0.12	2.17		
Age				−0.04	0.781
Gender				−0.13	0.359
Sensory				0.29	0.045
Step 2	0.17	0.05	1.23		
Age				−0.05	0.720
Gender				−0.09	0.547
Sensory				0.22	0.151
Pet_P				0.10	0.662
Pet_Attch				0.15	0.516

Pet_P = pet-positive behaviour; Pet_Attch = pet attachment.

3.6. Qualitative Analysis of Open-Text Questions

Thematic analysis was used to analyse the responses to the open-text questions. Four themes were identified in relation to parents' perspectives of the positive impacts of pets on their child. These were (1) anxiety, emotion regulation and sleep; (2) understanding of self and other; (3) communication, friendships, and social interactions; and (4) comfort and psychological health. In relation to negative impacts, it should be noted that 31 participants reported that there was no negative impact of pet ownership on their child. Despite this, one additional theme was identified around negative impacts: (5) pet-related anxiety and concerns. All themes are discussed below.

3.6.1. Theme 1: Anxiety, Emotion Regulation, and Sleep

It was commonly reported by parents that pet dogs and cats greatly helped children to regulate their emotions and feel calmer; this also helped to settle children at bedtime, helping them to feel 'safe and secure', thus improving their sleep quality. For example, children liked having pets within the bedroom at night or shortly before sleeping:

'Our cat helps my son to settle at night when she lies on his bed. She makes him feel safe'
(Participant 2)

'[Pet] helps [Child] to settle at night when she is in bed. [Child] struggles to sleep but feels better when [Pet] is near to her' (Participant 25)

Dogs and cats were reported to be a calming presence throughout the day too and, importantly, helped children to regulate their emotions and reduce 'meltdowns', such as through physical touch and affection, and a pet's relaxed behaviour was reflected upon the child:

'When my son is having a meltdown, the dog will come over and just lay with him and help him calm down' (Participant 59)

'Our dog is very relaxed when my daughter needs to cuddle her which helps her regulate and calm down' (Participant 65)

'When he is emotionally struggling or in meltdown he seeks the dog. The dog also comes over to him if he has had to be removed from a situation and calms him' (Participant 49)

Physical touch and proximity were also important for sensory stimulation for autistic children, offering an outlet for sensory needs:

‘[Child] craves sensory input so stroking the cat helps him to calm down and he enjoys her kneeding and purring. He would rather sit on the floor than move her from his chair when she’s sleeping, he doesn’t want to upset her. It shows real care and affection and that he cares about her feelings. More than he would most humans! He is very protective of her’ (Participant 44)

One caregiver mentioned that their cat provided ‘pressure therapy’, lying on a child’s body, helping them to regulate. Caregivers reported on their dog and cats’ ability to understand and respond to their child’s emotions, such as placing a paw on the child’s body when they are upset, sitting nearby, or lying next to, or close to, the child, seemingly to comfort them. Children were reported to confide in their pets when upset or worried, such as cuddling them, and were reported to talk to their pet about their worries, rather than going to a human family member. Children often accepted comfort from their pet even when they refused comfort from their caregiver.

3.6.2. Theme 2: Understanding of Self and Other

Important cognitive processes seemed to be involved in child–pet relationships, such as a child learning about their own emotions and feelings through understanding their pet’s needs and feelings, for example, pets also missing caregivers when they are away, pets also needing ‘alone time’, and pets also experiencing sensory overload:

‘We do a lot of social modelling with him. So for example our daughter has very high anxiety and leaving the house can be very difficult and being out of her safety zone. If I am away from the house our dog really misses me, and so does she, but she can comfort our dog and reassure him and in so doing is comforting herself and able to rationalize that I am coming back via helping out dog’ (Participant 4)

‘I think it helps her understand that people want and think different things’ (Participant 15)

‘He’s [child] very sensitive and understanding to the dog. And feels like they are very similar, in that the dog gets sensory overload just like him. So they almost have an understanding and he has developed a lot of patience for him’ (Participant 44)

The above quotes demonstrate how a pet can help a child understand their own feelings. Examining parental reports highlights that pets could also aid children’s development of theory of mind, that others have their own thoughts, wants, and needs. This in turn also helped children to gain both understanding and patience. It was also highlighted that pets helped children to understand irritation and arousal, as well as unpredictability, given that pet care is not always predictable. Pets also provided children with a caregiving role and sense of responsibility and accountability:

‘Learning to care for an animal and manage something that’s not always predictable’ (Participant 41)

3.6.3. Theme 3: Communication, Social Interactions, and Friendships

Caregivers reported that pets were helpful in aiding difficult conversations with their autistic child, being a safe and neutral being that they could ‘talk through’, therefore improving family communication:

‘We always talk ‘through’ our dog quite often especially about things that might be hard to discuss directly’ (Participant 4)

‘My daughter has created an alter ego for the cat through which she finds communicating easier’ (Participant 64)

Pets provided a comforting presence at home for the family, reducing the pressure for the child to speak in family situations. Pets facilitated ‘fun’ conversations between family members, such as creating an ‘alter ego’ for their pet and ‘giving them a voice’, which improved happiness for the whole family.

‘Our family have created a voice/alter ego for the dog so we have pretend conversations which makes everyone laugh’ (Participant 65)

Pets helped autistic children to communicate with others (e.g., other dog walkers), helping them practice ‘small talk’ and ‘niceties’, with pets being a safe and neutral topic of conversation. Having a shared interest empowered children to initiate interactions with others:

‘She meets other dog walkers and talks to them, practising social small talk and niceties. Gives her confidence when out and about to acknowledge others’ (Participant 33)

‘The pet also gives him something to talk about and tell people about which has made some social interactions easier for him’ (Participant 62)

Children could then practice these social skills at home when talking to their pet: *‘Can see he’s practicing his learned social skills on the cat’ (Participant 50)*. Pets also helped to improve autistic children’s confidence when communicating with others, with caregivers reporting that their child may have difficulties with conversation without the pet but has increased confidence communicating in the presence of their pet:

‘It has helped her in social situations to have a topic to talk about and she is more confident in new situations if the dog is with us’ (Participant 47)

Pets also helped children to interact with those who also have pets due to a shared common interest; pets therefore facilitated social interactions:

‘Our dog has had a huge positive impact on our son. He helped to train him, and he says regularly how much our dog helps him talk to people with a common interest’ (Participant 11)

Pets not only facilitated conversation but were viewed as sources of a friendship themselves, especially for children who were socially isolated:

‘He [the pet] is her best friend, she struggles interacting with children’ (Participant 8)

‘The cat is her special friend, they do have a bond’ (Participant 14)

‘He is a constant companion even when her friends aren’t being friends’ (Participant 17)

The stability and consistency of a pet’s friendship along with unconditional and non-judgmental aspects of a child–pet relationship were important, particularly for those who felt socially excluded and judged for being ‘different’:

‘...the unconditional love of his dog has done wonders for him when he has felt different, excluded, and bullied. His dog will never judge him and he has an adorable relationship with her. She is his constant friend’ (Participant 10)

3.6.4. Theme 4: Comfort and Psychological Health

Pets aided psychological wellbeing through ‘brightening mood’ when a child is feeling low and through providing a sense of comfort, particularly when a child is experiencing negative emotions, being reported to be attuned and responsive to a child’s emotional cues:

‘He instinctively goes to her when she is upset or sad and cuddling him is very comforting’ (Participant 4)

‘Provides comfort when he is upset. Amazingly doesn’t run off scared when he is crying but approaches and sits near. Sits on the landing outside the bedroom door like a guard dog at bedtime, even though she’s a cat’ (Participant 56)

These accounts also reflect the strong emotional bond that exists between children and their pets. Further accounts demonstrate the strong emotional bond that can develop between a child and their pet:

‘Our son is our dog’s favourite human. He plays with her better than any of the rest of the family do because he is properly invested in it. His affection towards her is utterly sincere. Because he is her favourite human she recalls to him brilliantly’ (Participant 38)

Further, pets provide a comforting presence, providing emotional support without the child feeling pressured to communicate:

‘The pet provides a comforting presence without the pressure to speak as my son often feels when around people’ (Participant 62)

This is also supported by data which showed that parents reported that their child would choose to talk to and confide in their pet over another family member:

‘When she was too sad to talk to any of us, she always would tell the dog what was wrong’ (Participant 35)

‘My child struggles with conversations, but not with the dog’ (Participant 48)

‘My son will confide how he is feeling to the dog and talk through what is happening’ (Participant 59)

In addition, improved confidence and self-esteem was noted, for example: *‘She [cat] improves self-esteem when she chooses to be with him [son]’* (Participant 36); being ‘chosen’ by the pet over other people enhanced feelings of self-worth. In relation to mental health, it was also noted by one parent that their dog *‘Saved her [the child’s] life by alerting us when she tried to commit suicide’* (Participant 33). Thus, the pet knew when something was wrong and how to alert parents to this, demonstrating how impactful the human–pet bond can be and how attuned and responsive to human emotions dogs can be. Parents reported that pets helped children to deal better with transitions (e.g., from home to school) and to establish and maintain routines, which can promote positive wellbeing and coping ability:

‘In the mornings, he [cat] comes and wakes her at the same time every day, which helps with her routine’ (Participant 64)

‘Walking the dog gives her a way to transition from school to home’ (Participant 33)

‘Leaving the house for activities that are not routine (i.e., going to school), are likely to cause [child] to become anxious and taking the dog reduces his anxiety and his behaviour, which is much easier on the rest of the family’ (Participant 57)

Similarly to neurotypical studies (Shoesmith et al., 2021), parents also reported that the presence of pets increased physical activity, increased confidence in leaving the house, and increased enjoyment for participating in family walks and exploring new places; this was mostly relevant for dog owners:

‘Child didn’t like leaving the house or physical exercise but now they have a dog she loves going for long walks’ (Participant 47)

‘I feel like he’s more confident and relaxed, he laughs and giggles when we are on walks and preferred them when it’s for the dog’ (Participant 51)

‘She also helps my child to be confident and happy to explore new places, if we didn’t have the dog, she wouldn’t go’ (Participant 61)

3.6.5. Theme 5: Pet-Related Anxieties and Concerns

This theme concerns parents’ reports that, in certain contexts, their child worries and has anxieties about their pet and relates to parental concerns regarding child–pet

interactions. For example, it appeared common for children to have separation anxiety when away from home and not with their pet:

'The only concern is that she [child] is so attached to him [pet] that going on holiday without him is really hard but we have managed that situation with lots of preparation and having him looked after by close friends who can keep us in contact with how he's doing' (Participant 4)

'She misses her a lot when away from home' (Participant 25)

'Sometimes she worries about the dog if they are separated' (Participant 19)

Negative emotions were often expressed in the absence of a pet, which may be explained by the importance of the pet for the child's emotional regulation, comfort, and companionship as described above. A child's worries and anxieties were often in relation to a pet's health, safety, and wellbeing, and such concerns negatively impacted upon a child's wellbeing:

'Makes him anxious if the cat isn't in the house when he goes to bed' (Participant 7)

'If she [pet] hurts herself, he [child] can really worry' (Participant 10)

'I do worry about when pet dies how this will affect son and how he will cope as they are so close' (Participant 30)

'Once the cat went missing and my child was beyond distraught. We were really concerned for their [child's] wellbeing' (Participant 63)

Parents also expressed concerns regarding child–pet interactions and reported that pet care was sometimes 'too much' for the child.

'He loves dog like a brother and worries for him. He struggles with remembering to play with him, but they are always close to each other either' (Participant 30)

'The responsibility of having to care for her and walk her is too much sometimes' (Participant 42)

Pets could sometimes negatively impact a child due to sensory sensitivity:

'The new puppy is quite barky so as our son has noise sensitivity with his ASD he finds the barking difficult' (Participant 20)

'Sometimes if they [Pet] are dirty or smell she [Child] doesn't like it' (Participant 15)

Although sensory stimulation from a pet was often perceived as positive, this was also described by parents as sometimes 'excessive', impacting upon a pet's welfare, along with interactions that were too 'rough' that could harm the animal:

'Tactile seeking made it very difficult in the first few months as my daughter found it hard to leave the kittens alone' (Participant 26)

'It has been hard for my daughter at times to understand that the dog doesn't always want attention. At the beginning she used to get very upset about it. Especially on the occasions he has given her a warning growl, it has triggered meltdowns' (Participant 47)

4. Discussion

This study investigated parental reports of autistic children's attachment to their pet (dog or cat), positive and negative behaviours with that pet, and how this relates to prosocial behaviour, peer problems, and psychological health (emotional difficulties, conduct problems, hyperactivity/inattention). Specifically, we hypothesised that parental reports of child–pet attachment and positive child–pet behaviour would be positively related to

prosocial behaviour and negatively related to peer problems, emotional symptoms, conduct problems, and hyperactivity. The first hypothesis was partially upheld. We found that children who engaged in more positive behaviours with their pet were more likely to demonstrate more prosocial behaviour. However, we did not find that child–pet attachment and positive child–pet behaviour were related to aspects of psychological health. No other hypotheses were supported. This study also examined qualitative parental responses to understand lived experience of the positive and negative impacts of the child–pet relationship and child–pet interactions for autistic children. Five themes were identified, which help to better situate the quantitative results.

Our findings demonstrated a positive association between positive pet behaviour and prosocial behaviour among autistic children, as reported by their parents. This supports and extends previous works, which found a relationship between pet ownership and prosocial behaviour among neurotypical children (N. R. Y. Chen et al., 2024; Christian et al., 2020). Our study suggests that in addition to pet ownership, it is important to consider the types of behaviour that the child engages in with the pet (e.g., positive vs. negative behaviours). Our qualitative findings further support this assertion by showing that engaging in caring behaviours with the pet (under parents' supervision) can give the child a sense of responsibility and accountability. In addition, we found that pets can help autistic children understand the needs, thoughts, and feelings of others. This may provide an explanation for the quantitative relationship between pet-positive behaviour and prosocial behaviour, in that pets help autistic children act in line with others' needs. Research has suggested that autistic individuals can find it difficult to recognise others' mental states (i.e., cognitive empathy; Fatima & Babu, 2024; Kimmig et al., 2024; Shalev et al., 2022; Sönmez & Jordan, 2024; Vilas et al., 2021), and, thus, caring for a pet may allow children to practice this skill. Future research is needed which examines the relationship between autistic children's pet behaviour, cognitive empathy, and prosocial behaviour.

Interestingly, parents' reports of their child's attachment to the pet were not related to prosocial behaviour. Previous research has found links between neurotypical children's pet attachment and prosocial behaviour (Hawkins & Williams, 2017; Li, 2022), suggesting that the impact of pet attachment upon prosocial behaviour may be different for autistic children. More research is needed to further examine the nature of autistic children's pet attachments and how this relates to behaviour.

Our quantitative findings also indicated no significant relationships between pet attachment/behaviours and the child's peer problems. Thus, parents' reports of the child's pet bond or pet-related behaviours did not impact upon reports of their relationships with peers. In contrast, Kerns et al. (2017) found that for neurotypical children, being closer to their pet was related to higher quality relationships with peers and less conflict. Our finding is interesting when considered in the context of the qualitative responses. The *Communication, Social Interactions, and Friendship* theme suggested that parents believed that pets enhanced interaction opportunities for their child. This supports previous research which has argued that pets can act as a 'social lubricant' for autistic children and encourage positive interactions with others (Carlisle, 2014; Carlisle et al., 2020; O'Haire, 2013). However, having a positive social interaction does not automatically create a friendship between individuals (Carrier, 1999). Thus, although autistic children may experience more interactions because of the pet, it cannot be assumed that this will correlate with friendships or lack of peer problems.

It should be noted though that within the *Communication, Social Interactions, and Friendship* theme was the acknowledgement that pets were seen as an alternative to friends. Some children were reported to trust the pet more than humans and viewed the pet as a friend who had unconditional love for them. Animals can be viewed as easier to create

bonds with, given their non-judgemental nature, availability, and unconditional support. Thus, some children may form such a close bond with the pet that their social needs are saturated and therefore feel less of a desire to bond with humans. Although pets may not address the child's peer problems, pets can provide the child with a different kind of companionship. Indeed, within the *Comfort and Psychological Health* theme, it was noted that children often chose to confide in the pet over a human and liked their pet's presence without the pressure to speak. This supports research with autistic adults that has found animals can provide an alternative way to experience social interaction that was free from the stressors involved in human contact (Atherton et al., 2023). It also supports O'Haire et al.'s (2015) hypothesis that pets act as a social buffer against the effects of stress.

In relation to psychological health, our quantitative results showed no relationships between parents' reports of their child's pet attachment/behaviour and emotional difficulties. Some previous research has found positive relationships between these variables in both autism and neurotypical samples (Byström & Persson, 2015; Kerns et al., 2023a, 2023b). It should be noted though that Grandgeorge et al. (2012) found that the benefit of pet ownership to emotional difficulties came in the initial stages of having the pet in an autistic population. Therefore, it seems if the pet was in the household for many years, the same benefit may not be found, as compared to those who recently acquired a pet. It is also unclear how long these benefits remained after the pets' arrival. This is further supported by a recent study which found that the benefits of pet ownership for wellbeing may be more likely within the initial stages of ownership among a neurotypical sample (Ellis et al., 2024a). In our study, the average age of the children was 11 years and 7 months, whereas parents reported the average age of the child when acquiring the pet was 6 years and 7 months. Thus, the lack of relationship between pet variables and emotional problems may be a result of length of time the family have had the pet. Future studies could therefore examine pet ownership duration and wellbeing benefits within the autistic population.

Despite this, the qualitative findings suggest a contradictory argument. For example, the *Anxiety, Emotion Regulation, and Sleep* theme represented parental beliefs that pet dogs and cats help their children's emotional regulation, feelings of calmness, reduced 'meltdowns', and helped sleep. This aligns with research recruiting neurotypical children (Yu, 2024). Our finding is important, given evidence that has shown that autistic children have difficulties with emotional self-regulations, such as emotion management, response inhibition, and delaying gratification (American Psychiatric Association, 2013; Baron et al., 2006; Laurent & Gorman, 2018). Further, Konstantareas and Stewart's (2006) work has demonstrated that autistic children tend to show less frequent use of effective emotion-regulation strategies than neurotypical children. Through the lens of emotion-regulation theories, pets can help children manage their emotions and understand irritation, arousal, and others' thoughts. Our *Comfort and Psychological health* theme also suggested that pets aided psychological wellbeing through 'brightening mood' when a child was feeling low and through providing a sense of comfort. In addition to this, parents also stated that pets can enhance children's confidence, self-esteem, and physical activity. A key mechanism commonly reported in the qualitative data here was the important role of physical touch and affection from pets, which aligns with previous work (e.g., Young et al., 2020). Further, our findings support that of Hawkins et al. (2024), who found that pets are attuned to neurotypical children's emotional cues. One parent within our sample explained how the pet dog had alerted them to their child's suicide attempt. Related to this and in support of previous research (e.g., Reider et al., 2023) is our finding within the *Communication, Interaction, and Friendship* theme that pets were helpful in aiding difficult conversations with their autistic child, being a safe and neutral being that they could 'talk through'.

What should be noted though is that the *Pet-related Anxieties and Concerns* theme reported on parental concerns that their pet may cause their child to experience separation anxiety and worry around the pet's health and safety. Further, although some parents reported a positive impact of sensory stimulation from a pet, others believed this could have a negative impact upon their child due to their sensory sensitivity. Further, other parents noted that at times when the pet did not want to play or want affection, this could cause distress for their child. This suggests a complex relationship between autistic children's pet relationship and wellbeing/emotional problems, whereby the pet can reduce some anxieties while increasing other types of anxiety. Such nuances may have been missed by the quantitative measures used in this study. Future research should take this into account when considering the impact of pets on autistic children's wellbeing. Research also needs to consider this from a pet welfare perspective. For example, insights on how parents ensure both the child's and the pet's need are met is needed.

Our study found no relationships between pet variables and conduct problems or hyperactivity. Although Christian et al. (2020) found that pet ownership was associated with poorer outcomes relating to neurotypical children's attention span and ability to complete tasks, there is limited research focusing on this. Given that our qualitative findings suggested that pets enhance autistic children's feelings of calmness and comfort, it is surprising that this has not been shown in these quantitative measures and is thus an area for future research.

We also found that none of the psychological wellbeing variables were associated with negative behaviours towards the pet. Further, descriptive data demonstrated that the mean score for negative pet behaviours was much lower than pet-positive behaviours. Thus, parents were more likely to report that their child engaged in caring behaviours rather than harmful behaviours (intentional or unintentional) towards their pet. From an animal welfare perspective, this is a positive finding, which suggests that autistic children are more engaged in positive than negative behaviours with their pet. However, it should be noted that one participant qualitatively reported that their dog would give the child a 'warning growl' when they needed space. This was the exception though as no other parent qualitatively reported child behaviours which suggested the child caused harm to the pet. Such a finding should be considered in line with a previous work, which suggested that children and animals can have a great impact upon each other's lives (Hawkins & Williams, 2017). Future research is needed which also focuses on pets' wellbeing.

5. Implications

This study has significant importance in providing families with valuable insights into the potential effects of autistic children's relationships with family pets. The findings have implications for developing practical guidelines which will help parents make the decision as to whether to bring a pet into the family as well as how to foster meaningful and safe relationships between the pet and their autistic child. For example, parents should allow and support their child to take on a caring role with the pet to enhance children's feelings of responsibility and accountability. This may have a positive impact upon their child's understanding of others and on their prosocial behaviour. Further, it is important that parents understand the impact of sensory stimulation. This will be beneficial to some autistic children's wellbeing while being less important or perhaps detrimental to others. The pet's wellbeing must also be closely monitored during child–pet interactions to support pet welfare and to reduce risk of harm. Parents must also understand the impact of pet health and separation anxiety on the child's wellbeing. Pets may enhance the child's confidence, physical activity, and social interactions, but parents should not automatically assume this will translate into increased friendships for their child. Despite this, our

findings suggest that a family pet can foster communication about difficult topics with the child and family members. Such recommendations will allow families with an autistic child to enjoy a pet while having a positive impact on child outcomes.

6. Limitations

Possible limitations of the study should be acknowledged. Self-report questionnaires may increase the likelihood of measurement bias and socially desirable responding (Campbell & Fiske, 1959). However, Podsakoff et al.'s (2003) procedural remedies were used to minimise this risk. Participants used the full range of response options, which increased our confidence in the validity of the results. Although there are benefits to online research, it must be acknowledged that there was potential for self-selection bias (Bethlehem, 2010). The findings should be considered in light of this. Another limitation relates to our measure of psychological health. Firstly, some of the SDQ sub-scales showed low internal consistency (e.g., peer problems $\alpha = 0.56$, conduct problems $\alpha = 0.62$). In addition, our qualitative findings suggested the need to use a measure which may consider different types of child anxieties. This is an area for future research. Related to this point was the cross-sectional nature of our study, and thus, we were not able to track the impact of pets and pet attachment over time. Our findings suggest the need for longitudinal research which examines how the child–pet bond and behaviours are related to child outcomes over time. Further, despite the favourable notion of investigating parental reports, some research has suggested parent and child viewpoints may differ when asked about specific topics (Hou et al., 2020). It would be useful for future research to also include child reports and behavioural observations. It would also be useful for future research to consider the socio-economic status of families involved, given that this may impact pet ownership (Purewal et al., 2019). Finally, it should be noted that many parents reported that their child had additional diagnoses, such as ADHD, dyslexia, dyspraxia, OCD, and PTSD. Given our sample size, we were not able to control for co-morbidities in the analysis. Thus, the observed effects may be driven by other factors that we did not measure.

7. Conclusions

To conclude, our quantitative data showed a positive association between positive pet behaviour and prosocial behaviour among autistic children. The qualitative results echoed this, showing that pets can help autistic children understand the needs of others (both animals and humans), and caring for a pet may therefore allow children to practice cognitive empathy skills. Although pet attachment and behaviours were not statistically related to children's peer problems, qualitatively, we found that pets enhanced human interaction opportunities for their child. We also found that pets may provide an alternative way to experience social interaction that was free from the stressors involved in human contact. In relation to psychological health, our quantitative results showed no relationships between parents' reports of their child's pet attachment/behaviour and emotional difficulties. Despite this, the qualitative findings suggested that pets helped children's emotional regulation, feelings of calmness and comfort, reduced 'meltdowns', and helped sleep, with a key mechanism underpinning these effects being the attunement of pets to children's emotional cues. However, it should be acknowledged that pets may heighten children's anxieties around separating from the pet and the pet's health and safety. Future research may wish to further consider species-specific differences in attunement. No relationships between pet variables and conduct problems or hyperactivity were found. The findings have implications for developing practical guidelines to help parents make the decisions around pet ownership as well as how to foster meaningful and safe relationships between the pet and their autistic child.

Author Contributions: Conceptualization, C.W., C.B. and R.D.H.; methodology, C.W., C.B. and R.D.H.; formal analysis, C.W. and R.D.H.; data curation, C.W., C.B. and R.D.H.; writing—original draft preparation, C.W., C.B. and R.D.H.; writing—review and editing, C.W., C.B. and R.D.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the School of Education and Social Sciences Ethics Committee at the University of the West of Scotland (protocol code 12021-16542-13819 and 7 May 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets presented in this article are not readily available because of the level of consent obtained from participants.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (DSM-5®). American Psychiatric Association.
- Ang, C. S., & MacDougall, F. A. (2022). An evaluation of animal-assisted therapy for Autism Spectrum Disorders: Therapist and parent perspectives. *Psychological Studies*, 67, 72–81. [PubMed]
- Arhant, C., Beetz, A., & Troxler, J. (2017). Caregiver reports of interactions between children up to 6 years and their family dog—Implications for dog bite prevention. *Frontiers in Veterinary Science*, 4, 130. [CrossRef]
- Atherton, G., Edisbury, E., Piovesan, A., & Cross, L. (2023). ‘They ask no questions and pass no criticism’: A mixed-methods study exploring pet ownership in autism. *Journal of Autism and Developmental Disorders*, 53, 3280–3294. [PubMed]
- Baron, G., Groden, J., Groden, G., & Lipsitt, L. P. (2006). *Stress and coping in autism*. Oxford University Press.
- Bethlehem, J. (2010). Selection bias in web surveys. *International Statistical Review*, 78, 161–188.
- Bould, E., Bigby, C., Bennett, P., & Howell, T. J. (2018). ‘More people talk to you when you have a dog’—Dogs as catalysts for social inclusion of people with intellectual disabilities. *Journal of Intellectual Disability Research*, 62, 833–841.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77–101. [CrossRef]
- Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. Sage.
- Byström, K. M., & Persson, C. A. L. (2015). The meaning of companion animals for children and adolescents with autism: The parents’ perspective. *Anthrozoös*, 28, 263–275.
- Campbell, D. R., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, 56, 81–105.
- Carlisle, G. K. (2014). Pet dog ownership decisions for parents of children with autism spectrum disorder. *Journal of Pediatric Nursing*, 29, 114–123.
- Carlisle, G. K., Johnson, R., Wang, Z., Brosi, T., Rife, E., & Hutchison, A. (2020). Exploring human–companion animal interaction in families of children with Autism. *Journal of Autism and Developmental Disorders*, 50, 2793–2805.
- Carrier, J. G. (1999). *People who can be friends: Selves and social relationships*. Routledge.
- Chen, N. R. Y., Majeed, N. M., Lai, G. J., Koh, P. S., Kasturiratna, S., Manmeet Kaur, A. Z. Y., Yong, H. J. C., & Hartanto, A. (2024). Human–animal interaction and human prosociality: A meta-analytic review of experimental and correlational studies. *Anthrozoös*, 37, 269–288.
- Chen, Y., Senande, L., Thorsen, M., & Patten, K. (2021). Peer preferences and characteristics of same-group and cross-group social interactions among autistic and non-autistic adolescents. *Autism*, 25, 1885–1900. [PubMed]
- Christian, H., Mitrou, F., Cunneen, R., & Zubrick, S. R. (2020). Pets are associated with fewer peer problems and emotional symptoms, and better prosocial behavior: Findings from the longitudinal study of Australian children. *The Journal of Pediatrics*, 220, 200–206. [CrossRef]
- Crompton, C., Ropar, D., Evans-Williams, C., Flynn, E., & Fletcher-Watson, S. (2020). Autistic peer-to-peer information transfer is highly effective. *Autism*, 24, 1704–1712. [PubMed]
- Data Protection Act. (2018) March 25. Available online: <https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted> (accessed on 2 February 2024).
- Dean, M., Chang, Y. C., Shih, W., Orlich, F., & Kasari, C. (2023). Social engagement and loneliness in school-age autistic girls and boys. *Women’s Health*, 19, 17455057231170973. [CrossRef] [PubMed]

- Ellis, A., Loughnan, S., Hawkins, R. D., & Stanton, S. C. (2024a). The associations between human–companion animal relationship duration, companion animal life stage, and relationship quality. *Animals*, 14(11), 1606.
- Ellis, A., Stanton, S. C. E., Hawkins, R. D., & Loughnan, S. (2024b). The link between the nature of the human–companion animal relationship and well-being outcomes in companion animal owners. *Animals*, 14, 441.
- Factor, R. S., Moody, C. T., Sung, K. Y., & Laugeson, E. A. (2022). Improving social anxiety and social responsiveness in autism spectrum disorder through PEERS®. *Evidence-Based Practice in Child and Adolescent Mental Health*, 7, 142–159.
- Fatima, M., & Babu, N. (2024). Cognitive and affective empathy in autism spectrum disorders: A meta-analysis. *Review Journal of Autism and Developmental Disorders*, 1(4), 756–775. [CrossRef]
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41, 1149–1160.
- Frith, U. (2004). Emanuel Miller lecture: Confusions and controversies about Asperger syndrome. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 45, 672–686.
- Fuentes, C., Flores-Vergara, S., Gálvez-Zurita, J., Urra-Albornoz, C., la Torre Choque, C., & Bolaños, M. C. (2023). Comparison of social isolation in autistic children and adolescents according to age, marital status and number of siblings. *Journal of Education and Health Promotion*, 12, 316.
- Goh, A. Y. H., Chia, S. M., Majeed, N. M., Chen, N. R. Y., & Hartanto, A. (2023). Untangling the additive and multiplicative relations between natural scenery exposure and human–animal interaction on affective well-being: Evidence from daily diary studies. *Sustainability*, 15, 2910. [CrossRef]
- Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, 38, 581–586.
- Goodman, R., Ford, T., Simmons, H., Gatward, R., & Meltzer, H. (2000). Using the strengths and difficulties questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *British Journal of Psychiatry*, 177, 534–539.
- Grandgeorge, M., Tordjman, S., Lazartigues, A., Lemonnier, E., Deleau, M., & Hausberger, M. (2012). Does pet arrival trigger prosocial behaviors in individuals with autism? *PLoS ONE*, 7, e41739. [CrossRef]
- Grasso, M., Lazzaro, G., Demaria, F., Menghini, D., & Vicari, S. (2022). The strengths and difficulties questionnaire as a valuable screening tool for identifying core symptoms and behavioural and emotional problems in children with neuropsychiatric disorders. *International Journal of Environmental Research and Public Health*, 19, 7731.
- Green, J., Charman, T., McConachie, H., Aldred, C., Slonims, V., Howlin, P., Le Couteur, A., Leadbitter, K., Hudry, K., Byford, S., Barrett, B., Temple, K., Macdonald, W., Pickles, A., & PACT Consortium. (2010). Parent-mediated communication-focused treatment in children with autism (PACT): A randomised controlled trial. *Lancet*, 19, 2152–2160.
- Greenlee, J., Winter, M., & Johnson, M. (2020). Depression symptoms in adolescents with autism spectrum disorder: A contextual approach to mental health comorbidities. *Journal of Adolescence*, 85, 120–125.
- Grigore, A. N., & Bazgan, M. (2017). Effects of assisted animal therapy on the development of socio-emotional abilities of children with autism. *Bulletin of the Transilvania University of Brasov. Series VII, Social Sciences and Law*, 10, 231–238.
- Hawkins, R. D., Kuo, C. H., & Robinson, C. (2024). Young adults’ views on the mechanisms underpinning the impact of pets on symptoms of anxiety and depression. *Frontiers in Psychiatry*, 15, 1355317. [CrossRef] [PubMed]
- Hawkins, R. D., Robinson, C., & Brodie, Z. P. (2022). Child–dog attachment, emotion regulation and psychopathology: The mediating role of positive and negative behaviours. *Behavioral Sciences*, 12, 109. [CrossRef]
- Hawkins, R. D., Robinson, C., & McGuigan, N. (2023). The benefits and risks of child–dog attachment and child–dog behaviours for child psychological well-being. *Human-Animal Interactions*, 2023, 0034. [CrossRef]
- Hawkins, R. D., & Williams, J. (2017). Childhood attachment to pets: Associations between pet attachment, attitudes to animals, compassion, and humane behaviour. *International Journal of Environmental Research and Public Health*, 14, 490. [CrossRef]
- Hillman, K., Dix, K., Ahmed, K., Lietz, P., Trevitt, J., O’Grady, E., Uljarević, M., Vivanti, G., & Hedley, D. (2020). Interventions for anxiety in mainstream school-aged children with autism spectrum disorder: A systematic review. *Campbell Systematic Reviews*, 16, e1086. [CrossRef] [PubMed]
- Holcomb, R., Williams, R. C., & Richards, P. S. (1985). The elements of attachment: Relationship maintenance and intimacy. *Journal of the Delta Society*, 1, 28–34.
- Hou, Y., Benner, A. D., Kim, S. Y., Chen, S., Spitz, S., Shi, Y., & Beretvas, T. (2020). Discordance in parents’ and adolescents’ reports of parenting: A meta-analysis and qualitative review. *American Psychologist*, 75, 329. [CrossRef]
- Kerns, K. A., Dulmen, M. H., Kochendorfer, L. B., Gastelle, M., Obeldobel, C. A., & Horowitz, A. (2023a). Are children’s relationships with pet dogs uniquely related to children’s social and emotional competence and adjustment? *Human-Animal Interactions*, 2023, 0018. [CrossRef]
- Kerns, K. A., Koehn, A. J., van Dulmen, M. H. M., Stuart-Parrigon, K. L., & Coifman, K. G. (2017). Preadolescents’ relationships with pet dogs: Relationship continuity and associations with adjustment. *Applied Developmental Science*, 21, 67–80. [CrossRef]
- Kerns, K. A., Obeldobel, C. A., House, H., Kochendorfer, L. B., White, A., & Gastelle, M. (2023b). Children’s experiences of positive affect with pet dogs: A multi-method study. *Human-Animal Interactions*, 2023, 0022. [CrossRef]

- Kimmig, A. C. S., Burger, L., Schall, M., Derntl, B., & Wildgruber, D. (2024). Impairment of affective and cognitive empathy in high functioning autism is mediated by alterations in emotional reactivity. *Scientific Reports*, 14, 21662.
- Konstantareas, M. M., & Stewart, K. (2006). Affect regulation and temperament in children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 36, 143–154. [CrossRef]
- Kreslins, A., Robertson, A. E., & Melville, C. (2015). The effectiveness of psychosocial interventions for anxiety in children and adolescents with autism spectrum disorder: A systematic review and meta-analysis. *Child Adolescent Psychiatry Mental Health*, 9, 22. [CrossRef]
- Lasgaard, M., Nielsen, A., Eriksen, M. E., & Goossens, L. (2010). Loneliness and social support in adolescent boys with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 40, 218–226. [CrossRef]
- Laurent, A. C., & Gorman, K. (2018). Development of emotion self-regulation among young children with autism spectrum disorders: The role of parents. *Journal of Autism and Developmental Disorders*, 48, 1249–1260. [PubMed]
- Li, J. (2022). The research on the correlation among pet attachment, prosociality, social support and loneliness based on MF-DCCA. *Academic Journal of Computing & Information Science*, 5, 26–31.
- Lisk, C., & Lawson, L. M. (2024). Investigating human-animal interactions in homes of children with Autism Spectrum Disorders: A mixed-methods approach. *Society & Animals*, 1, 1–25.
- London, M. D., Mackenzie, L., Lovarini, M., Dickson, C., & Alvarez-Campos, A. (2020). Animal assisted therapy for children and adolescents with autism spectrum disorder: Parent perspectives. *Journal of Autism and Developmental Disorders*, 50, 4492–4503. [CrossRef] [PubMed]
- McKinlay, J., Wilson, C., Hendry, G., & Ballantyne, C. (2022). “It feels like sending your children into the lions’ den”—A qualitative investigation into parental attitudes towards ASD inclusion, and the impact of mainstream education on their child. *Research in Developmental Disabilities*, 120, 104–128.
- Meehan, M., Massavelli, B., & Pachana, N. (2017). Using attachment theory and social support theory to examine and measure pets as sources of social support and attachment figures. *Anthrozoös*, 30, 273–289. [CrossRef]
- Mehrotra, M., White, N., Foley, S., & Hughes, C. (2024). Sibling and pet relationships: Links with adversity and adjustment in pre-adolescence. *Applied Developmental Science*, 1–17. [CrossRef]
- Muldoon, J. C., Williams, J. M., Lawrence, A., & Currie, C. (2019). The nature and psychological impact of child/adolescent attachment to dogs compared with other companion animals. *Society & Animals*, 27, 55–74.
- Mullan, A., Boyd, K., & McConkey, R. (2021). The impact of a brief home-based intervention on families with a child with Autism Spectrum Disorder. *Journal of Developmental and Physical Disabilities*, 33, 693–708.
- O’Haire, M. E. (2013). Animal-assisted intervention for autism spectrum disorder: A systematic literature review. *Journal of Autism and Developmental Disorders*, 43, 1606–1622. [PubMed]
- O’Haire, M. E., McKenzie, S. J., Beck, A. M., & Slaughter, V. (2015). Animals may act as social buffers: Skin conductance arousal in children with autism spectrum disorder in a social context. *Developmental Psychobiology*, 57, 584–595.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879.
- Purewal, R., Christley, R., Kordas, K., Joinson, C., Meints, K., Gee, N., & Westgarth, C. (2019). Socio-demographic factors associated with pet ownership amongst adolescents from a UK birth cohort. *BMC Veterinary Research*, 15, 1–15.
- Rehn, A. K., Caruso, V. R., & Kumar, S. (2023). The effectiveness of animal-assisted therapy for children and adolescents with autism spectrum disorder: A systematic review. *Complementary Therapies in Clinical Practice*, 50, 101719.
- Reider, L. B., Kim, E., Mahaffey, E., & LoBue, V. (2023). The impact of household pets on children’s daily lives: Differences in parent–child conversations and implications for children’s emotional development. *Developmental Psychology*, 59(11), 2148–2161.
- Russell, G., Rodgers, L. R., & Ford, T. (2013). The strengths and difficulties questionnaire as a predictor of parent-reported diagnosis of autism spectrum disorder and attention deficit hyperactivity disorder. *PLoS ONE*, 8, e80247.
- Salayev, K. A., & Sanne, B. (2017). The strengths and difficulties questionnaire (SDQ) in autism spectrum disorders. *International Journal on Disability and Human Development*, 16, 275–280.
- Schalamon, J., Ainoedhofer, H., Singer, G., Petnehazy, T., Mayr, J., Kiss, K., & Höllwarth, M. E. (2006). Analysis of dog bites in children who are younger than 17 years. *Pediatrics*, 117, e374–e379. [PubMed]
- Schohl, K. A., Van Hecke, A. V., Carson, A. M., Dolan, B., Karst, J., & Stevens, S. (2014). A replication and extension of the PEERS intervention: Examining effects on social skills and social anxiety in adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 44, 532–545.
- Scoresby, K. J., Strand, E. B., Ng, Z., Brown, K. C., Stilz, C. R., Strobel, K., Barroso, C. S., & Souza, M. (2021). Pet ownership and quality of life: A systematic review of the literature. *Veterinary Sciences*, 8, 332. [CrossRef]
- Shalev, I., Warriar, V., Greenberg, D. M., Smith, P., Allison, C., Baron-Cohen, S., Eran, A., & Uzevovsky, F. (2022). Reexamining empathy in autism: Empathic disequilibrium as a novel predictor of autism diagnosis and autistic traits. *Autism Research*, 15, 1917–1928. [CrossRef]

- Shoesmith, E., Shahab, L., Kale, D., Mills, D. S., Reeve, C., Toner, P., Santos de Assis, L., & Ratschen, E. (2021). The influence of human–animal interactions on mental and physical health during the first COVID-19 lockdown phase in the UK: A qualitative exploration. *International Journal of Environmental Research and Public Health*, 18, 976. [PubMed]
- Smees, R., Rinaldi, L. J., Simmons, D. R., & Simner, J. (2023). The parent-completed glasgow sensory questionnaire: Exploring children's sensory sensitivities and their relationship to well-being. *Journal of Child and Family Studies*, 32, 1805–1822.
- Sönmez, D., & Jordan, T. R. (2024). Investigating associations between cognitive empathy, affective empathy and anxiety in adolescents with autism spectrum disorder. *International Journal of Developmental Disabilities*, 70, 957–965.
- Spain, D., Sin, J., Harwood, L., Mendez, M. A., & Happé, F. (2017). Cognitive behaviour therapy for social anxiety in autism spectrum disorder: A systematic review. *Advances in Autism*, 3, 34–46. [CrossRef]
- Vilas, S. P., Reniers, R. L., & Ludlow, A. K. (2021). An investigation of behavioural and self-reported cognitive empathy deficits in adolescents with autism spectrum disorders and adolescents with behavioural difficulties. *Frontiers in Psychiatry*, 12, 717877. [CrossRef]
- Wang, X., Auyeung, B., Pan, N., Lin, L. Z., Chen, Q., Chen, J. J., Liu, S. Y., Dai, M. X., Gong, J. H., Li, X. H., & Jing, J. (2022). Empathy, theory of mind, and prosocial behaviors in autistic children. *Frontiers in Psychiatry*, 13, 844578.
- Wauthier, L. M., Farnfield, S., & Williams, J. M. (2022). The role of attachment in children's relationships with pets: From pet care to animal harm. *Human-Animal Interactions*, 2022, 0024. [CrossRef]
- World Health Organization. (2023, November 15). *Autism key facts*. Available online: <https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders#:~:text=Key%20facts,not%20diagnosed%20until%20much%20later> (accessed on 2 February 2024).
- Young, J., Pritchard, R., Nettle, C., & Banwell, H. (2020). Pets, touch, and COVID-19: Health benefits from non-human touch through times of stress. *Journal of Behavioral Economics Policy*, 4, 25–33.
- Yu, C. (2024). A systematic review of the positive effects of pets on child development. *Communications in Humanities Research*, 39, 82–87.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

Supporting Families to ‘Make the Most’ of the Relationship Between Their Companion Dogs and Their Children with Autism Spectrum Condition: A Qualitative Exploration of the ‘Family Dog Service’

Emily Shoesmith ^{1,*}, Heidi Stevens ¹, Selina Gibsone ², Cari Miles ², Hannah Beal ², Kelly Jennings ² and Elena Ratschen ¹

¹ Department of Health Sciences, University of York, York YO10 5DD, UK; heidi.stevens@york.ac.uk (H.S.); elena.ratschen@york.ac.uk (E.R.)

² Dogs for Good, The Frances Hay Centre, Blacklocks Hill, Banbury OX17 2BS, UK; selina.gibsone@dogsforgood.org (S.G.); cari.miles@dogsforgood.org (C.M.); hannah.beal@dogsforgood.org (H.B.); kelly.jennings@dogsforgood.org (K.J.)

* Correspondence: emily.shoesmith@york.ac.uk

Abstract: Evidence suggests that assistance and therapy dogs can positively impact the mental and physical health of children with autism spectrum condition (ASC) and their families. However, these services are often costly and inaccessible. As an alternative, companion dogs (e.g., non-specialist-trained pet dogs) may offer similar benefits. To support families in selecting and training a dog to benefit the whole family, a charity named Dogs for Good has designed the Family Dog Service. This qualitative study aimed to explore the perceived impact of human–dog interactions and relationships for children with ASC and their families, and their perceptions of the Family Dog Service. Interviews were conducted with 16 parents of children with ASC who had engaged with the service within the last five years. Thematic analysis identified four main themes. These related to the positive impact of the companion dog on the child with ASC (e.g., enhanced focus and attention, reduction in loneliness, and reduced anxiety-based behaviours) and the parents (e.g., increased respite and wellbeing). However, parents also reported challenges of dog ownership (e.g., adjustment to routines and barriers associated with the development of the human–dog relationship). These challenges appeared to be mitigated by tailored guidance and support from the Family Dog Service. The findings indicate that companion dog ownership provided benefits to children with ASC and their families, similar to those reported for autism assistance dogs. While the findings do not suggest that companion dogs can replace the important role played by specialist trained assistance dogs, it is possible that reported benefits may occur due to the development of the human–dog relationship, facilitated by the support offered by the Family Dog Service. The service may provide a practical, valuable alternative in light of restrictions and challenges often associated with securing assistance dog placements.

Keywords: companion dogs; autism spectrum condition; mental health; qualitative

1. Introduction

Autism spectrum condition (ASC) is a heterogeneous neurodevelopmental condition defined by the DSM-5 as an individual experiencing persistent difficulties in social communication and social interaction across multiple contexts and exhibiting restricted and

repetitive patterns of behaviours, interests, or activities (American Psychiatric Association, 2013). According to the Global Burden of Diseases, ASC impacted approximately 28 million individuals (Solmi et al., 2022) and nearly 3 million children under 5 years of age (Kang et al., 2023) internationally in 2019. As ASC is a lifelong and individualised condition that can impact education, employment, independent living, and social integration (Howlin et al., 2004), it is important that support is dynamic and adaptable to individual needs (Hall et al., 2016). Additionally, it is imperative that psychological and practical support is accessible to the primary caregivers of children with ASC (Hyman et al., 2020).

Dogs have been increasingly involved in support offered to children with ASC and their families in a range of contexts, such as dog-assisted services (Abadi et al., 2022; Galvany-López et al., 2024; Hill et al., 2020; Hüsken et al., 2022; Nieforth et al., 2021) and assistance dog placements (Hellings et al., 2022; Leung et al., 2022; Shoesmith et al., 2024; Starkweather et al., 2024; Tseng, 2023). Evidence indicates that dog-assisted services can have positive impacts on both the mental and physical health of children with ASC, including improved social behaviour and interaction (Ben-Itzhak & Zachor, 2021; Nieforth et al., 2021), behavioural regulation (London et al., 2020), physical activity (Abadi et al., 2022), and reduced stress (Meints et al., 2022). Likewise, previous research suggests that assistance dogs are able to support children with ASC with their emotional regulation, community participation, and social skills (Appleby et al., 2022; Burgoyne et al., 2014; Carlisle, 2015; Hellings et al., 2022; Shoesmith et al., 2024; Tseng, 2023), as well as enhance wider family wellbeing (Hellings et al., 2022; Leung et al., 2022; Shoesmith et al., 2024). However, further research is needed, as earlier studies on dog-assisted services or assistance dogs for children with ASC are limited due to variability in methodologies, implementation, and reporting (Tseng, 2023).

While it is increasingly well established that assistance dogs and certified therapy dogs can be beneficial for children with ASC and their families (Abadi et al., 2022; Ben-Itzhak & Zachor, 2021; Hellings et al., 2022; London et al., 2020; Shoesmith et al., 2024), this support is often inaccessible and expensive (Hall et al., 2016). Therefore, companion dogs (e.g., non-specialist-trained pet dogs) might be a potential, more practical alternative. Indeed, research has reported that similar benefits for children with ASC might be accrued from companion dogs without specialist training (Wright et al., 2016); for example, improved prosocial behaviours (Grandgeorge et al., 2012), reduced restrictive behaviour patterns (Byström & Persson, 2015), and reduced anxiety (Wright et al., 2015b). Additionally, companion dogs can reduce stress for primary caregivers (Wright et al., 2015a) and enhance overall family functioning (Walsh, 2009; Wright et al., 2015b). However, there are also challenges associated with dog ownership, including the time commitment for training and care, potential issues with the child bonding with the dog, risks of dog bites, and financial costs (Carlisle, 2014; Wright et al., 2016). Therefore, it is imperative for families to consider both the benefits and challenges of dog ownership, and how to establish a healthy relationship between the dog and family members.

To equip parents with the knowledge and long-term support required for choosing and training a dog, a UK-based charity named Dogs for Good has designed the Family Dog Service. The workshops involved in this service aim to harness the full potential of a companion dog to improve the lives of children with ASC and their families, while prioritising the welfare and wellbeing of the humans and dogs involved. While research has explored the impact of assistance and companion dogs on various populations, including children with ASC (Abadi et al., 2022; Ben-Itzhak & Zachor, 2021; Hellings et al., 2022; London et al., 2020; Shoesmith et al., 2024), there have been no investigations into the effects of any novel support and educational programmes designed to help families select and train a companion dog for families with ASC. Therefore, the aim of the current study was

to explore the parental experiences of the Family Dog Service and the perceived impact of human–animal interactions and relationships on children with ASC and their families. This study offers entirely new insights by examining how such a service supports the parents of children with ASC across different stages of dog ownership.

2. Materials and Methods

2.1. Study Design

Individual qualitative semi-structured interviews were conducted with the parents of children with ASC who had engaged with the Family Dog Service.

2.2. Ethical Approval

Ethical approval for the study was granted by the Health Sciences Research Ethics Committee at the University of York, UK, on 21 November 2023 (ref: HSRGC/2023/596/B).

2.3. Overview of the Dogs for Good Service

The service is a UK-based charity named Dogs for Good (previously known as Dogs for the Disabled). This charity provides a range of services including the training and placement of assistance dogs with adults and children (Shoesmith et al., 2024). Dogs for Good also offer the Family Dog Service, open to parents of autistic children (aged between 3 and 16 years), including those currently on the diagnostic pathway). The broad age range ensures that the service is accessible to a wide demographic of families with children with ASC, thereby maximising potential reach. The workshops are designed for families at every stage of dog ownership, including the following: (1) the early stages, when families are considering and researching how a dog can support their child; (2) the process of choosing, introducing, and training a dog; and (3) those who already own a companion dog and are seeking guidance on how the dog can support both their child and the wider family.

The Family Dog Service began in June 2010, and their workshops were delivered in-person until 2020. In September 2020, the service transitioned to online workshops due to the COVID-19 pandemic. To deliver this service remotely, the Family Dog Service's workshops are pre-recorded by dedicated Family Dog Instructors and accessed via the on-line platform SharePoint. Each pre-recorded workshop is accompanied by a corresponding 'workshop live' event, held as a group video call on Microsoft Teams. The 'workshop live' events are led by dedicated Family Dog Instructors and recap the pre-recorded workshop content, offer the opportunity for the instructors to answer any questions, and generate discussions within the group. Five 'workshop lives' are available with a duration of 1.5–2 h, with the exception of the introduction that is approximately 45 min (Table 1).

In addition to the workshops, families also receive access to lifetime support from the Family Dog Instructors and a range of resources including fact sheets and videos. These resources provide supplementary guidance and information to what is covered in the workshops. Additionally, families have access to a private Family Dog Service Facebook group to seek advice or support from the instructors and their peers, and this group is moderated by the dedicated Family Dog Instructors.

Table 1. Overview of Family Dog Service live workshops.

Workshop	Content
Introduction	The introduction involves meeting other people in the group, the instructors, and is for the Dogs for Good team to ensure the group is comfortable and familiar with the technical aspects of the workshops.
Selecting the right dog	This workshop is optional and covers considerations regarding the type of dog to select (e.g., breed, size, age) and advice on buying or adopting a dog (e.g., from rescue centres or breeders).
Workshop 1	This workshop involves information related to looking after the family dog (including meeting their needs). This includes guidance on food, nutrition and diet, health (including how to perform a basic health check), and considerations around grooming. This workshop also involves content related to safety in the home and appropriate behaviour, positive mental experiences for their dog in their experience of growing and learning, dog-related laws, building the dog and child relationship, and considering ways to support both the child and the dog.
Workshop 2	This workshop primarily focuses on how families can help their dog in the home to make sure they feel safe and comfortable. Content includes understanding dog language and communication, what to do with the dog's communication, how the dog can help the child, the theory of how dogs learn, how to encourage wanted behaviour, and the impact of negative methods on the relationship with the family dog.
Workshop 3	This workshop involves content relating to how to train the dog, discussing different dog training styles and tools, and advanced training and recognised autism assistance taskwork (e.g., head rest, body rest, nose nudge, button push).

2.4. Recruitment

An advert to invite expressions of interest in participating in this study's interviews was posted in the private Family Dog Service Facebook group. The private Facebook group is only accessible to members who have completed (or are currently completing) the Family Dog Service workshops. Contact details were provided on the advert, so interested members could contact the researcher directly. Prior to obtaining their consent, the first author responded to potential participants to confirm they met the inclusion criteria: (1) have at least one child with ASC aged 3–16 years (including those on the diagnostic pathway); (2) be current or recent (last 5 years) participants in the Family Dog Service; and (3) be able to speak English sufficiently to participate in interviews. Eligible participants were sent a Participant Information Sheet and consent form to complete and return via email.

2.5. Data Collection

Demographic information was gathered about participants' age (in bands), gender (male, female, non-binary/third gender), number of children with ASC (confirmed or suspected diagnosis), their age (in bands), gender (male, female, non-binary/third gender), and any comorbidities (confirmed or suspected).

Semi-structured interviews were conducted by the first author to gain an in-depth understanding of participating families' experiences with the Family Dog Service, and the perceived impact of human–animal interactions and relationships for children with ASC and their wider family network. Interview topic guides were developed based on existing posts in the Family Dog Service Facebook group. Data were obtained from posts in the Family Dog Service Facebook group and imported to Microsoft Excel. A thematic coding framework was generated that consisted of categories synthesising the experiences of the service and/or the family dog that participants described. This framework facilitated the

development of the interview topic guide, which was then refined in collaboration with the Dogs for Good team.

The interview topic guide is provided in Supplementary Material S1. All interviews were conducted via a remote platform, were audio recorded and transcribed verbatim. All participants were given ID numbers to anonymise the transcripts. Data collection took place between January and April 2024.

2.6. Data Analysis

Thematic analysis was conducted, including data familiarisation, coding, and searching for and defining themes (Braun & Clarke, 2006). Data collection and analysis occurred concurrently; themes and issues from earlier interviews informed the content of subsequent interviews, and the topic guide continued to evolve throughout data collection. As data collection and analysis progressed, a coding framework was devised and applied to transcripts by ES using NVivo 13 (Lumivero, 2020). A second author (HS) independently reviewed the themes to ensure consensus with the assignment of theme names and illustrative quotes.

3. Results

Interviews were conducted with 16 parents who collectively reported about 25 children with ASC (Table 2). The average length was 51 min (range: 35–68 min).

Table 2. Interview participant characteristics.

		N (%)
Gender	Female	15 (93.8)
	Male	1 (6.2)
	35–44	9 (56.3)
	45–54	7 (43.7)
Ethnicity	White (any White background)	15 (93.8)
	Chinese	1 (6.2)
Number of children with ASC ¹	1	10 (62.5)
	2	5 (31.3)
	5	1 (6.2)
Age of children with ASC ¹	3–6	3 (12.0)
	7–10	11 (44.0)
	11–14	9 (36.0)
	15–16	2 (8.0)
Gender of children with ASC ¹	Female	9 (36.0)
	Male	16 (64.0)
Comorbidities of children with ASC ¹	Anxiety disorder	6 (37.5)
	ADHD	6 (37.5)
	Learning difficulties (e.g., dyslexia, dyspraxia)	4 (25.0)

Table 2. *Cont.*

		N (%)
Family dog breed	Labrador	4 (25.0)
	Labradoodle	2 (12.5)
	Golden doodle	2 (12.5)
	Whippet	1 (6.3)
	Dachshund	1 (6.3)
	Staffordshire Bull Terrier	1 (6.3)
	Cocker Spaniel/Poodle mix	1 (6.3)
	Springer Spaniel/Poodle mix	1 (6.3)
	Cocker Spaniel/Yorkshire Terrier mix	1 (6.3)
	Beagle	1 (6.3)
	St. Bernard	1 (6.3)
Length of current dog ownership	6 months–1 year	2 (12.5)
	1–3 years	8 (50.0)
	3 years+	6 (37.5)
Previous experience of dog ownership	Yes	10 (62.5)
	No	6 (37.5)

¹ Confirmed or suspected diagnosis.

The thematic analysis of transcripts resulted in the identification of four main themes with associated clusters of sub-themes related to various aspects of human–animal interactions and relationships, family dynamics, and experiences of the Family Dog Service (Table 3). To illustrate themes and sub-themes, verbatim quotes are presented below.

Table 3. Themes and associated sub-themes.

Themes	Sub-Themes
Improvement of psychosocial and functional aspects associated with ASC	• Enhanced focus and attention • Reduction in loneliness and engagement in social interaction • Increased physical exercise and time outdoors • Reduced anxiety-based behaviours • Tolerating changes and willingness to engage in new activities
Positive impact of the companion dog on parents of children with ASC	• Increased parental respite • Increased parental wellbeing
Challenges and considerations associated with dog ownership for families with children with ASC	• Key considerations when selecting a dog • Adjusting to a new dog within the family unit • Challenges associated with the development of the human–dog relationship
Experiences of the Family Dog Service workshops	• Motivation to attend the workshops • Information tailored to families with ASC • Access to lifetime support

3.1. Improvement of Psychosocial and Functional Aspects Associated with ASC

3.1.1. Enhanced Focus and Attention

Many participants reported that their child's focus and attention had improved since integrating the dog into the family unit. Participants expressed how their child was more willing to engage with and maintain concentration on activities due to the presence of the dog.

"His attention is much more focused with her, being able to act the responsible owner. Sometimes, he is hyper focused on his computer, and he doesn't need [dog's name] around him, and that's fine, but when he's not, she certainly increases his focus on activities that she's involved with, and that's where she pays dividends again. She's fantastic."

"Since [dog's name], his academic ability has come on. We try to get [dog's name] to listen to him read, I think it is knowing somebody is there on his side as well. So, it's really helped his language because he likes to read to [dog's name], and it keeps him focused."

The responsibility associated with dog ownership also appeared to improve the child's focus and willingness to partake in caretaking tasks (e.g., walking, grooming, and training the dog).

"He loves the fact he's got something to focus on, someone to look after, because most of the time, it's other people keeping him on track, so this is the other way around, and I think he likes that."

"The focus is on, you know, I want to give her food, I want to see her, walk her, and give her cuddles before school, I want to get back from school because I want to see what she has been up to."

Additionally, one participant spoke about how their child frequently did not respond to a range of stimuli, including animals in community settings. While this caused initial apprehension to introduce a dog to the home, the parent noted how their child had shown improvements and started to pay attention to the dog's activities.

"Whenever we go to zoos or farms or anything, he does not notice any animals and that's why we were worried about getting a dog. But he notices [dog's name]. He watches him, he sees what he's doing, and sometimes, if he's gone into his crate, [son's name] will lean over the sofa and look around to see where he's gone. He'll like, lean up to see where he is, which is lovely."

3.1.2. Reduction in Loneliness and Engagement in Social Interaction

Parents reported that the constant source of companionship appeared to ameliorate the child's feelings of loneliness. This was often attributed to the positive relationship established between the child and the dog.

"[Daughter's name] feels lonely, and I think she's isolated because she's not accessing school [. . .] I can already see there's a friendship there with [dog's name], like an unconditional friendship, and I think when [daughter's name] is feeling lonely, she can go to see [dog's name] and it'll take that feeling of loneliness away. I think the loneliness aspect, it's not quite the same as having, like, a girl friend, but I think it still makes her feel like she's got somebody, that social companionship. I think a dog can bring out so much and make a world of difference."

"They're just best friends. As soon as [daughter's name] wakes up in the morning, [dog's name] is straight up there to say hello, just having that somebody who's happy to see you with a big waggy tail. It's about the companionship, it's her best friend. They do everything together. Just having that for [daughter's name] is amazing. It helps bring her down, it's somebody that she doesn't have to explain that she's in a mood to, [dog's name]"

is just there with a happy little face, I think it's that utter acceptance that a dog brings. The bond between them is really strong."

Many participants also noted that they had observed an improvement in their child's social interaction. Specifically, they expressed that their child's confidence had improved when interacting with others when the topic of conversation focused on the dog.

"[Daughter's name] is selective mute, she doesn't speak very often unless she's really calm at home. The dog helps her to talk because she'll print out pictures of the dog, she made an album and printed it all out and took it to show all the teachers, and it opens the conversation, and then she'd able to answer questions about the dog, which is really amazing."

"I think [daughter's name] doesn't mind if people come over and talk to her about [dog's name] because it's not about her. She's found that deflection quite good, because it's something she knows about. She's my dog, so I can talk to you about it."

Lastly, the presence of the dog appeared to represent a shared common interest, facilitating discussions and aiding conflict management in a way that did not cause distress or overwhelm the child.

"The dog is an icebreaker for us, because if I tell [son's name] to do anything, he won't like it. He can become aggressive towards commands, but with the dog, he likes to speak about it, he will be much better, he will talk to us about it, if we are talking about the dog while asking him to do something, that's better. It's like a buffer between us."

"It gives us a common conversation, a different conversation, whereas for the last 12 years, it's been about her behaviour, it's been about the meltdowns. She doesn't want the attention in that way but that's what the conversation has been about. The fact I can train [daughter's name] to train [dog's name] through what I've learned through Dogs for Good, I think that's great."

3.1.3. Increased Physical Exercise and Time Outdoors

The majority of participants spoke about how the family dog had improved the child's motivation and willingness to exercise and spend time outdoors. While this was directly beneficial for the child's fitness and activity levels, most participants reported how this had been valuable for their child's wellbeing and emotional regulation.

"We play rugby after school, and he goes through phases where he doesn't want to go at all, and when he didn't want to go, I suggested [dog's name] comes with us, and then he was happy to go. So, it actually helped us to get out and do that because physical activity is also really good for him to regulate."

"She would never, even though she probably needed to get her tunes in and walk around the block after school to get rid of the day, she would never say, can I go for a walk? Now, she'll come in, play with [dog's name], and say, I'm taking him for a walk, and off they go. You just don't realise how revolutionary that is until you stop and think, she's just left the house on her own! Just having that for her mental health, getting outside, having the exercise."

Additionally, one participant spoke about his child's hypersensitivity to light, which affected their confidence and motivation to spend time outdoors. However, this had improved 'an incredible amount' since owning the family dog.

"We've had some really great successes with him being able to go outside [...] he struggles with changes of lighting, so going outside is such a big thing for him, and he will really struggle. He's got ski goggles he wears and photochromatic glasses, and he's got a way of

going out effectively, which he can do, but it's helped an incredible amount having [dog's name]."

3.1.4. Reduced Anxiety-Based Behaviours

All participants spoke about how the family dog provided a calming influence on their child with ASC, particularly when they were distressed and exhibited anxiety-based behaviours.

"It is just so clear he feels much safer and comfortable with just her presence. If he has a wobble, he just focuses on [dog's name], even just a pat on the head, it really reduces his anxiety that was much more heightened without her."

Parents reported that children with pathological demand avoidance (PDA) often responded negatively to demands or expectations, resulting in heightened anxiety. Participants expressed that their dog's non-judgemental and predictable behaviour helped to soothe the child, particularly during stressful episodes.

"With his PDA, he struggles with anything that feels like a demand. Even something as simple as getting dressed can trigger a meltdown. But with [dog's name], there's no pressure. She's just there, waiting calmly, and somehow that helps him regulate himself. When he's stressed, she doesn't demand anything from him, she just offers comfort. It's like she knows exactly what he needs without asking for anything in return."

Some participants reported that their child had difficulty with behavioural and emotional regulation that could lead to violence, withdrawal, or avoidance of social and sensory experiences. The calming effect and unconditional love from the dog were noticeable when daily stress was experienced.

"I think it's that unconditional love. I think for [son's name], with his PDA, he has a lot of shame and guilt when he's had meltdowns, when he's hurt people. He says, 'I'm really sorry, I'm really awful, that was awful of me, I hate myself'. It's very unconditional for [dog's name], he doesn't hold a grudge even if he does have a massive meltdown right next to him, [dog's name] doesn't even react to [son's name], he will just snuggle into him for a cuddle, or for him to give him a stroke. So, he's a constant in that respect, there's no judgement, there's no kind of, I just want to be with you when you're happy, I just want to be with you when you're quiet."

Some participants expressed how their dog would seek closer proximity to their child during a meltdown and would often 'intuitively' know what the child needed to comfort them. This could include laying on the child, other physical contact, or simply being present in the same room.

"She's fantastic when [son's name] is having a meltdown, she knows. Seems to just know whether he needs her near him, not near him, touching him, not touching him. Once, he started hyperventilating [...], his legs were thrashing all over the place. Without being instructed to do anything, [dog's name] very slowly sort of pulled herself and laid over his lower leg and pinned his legs down. She was very calm about the whole thing, just very slowly, put a foot and then a head over his ankles, and within about five minutes, his whole body relaxed."

"She goes to [daughter's name], even if she's crying and she's really loud, [dog's name] goes to her and wants to help [...] leaning against her, or something like that, you know, just a presence, a calming presence."

"[Daughter's name] has meltdowns, but actually, we're finding with [dog's name] here, it almost prevents them, because she's there ready for a cuddle, and that just helps calm"

everything down. She's very tactile, so the minute you sit down, you get this 15kg dog literally jump on you, and that at the moment is enough for [daughter's name]."

Additionally, participants spoke about how their child benefitted from the opportunity to verbalise their anxieties to the dog without judgement.

"[Daughter's name] might worry about telling me something, yet I can hear her chatting to [dog's name] upstairs, and I think [dog's name] has changed the dynamic, and has been something to diffuse whatever is going on for her, I didn't think I would see the benefit, because how could possibly a dog take that all away? But she does. [Daughter's name] still speaks to me, obviously, but it's not that constant, 'mum, I need to be with you, because that's where I feel safe', that's kind of deflect to [dog's name], where she feels her version of safe, she says she feels emotionally safe."

"If he's had a big meltdown, he finds it really difficult to then recover from that and not feel really shameful and really guilty. I've noticed he will go upstairs with [dog's name] and I hear him talking to [dog's name] and telling him, 'I need a cuddle, I've been such a naughty boy, I'm such a horrible person. I guess if he didn't have [dog's name], he wouldn't have anyone to do that with because he doesn't want to do it with us because he's still feeling very bad about it. It's nice for him to be able to externalise that more than keeping it all in."

Lastly, while some participants stated that they wanted to train their dog to specifically prevent a meltdown or provide deep pressure therapy, the companionship provided by the dog, the development of the human–dog relationship, and subsequent enhanced wellbeing was frequently seen as the priority.

"You finally feel like you've got some help for your child, but you have to remember it's a dog. I put so much hope into [dog's name] to help me with [daughter's name], but I still need [dog's name] to be happy too, and first and foremost, she's a family pet. She's a family pet, and like I say, if eventually she doesn't do deep pressure therapy, but she still gives her great cuddles and flops all over her, fine, you know, she's not going to be kicked out or not pass an exam. You know, she's good enough already, so, great."

"I didn't anticipate the impact she has truly had. I just thought I was going to be able to train her for pressure therapy ultimately, but I didn't anticipate the overarching support mechanism that she was going to become for both [son's name], and if I'm really honest, hand on heart, myself. It's that sort of bond, and something else to focus on."

3.1.5. Tolerating Changes and Willingness to Engage in New Activities

Some participants noted that the family dog had influenced their child's acceptance to change and willingness to try new things. For many parents, this was an important achievement given their child's usual fixed interests and rigid behaviours.

"When you go on holiday, you're not really sure what you're going to do for the day, my kids can't deal with that because they don't know where they're going. They don't know what to expect, we haven't planned it. It's really hard for them. Put the dog into the mix, and they ground us, everyone's so much calmer, and we can just chill."

"[Son's name] would never go downstairs by himself. Now he knows [dog's name] is there, he's really happy to go downstairs in the morning, he'll go get [dog's name] and watch some TV, whereas before, he wouldn't have done that, he's happy to do that now because he knows [dog's name] is there, it's amazing."

One participant suggested that their child's acceptance to change could be attributed to the sense of responsibility associated with ownership, and the child understood the requirement to fulfil the dog's needs.

“When [dog’s name] needs a walk, that sort of, overrules his needs and overrules the ‘Mummy needs to be home at this time’, you say, well, who’s going to walk [dog’s name]? And then if he knows she needs a walk, that’s okay, he understands that.”

3.2. Positive Impact of the Companion Dog on Parents of Children with ASC

3.2.1. Increased Parental Respite

In addition to the direct benefits of the family dog to the child with ASC, the majority of parents expressed that the dog also had a positive impact on them. Specifically, participants indicated that they felt less stressed, as their child felt safe and comfortable in the presence of the dog, and this subsequently led to an increase in respite for the parent.

“She’s taken the pressure off. [Dog’s name] is an extension of me, but in a way that I could never give [daughter’s name]. I didn’t realise how much I needed her, not for cuddles or whatever, but I needed her to help me to help [daughter’s name], to take some of that pressure off, to take some of that emotional burden away, which is a big ask for a little yellow Labrador, but actually [dog’s name] does that, just by being there. So, that then directly impacts the whole house, because everything is just that little bit calmer. I have been [daughter’s name] emotional crutch, and it’s now given me some time to myself.”

Some participants reported that before they introduced a dog to the home, they experienced feelings of guilt when taking time for themselves. However, dog ownership allowed them to take ‘justifiable respite’ while meeting the needs of the dog, which appeared to reduce these negative feelings. Participants indicated this benefit was often unexpected as they had introduced the dog to the home primarily to support their child with ASC.

“The thing that I didn’t expect was actually me having some time outdoors by myself. Having some time to myself in the fresh air, and for it to be justified, because when I used to work, that used to be my respite. But it was justifiable respite, because it was bringing money in and helping other people. This has given me that again, because I can justify it, I’m meeting his needs as well, but then I’m also getting time to myself.”

One participant also spoke about the benefit of the dog when their child was with a professional caregiver, as she was able to spend time outdoors with her partner and the dog, which increased feelings of normalcy.

“When we’ve got a carer over for [son’s name], we’ll take [dog’s name] to the pub, he’ll sit with us in the pub. It’s just a nice thing, like, we can actually be normal and do normal things because we can’t ever take [son’s name] anywhere like that. It’s nice to go out as sort of a family with our dog child and sit and have a drink, and just feel normal. I think that’s a massive thing because that just doesn’t happen in day to day life.”

3.2.2. Increased Parental Wellbeing

Many participants also spoke about how the dog had increased their own and their partner’s mental health and wellbeing, primarily attributed to the unconditional love and companionship provided by the dog. This also appeared to be an unexpected benefit, as participants indicated that this improvement in wellbeing was surprising.

“For us, it was unexpected. I didn’t ever think about it from my point of view other than the additional burden. I know that sounds horrible, but I was doing it for the kids [. . .] I did not at any point think about the companionship and bond for me or [husband’s name]. I just didn’t even think about that, and how good it makes us feel, so that has been a pleasant surprise.”

“I never considered the positive impact of just having her. It’s been a pleasant surprise, and we find it so rewarding. Just to have a cuddle, that unconditional love, like this

morning, when I woke up, I felt sad and heavy, and [husband's name] came up with [dog's name], which normally we don't do. She just got on the bed with me, and it was like, okay, I'm okay now, I'm going to get on with the day. So, she is benefitting us."

3.3. Considerations and Challenges Associated with Dog Ownership for Families with Children with ASC

3.3.1. Key Considerations When Selecting a Dog

Participants identified important factors to consider when selecting the correct dog breed for their family, including size and sensory issues (e.g., coat length, type).

"I needed a dog of a fair size because we're doing deep pressure therapy with [daughter's name], and I learned that, you know, the heavier the better. Probably the Labrador was as heavy as I was prepared to go."

"My son wouldn't have coped with dogs that either moult or shed a lot, but then golden retrievers were talked about as being really good. So, he doesn't like wiry sort of coats. So, the golden doodle just ticked so many boxes. You know, that doesn't shed and has got a long, shaggy coat."

Participants frequently noted that they may not have thought about these factors if they had not completed the Family Dog Service workshops.

"It was really helpful, and I think it'd be really helpful for a lot of other people, especially because things like, what kind of preference does your child have to touching things, and like, are they sensory seekers? Are they going to be kind of rough handed with the dog? You know, do you need a bigger dog or like, would a smaller dog be better? I think there were so many questions that were really interesting things I never really would have thought about."

3.3.2. Adjusting to a New Dog Within the Family Unit

Participants often spoke about the challenge associated with integrating a new dog into the family unit and adjusting to a new lifestyle and routine. This challenge was amplified in certain situations, for example, when the child was described as less tolerant to change or if the child had germ phobia.

"Initially, he was terrible. He wouldn't touch her. If he did touch her, he had to wash his hands. He would stand and watch me bath her but wouldn't involve himself. He would put her food on the floor but wouldn't prepare the food. Whilst we were house training, that was very challenging as he would laugh and giggle if she did her business inside, but it really did kick in as soon as it was tidied up, it was, has it been disinfected? What have you wiped it with? Is that clean? Can I walk on it?"

"There was obviously the changing routine, and it did impact the kids a bit, particularly [daughter's name] who did struggle with something else coming ahead of her, like, if his needs needed to be met first before hers."

The change in routine also impacted some parents, who highlighted that the responsibility of caring for a dog was more challenging and time consuming than anticipated.

"I found it more challenging than anyone because it was my routine that changed the most, it changed my life, completely. I'm the one who has to rush back from work, I'm the one who gets up to go out early in the morning, even if I've got something on. I knew it was going to be hard, and it would be a big commitment, but it's probably bigger than I ever realised."

As a result, participants identified that this sometimes compromised the way families felt about acquiring a dog, but strategies and support provided by the Family Dog team

appeared to mitigate this barrier. Subsequently, this appeared to enhance the relationship between the family and the dog and ensure that the integration and lifestyle adjustment was more manageable.

"It's quite tricky at the beginning, it's hard work, and I'd be on walks, and I was like, nearly crying, because she's pulling so much. I was like, oh my goodness, what have I done? It was helpful to speak about focusing on like, how it will be able to help [son's name]. They also include stories in there to explain how it's helped other families too, and it's really good, because that helps you to sort of, get through the hard times."

"It can be a really challenging start, and I think it was so useful because they like, help to set her up to succeed, and setting up this relationship to what will work. You know, like positive reinforcement, not putting too more pressure on the relationship between them, giving ideas for stuff like enrichment that [son's name] could get involved in, you know, like, little puzzle toys. [The service] helped me to introduce them in a certain way and I wouldn't have known how to do that."

3.3.3. Challenges Associated with the Development of the Human–Dog Relationship

While many of the perceived benefits to the child with ASC were attributed to the development and impact of the human–dog relationship, the majority of participants described that this relationship took time to develop.

"I'm not going to say there was an instant bond. Everything within him wanted to adore her like he could see people around him doing. But he does take a while, but it's because he approaches everything from a logical perspective and not an emotional one, but that almost is the barrier that prevents him from being able to relax and enjoy things sometimes."

Participants highlighted barriers to the development of the relationship that included impatience from the child when training the puppy, behaviour associated with a puppy (e.g., nipping, jumping) that distressed the child and contributed to sensory overload, and germ phobia.

"[Daughter's name] was so fixated on her being there, and we had to say, puppies sleep, you're not going to pick her up and put her on you when she's sleeping. It was getting [daughter's name] to settle, because the anticipation was so much and she just wanted this dog to help her, and we had to slow her down and keep in mind she is still only a puppy."

"At the time, she just thought [dog's name] doesn't like me, and we had to explain that she's done it to all of us. But obviously, [daughter's name] reaction is much stronger to getting a little scratch from a puppy tooth and we can just go, it's just a little scratch, but for [daughter's name], little scratches are more painful or a bigger sensory experience."

"In the first two weeks, [dog's name] was sneezing phlegm balls out, and he hates having like anything gross on him. So, her sneezing all over him, luckily, it did stop after two weeks, but that added to it, like, he didn't really want to be near her in case she sneezed on him, so that was hard too, but who can plan for that?"

While the development of the relationship was often perceived as a time-consuming but worthwhile process, many participants expressed that the Family Dog Service provided support and advice that helped to build and maintain the relationship.

"The bond is growing, it's certainly progressing. The service has definitely helped, all the things like setting up at the beginning to help not put pressure on him and the relationship between them [...] it's definitely better because of the service, because it's helped me to introduce them in a certain way and I wouldn't have known how to do that."

“I think [the relationship] would have naturally occurred, but I think what it’s done, it’s sort of sped it up or just gave us a bit more insight into what’s possible. I think if we just got a dog and did normal puppy training, we would have seen benefits, just from having a dog who has an affectionate and sociable nature. But, what the Family Dog Service did, is kind of, help us realise what is possible and sped that up [...] I think it helps to, that sort of hand holding and being guided on the path of, this is what is possible with a family dog to support a child with autism.”

3.4. Experiences of the Family Dog Service Workshops

3.4.1. Motivation to Attend the Workshops

The majority of participants expressed that they were motivated to engage with the Family Dog Service as they had initially embarked on research relating to autism assistance dog placements. However, many parents identified barriers to these placements, including the expense, the strict criteria related to their child’s age and stage of diagnostic pathway, and the time taken to be matched with an appropriate assistance dog. Therefore, many participants spoke about how the Family Dog Service was an appropriate and beneficial alternative.

“We wanted to get a dog from a charity, fully trained, arrive on your doorstep, here I am, but because of lockdown, we kind of missed the boat on that as [son’s name] was getting too old. I think he was 10 by the time we made a definite decision, and most of them had shut their books. So, that was kind of like, if we’re going to do it, we’re going to have to do it ourselves. How can we do that? So, I looked what was available to try and understand if it was really doable because [son’s name] is quite challenging and a lot of hard work, so I wanted to make sure I was going to be able to manage that alongside looking after him as well.”

Other parents expressed that they signed up for the service to gain support and advice about introducing a dog into the family, especially for those who had no previous experience of dog ownership.

“We didn’t have any experience with dogs, we didn’t really know what we were doing. So, just having somebody to kind of support us and help set us up right, so we can get the right outcomes that would help, that would work for us, because it was a bit risky in the sense that like, it could go terribly wrong. The dog could just be barking all the time, and it could have a really negative impact, so it was kind of having the knowledge to know what we were doing to set her up, and set her up right, to support [son’s name].”

Additionally, all parents expressed that the workshops appealed to them as the workshop content was tailored to families with ASC, and that in itself was motivation to sign up.

“What I’ve found is, with an autism diagnosis, it’s like a full stop. You get your report, you have all this hype and so many years of building up to it, and then that’s it. We had to self-educate very much. One part of that was through a lot of Googling, what support can I get for my child with autism? [...] I went on their website and they’re very much family-oriented and work with families with autism. I almost wanted to cry with relief after finding them.”

3.4.2. Information Tailored to Families with ASC

All participants spoke about the value of the workshops offering information tailored to families with ASC. In particular, participants frequently expressed the benefit of discussing ways to avoid sensory overload, or the benefit of sensory feedback from dog-related activities.

“They talked about, the sound of the dogs, I mean, this is so specific, but the sound of the dog’s collar, the dog’s tag clinking against the dog bowl can be a sensory issue, and for us, that is definitely true. I hadn’t thought of it, but it definitely is, and so they explained that you don’t have to feed your dog that way. There are lots of different ways you can do it. You know, you can scatter feed, you can use a lick mat, it just absolutely blew my mind.”

“It’s definitely helped us to think about things and to see there are other ways of doing things, like the sort of sensory specific stuff, they did a really useful section on that [...] They talked about using a particular grooming tool so that your child gets sensory feedback from grooming, but also is good for the dog, you know, things I didn’t think about.”

Participants provided other examples of how the content was tailored to families with ASC, including support and strategies to facilitate the introduction of a new dog into a family unit with children with ASC.

“They talk about how to have a dog in the household when you’ve got a child who is autistic and how to help them to relate to the dog because they might not necessarily have that understanding. They said a few things that stuck in my mind, like having a collar or bedding that was related to the special interest of the child, so they felt like the dog was more connected to them.”

“They suggested to send [the breeder] audio clips of him having a meltdown so [the breeder] used to play them to the puppies when they were tiny, alongside washing machine noises and you know, the kind of normal socialisation bits that a good breeder might do. The first meltdown he had was the day after he arrived [...], he just trotted over to the same room as [son’s name], sat down next to him, and just didn’t even bat an eyelid. He was not fazed at all, and I think [son’s name] was so shocked by that because [dog’s name] had opted to be there, opted to be with him.”

In addition, the content to support parents to train the family dog ‘advanced task work’ was well received, as these skills would have a positive impact on the child with ASC.

“We did all the conventional training courses with our springer spaniel, but this is more for that interaction with the family, and you know, with the children with autism. Particularly the nose nudge and the head rest, those will be the techniques that are really helpful for children with autism, but you wouldn’t get that on a conventional training course.”

Many participants identified how the Family Dog Service may differ from a conventional dog training course. They expressed that the tailored content and support would likely not be provided in ‘traditional’ training, as the focus would be on training the dog rather than training the dog to support the child with ASC.

“It’s the understanding of the unique nature of autistic families, and how a lot of other training courses would just require you to make changes to how you behave and interact with the dog, for example, telling your children that they can do this, and they can’t do that, that just doesn’t work for us. We need somebody who understands that our children don’t work that way, and they might need, you know, tailored resources. It’s the fact they combine up to date modern, sympathetic training methods with the understanding of the particular challenges that our families face, combining the two together, it’s just amazing.”

Lastly, parents also appreciated how the service was tailored to families with ASC while still prioritising the welfare of the family dog, promoting the use of positive reinforcement, and treating the dog as an equal member of the family. This included considering the

dog's safety and wellbeing, especially when the child with ASC exhibited anxiety-related behaviours.

"It hugely helped us to prepare, knowing how to manage a dog during a meltdown, it was so important to get right from the start, so we don't scare [dog's name]. Thinking about giving him places to go to rest if [son's name] is wound up. They also taught us so much about socialising and dog behaviour which means I think we are getting more out of our dog than we would have."

"It was all about setting the dog up to succeed, like everything we did in those early stages taught her so much with regards to self-control and it just made it all work, it was just all the building blocks for her to succeed. I think because it was all positive reinforcement as well, it was just really nice and refreshing, it just really worked for us."

3.4.3. Access to Lifetime Support

All participants spoke about the value of the lifetime support offered by the Family Dog Service team. Many participants expressed how they had contacted the team between or upon completion of the workshops to seek additional advice or support and always received detailed responses which answered their queries and provided reassurance. Additionally, there was consensus among participants that these responses went above and beyond that of independent research due to the team's knowledge and expertise about both dog training and supporting families with ASC.

"The thing that was most attractive for all of it was how approachable the team were, and the fact they are always there if you've got a question. They were very clear, if at any point you need any support on training your dog, you've got any questions, no matter how daft, please get in touch with us, we will always help you. I think because autism is not something that is a static condition, knowing how hard it is to get any kind of support for an autistic child, it was beyond comforting to know that they were probably one of the few people I've ever spoken to where they'd actually said that, don't worry if things change, and as and when they change, we can help, we can always work with you, look at behaviours and see how we can build something in."

In addition to the ongoing support offered by the team, participants also have access to ongoing peer support via the private Facebook group. This forum was perceived as beneficial, as many participants expressed how 'comforting' it was to talk to other families with autistic children, and also to read realistic experiences of others in similar situations.

"I use the Facebook group a lot and I watch the chats and its helpful to see advice given for the future. It's also nice to have that connection with other families who have an autistic child, it's comforting."

"Unlike a lot of social media, it's not all just the positive highlight stuff, like people are putting on there, you know, not fails, but 'this isn't working', 'does anyone have any advice on this', so it's not a group that you go on where it's just going to make you feel like you've been rubbish at training your dog, because actually, it's a good balance."

4. Discussion

This qualitative study explored the experiences of families of children with ASC and their perceptions of the Family Dog Service and the perceived impact of human–dog interactions and relationships. Overall, findings indicate that companion dog ownership provided emotional and physical benefits and increased participation in activities and socialisation. Challenges associated with dog ownership were also discussed, but participants indicated that the guidance provided by the service helped to mitigate these difficulties and support the family. Parents appeared to have very positive perceptions of the service and were able

to implement strategies and techniques they had learned from the workshops to harness the full potential of a companion dog for their child and wider family network.

4.1. Impact of Companion Dog on Families with ASC

The current findings indicate the potential of companion dogs to improve child well-being while also positively impacting the wider family network. While previous research has reported that an important factor of assistance dogs is the ability to provide more specific, specialist task work compared to untrained companion dogs (Gravrok et al., 2020); the benefits of a companion dog outlined in this study are similar to those reported for autism assistance dog placements (Burrows et al., 2008; Shoesmith et al., 2024). Based on the current findings and the previous literature evaluating the impact of companion dogs on families with ASC (Grandgeorge et al., 2012; Wright et al., 2015b), it is plausible to suggest that these benefits may not directly occur due to the specialist training that an assistance dog has received. Rather, these outcomes may be related to the presence of the dog and the relationship that develops between the dog, the child with ASC, and the wider family network. While the development of the relationship will occur naturally over time (Hellings et al., 2022), participants in the current study noted that the Family Dog Service provided the foundation to introduce the child and the dog in a way that would facilitate a healthy and positive relationship. It is possible that via the acquisition of a trained autism assistance dog, organisations provide specific support to both the individual and the dog, whereas breeders and shelters may not. This variation in support may potentially contribute to differences in the perceived impact of the dog in different contexts (Gravrok et al., 2020). This aligns with our current findings, as parents frequently valued the lifetime support and guidance offered via the Family Dog Service, starting from the consideration of acquiring a companion dog. While we do not suggest in any way that companion dogs can replace the important role played by trained assistance dogs, future research should explore the differences between families with assistance dogs, those with companion dogs alone, and those participating in services like the Family Dog Service. This could provide deeper insights into how dogs can impact families with ASC and the mechanisms underpinning these outcomes in various contexts.

Additionally, participants highlighted the key considerations when selecting a dog that may impact how the child with ASC interacts with and develops a relationship with the dog. For example, ensuring dog characteristics match the sensory preferences of the child (e.g., type and length of coat) or considering the size of the dog (e.g., larger dogs for deep pressure therapy). The current findings suggest that these are important considerations that may not have been at the forefront of their decision-making if participants had not received the support and guidance from the Family Dog Service. Future research should further explore how families with ASC make decisions when selecting the dog breed, and whether certain dog characteristics may impact the perceived benefits of dog ownership.

Lastly, despite these perceived benefits, participants in the current study also reported some challenges. These primarily included the time and commitment associated with dog ownership and training, aligning with previous evidence (Carlisle, 2014). While it is important for prospective owners to consider these factors before acquiring a dog, it appeared that the support and advice provided by the Family Dog Service mitigated any negative feeling towards these challenges and supported parents during the early stages of ownership and beyond. Overall, these findings highlight the importance of the service, which provides a unique and alternative approach to those who may be unable to access an autism assistance dog for a range of reasons.

4.2. Experiences and Perceptions of the Family Dog Service

The context in which dog owners may access or be exposed to opportunities for education and support regarding their dog varies considerably. This can be through formal methods or approaches (e.g., veterinary consultations or training programmes). However, it is more likely that owners access information via informal methods (e.g., television programmes, social media platforms). This information may be unregulated, inaccurate, and could potentially influence the way a dog is trained and subsequently the welfare of companion dogs living in family homes (Philpotts et al., 2019). Inaccurate information might be due to the lack of understanding or misinterpretation of information related to dog ownership, its complexities, and the existing evidence base. An example of this still remains clear in existing dog training programmes, with the concept of the ‘alpha dog’ and negative forms of punishment still being used and encouraged by self-appointed dog behaviour experts (Philpotts et al., 2019). In the current study, participants valued the Family Dog Service approach that discouraged these types of training methods and promoted the use of positive reinforcement, treating the dog as an equal member, and prioritising the dog’s welfare.

In addition to this positive approach, participants expressed how beneficial it was to find a service that was family-oriented and tailored to work specifically with ASC. This was commonly cited as one of the most appealing features of the service and also motivated most participants to initially engage with the workshops. Many parents expressed how difficult it was to find support to assist their child with ASC following a diagnosis, so the team’s expertise and knowledge in both dog training and living with ASC was highly valued. Given the heterogenous nature of ASC, it is imperative that any training delivered to parents of children with ASC adopts a person-centred approach, rather than enforcing a ‘one size fits all’ structure (Roberts et al., 2023). This tailored approach was also reflected in the ongoing lifetime support offered by the Family Dog Service team, who acknowledge ASC is not a static condition, and every child will have unique experiences and challenges. This understanding of how ASC impacts the child and their family appeared to be a key factor for successful uptake and implementation.

The interactive nature of the workshops and access to a private Facebook group that offered the opportunity to communicate with other parents in a similar situation was also well received. Support from other parents was perceived as beneficial for both aspects related to dog ownership and difficulties associated with their child’s confirmed or suspected diagnosis. This aligns with previous research, as studies have reported that parents who received support from their peers felt heard, validated, and connected to others who have shared similar experiences (Batchelor et al., 2021; Lee et al., 2024; Sullivan-Bolyai & Lee, 2011). The support offered by other parents, alongside the ongoing support offered by the Family Dog Service team, also appeared to be a key facilitator for successful engagement.

4.3. Limitations

Firstly, self-selection bias may influence the current findings as parents who agreed to participate may have had different experiences than those who chose not to participate. It may be the case that those who had a positive experience of the service and/or introducing a companion dog to the home were more willing and motivated to express interest in participating. Therefore, the findings may not be generalisable to the entire cohort who have experienced the Family Dog Service. In the future, a larger sample would be required to demonstrate the effectiveness of the service, and whether the service results in positive impacts that may not be seen as a result of a companion dog without the additional support and guidance. Secondly, the sample was primarily limited to the inclusion of

mothers as only one father opted to participate. Fathers of children with ASC have been underrepresented in the literature and their perspectives may differ (Adkins et al., 2023). This gender imbalance is a commonly cited barrier in human–animal interaction research, and future, larger studies should actively seek to overcome this, e.g., by stratified sampling strategies. Thirdly, the service is accessible to families with children with ASC across a broad age range (3–16 years). While this is important for ensuring the service remains accessible to a diverse demographic of families with children with ASC, this range may also introduce variations in the benefits and challenges experienced by parents of young children compared to those of adolescents. Although no such differences were observed in the current data, further research with a larger sample of participants could provide valuable insights into whether distinct differences occur across different age groups. Lastly, interviews were only conducted with parents who had engaged with the Family Dog Service online since it was adapted from in-person workshops due to the COVID-19 pandemic. It would be beneficial to explore the benefits and challenges of this method of delivery and compare experiences to those who engaged with the service in person.

5. Conclusions

Companion dogs can have a positive impact on children with ASC and may be an important source of support for the wider family network. However, to harness the full potential of a companion dog, it is important for families to have access to educational and support programmes that provide guidance and strategies to facilitate a healthy, positive, and supportive relationship between the dog and the family. While the findings do not claim that companion dogs can replace the important role played by specialist trained assistance dogs, this service may provide a practical and valuable alternative in light of the restrictions and challenges often associated with securing assistance dog placements.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/bs15020162/s1>, S1: Interview topic guide.

Author Contributions: Conceptualization, E.R., S.G. and E.S.; methodology, E.R. and E.S.; software, E.S. and H.S.; validation, E.S., E.R. and S.G.; formal analysis, E.S. and H.S.; investigation, E.S. and H.S.; resources, E.S. and H.S.; data curation, E.S. and H.S.; writing—original draft preparation, E.S.; writing—review and editing, E.S., H.S., S.G., C.M., H.B., K.J. and E.R.; visualization, E.R., E.S. and S.G.; supervision, E.R.; project administration, E.S.; funding acquisition, E.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Tees, Esk and Wear Valleys NHS Foundation Trust Research Capability Funding Award. E.R., E.S. and H.S. are supported by the NIHR Yorkshire and Humber Applied Research Collaboration: <https://arc-yh.nihr.ac.uk/acknowledgements>.

Institutional Review Board Statement: Ethical approval for the study was granted by the Health Sciences Research Ethics Committee at the University of York, UK, on 21 November 2023 (ref: HSRGC/2023/596/B).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All relevant data are uploaded to the OSF repository and available via the following URL: <https://osf.io/6m3rh/> (accessed on 2 June 2024).

Acknowledgments: We would like to thank all parents who took part in this study.

Conflicts of Interest: S.G., C.M., H.B., and K.J. were involved in the design and/or delivery of the service evaluated in this study. However, these authors were not involved in the data collection, analysis, or interpretation of the data. All aspects of this study, including data handling and analysis, were conducted independently to ensure objectivity and minimise any potential conflicts of interest.

The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

- Abadi, M. R. H., Hase, B., Dell, C., Johnston, J. D., & Kontulainen, S. (2022). Dog-assisted physical activity intervention in children with autism spectrum disorder: A feasibility and efficacy exploratory study. *Anthrozoos*, 35(4), 601–612. [CrossRef]
- Adkins, J. R., Mulé, C. M., Linder, D. E., Must, A., Cash, S. B., & Foltz, S. C. (2023). Exploring health behaviors and the role of pet dogs in households with autistic children: The DANE study [Original Research]. *Frontiers in Pediatrics*, 11, 1153124. [CrossRef] [PubMed]
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (Vol. 5). American Psychiatric Association.
- Appleby, R., Wright, S., Williams, L., & Stanley, M. (2022). Australian parents' experiences of owning an autism assistance dog. *Health & Social Care in the Community*, 30(6), e4113–e4121.
- Batchelor, M., Maguire, S., & Shearn, J. (2021). "They just get it" an exploration of father's experiences and perceptions of a support group for men caring for children with disabilities and/or developmental delay. *Journal of Applied Research in Intellectual Disabilities*, 34(1), 263–273. [CrossRef] [PubMed]
- Ben-Itzhak, E., & Zachor, D. A. (2021). Dog training intervention improves adaptive social communication skills in young children with autism spectrum disorder: A controlled crossover study. *Autism*, 25(6), 1682–1693. [CrossRef]
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. [CrossRef]
- Burgoyne, L., Dowling, L., Fitzgerald, A., Connolly, M., Browne, J., & Perry, I. (2014). Parents' perspectives on the value of assistance dogs for children with autism spectrum disorder: A cross-sectional study. *BMJ Open*, 4(6), e004786. [CrossRef] [PubMed]
- Burrows, K. E., Adams, C. L., & Spiers, J. (2008). Sentinels of safety: Service dogs ensure safety and enhance freedom and well-being for families with autistic children. *Qualitative Health Research*, 18(12), 1642–1649. [CrossRef] [PubMed]
- Byström, K. M., & Persson, C. A. L. (2015). The meaning of companion animals for children and adolescents with autism: The parents' perspective. *Anthrozoos*, 28(2), 263–275. [CrossRef]
- Carlisle, G. K. (2014). Pet dog ownership decisions for parents of children with autism spectrum disorder. *Journal of pediatric nursing*, 29(2), 114–123. [CrossRef]
- Carlisle, G. K. (2015). The social skills and attachment to dogs of children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 1137–1145. [CrossRef] [PubMed]
- Galvany-López, P., Martí-Vilar, M., Hidalgo-Fuentes, S., & Cabedo-Peris, J. (2024). The impact of dog-assisted therapy among children and adolescents with autism spectrum disorder: A systematic review. *Children*, 11(12), 1499. [CrossRef] [PubMed]
- Grandgeorge, M., Tordjman, S., Lazartigues, A., Lemonnier, E., Deleau, M., & Hausberger, M. (2012). Does pet arrival trigger prosocial behaviors in individuals with autism? *PLoS ONE*, 7(8), e41739. [CrossRef] [PubMed]
- Gravrok, J., Howell, T., Bendrups, D., & Bennett, P. (2020). Thriving through relationships: Assistance dogs' and companion dogs' perceived ability to contribute to thriving in individuals with and without a disability. *Disability and Rehabilitation: Assistive Technology*, 15(1), 45–53. [CrossRef] [PubMed]
- Hall, S. S., Wright, H. F., & Mills, D. S. (2016). What factors are associated with positive effects of dog ownership in families with children with autism spectrum disorder? The development of the lincoln autism pet dog impact scale. *PLoS ONE*, 11(2), e0149736. [CrossRef]
- Hellings, D., Joosten, A., Hatfield, M., & Netto, J. (2022). Benefits and challenges of assistance dogs for families of children on the autism spectrum: Mothers' perspectives. *Qualitative Health Research*, 32(11), 1648–1656. [CrossRef] [PubMed]
- Hill, J., Ziviani, J., Driscoll, C., Teoh, A. L., Chua, J. M., & Cawdell-Smith, J. (2020). Canine assisted occupational therapy for children on the autism spectrum: A pilot randomised control trial. *Journal of Autism and Developmental Disorders*, 50(11), 4106–4120. [CrossRef] [PubMed]
- Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. *Journal of Child Psychology and Psychiatry*, 45(2), 212–229. [CrossRef]
- Hüsken, C. J., Peters-Scheffer, N. C., & Didden, R. (2022). A systematic review of dog-assisted therapy in children with behavioural and developmental disorders. *Advances in Neurodevelopmental Disorders*, 6, 1–10. [CrossRef]
- Hyman, S. L., Levy, S. E., Myers, S. M., Kuo, D. Z., Apkon, S., Davidson, L. F., Ellerbeck, K. A., Foster, J. E., Noritz, G. H., & Leppert, M. O. C. (2020). Identification, evaluation, and management of children with autism spectrum disorder. *Pediatrics*, 145(1), e20193447. [CrossRef] [PubMed]
- Kang, L., Liu, J., Liu, Y., Liang, W., Yang, F., & Liu, M. (2023). Global, regional, and national disease burden of autism spectrum disorder among children under 5 years from 1990 to 2019: An analysis for the Global Burden of Disease 2019 Study. *Asian Journal of Psychiatry*, 79, 103359. [CrossRef] [PubMed]

- Lee, J. D., Terol, A. K., Yoon, C. D., & Meadan, H. (2024). Parent-to-parent support among parents of children with autism: A review of the literature. *Autism*, 28(2), 263–275. [CrossRef] [PubMed]
- Leung, J. Y.-L., Mackenzie, L., & Dickson, C. (2022). Outcomes of assistance dog placement in the home for individuals with autism spectrum disorder and their families: A pilot study. *Australian Occupational Therapy Journal*, 69(1), 50–63. [CrossRef] [PubMed]
- London, M. D., Mackenzie, L., Lovarini, M., Dickson, C., & Alvarez-Campos, A. (2020). Animal assisted therapy for children and adolescents with autism spectrum disorder: Parent perspectives. *Journal of Autism and Developmental Disorders*, 50(12), 4492–4503. [CrossRef] [PubMed]
- Lumivero. (2020). *About NVivo*. Available online: <https://help-nv.qsrinternational.com/14/win/Content/about-nvivo/about-nvivo.htm> (accessed on 2 December 2024).
- Meints, K., Brelsford, V. L., Dimolareva, M., Marechal, L., Pennington, K., Rowan, E., & Gee, N. R. (2022). Can dogs reduce stress levels in school children? Effects of dog-assisted interventions on salivary cortisol in children with and without special educational needs using randomized controlled trials. *PLoS ONE*, 17(6), e0269333. [CrossRef]
- Nieforth, L. O., Schwichtenberg, A., & O’Haire, M. E. (2021). Animal-assisted interventions for autism spectrum disorder: A systematic review of the literature from 2016 to 2020. *Review Journal of Autism and Developmental Disorders*, 10, 255–280. [CrossRef]
- Philpotts, I., Dillon, J., & Rooney, N. (2019). Improving the welfare of companion dogs—Is owner education the solution? *Animals*, 9(9), 662. [CrossRef]
- Roberts, M. Y., Sone, B. J., Jones, M., Grauzer, J., Sudec, L., Stern, Y. S., Kwok, E., Losh, M., & Kaat, A. (2023). One size does not fit all for parent-mediated autism interventions: A randomized clinical trial. *Autism*, 27(2), 443–455. [CrossRef] [PubMed]
- Shoesmith, E., Gibsone, S., Bracher, E., Smolkovič, I., Jennings, K., Viles, L., Easton, K., & Ratschen, E. (2024). The impact of living with assistance dog placements on quality of life in children and adults with autism spectrum disorder or a physical disability: A longitudinal service evaluation. *Human-Animal Interactions*. [CrossRef]
- Solmi, M., Song, M., Yon, D. K., Lee, S. W., Fombonne, E., Kim, M. S., Park, S., Lee, M. H., Hwang, J., & Keller, R. (2022). Incidence, prevalence, and global burden of autism spectrum disorder from 1990 to 2019 across 204 countries. *Molecular Psychiatry*, 27(10), 4172–4180. [CrossRef] [PubMed]
- Starkweather, M., Germain, A. E., & Kivlen, C. A. (2024). Pawsitive purpose: The impact of autism assistance dogs on the occupations of autistic children. *The Open Journal of Occupational Therapy*, 12(3), 1–10. [CrossRef]
- Sullivan-Bolyai, S., & Lee, M. M. (2011). Parent mentor perspectives on providing social support to empower parents. *The Diabetes Educator*, 37(1), 35–43. [CrossRef] [PubMed]
- Tseng, A. (2023). Brief report: Above and beyond safety: Psychosocial and biobehavioral impact of autism-assistance dogs on autistic children and their families. *Journal of Autism and Developmental Disorders*, 53(1), 468–483. [CrossRef]
- Walsh, F. (2009). Human-animal bonds II: The role of pets in family systems and family therapy. *Fam Process*, 48(4), 481–499. [CrossRef] [PubMed]
- Wright, H., Hall, S., Hames, A., Hardiman, J., Burgess, A., PAWS Project Team, Mills, R., & Mills, D. (2016). Effects of pet dogs for children with Autism Spectrum Disorders (ASD) and their families: Expectations versus reality. *Human-Animal Interaction Bulletin*, 44(2), 179–186. [CrossRef]
- Wright, H., Hall, S., Hames, A., Hardiman, J., Mills, R., & Mills, D. S. (2015a). Acquiring a pet dog significantly reduces stress of primary carers for children with autism spectrum disorder: A prospective case control study. *Journal of Autism and Developmental Disorders*, 45(8), 2531–2540. [CrossRef] [PubMed]
- Wright, H., Hall, S., Hames, A., Hardiman, J., Mills, R., PAWS Project Team & Mills, D. (2015b). Pet dogs improve family functioning and reduce anxiety in children with autism spectrum disorder. *Anthrozoos*, 28(4), 611–624. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

Pawsitive Impact: Measuring the Dog Mentor's Effect in Neurodivergent Students

Mirena Dimolareva ^{1,*}, Ella Doolan-Dransfield ², Jenny Duckworth ³, Victoria L. Brelsford ¹, Kerstin Meints ¹ and Nancy R. Gee ^{4,5}

¹ School of Psychology, Sport Science and Wellbeing, University of Lincoln, Lincoln LN5 7AY, UK; vbrelsford@lincoln.ac.uk (V.L.B.); kmeints@lincoln.ac.uk (K.M.)

² Division of Psychology and Language Sciences, University College London, London WC1E 6BT, UK; ella.doolan-dransfield.23@ucl.ac.uk

³ The Dog Mentor, Rochester ME3 8RU, UK; jen@thedogmentor.co.uk

⁴ Center for Human-Animal Interaction (CHAI), Virginia Commonwealth University, Richmond, VA 23298, USA; nancy.gee@vcuhealth.org

⁵ Department of Psychiatry, Virginia Commonwealth University, Richmond, VA 23298, USA

* Correspondence: midimolareva@lincoln.ac.uk

Abstract

Children diagnosed with autism face many barriers to learning. Animal Assisted Services and Interventions (AAS/AAI) have been adopted to support children within schools. The Dog Mentor is a UK-based organisation that provides training for handlers and assesses dogs to be integrated within schools. It adopts a rigorous and continuous training package and ensures the safety and welfare of all involved by adopting a whole school approach. This research uses content analysis to understand the types of activities and outcomes in The Dog Mentor programme, as established by teachers and dog handlers, across 58 schools. Teachers and dog handlers perceived that The Dog Mentor successfully supported children with autism, using a variety of sessions. This variability is seen as a benefit as it enables the intervention to be tailored to meet the needs of the students. Handler-reported benefits include creating a calm environment, promoting engagement, and supporting learning. Improved self- and emotion regulation, mental health, and resilience were also noted by the handler reports. Future research needs to investigate these perceived benefits using quantitative data, as well as look into outcomes relating to the dogs supporting others with bereavement and trauma. This topic was briefly mentioned by two of the schools, but there was not enough data to understand the impact in depth.

Keywords: autism; education; school; Animal-Assisted Services and Interventions; dogs

1. Introduction

Neurodivergent people experience and interact with the world differently than neurotypical individuals, owing to how they process information, resulting in a difference with learning, behaviour, and daily tasks (National Autistic Society, 2025; Benderix et al., 2006). Neurodivergent conditions cover a wide spectrum of abilities and challenges that individuals face, including Autism Spectrum Disorder (ASD) (McGee, 2012). Within the UK, one in 100 people is on the autism spectrum, a lifelong neurodevelopmental condition, varying in severity and characteristics (National Autistic Society, 2025; CDC, 2024). For children diagnosed with autism, difficulties in communication and delays in development are witnessed, with recommended early interventions (Landa, 2007; Cheng et al., 2023). Yet delays in

diagnosis due to long waiting lists are common within the UK (British Medical Association, 2024). Upon diagnosis, further delays are experienced when obtaining an Educational Health Care Plan (EHCP), which is essential for outlining the child's needs in relation to sensory sensitivities, communicative difficulties, and challenging behaviours, creating significant barriers to learning (McDougal et al., 2020; Naznin et al., 2023). The deadline for completion of an EHCP is 20 weeks, but only half are issued within this timeframe (UK Parliament, 2024). These delays deny the opportunity for the recommended early intervention and support, essential for removing barriers to facilitate children's learning (British Medical Association, 2024; Machelicek et al., 2007).

To facilitate learning, schools utilise a variety of support strategies and interventions, such as social stories to teach social skills and change the learning environment, aiming to engage the child and enhance learning (Gray & Garand, 1993; Machelicek et al., 2007). More recently, the use of Animal-Assisted Services and Interventions (AAS/AAI) has become more popular. Improvements in autism symptoms, social interaction, social functioning, and communication in children on the autism spectrum have been demonstrated (Dimolareva & Dunn, 2021; Meints et al., 2022; Sissons et al., 2022; Gabriels et al., 2015, 2018). Within educational settings, school staff have positive perceptions of the implementation of AAIs to support mental health (Leos et al., 2022). AAS/AAs have shown to improve psychological, social, and academic outcomes, creating a positive school environment, with dogs assisting students in regulating their emotions and behaviours, yet outcomes relating to improvement of social skills have been mixed (Zents et al., 2017; Baird et al., 2023; Wintermantel et al., 2024; O'Haire et al., 2014; Anderson & Meints, 2016). Furthermore, there is significant variability in AAS/AAI sessions, including the structure within the sessions and frequency per week and overall duration (Heimlich, 2001; Somervill et al., 2009; Limond et al., 1997; Martin & Farnum, 2002). Though variations can be beneficial, to address various needs, it makes generalisation and guidance around effectiveness difficult.

The Dog Mentor is a UK-based organisation that assesses school dogs and provides training for handlers and wider academic support to integrate animals within the curriculum delivery. Over 600 schools are registered with the organisation, which all employ a whole school approach to ensure the well-being of the dog is not compromised. This includes the use of strategies to regulate children's behaviour and a set way to behave throughout the school, regardless of whether the dog is currently there. For instance, at lunch, children take extra care not to drop food, as this can make the dog sick if they consume it. Another example is the children are taught "Dog Mentor breathing", which gets them to think about their breathing, de-escalating a behaviour, and helping them to physically regulate in a challenging situation. The training for all staff working with the dog mentors is based on positive reward, empathy, respect for the animal, and children's self-regulation prior to interaction. As part of the registration, a rigorous risk assessment is completed, specific to the educational environment and dog(s). The registered schools also have access to dog-related materials and activities they can integrate into their curriculum. Meanwhile, there is flexibility for school staff to incorporate the work with the dogs as necessary providing the overall risk assessment is followed. This is a key element of The Dog Mentor to ensure the safety of all and optimal outcomes. As the programme has grown, schools have shared many case studies of impact that the dogs have had. The variability seen in the research field is also evident within The Dog Mentor, but here, we have a large sample of schools that follow the same basic principles. As a result, we are able to develop research and look at different aspects of the AAS/AAI and their effectiveness. For a first qualitative evaluation of the impact of the programme, the current paper presents questionnaire data from the schools that have incorporated work with the dogs

for their children on the autism spectrum. Content analysis has been used to answer the following questions:

1. To what extent is The Dog Mentor effective at reducing the symptoms experienced by children on the autism spectrum?
2. How can The Dog Mentor be integrated to effectively reduce the symptoms experienced by children on the autism spectrum?
3. To what extent is The Dog Mentor effective at facilitating learning for children on the autism spectrum?

2. Materials and Methods

2.1. Data Collection

The Dog Mentor team regularly contacts the schools within the programme to keep updated on the work that is ongoing and to provide support with any challenges and additional materials for lessons. One questionnaire the schools received related to the work and challenges of incorporating the dog into the educational process with diagnosed and undiagnosed neurodivergent children. The data was anonymised by JD (founder of The Dog Mentor) and sent to the research team for analysis.

The Dog Mentor aims to support schools in incorporating dogs within their settings. As a result, it is driven by the needs of the school, and there is no typical length or duration of each setting. Some schools have had their dog only when a specific need arises- for example, a bereavement in the family resulting in a child struggling to go to school, so the dog has been included in the routine to support the child in going to school. On the opposite end of the scale, some dogs are in school daily (and some schools have more than one dog) and have a timetable with different activities and rest periods. Here, it is also vital to note that the activity of the dog depends on the age, personality, and energy of the dog, too. This is part of the initial assessment and is reviewed regularly to ensure dogs are not overworked. In addition to that, The Dog Mentor is adaptive in nature, so more guidance is added when challenges occur. For instance, the safety of the dog is paramount, so there are clear instructions on how to lead a dog down a corridor and through fire (and other) doors, to ensure the dog is not either stroked by children/crowded or trapped/hurt by a door.

2.2. Participants

Fifty-eight schools responded to the questionnaire, including primary schools ($n = 30$), Special Educational Needs schools (SEN)/Specialist Provision ($n = 12$), secondary schools ($n = 9$), through schools which include nursery to 18 years ($n = 3$), primary schools with nursery schools ($n = 2$), infant schools ($n = 1$) and a primary and secondary school ($n = 1$). No individual-level diagnostic, severity, or demographic data were collected for specific children. Respondents answered based on their experience with students whom they understood to be on the autism spectrum and/or otherwise neurodivergent, including both formally diagnosed and undiagnosed pupils. All responses were provided by the dog handlers, who are employed by the school, and being a handler is an additional role to their primary job (e.g., teaching assistant, teacher, SENCO). One respondent was from the finance department of the school, but the remaining respondents ($n = 57$) were all teaching staff. All respondents therefore had a good understanding of the outcomes they had seen in the children with a variety of interventions, including the Dog Mentor and other non-animal related interventions, for comparison. No financial incentive was provided, and the questionnaire was only sent once to avoid pressuring respondents.

2.3. Questionnaire

The questionnaire was developed by the Dog Mentor team, and the respondents did not have to answer all the questions. At the end of each question below, we have indicated how many of the handlers responded to each question. The questionnaire included the following questions:

- Have you been able to use your Dog Mentor(s) to achieve any of the following: when you have worked with children with autism or undiagnosed neurodiversity? The options were based on the training provided by The Dog Mentor and were: reducing stress and anxiety; promoting a more productive environment for learning; curriculum support; help with social interactions; build long term rapport; promote empathy and a caring attitude within school; teaching responsibility; teaching and creating positive body movements; supporting with communication; teaching self-care and life skills; develop and establish acceptance understand constructive criticism; self-awareness; self-regulation; empathy; focus and on task behaviour; resilience; dissolve attachment seeking behaviour; exploring ideas, environments, subjects; support with sensory issues; support with daily structure and routines; support with making mistakes and natural consequences; support with restoring relationships after challenging situations; promote positive authentic environments; promoting relaxed classrooms; improve engagement; positive environment (58/58 responses)
- Thinking specifically of the children with autism that your Dog Mentor has been involved with, what activities did the dog participate in? (57/58 responses)
- Thinking specifically of the children with autism that your Dog Mentor has been involved with, can you provide more details on the aims of the activities you completed? (52/58 responses)
- Do you think the dog has been useful in achieving the goals you set out to achieve when working with the children with autism? (55/58 responses) Please let us know why you chose the above answer. (49/58 responses)
- What would you say the biggest challenge was when incorporating the Dog Mentor within the tasks with children with autism? (53/58 responses)

The aim was to keep the questionnaire brief, with open-ended questions so all respondents could provide as much detail as they felt was necessary. This also ensured that even if teachers had little time, they could still provide some information on the work they were doing. It is also important to note that not only did respondents not have to answer all questions, but not all schools that are part of The Dog Mentor completed this questionnaire. This may have been due to them not including the dogs to work with neurodivergent children, or because they have not seen a benefit in doing so, and, therefore, felt they did not have anything to share. As the current questionnaire is framed to ask for best practice in order to find out 'what works', it is likely that we have more positive responses in the effectiveness of The Dog Mentor within the neurodivergent population. However, this allows us to explore this avenue and provide guidance to schools, as well as complete a larger-scale evaluation of the effectiveness of this work. This will be incorporated in later research with a larger, more scientifically rigorous design.

2.4. Analysis and Coding

Two researchers (EDD and JD) analysed the data via content analysis, following a four-step procedure. Raw data was read through to understand the contexts of the data before a hybrid coding approach was undertaken. Deductively, a tally was completed for results gained for question one to assess the frequency of responses, and inductively, new codes were developed from the raw data for the remaining questions. Codes were then grouped together through content relationship, creating sub-themes, and additionally

tabulated for frequency. Finally, sub-themes were grouped together in similarity, creating overall common themes.

Intercoder Reliability

The data were independently coded by two of the authors trained in content analysis (EDD, JD), one with further training in qualitative methods (EDD–MRes in Social Research). Themes uncovered were compared and achieved a percent agreement of 90% inter-rater reliability. Trauma and loss support was selected as a possible theme by JD, but due to the infrequency of mentions (seven total occurrences across two schools), its exclusion was agreed upon by the coders in the final write-up. The team agreed that this theme should be explored in future research to understand the impact of AAS/AAI for children on the autism spectrum experiencing trauma and loss.

3. Results

Almost all the schools (93%) reported The Dog Mentors' usefulness in achieving their aims in supporting children on the autism spectrum, utilising a variety of interventions (Table 1), and improving three key areas: learning, mental health, and relationships.

Table 1. The frequency of schools (N = 58) using The Dog Mentor intervention techniques.

Intervention	Frequency	Success Rate
Therapeutic approach (regulation support, ELSA)	40	85%
One-on-one (individual support)	25	84%
Curriculum support (reading support)	23	86%
Meet and Greet (gate duty, helping students into school)	20	95%
Group/class sessions (classroom support)	16	87%
Transitions (changing classes, leaving school)	12	91%
Praise and Reward (positive reward for behaviour)	11	100%
Responsibilities (walks, filling water bowl)	10	100%
Own timetable (set schedule for dog)	8	62%
Free roam/access (free access to the dog for students)	6	66%
Playground access (dog available at breaktime)	2	100%

3.1. Theme 1: Facilitated Learning

All of the schools reported an improvement in learning with the dog mentors, creating a positive environment and supporting overall learning.

3.1.1. Subtheme: Creating a Positive Environment

The most commonly reported aspect related to facilitating learning surrounded creating a positive environment for children on the autism spectrum. The dog mentors (dog and handler teams) achieved this through positive projection of behaviour and communication, building long-term rapport and promoting a relaxed classroom environment. Creating this positive environment was achieved by the dog mentors in the majority of schools (84%), with one school sharing, "by showing that the dog mentor is willing to enter unfamiliar environments, students model that. . . this can then be transferred to their own concerns and anxieties". There were frequent mentions of how building long-term rapport (70%) helped the children to trust their dog mentor, helping them attend school. For instance, one

school shared, “We have one child with ASD that we have been working with for about one year, and they refuse to attend school. More recently, they have attended school for about 1 h two times a week, and while on the school site, they sit with [the dog mentor]. A similar frequency highlighted how the dog mentors helped promote relaxed classrooms (70%) with dog mentors “providing a steady, non-judgemental presence” in class and helped to settle their pupils with “a calming presence which brings comfort to the students working in there”. Over half the schools agreed that the dog mentors promoted a more productive environment for learning for their students (58%), through creating a comfortable environment, having a “positive impact on children involved” with improved attendance specifically noted.

3.1.2. Subtheme: Supported Learning

The schools reported how the dog mentors supported learning through improving engagement, focusing on tasks, and curriculum support. The majority of schools (75%) shared how the dog mentors improved engagement amongst children on the autism spectrum by creating a calm environment, “[allowing] them to engage in their learning environment more fully”, with schools reporting “significant positive outcomes of engagement in activities”. Likewise, just over half the schools (53%) reported improvement when focusing on the tasks when the dog mentor was in the classrooms with the children. They reported that the dog mentors “offered some one-on-one time as a reward” for completing tasks, which has proven useful “when no other incentives work”. Just under half of the schools (44%) were additionally able to involve the dog mentors in curriculum support, with one school making treats for their dog mentor, with ingredients “[needing] to be measured and weighed using mathematical skills in the process. This was enjoyed by the child immensely”, and another school encouraging children “to read to the dog, to help gain confidence”, with the dog being a non-judgemental listener, which likely reduced children’s anxiety about trying to read.

3.2. Theme 2: Mental Health

3.2.1. Subtheme: Emotional Management

The most commonly reported aspect regarding mental health was how the dog mentors helped children regulate their emotions, with the majority of schools (88%) teaching ‘self-regulation through co-regulation’, which included the dog (the respondents did not mention the impact of the handler, although this may, of course, impact the observed outcomes). This improved regulation was perceived as preventing emotional outbursts, “where often [they] would have exploded,” as a result, helping the student to calm down quicker when working with the dog mentor. For instance, students are able and willing to take movement breaks or “time out of class to spend time with the dog mentor” to self-regulate. In addition to the child controlling their emotions and behaviour, during the encounter with the dog, a learning opportunity to build awareness and teach the child about the dog’s needs, “aware they have to be calm around the [dog mentor]”, also teaches the child perspective taking and further embeds the importance of their ability to regulate. By enabling children to self-regulate, they are spending more time in the classroom and on the curriculum-related tasks set. Another perceived benefit by school staff resulting from the time spent with the dogs and the improvement in self-regulation is the children’s improvement in understanding constructive criticisms (30%) (as they are more able and willing to engage in discussion), and half the schools also reported an increase in resilience (53%) with children “having much calmer days knowing [the Dog Mentor] is in school”.

In addition to the improved self-regulation and related benefits, nearly all of the schools (98%) reported how the dog mentors helped reduce stress and anxiety amongst the

students, evident in different transition-related situations that occur within the educational setting. For instance, the dog mentor “accompanies a student to a new classroom or unfamiliar setting”. This is one of the anecdotally discussed benefits of the dog-handler teams who are part of The Dog Mentor programme. As a result, the organisation has guidelines on how to conduct meet and greet sessions at the school gates and transitioning between classrooms safely, ensuring the welfare of the dog (no crowding/scaring the dog). In addition to stress and anxiety reduction during periods of transition, the dogs have had a similar impact on students during daily lessons, as the presence of the dogs has acted as a positive addition to the classroom, resulting in “fewer signs of stress and anxiety”. Furthermore, during exams, when students are particularly anxious and stressed, having the dogs present has allowed students to “have a break [meaning they] can return positively” and complete the assessment to the best of their ability. Although this is based on staff perception of the impact of the dogs on the students on the autism spectrum, it is based on differences that are evident to the individuals who know the child well. As a result, more rigorous research, with physiological measures (of stress) need to be conducted, which will in turn indicate the overall level of impact (i.e., is it a minimal or large reduction in stress and is it statistically or clinically significant).

3.2.2. Subtheme: Support with Daily Life

Schools reported how the Dog Mentors helped support the children’s essential skills beyond school, which contributes to their growth and development. For instance, the dog mentors supported with daily structure and routine (70%), such as “meeting children at the start of the day” and “movement breaks”. The dog mentor was also involved in teaching the children responsibility (60%), “making sure the dog’s needs were fulfilled,” such as food and water bowls being full, and having increased self-awareness (46%), knowing they “must be calm around the dog”. Less commonly reported was how the dog mentor was involved in the teaching of self-care and life skills (46%) as children modelled the behaviour and related to what the dog needs to do and how that relates to what they need to do. This resulted in the staff perceiving improved outcomes in pupils understanding their own behaviour better, developing and establishing acceptance (36%), making mistakes (41%), and support with sensory issues (48%). Sensory issues were observed on a needs basis, such as one child who sought the dog mentor throughout the day as they found playtime “overwhelming”, but with some children avoiding the dog mentor when the dog was wet due to the smell of the dog and the feeling of their fur.

3.3. Theme 3: Healthy Relationships

3.3.1. Subtheme: Communication

The dog mentors encouraged children’s communication, and this was reported to have increased. The majority of schools indicated that the dog mentors helped with social interactions (86%), “encouraging turn-taking and social interactions in structured play”. The adaptability of the dog mentors to each child helped to “reduce stimming behaviours and increase communication”, helping the children to feel better understood due to the improved ability to communicate. Furthermore, the use of praise and awards while interacting with the dogs additionally supported the children in communicating with others (69%), such as one child who asked in a full sentence to see their dog mentor, promoting their speech. The therapeutic environment that the dog mentors provided additionally enabled another school to encourage their students on the autism spectrum who also had mutism to speak, providing calmness to reduce the children’s anxiety. The dog mentors helped in breaking down communicative barriers, which helped teachers and staff better communicate with all students with additional needs. Teaching and creating

positive body movements was also highlighted within the schools (44%); however, some schools (36%) raised concerns about keeping the dog mentors safe from the unpredictability of the behaviours expressed by the pupils on the autism spectrum, reinforcing being gentle and not grabbing the dog mentor or screaming. Though the dogs were tolerating the noise, it is important that they are not placed in situations where they have to tolerate unpleasant noise and behaviour. This is in line with The Dog Mentor training, which attempts to minimise these situations to ensure the dog's well-being.

3.3.2. Subtheme: Developing Empathy

One of the largest reported aspects achieved by The Dog Mentors was the ability to promote and help the teachers to teach children on the spectrum about empathy, both within school (84%) and more generally (81%). For instance, one school noted how they involved the Dog Mentor: "talking about how [the Dog Mentor] showed us their feelings and emotions and then the similarities and differences". Another school noted how the children "who visit their dog mentor on a regular basis developed more empathy and a calmer manner", as well as another school noting how their students have an "increased care for others". However, one school raised concerns about engagements where their student's developmental level did not meet their chronological age, not engaging as well as others. It is possible that dog mentors may be best suited for children who are developing as expected for their chronological age, if the dogs are seen as a distraction by some children with greater developmental delays. On the other hand, it may be that over time, the dogs can support children with a significant delay, but different strategies need to be implemented. It is difficult to draw conclusions, and further, in-depth research looking at the intervention structure, length, and duration per session, as well as the child's profile and areas of delay need to be explored.

4. Discussion

According to dog handler reports, The Dog Mentor successfully supported children with autism, using a variety of sessions, experiencing teacher-reported fewer autism-related challenges in the classroom environment. This may indicate a reduction in autism symptoms as assessed by diagnostic tools, in line with previous research (e.g., Dimolareva & Dunn, 2021), but a thorough investigation with these measures is needed to assess this with confidence. Different interventions were likely to arise due to the spectrum of characteristics autism presents, creating differing needs for each individual. This is evident within the work of the schools registered with The Dog Mentor, and this research in particular, as the schools have highlighted that they employ a different structure of sessions. This is also in line with previous research, which has compared outcomes for one-to-one therapeutic sessions and whole class engagements (CDC, 2024; Heimlich, 2001; Somervill et al., 2009). Previous concerns relating to the variability of interventions emphasised the difficulty in assessing the effectiveness and generalising the findings. However, school staff participating in this research emphasised the need for variability within AAs to suit the different needs of children and therefore optimise any potential benefits, such as learning and emotion regulation (Limond et al., 1997; Martin & Farnum, 2002).

For instance, school staff reported that meet and greet activities encouraged children to enter schools and created positive, calm environments, promoting engagement and supporting learning. Creating this optimal environment for learning is usually expensive, but an essential step in removing a major barrier to learning for children on the autism spectrum (Naznin et al., 2023; Zents et al., 2017; Baird et al., 2023). Therapeutic interventions from The Dog Mentor, such as regulation support, improved the children's mental health, providing structure to their daily life, encouraging resilience within school, which actively

contributed to their own personal growth (see also Wintermantel et al., 2024). The Dog Mentor additionally helped support school staff in their understanding and teaching of the children, such as using praise and reward techniques, helping enhance empathy towards peers, and improving communication of needs. This further facilitates learning, providing more evidence of improved social skills through better communication and empathy development within a classroom setting (Leos et al., 2022; O'Haire et al., 2014).

Unlike in previous research, where a set plan was followed by the researchers, The Dog Mentor adapted to the environment and the needs of each school and their structure, highlighting the flexibility of The Dog Mentor programme to facilitate learning in children on the autism spectrum, despite their differing experiences in learning (Benderix et al., 2006). These findings show that with The Dog Mentors' training based on positive reward, empathy, respect for the animal, including encouraging children's self-regulation prior to interaction, improvements in learning, mental health, and encouragement of healthier relationships were observed by teachers and Dog Mentor staff.

5. Limitations

Although these findings are promising and shine light on the types of outcomes that seem to be improved because of The Dog Mentor's dogs and handlers, it is important to treat them with caution. The findings are based on the perception of handlers, and as a result, the data are subjective and qualitative. Furthermore, the initial checklist asked respondents to indicate which positive outcomes they had achieved (e.g., reduced stress, improved engagement), without offering neutral or negative outcomes, which may have further biased the responses towards the perceived benefits. The data were collected by asking any of the enrolled schools to complete the questionnaire if they wished to do so, with no incentive, to ensure handlers were not forced to participate. Of the 600+ schools, 58 responses were collected. This may have resulted in the exclusion of some schools (e.g., fewer staff, higher level of challenges within their children), which would raise the question of whether the data is representative of all schools. Furthermore, likely, the handlers who did not see a benefit or had not included the dogs with neurodivergent students did not complete the questionnaire, as if they felt they did not have anything to share. As a result, we may see more positive findings in these outcomes. Although these findings show promise, it is important to assess whether this effectiveness is seen through more schools and assess how long it takes to see the differences in a standardised measure, with a more scientifically rigorous design. With this in mind, it is important to take these exploratory findings with caution. For the research team, these initial findings will guide our planning of a larger, rigorous research plan to evaluate The Dog Mentor's impact across schools. Within our future research, we will select standardised questionnaires to rigorously assess the perceived improvements stated here. Future research will ensure more support for the schools to participate and a longer time frame for schools to engage in the research.

6. Conclusions

This qualitative research indicates that The Dog Mentor staff have found the dogs to facilitate learning when integrated within a wider education curriculum provided for children on the autism spectrum. This perceived support may remove some barriers to learning through the promotion of more adaptive behaviours. These handler-stated behaviours include improved self-regulation, wellbeing and communication, as well as reduced anxiety around transition into school. This was observed by children having increased attendance at schools through the support of the dogs during periods of transition.

Through a variety of different sessions, the dogs were perceived to have facilitated learning, potentially developing children's emotional self-regulation and relationships

with others. The findings from this study have added to knowledge about AAS/AAI for children on the autism spectrum in schools, highlighting the potential importance of variety and flexibility for dog-assisted support for meeting individual needs.

Future research should investigate the use of AAS/AAI for neurodivergent children experiencing trauma and loss, outside and within learning environments. Though not a common finding within this research, it was highlighted within responses from two schools how a dog mentor can help children with bereavement and trauma support. Not only does trauma directly impact learning, but childhood trauma is associated with an increased risk of suicide. This is a particular concern as people on the autism spectrum are at a higher risk of suicide (Steane, 2019; Yao et al., 2023; Newell, 2021). Due to the small number of occurrences in this study, future investigation into how The Dog Mentor may be suited to support children who have experienced trauma should be undertaken, potentially finding effective ways of support.

Author Contributions: Conceptualization, M.D., J.D., V.L.B., K.M., and N.R.G.; methodology, M.D., J.D., E.D.-D., V.L.B., K.M., and N.R.G.; formal analysis, E.D.-D., and J.D.; resources, J.D.; data curation, J.D., M.D., and E.D.-D.; writing—original draft preparation, M.D., and E.D.-D.; writing—review and editing, M.D., E.D.-D., J.D., V.L.B., K.M., and N.R.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the British Psychological Society Ethics Guidelines and approved by the University of Lincoln Ethics Committee (UOL2025_20689, 6 March 2025).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Upon publication of the paper, anonymous data will be available on the University of Lincoln Repository.

Acknowledgments: Thank you to all schools, handlers, owners, dogs, and children who are involved with The Dog Mentor for their continued support and work to ensure everyone benefits from these human–animal interactions. Special thank you to the teachers and handlers who gave up their time to complete the questionnaire and provide their insight into the benefits and challenges of working with the Dog Mentors.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- 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. [CrossRef]
- Baird, R., Berger, E., & Grove, C. (2023). Therapy dogs and school wellbeing: A qualitative study. *Journal of Veterinary Behavior*, 68, 15–23. [CrossRef]
- Benderix, Y., Nordstrom, B., & Sivberg, B. (2006). Parents' experience of having a child with autism and learning disabilities living in a group home: A case study. *Autism*, 10(6), 629–641. [CrossRef]
- British Medical Association. (2024). *Autism spectrum disorder*. British Medical Association. Available online: <https://www.bma.org.uk/media/2058/ehcs-briefing.pdf> (accessed on 10 October 2025).
- CDC. (2024, May 16). *Signs and symptoms of autism spectrum disorder*. Autism Spectrum Disorder (ASD).
- Cheng, W. M., Smith, T. B., Butler, M., Taylor, T. M., & Clayton, D. (2023). Effects of parent-implemented interventions on outcomes of children with Autism: A meta-analysis. *Journal of Autism and Developmental Disorders*, 53(11), 4147–4163. [CrossRef]
- Dimolareva, M., & Dunn, T. J. (2021). Animal-assisted interventions for school-aged children with Autism Spectrum Disorder: A meta-analysis. *Journal of Autism and Developmental Disorders*, 51(7), 2436–2449. [CrossRef] [PubMed]
- Gabriels, R., Pan, Z., Dechant, B., Agnew, J., Brim, N., & Mesibov, G. (2015). Randomized controlled trial of therapeutic horseback riding in children and adolescents with Autism Spectrum Disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 54(7), 541–549. [CrossRef] [PubMed]

- Gabriels, R., Pan, Z., Guerin, N., Dechant, B., & Mesibov, G. (2018). Long-term effect of therapeutic horseback riding in youth with Autism Spectrum Disorder: A randomized trial. *Frontiers in Veterinary Science*, 5, 156. [CrossRef]
- Gray, C., & Garand, J. D. (1993). Social stories: Improving responses of students with autism with accurate social information. *Focus on Autism and Other Developmental Disabilities*, 8(1), 1–10. [CrossRef]
- Heimlich, K. (2001). Animal-assisted therapy and the severely disabled child: A quantitative study. *Journal of Rehabilitation*, 67(4), 48–54.
- Landa, R. (2007). Early communication development and intervention for children with autism. *Mental Retardation and Developmental Disabilities Research Reviews*, 13(1), 16–25. [CrossRef]
- Leos, R. A., Cuccaro, P. M., Herbold, J. R., & Hernandez, B. F. (2022). Exploring school staff perceptions relating to animals and their involvement in interventions to support mental health. *International Journal of Environmental Research and Public Health*, 19(12), 7126. [CrossRef]
- Limond, J., Bradshaw, J., & Cormack, M. (1997). Behavior of children with learning disabilities interacting with a therapy dog. *Anthrozoos*, 10(2/3), 84–89. [CrossRef]
- Machelicek, W., O'Reilly, M. F., Beretvas, N., Sigafoos, J., & Lancioni, G. E. (2007). A review of interventions to reduce challenging behavior in school settings for students with Autism Spectrum Disorders. *Research in Autism Spectrum Disorders*, 1(3), 229–246. [CrossRef]
- Martin, F., & Farnum, J. (2002). Animal-assisted therapy for children with pervasive developmental disorders. *Western Journal of Nursing Research*, 24(6), 657–670. [CrossRef] [PubMed]
- McDougal, E., Riby, D. M., & Hanley, M. (2020). Teacher insights into the barriers and facilitators of learning in autism. *Research in Autism Spectrum Disorders*, 79, 101674. [CrossRef]
- McGee, M. (2012). Neurodiversity. *Contexts*, 11(3), 12–13. [CrossRef]
- Meints, K., Brelsford, V., Dimolareva, M., Maréchal, L., Pennington, K., Rowan, E., & Gee, N. R. (2022). Can dogs reduce stress levels in school children? Effects of dog-assisted interventions on salivary cortisol in children with and without special educational needs using randomized controlled trials. *PLoS ONE*, 17(6), e0269333. [CrossRef]
- National Autistic Society. (2025, October 10). Retrieved from *what is autism*. National Autistic Society.
- Naznin, N., Akter, A., & Islam, A. (2023). Opportunities & barriers in special education for children with autism. *Canadian Journal of Educational and Social Studies*, 3(1), 117–125. [CrossRef]
- Newell, V. (2021, July 27). *Autistic people and suicidality*. National Autistic Society.
- O'Haire, M. E., McKenzie, S. J., McCune, S., & Slaughter, V. (2014). Effects of classroom animal-assisted activities on social functioning in children with Autism Spectrum Disorder. *Anthrozoos*, 20(3), 162–168. [CrossRef]
- Sissons, J. H., Blakemore, E., Shafi, H., Skotny, N., & Llyod, D. M. (2022). Calm with horses? A systematic review of animal-assisted interventions for improving social functioning in children with autism. *Autism*, 26(6), 1320–1340. [CrossRef]
- Somervill, J., Swanson, A., Robertson, R., Arnett, M., & MacLin, O. (2009). Handling a dog by children with attention-deficit/hyperactivity disorder: Calming or exciting? *North American Journal of Psychology*, 11(1), 111–120.
- Steane. (2019). Removing traumatic barriers to learning: The need for effective trauma-informed approach to learning legislation in Pennsylvania. *Temple Law Review*, 92(1), 299.
- UK Parliament. (2024). *Support for children and young people with special educational needs*. UK Parliament.
- Wintermantel, L., Grove, C., & Laletas, S. (2024). Children's perceptions of a therapy dog-assisted social and emotional learning intervention: Survey and interview findings. *Journal of Research in Childhood Education*, 39(1), 22–41. [CrossRef]
- Yao, K., Chen, P., Zhou, H., Ruan, J., Chen, D., Yang, X., & Zhou, Y. (2023). The effect of childhood trauma on suicide risk: The chain mediating effects of resilience and mental distress. *BMC Psychiatry*, 23, 865. [CrossRef]
- Zents, C. E., Fisk, A. K., & Lauback, C. W. (2017). Paws for intervention: Perceptions about the use of dogs in schools. *Journal of Creativity in Mental Health*, 12(1), 82–98. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

The Acceptability of Occupational Therapy Using Zones of Regulation™ Concepts in an Equine Environment to Autistic Children

Jacqueline M. Browne¹, Sarah Jean Reega², Ellen M. Rankins^{2,3}, Arlene A. Schmid^{1,3}
and B. Caitlin Peters^{1,2,3,*}

¹ Department of Occupational Therapy, Colorado State University, Fort Collins, CO 80523, USA; arlene.schmid@colostate.edu (A.A.S.)

² Temple Grandin Equine Center, Department of Animal Sciences, Colorado State University, Fort Collins, CO 80523, USA; sarah.reega@colostate.edu (S.J.R.); ellen.rankins@colostate.edu (E.M.R.)

³ Colorado State University Spur Campus, Denver, CO 80216, USA

* Correspondence: caiti.peters@colostate.edu

Abstract: Autistic children often have impaired self-regulation which can impact daily functioning and life outcomes. Occupational Therapy Using Zones of Regulation™ Concepts in an Equine Environment (OT-ZOR-Equine) is a standardized intervention that integrates both the Zones of Regulation™ curriculum and horses into occupational therapy to address self-regulation in autistic children. We aimed to assess the acceptability of OT-ZOR-Equine to participating autistic children. A qualitative descriptive research study was conducted with six autistic children ages 7–9 years who received ten weeks of OT-ZOR-Equine. Children participated in semi-structured interviews that used questions guided by the Theoretical Framework of Acceptability. We analyzed interview transcripts using directed content analysis. Autistic children found OT-ZOR-Equine to be generally acceptable. The children especially enjoyed horse riding but found the Zones of Regulation™ curriculum and certain aspects of riding to be less acceptable. Tailoring OT-ZOR-Equine to integrate each client's preferences and needs may make this intervention more acceptable to autistic children. The findings of this study support the continued use of and research on OT-ZOR-Equine or similar occupational therapy interventions that integrate horses to influence self-regulation in autistic children.

Keywords: occupational therapy; equine-assisted services; autism; acceptability; self-regulation

1. Introduction

Approximately one out of every thirty-six children in the United States has been identified as having autism (Centers for Disease Control & Prevention, 2023). Individuals with autism may have difficulty with social communication and demonstrate restricted, repetitive behaviors (APA, 2013). Although not part of the diagnostic criteria, impaired self-regulation is increasingly recognized as a prominent aspect of autism (Laurent & Gorman, 2018; Mazefsky & White, 2013; Samson et al., 2014, 2015). Self-regulation refers to the capacity to monitor, assess, and alter one's emotional state, arousal level, and actions in order to perform goal-directed behaviors (Laurent & Gorman, 2018; Hofmann et al., 2012). For individuals with autism [referred to as "autistic" moving forward (Bottema-Beutel et al., 2021), impaired self-regulation is often exhibited in increased physiological responsiveness to everyday activities (Corbett et al., 2006; Spratt et al., 2012) and challenges with emotional management (Beck et al., 2020; Cai et al., 2018). Difficulty with self-regulation also presents

in autistic children as behavioral differences, such as elevated hyperactivity, agitation, elopement, combativeness, or self-harm (Doehring et al., 2014; Mazefsky & White, 2013; Mazefsky et al., 2014). Difficulty with self-regulation can influence autistic children's daily functioning and overall well-being, as impaired self-regulation is linked to lower social adjustment (Nader-Grosbois & Mazzone, 2014), diminished academic performance (Konstantareas & Stewart, 2006), and higher levels of anxiety (Swain et al., 2015). Compared to non-autistic individuals, autistic children also have increased difficulty implementing self-regulation strategies to handle everyday encounters (Jahromi et al., 2012; Samson et al., 2014, 2015). Thus, it is important to utilize therapeutic interventions that support autistic children's development and use of adaptive self-regulation strategies (Samson et al., 2015).

Occupational therapists support self-regulation in autistic children by helping them understand and learn strategies to modify their emotional state and degree of physiological arousal (Martini et al., 2016). One increasingly popular occupational therapy intervention used to address self-regulation in this population is occupational therapy in an equine environment (OTEE) (Lindley et al., 2018). During OTEE, occupational therapists use the movement of a horse and related activities (e.g., grooming, saddling, etc.) as tools to address functional outcomes (McDaniel Peters & Wood, 2017; Ajzenman et al., 2013). There are promising preliminary outcomes of OTEE for autistic children, including increased adaptive behaviors (Ajzenman et al., 2013), increased social motivation (Peters et al., 2022), improved occupational performance in individual goal areas (Peters et al., 2022), improved task engagement (Llambias et al., 2016), increased participation in everyday activities (Ajzenman et al., 2013), and improved posture (Ajzenman et al., 2013). Despite these promising outcomes, the existing literature on OTEE largely encompasses pilot studies without active comparison groups or standardized intervention protocols. To address these gaps in research and to specifically study the efficacy of OTEE for improving self-regulation in autistic children, our research team developed Occupational Therapy using Zones of Regulation™ Concepts in an Equine Environment (OT-ZOR-Equine; Peters et al., 2024b). OT-ZOR-Equine is a standardized intervention protocol that integrates “(1) evidence-based practices relevant to occupational therapy for autistic children, (2) concepts from the Zones of Regulation™ curriculum, and (3) purposeful integration of horses into occupational therapy” (Peters et al., 2024b, p. 3). The Zones of Regulation™ curriculum helps children to identify emotions, group emotions within four specific “zones”, and use strategies (“tools”) for emotional management (Kuypers, 2011; Peters et al., 2024b).

In a preliminary efficacy study, OT-ZOR-Equine was found to improve self-regulation and social functioning in autistic children (Peters et al., 2024b). An ongoing randomized controlled trial (RCT; NCT05846932) is further studying the efficacy of OT-ZOR-Equine. However, the existing literature and the ongoing study (NCT05846932) have not included the perspectives of the autistic children who participate in OT-ZOR-Equine. Rather, parent-report has been utilized to measure outcomes and intervention acceptability (Peters et al., 2024b). Specifically, a previous study of 14 autistic youth and their parents found that parents were satisfied with OT-ZOR Equine, expressing that it was a good fit for their child, their child enjoyed it, it was beneficial, and that they would recommend the intervention to other caregivers of autistic youth. Further, there was a 100% participant retention rate and 95% attendance rate, demonstrating good adherence to the intervention. However, the acceptability of OT-ZOR Equine from the perspective of the children who actually participate in the intervention has not been studied. There is increasing recognition of the importance of including autistic voices in autism intervention research (Chown et al., 2017), as exemplified by the recent “Evidence, Ethics, and Effectiveness of Autism Interventions” Executive Summary that states “intervention research should address the autistic person's experience of the intervention, including their internal experiences and wellbeing” (Autistic

Self Advocacy Network, 2022). Therefore, it is necessary to understand the acceptability of OT-ZOR-Equine from the perspective of autistic children.

Intervention acceptability refers to the “extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experiential cognitive and emotional responses to the intervention” (Sekhon et al., 2017, p. 5). It is imperative to assess the acceptability of a healthcare intervention to those participating in the intervention, as acceptability may influence execution, adherence, results, and efficacy of an intervention (Sidani & Braden, 2011; Sekhon et al., 2022). Sekhon et al. (2017) developed the Theoretical Framework of Acceptability to operationalize the acceptability of healthcare interventions. In the framework, acceptability is composed of seven constructs: (1) affective attitude, (2) burden, (3) ethicality, (4) perceived effectiveness, (5) intervention coherence, (6) self-efficacy, and (7) opportunity costs.

The purpose of this study was to examine the acceptability of OT-ZOR-Equine from the perspective of autistic children who participated in the intervention. To accomplish this purpose, we selected four of the constructs from Sekhon et al.’s (2017, 2022) Theoretical Framework of Acceptability that were the most concrete, and therefore easiest for autistic children to understand. Affective attitude refers to “how an individual feels about the intervention” (Sekhon et al., 2022, p. 5); burden refers to “the amount of effort required to participate in the intervention” (p. 5); perceived effectiveness refers to “the extent to which the intervention has achieved its intended purpose” (p. 5); and self-efficacy refers to “the participant’s confidence that they can perform behaviors required to participate in the intervention” (p. 5). Therefore, to assess these four aspects of intervention acceptability, we asked the following research questions:

1. What are the participants’ attitudes towards OT-ZOR-Equine?
2. How much effort was required for children to participate in OT-ZOR-Equine?
3. To what extent did participants perceive OT-ZOR-Equine to influence their self-regulation?
4. How confident, or unconfident, did participants feel in their ability to participate in OT-ZOR-Equine?

2. Materials and Methods

We implemented a qualitative descriptive research approach. This approach is effective when researchers aim to provide straightforward and accurate descriptions of participants’ experiences or perspectives of a phenomenon, especially a minimally studied phenomenon (Sandelowski, 2000, 2010; Kim et al., 2016). To collect data, the qualitative descriptive research method frequently uses semi-structured interviews in which open-ended questions are guided by a specific framework (Sandelowski, 2010). In this study, interview questions were based on a Theoretical Framework of Acceptability put forth by Sekhon et al. (2017, 2022). Consistent with a qualitative descriptive approach, data analysis consisted of a qualitative content analysis. In this method, investigators analyze the data using subtle interpretations, to stay as near to the participants’ original words as possible (Sandelowski, 2000; Kim et al., 2016). These “data-near interpretations” separate qualitative content analysis apart from approaches that utilize theory-driven or more complex levels of interpretation such as grounded theory or phenomenology (Sandelowski, 2010, p. 79).

The Institutional Review Board of Colorado State University approved the procedures of this qualitative descriptive study.

2.1. Participants

We recruited autistic children from an ongoing RCT (NCT05846932). As part of their participation in the RCT, all children had previously been screened to ensure they met the following criteria: ages 6–11, diagnosed with autism, met clinic cut-offs for autism on the

Autism Diagnostic Observation Schedule (ADOS) and Social Communication Questionnaire, had a non-verbal IQ ≥ 65 , were verbally fluent as defined by the ADOS, experienced irritability, and had not ridden horses for 10+ hours in the past 6 months. Once children in the Summer 2024 cohort completed at least eight weeks of OT-ZOR-Equine ($n = 6$), they were eligible to complete the current study, distinct from the RCT, which consisted of a qualitative interview. Parents received an IRB-approved informational flyer about this study during week eight of the 10-week intervention. Interested participants verbally informed ER they were interested in the study during week eight or nine of the OT-ZOR-Equine intervention, or they followed up via phone call or email as listed on the flyer. ER scheduled participants for an in-person or online interview, depending on participant preference.

One week prior to the interviews, JB emailed parents consent and assent forms as well as the open-ended interview questions to review beforehand. Just prior to the interviews, parents (five mothers and one father) consented to have their child participate in interviews, and all six children provided either verbal or non-verbal assent. Upon completion of the interview, participants received a \$20 gift card and merchandise (hat, stuffed animal, or mug) from Temple Grandin Equine Center (TGEC). Table 1 provides demographic and clinical information of the children who enrolled in the study.

Table 1. Participant characteristics.

Pseudonym	Sex	Age	Race/Ethnicity	ABAS-3 Composite	SCQ	Non-Verbal IQ	Diagnoses	Household Income
Joe	Male	7	White/Hispanic	80	17	110	Autism, Asthma	\$81,000–\$100,000
Sam	Male	8	Multi/Not Hispanic	87	13	105	Autism, ADHD, Developmental Delays	>\$160,000
Hanna	Female	7	Asian/Not Hispanic	84	24	93	Autism	\$51,000–\$65,000
Ben	Male	8	White/Not Hispanic	75	16	108	Autism, ADHD	>\$160,000
Maya	Female	7	White/Not Hispanic	68	13	93	Autism	>\$160,000
John	Male	9	Asian/Not Hispanic	75	27	113	Autism	>\$160,000

ABAS-3 = Adaptive Behavior Assessment System, Third Edition; SCQ = Social Communication Questionnaire.

2.2. The Intervention

The OT-ZOR-Equine intervention was first described by our team in Peters et al. (2024b) and is summarized here. The intervention was delivered to participants by an occupational therapist with training from the American Hippotherapy Association, Inc. for an hour, once a week for ten weeks during an ongoing RCT (NCT05846932). Each session included the following: (1) a caregiver check-in while the child provided a pre-test saliva sample, (2) 45 min of therapeutic activities mounted on a horse, and (3) caregiver education while the child provided a post-test saliva sample. The mounted therapeutic activities in all sessions were guided by the following critical elements:

1. Use of equine movement and the participant's interests (including preferred equine activities) to optimize attention and engagement in the therapy session.
2. Direct instruction of a self-regulation skill (see list below).

3. Therapeutic activities that integrate horses to practice the week's targeted self-regulation skill (minimum of 40 min mounted; trotting optional but often included; minimum of three opportunities to practice the skill).
4. Individualized positive reinforcement for practicing the self-regulation skill.
5. Scaffolding skill performance using prompting, fading, shaping, chaining, and feedback.
6. Arrangement of the environment to best support skill performance (i.e., horse selection, tack selection, arena set-up).

Each week, the therapy session focused on a distinct self-regulation skill, drawn from the Zones of Regulation curriculum (Kuypers, 2011), including:

1. Categorizing emotions and alertness states into four "Zones"
2. Understanding the purpose of a regulation "tool"
3. Recognizing emotions in others
4. Identifying common emotional responses to various situations
5. Identifying individualized body cues for different "Zones"
6. Identifying sensory self-regulation tools
7. Identifying calming self-regulation tools
8. Identifying cognitive self-regulation tools
9. Creating an individualized self-regulation toolbox
10. Using an individualized self-regulation toolbox

2.3. Data Collection

As part of the enrollment process for the OT-ZOR-Equine RCT (NCT05846932), participants completed a demographic form and several standardized assessments, which were used to characterize their baseline clinical presentation. Parents completed the Adaptive Behavior Assessment System, Third Edition (ABAS-3), an assessment of adaptive skills (Harrison & Oakland, 2015), and the Social Communication Questionnaire (SCQ) which screens for autism spectrum disorder (Rutter & Bailey, 2003). ER administered the Leiter-3 to all participants to characterize their non-verbal IQ (Roid et al., 2013).

For the current study, JB conducted semi-structured interviews with participants within one week of their completion of the 10-week OT-ZOR-Equine intervention. Four participants completed in-person interviews, and two participants completed online interviews via Microsoft Teams™ (version 24180.210.3001.6635). Mothers of five participants and the father of one participant were present for the duration of their child's interview. Interviews ranged from ten to eighteen minutes, occurred in English, and were audio recorded via Microsoft Teams™. Participants were welcomed to play with toys or eat a snack to increase their comfort throughout the interview. Interviews included open-ended questions that were adapted from the Theoretical Framework of Acceptability (Sekhon et al., 2017, 2022) and were reworded in a semi-structured interview guide (Table 2) to be age-appropriate for autistic children. Thus, we asked participants about (a) their attitude towards OT-ZOR-Equine, (b) their perceived burden to participate in OT-ZOR-Equine, (c) their perceptions on the influence of OT-ZOR-Equine on their self-regulation, and (d) their confidence in participating in OT-ZOR-Equine. When participants only utilized body language (i.e., head nod) to answer a question, JB verbally reflected their response back to them (i.e., "yes?", "no?", "I see you shaking your head yes") and made a fieldnote indicating that the participant utilized non-verbal answers during the interview. Some participants demonstrated difficulty producing answers to various questions throughout the interviews, likely due to impaired social communication common in autistic children. Therefore, for at least one question in each interview, JB verbally provided participants with an array of potential responses (i.e., "easy", "medium", or "hard") they could choose to use and supplied examples of activities completed throughout the intervention to support

participants' recall of the intervention. Three parents naturally provided similar assistance throughout the interview (i.e., without prompting to do so by the research team), reminding their child of the activities they engaged in during OT-ZOR-Equine or prompting them with a set of possible answers. Additionally, an age-appropriate definition of the word "confidence" was provided to participants if they did not know what confidence meant. JB also told participants that they could choose to skip any questions throughout the interview, and that there were no right or wrong answers. The first six questions and responses of one participants' interview were unintentionally not recorded due to user error of Microsoft Teams™ recording function; however, her responses to the remaining fifteen questions were recorded.

Table 2. Semi-structured interview guide.

Attitude Towards the Intervention	
1.	Did you like riding your horse?
a.	If yes, what did you like about riding your horse?
b.	What is your favorite part about riding your horse?
c.	If no, what did you not like about riding your horse?
2.	Did you like learning about zones/feelings with your horse?
a.	If yes, what did you like about learning zones/feelings with your horse?
b.	What is your favorite part about learning zones/feelings with your horse?
c.	If no, what did you not like about learning zones/feelings with your horse?
3.	Did you like being with [their therapist's name]?
a.	If yes, what did you like about being with [their therapist's name]?
b.	What is your favorite part about being with [their therapist's name]?
c.	If no, what did you not like about being with [their therapist's name]?
Burden to Participate	
4.	How hard was it to ride your horse?
5.	How hard was it to learn about the zones/feelings with your horse?
6.	How hard was it to be with [their therapist's name]?
Perceived Effectiveness on Self-regulation	
7.	How did you feel when you were riding your horse?
a.	Did you feel calmer when you were riding your horse?
b.	Did you feel excited when you were riding your horse?
c.	Did you feel mad when you were riding your horse?
d.	Did you feel uncomfortable when you were riding your horse?
8.	Do you think riding your horse has made it easier for you to feel calm or focused?
a.	If yes, can you tell me about how you think riding your horse has helped you feel calmer?
b.	If no, can you tell me more about that?
9.	Do you think riding your horse helps you feel better when you are mad or uncomfortable?
a.	If yes, can you tell me about how you think riding your horse has helped you feel better?
b.	If no, can you tell me more about that?
10.	How did you feel when you were learning about zones/feelings?
a.	Did you feel calmer when you were learning about zones/feelings?
b.	Did you feel excited when you were learning about zones/feelings?
c.	Did you feel mad when you were learning about zones/feelings?
d.	Did you feel uncomfortable when you were learning about zones/feelings?
11.	Do you think learning about zones/feelings has made it easier for you to feel calm or focused?
a.	If yes, can you tell me about how you think learning about zones/feelings has helped you feel calmer?
b.	If no, can you tell me more about that?

Table 2. Cont.

Perceived Effectiveness on Self-regulation	
12.	Do you think learning about zones/feelings helps you feel better when you are mad or uncomfortable?
a.	If yes, can you tell me about how you think learning about zones/feelings with your horse has helped you feel better when you are mad or uncomfortable?
b.	If no, can you tell me more about that?
13.	Did learning about zones/feelings change how you regulate/manage your emotions at home or school?
a.	If yes, can you tell me more about how learning about zones/feelings with your horse changed how you regulate/manage your emotions at home or school?
b.	If no, can you tell me more about that?
14.	Are there any tools/strategies you have learned that help you feel better when you are at home or school?
Self-Efficacy in Participation	
15.	How confident did you feel about riding your horse?
16.	How confident did you feel about learning about zones/feelings with your horse?
Suggested Improvements	
17.	What did you not like about riding your horse?
18.	What would make riding your horse more comfortable or fun?
19.	What did you not like about learning about zones/feelings with your horse?
20.	What would make learning about zones/feelings with your horse more comfortable or fun?
General Acceptability	
21.	Would you want to go back to Temple Grandin Equine Center to ride your horse again?
22.	Would you want to go back to Temple Grandin Equine Center to learn about zones/feelings with your horse again?

Transcripts from each interview recording were downloaded from Microsoft Teams™. JB listened to the audio recordings repeatedly while concurrently reading the transcripts to identify and correct any errors in the transcripts. JB de-identified the transcripts by replacing names with a pseudonym. De-identified transcripts were then saved in a Microsoft Word™ document, and uploaded to NVivo version 14, a qualitative data analysis software program.

2.4. Data Analysis

Qualitative content analysis is the preferred method of data analysis in qualitative descriptive research (Kim et al., 2016; Sandelowski, 2000). We implemented a directed content analysis, a type of content analysis that utilizes an existing theory or framework to deductively derive codes or categories (Hsieh & Shannon, 2005). Therefore, we created four a priori categorical codes based on the four selected constructs from the Theoretical Framework of Acceptability (Sekhon et al., 2017, 2022): (1) the participant's attitude towards the intervention, (2) their perceived burden to engage in the intervention, (3) the perceived effectiveness of the intervention, and (4) the participant's self-efficacy in participating in the intervention. Multiple subcodes under each a priori categorical code were also deductively created based on the Theoretical Framework of Acceptability and defined in NVivo prior to the initial round of coding. During the first round of coding, the interview transcript data were reviewed line-by-line by JB, using the categorical codes and subcodes to group text into categories. Categorical codes and subcodes were also inductively developed from the data during the initial round of coding. After the initial coding round, all codes were peer reviewed with BCP, and codes were combined and redefined into the final coding scheme. JB and SJR then separately reviewed all transcripts to apply the final coding scheme. The coding of JB and SJR were compared to examine intercoder agreement. There

was substantial agreement between 85.54% of codes ($\kappa > 0.6$) and excellent agreement between 78.29% of codes ($\kappa > 0.8$). Any discrepancies in coded data were discussed among the three researchers until an agreement was reached. We decided that one new code that arose inductively during SJR's initial coding process should be part of the final coding scheme. This code related to a participant feeling "silly" during the intervention and was applied to the final coding system. We also came to the consensus that any of the participants' responses that were unclear or provided conflicting information were not included in the final coding scheme, as we did not want to incorrectly represent what the participant was trying to communicate. Finally, we agreed to code the interviewer's response to participants' non-verbal body language (i.e., head nod) when the participant did not provide a verbal response. The codes were then reviewed and compared within and between categories and subcategories to synthesize the findings both narratively and through tables.

2.5. Trustworthiness

We used various strategies to strengthen the trustworthiness of this study. We engaged in reflexivity throughout the study, considering our positionality and experience related to autistic children and OT-ZOR-Equine, which may have shaped the interpretation and approach of this study (Creswell & Poth, 2018). JB's experience supporting autistic children and utilizing the Zones of Regulation™ curriculum in equine environments and her doctoral level education in occupational therapy shaped her approach to interviewing participants and may have influenced data analysis. Likewise, as the creator of OT-ZOR-Equine with experience implementing this intervention with several cohorts of research participants, BCP utilized her expertise to guide this study's methodology and data analysis. SJR, the secondary coder, was a PhD candidate in Animal Sciences with a focus on equine-assisted services at the time of data analysis. She was less experienced with implementing OT-ZOR-Equine but still knowledgeable about the content of the intervention. Aware of their favorable opinions toward equine-assisted services, JB, SJR, and BCP paid special attention to capture any potentially negative comments about OT-ZOR-Equine during both the interviews and data analysis. Additionally, throughout the data analysis process, JB documented assumptions and interpretations within memos in NVivo. The memos, interview transcripts, and descriptions of codes were all utilized as an audit trail. We conducted peer reviews of interview questions and the coding scheme in weekly research team meetings to check accuracy and to limit the effect of researchers' positionality on data collection and analysis (Creswell & Poth, 2018; Bhattacharya, 2017).

We also used data triangulation to enhance the validity of the findings. This was achieved through (1) data source triangulation (collecting data from six participants), (2) investigator triangulation (JB and SJR independently analyzing and remaining blinded to each other's initial coding), and (3) methodological triangulation (comparing findings from this study with findings from previous studies that reported on acceptability of OT-ZOR-Equine from parental perspectives; see Section 4; Creswell & Poth, 2018). Discussing and resolving any discrepancies in JB and SJR's coding allowed us to reach intercoder agreement which enhanced the reliability of the results (Creswell & Poth, 2018). Integrating exact quotations of autistic children into the results contributed to rich descriptions of the participants' perspectives and reinforced our data-near interpretations. These dense descriptions strengthen the transferability of this study (Creswell & Poth, 2018).

3. Results

All six participants who completed the OT-ZOR-Equine intervention in Summer 2024 (NCT05846932) enrolled and completed the current study. Four primary themes arose

from the data. Each theme summarized important concepts connected to the a priori categorical codes used to direct the data analysis process. The first theme focused on the participants' attitudes towards the intervention. The second theme focused on the children's perceived effort to participate in the intervention. The third theme focused on participants' perceptions of how the intervention influenced their self-regulation, and the fourth theme focused on the children's self-efficacy in participating in the intervention.

3.1. Participants' Attitudes Towards the Intervention

Table 3 provides selected participant responses because they illustrate participants' attitudes towards the intervention. Overall, the children had a primarily positive attitude towards OT-ZOR-Equine. All six children affirmed or expressed enjoyment of engaging in the intervention. The participants especially liked riding and interacting with the horse, and they mentioned multiple preferred factors, including trotting, the sensory experience of riding or engaging with the horse, the horse's demeanor, riding backward, and playing games while mounted on the horse (see Table 3). However, four participants also noted non-preferred aspects of riding. In week seven of the 10-week intervention, Ben fell off the horse when the horse spooked to the sound of a falling broom nearby; the horse sidestepped quickly, causing the participant to fall to the ground. Ben did not sustain any injuries, but he expressed during the interview that he was nervous in the session following the fall when his horse "twitch[ed]". John also felt nervous about the potential of falling off a large horse during the first week of the intervention, but expressed he became more comfortable with time. He also disliked the amount of dirt on the horse, or when he rode a non-familiar horse (due to his usual horse being unavailable one day). Joe felt uncomfortable sitting backward in the saddle during an activity, and Hanna did not like getting off the horse. Ben and Joe stated that there was nothing that they did not enjoy about riding. Despite some non-preferred aspects of riding the horse, all participants affirmed that they would like to return to TGEC to ride a horse again.

All of the participants who responded to the question ($n = 5$) stated that they enjoyed engaging with the occupational therapists. John explained that his therapist ensured he was safe, and Ben liked the therapist's instructions throughout the intervention. Maya liked when the therapist put her helmet on, and John and Ben mentioned that their therapist was "nice".

There were varied attitudes towards the Zones of Regulation™ curriculum that was taught throughout the intervention. Three participants liked learning about the Zones of Regulation™ curriculum. However, only Sam stated that he would like to return to TGEC to learn about the Zones of Regulation™ curriculum again. All other participants indicated that they would not want to engage in Zones of Regulation™ activities again. John and Joe felt that the Zones of Regulation™ curriculum was boring, as John explained that he had previously learned about it at school. Joe also stated that he "hate[d]" learning about the self-regulation skills.

Participants shared diverse suggestions for improving the enjoyment or comfort of the OT-ZOR-Equine intervention. Four participants gave recommendations for the horse-riding experience. John explained that he enjoyed riding but would prefer it if the time spent mounted on the horse was shorter, less messy, and did not include the Zones of Regulation™ activities. Sam suggested "trotting", and Joe suggested galloping to make riding more fun. Hanna suggested having comfort items (i.e., her stuffed animal or a snack) while on the horse or jumping on the trampoline during the intervention. Maya had no suggested additions for improving the comfort or enjoyment of riding. Furthermore, four participants had no suggestions to make the experience of learning the Zones of Regulation™ curriculum more comfortable or engaging, but two children suggested additions

for making the Zones of Regulation™ activities more fun. Joe explained that he would enjoy galloping during the Zones of Regulation™ activities, and Hanna thought it would be more fun to have her stuffed animal with her on the horse.

Table 3. Attitudes toward the intervention. Selected participant responses that best illustrate the theme.

Subcodes	Participant Quotes
Liked Being with the Horse	Ben: I don't think there was anything I didn't like riding on Bluebell. John: I like riding horses overall. Joe: I would even pay \$50,000 to buy Concho. I want Concho as my pet.
Non-preferred Factors of Riding	Ben: And there was another day, um the day after I fell off where I was nervous because she was twitching a lot and I felt that was like, and that kind of made me nervous. John: I already said that he's too messy Joe: Only when I had to ride in the saddle backward. . . It's the it's the most uncomfortable thing in the entire world.
Liked Being with Occupational Therapist	Ben: That she would always, all the time, she would tell me the instructions um when I was doing something John: Um. She's really nice. John: She always makes sure that I'm really safe.
Liked Learning Zones of Regulation™ Curriculum	Interviewer: Did you like learning about feelings with your horse? Maya: Mm-hmm. Interviewer: Do you want to come back to the Temple Grandin Center to learn about feelings? Sam: Yeah
Did Not Like Learning Zones of Regulation™ Curriculum	John: It was the most boring thing. . . because I already know a lot about zones. . . I felt like like why are you even doing this? I already know all of this. Interviewer: Did you like learning about zones with Concho? Joe: I hate it. . . it was boring. Interviewer: Would you want to come back here to learn about feelings with Harley? Maya: Hmm nah.
Suggestions for Riding Horse	Interviewer: What would make riding your horse more fun? Hanna: If if, if llama [participant's stuffed animal] was there. . . If we eat s'mores John: I wish the time I was on Chunky was shorter. Not because I don't like it, but because it's just really long Interviewer: What would make riding Flyer more fun? Sam: Trotting.
No Suggestions for Riding Horse	Interviewer: Was there anything you didn't like about riding Concho? Joe: No Interviewer: What would make riding Concho more comfortable or more fun? Joe: Nothing. It's good as it is.
Suggestions for the Zones of Regulation™ Curriculum	Interviewer: What would make learning about feelings more comfortable or more fun? Hanna: Llama [participant's stuffed animal]. Interviewer: Having your llama with you? Interviewer: What would have made it more fun to learn about zones? Joe: If I got to gallop.
No Suggestions for the Zones of Regulation™ Curriculum	Interviewer: What would make learning about feelings more fun? Sam: Uhh. I don't know.

3.2. Burden to Participate in the Intervention

Table 4 provides selected participant responses that illustrate participants' perceived effort to participate in OT-ZOR-Equine. The burden, or perceived amount of effort required to participate in OT-ZOR-Equine was specific to each aspect of the intervention—riding the horse, learning the Zones of Regulation™ curriculum, or engaging with the occupational therapist. Participants primarily found there was a low amount of effort needed to ride the horse, with four children stating it was “easy” or “not that hard” to ride, and Maya affirmed it was a “medium” level of difficulty. For learning Zones of Regulation™ content, there were varied responses. Maya, Joe, and John found it was “easy”; however, John also stated it was “hard” because he felt bored during the Zones of Regulation™ activities. Sam and Ben expressed an intermediate level of effort. Sam indicated learning Zones of Regulation™ was “medium” difficulty, and Ben stated it was “a little tricky”. Engaging with the occupational therapist was “easy” or “not that hard” for four participants, and Maya was unsure of how difficult it was for her to interact with the occupational therapist. Additionally, John expressed concerns with the logistical feasibility of OT-ZOR-Equine. He highlighted the burden of TGECC being “far away” and his discomfort during the hot car ride to travel to the riding center during the summer. John also mentioned his dislike of the saliva collection process used to collect data for the ongoing RCT.

Table 4. Burden to participate in the intervention. Selected participant responses that best illustrate the theme.

Subcodes	Participant Quotes
Easy to Ride Horse	Interviewer: How hard was it to ride Concho? Joe: Easy. . . Easy peasy lemon squeezy
Medium to Ride Horse	Interviewer: Was it easy, medium, or hard to ride Harley? Maya: I think medium.
Easy to Learn the Zones of Regulation™ Curriculum	Interviewer: How hard was it to learn about zones? Joe: Easy. Easy. Easy.
Medium to Learn the Zones of Regulation™ Curriculum	Interviewer: How about learning feelings? Was that easy, medium, or hard? Sam: Medium. Interviewer: How hard was it to learn about zones? Ben: A little tricky
Hard to Learn Zones of Regulation™	Interviewer: How hard was it to learn about zones? John: Hard because like it was boring to boring to learn about again.
Easy to Be with Therapist	Interviewer: And about how hard was it to hang out with Erin? Sam: Hmm. Easy.
Unsure of Difficulty Being with Therapist	Interviewer: How hard was it to be with Mary? Maya: I don't know
Logistical Feasibility Concerns	John: I just don't like that it's so far away and about and like the saliva sample. . . It was hot when we drive there.

3.3. Perceived Effect of the Intervention on Participants' Emotional State and Self-Regulation

Table 5 provides selected participant responses that illustrate participants' perceptions on how the intervention did or did not influence their self-regulation. While riding the horse, the children predominately reported feeling positive emotions. Five participants indicated they felt “calm”, four were “happy” or “excited”, and two felt “good” while riding (See Table 5). Maya stated she felt “comfortable” riding the horse. None of the six children mentioned that they felt mad, and five children never felt “uncomfortable”

while on the horse. Furthermore, five participants confirmed that riding influenced their emotional management. The children mentioned that riding changed their emotional state, and they felt calmer or more focused after horseback riding. Four children indicated that riding helped them feel better when they were feeling uncomfortable or mad. For example, John noticed he felt happier after riding the horse. Ben explained that the speed of the horse influenced how he felt; when the horse trotted, he felt excited, but when the horse walked slowly, he felt calm. However, four participants also experienced negative emotions while riding. John felt “dirty” and “funny” when touching the horse’s hair and initially “scared” to fall off the horse. Ben felt “nervous” after his fall from the horse, and Sam felt “surprised” when the horse trotted. Joe felt “uncomfortable” riding backward and “bored” while riding. Additionally, only Joe indicated that riding had no noticeable effects on his self-regulation; he did not think that riding helped him feel better or calmer when he was uncomfortable.

Table 5. Perceived effect of the intervention on participants’ emotional state and self-regulation. Selected participant responses that best illustrate the theme.

Subcode: Feelings Experienced While Riding	
Subcodes	Participant Quotes
Calm	Interviewer: How did you feel while you were riding him? John: Relaxed.
Happy	Interviewer: How did you feel while you were riding Harley? Maya: Happy.
Good	Ben: Um Good. Interviewer: You felt good when the horse trotted? Ben: Mm-hmm.
Comfortable	Maya: More comfortable. Interviewer: It was comfortable riding Harley? Maya: Mm-hmm.
Excited	Interviewer: You felt good when the horse trotted? Ben: It it made me feel, like excited.
Surprised	Sam: Ah, surprised Interviewer: What about riding flyer made you feel surprised? Sam: Like the trotting.
Not Uncomfortable	Interviewer: Did you feel uncomfortable while you’re riding your horse? Hanna: No.
Not Mad	Interviewer: Did you feel mad when you were riding your horse? Hanna: No.
Bored	Interviewer: Did you feel calm while you were riding Concho? Joe: Bored.
Uncomfortable	Interviewer: Did you ever feel uncomfortable while you were riding Concho? Joe: Only when I had to ride in the saddle backwards. . . It’s the it’s the most uncomfortable thing in the entire world.
Nervous	Ben: So there So there was that one day I fell off and there was another day, um the day after I fell off where I was nervous because she was twitching a lot and I felt that was like, and that kind of made me nervous. John: So at first I felt scared because I thought I might fall down because it would really hurt because we’re really up high on a horse and horses are really tall and they’re almost tall and and Chunky’s taller than me.

Table 5. Cont.

Subcode: Feelings Experienced While Riding	
Subcodes	Participant Quotes
Dirty	John: Also dirty because Chunky kept doing a thing a thing, and then he kept splashing like that like the dust on us.
Funny	John: I tried to put, I tried putting Chunky's hair on the other side. Interviewer: Yeah. How did that make you feel? John: Uh funny.
Subcode: Feelings Experienced Learning the Zones of Regulation™ Curriculum	
Subcodes	Participant Quotes
Calm	Interviewer: How else did you feel while you're learning about feelings? Maya: Just chill.
Good	Interviewer: How did you feel while you were learning about zones? Ben: Um good.
Happy	Interviewer: How did you feel when you were learning about feelings? Hanna: Hmm. Happy.
Excited	Interviewer: Did you feel excited while you were learning about feelings? Sam: Uh yeah.
Not Uncomfortable	Interviewer: Did you feel uncomfortable while you were learning about feelings? Sam: Uh no.
Not Mad	Interviewer: What about did you feel mad while you were learning about feelings? Hanna: No.
Not Excited	Interviewer to Hanna: How about did you feel excited while you were learning about feelings? Interviewer: No? [interviewer's response to Hanna's head shaking 'no']
Bored	Interviewer: Did you like learning about zones while you were with Chunky? John: It was the most boring thing. . .because I already know a lot about zones.
Subcode: Riding Affects Self-Regulation	
Subcodes	Participant Quotes
Riding Influences Emotional Management or Emotional State	Interviewer: Do you think riding Harley has made it easier for you to feel calm or focused? Maya: Focused. Interviewer: Do you think riding Flyer has made it easier for you to feel calm or focused? Sam: Yeah. Sam: It makes me feel better. John: I think there's if I was not feeling good like before I rode chunky. Then I was really happy after.
No Noticeable Effects on Self-Regulation from Riding Horse	Interviewer: Do you think riding Concho helps you feel better when you're mad or uncomfortable? Joe: No.

Table 5. Cont.

Subcode: Feelings Experienced While Riding	
Subcodes	Participant Quotes
Subcode: The Zones of Regulation™ Curriculum Affect Self-Regulation	
Subcodes	Participant Quotes
The Zones of Regulation™ Curriculum Influences Emotional Management or Emotional State	Interviewer: What about... do you think learning about feelings with Harley has changed how you manage your emotions at home or at school? Maya: Umm. At home. Interviewer: Do you think learning about feelings has made it easier for you to feel calm? Sam: Yeah. Interviewer: Is there anything else you learned while you were with Bluebell that you use at the Y? Ben: Well, I, I don't, maybe, um, everything's not a big deal.
Tools from the Zones of Regulation™ Curriculum Used in Daily Life	Interviewer: Is there anything you learned while you're with Harley that you do while you're at home? Maya: Breathing... I mean...the lazy eight...And the six eight breathing right... Palm press. Interviewer: What kind of things did you learn that you use at home? Sam's Father: Do you think about the zones? Sam's Father: Sometimes you think about the zones and how you're feeling? Sam: Yeah. Interviewer: Did you learn any tools that help you at other places? Ben's Mother: At the YMCA? Ben: Uh-huh. Interviewer: Hmm what kind of tools did you learn? Ben: Um lazy eight and belly breath.
No Noticeable Effects on Self-Regulation from the Zones of Regulation™ Curriculum	Interviewer: Ok so do you think learning about zones has made it easier for you to feel calm? John: I mean I already knew about zones in the first place so it didn't really help because I already knew about zones. I learned at school. Interviewer to Hanna: Do you think learning about feelings with your horse helps you feel better when you're mad or uncomfortable? Interviewer: No? [Interviewer's response to Hanna's head shaking 'no'].

For the Zones of Regulation™ aspects of the intervention, participants also experienced positive feelings overall. Four participants indicated that they felt “calm”, two were “excited” or “happy”, and Ben felt “good” while learning the Zones of Regulation™ curriculum. Three children stated that they did not feel mad, and two children never felt uncomfortable engaging in the Zones of Regulation™ curriculum. Additionally, four participants reported that learning the Zones of Regulation™ curriculum had a positive influence on their ability to manage their emotions or change their emotional state. They explained that the Zones of Regulation™ curriculum changed how they manage emotions at home or in the community or helped them to feel calmer. Maya also noted that learning the Zones of Regulation™ helped her to feel more focused and allowed her to help herself feel better. Ben mentioned that he learned that “everything's not a big deal.” The children emphasized specific self-regulation tools they learned through the Zones of Regulation™ activities that they now use in their daily lives. Maya and Ben stated that they used multiple types of breathing at home or their community recreation center, and Sam affirmed that breathing helped him feel calmer. Sam also thinks about the Zones of Regulation™ curriculum at home, and Joe said he may use the Zones of Regulation™ tools in the future. Hanna mentioned jumping on the trampoline as a tool for self-regulation

that she uses at home. However, three participants encountered negative emotions during the Zones of Regulation™ learning activities and one participant did not notice changes in their self-regulation. John and Joe reported feeling “bored”, and Hanna did not feel excited by the Zones of Regulation™ content. John explained that he saw no difference in his self-regulation because he was already familiar with the content.

3.4. Participants’ Self-Efficacy in Participating in the Intervention

Table 6 provides selected participant responses that illustrate participants’ self-efficacy in participating in OT-ZOR-Equine. The children’s self-efficacy, or confidence, in participating in OT-ZOR-Equine varied, but was higher for riding the horse compared to learning the Zones of Regulation™ curriculum. Maya, Sam, and Joe felt confident about riding (see Table 6). In contrast, John mentioned that during the first session, he was not confident about staying on the horse. However, the more time he spent riding the horse, his confidence slightly improved, but he was still uncertain. Ben chose to skip the question, and Hanna’s answer was unclear. Only three participants shared their self-efficacy regarding learning the Zones of Regulation™ curriculum. Maya and Sam were confident in learning the Zones of Regulation™ curriculum, and Joe was unsure of his confidence level.

Table 6. Self-efficacy in participating in the intervention. Selected participant responses that best illustrate the theme.

Subcode	Participant Quotes
Confident Riding the Horse	Interviewer: Did you feel confident while you were riding Flyer? Sam: Uh yeah.
Not Confident Riding the Horse	Interviewer: How confident did you feel riding Chunky? John: So at first I felt scared because I thought I might fall down.
Unsure of Confidence Riding the Horse	Interviewer: How did you feel after riding him for a little bit? John: I felt more safe, but still like, not perfect.
Confident Learning the Zones of Regulation™ Curriculum	Interviewer: Did you feel confident while you were learning about feelings? Joe: Uh yeah.
Unsure of Confidence Learning the Zones of Regulation™ Curriculum	Interviewer: How confident did you feel learning about zones with Concho? Joe: I don’t know.

4. Discussion

We aimed to describe the aspects of OT-ZOR-Equine that were acceptable or unacceptable to participating autistic children. Based on the children’s attitudes toward the intervention, their perceived burden and self-efficacy in participating, and their perceptions of the effect of the intervention on their self-regulation, we conclude that the children generally found OT-ZOR-Equine to be an acceptable intervention. This is also supported by the fact that all children expressed they would want to return to the Temple Grandin Equine Center to ride horses again. The children especially enjoyed riding and interacting with the horse. However, some participants also considered aspects of the intervention to be less acceptable. Multiple children indicated that they did not enjoy the Zones of Regulation™ curriculum, although two out of those three participants did find the Zones of Regulation™ curriculum helpful in improving their self-regulation skills. In the following paragraphs, we will discuss the less-preferred aspects of the intervention, suggestions for improving acceptability of self-regulation interventions, and how this study compares with other investigations of autistic children’s acceptability of healthcare interventions.

4.1. Perceived Difficulty of Self-Regulation-Focused Interventions

It is evident from the data that the children greatly enjoyed engaging with and riding the horse, but they were not as satisfied with the Zones of Regulation™ curriculum. Although half of the participants said it was “easy” to participate in the Zones of Regulation™ learning activities, and multiple participants experienced positive feelings, most children did not want to continue learning about the curriculum. The curriculum focused on understanding emotions and self-regulation, both of which are often difficult for autistic children (Kuypers, 2011; Mazefsky & White, 2013; Rieffe et al., 2006; Samson et al., 2014, 2015). Therefore, it is not surprising that a sample of children with impaired self-regulation and emotional awareness found that working on these topics during the Zones of Regulation™ activities was less preferred. Despite the challenges, self-regulation skill development is still a worthy pursuit, given that self-regulation is consistently identified as an outcome that matters to autistic people (Autistic Self Advocacy Network, 2022), and poor self-regulation skills can have detrimental effects on life outcomes (Nader-Grosbois & Mazzone, 2014; Konstantareas & Stewart, 2006; Swain et al., 2015). Participants in this study used breathing strategies and a variety of other individualized self-regulation tools that they learned during the intervention to support their self-regulation at home and in the community. The children also noticed that they felt calmer or more focused from learning the Zones of Regulation™ curriculum. These perceived improvements in self-regulation align with previous research that occupational therapy using Zones of Regulation concepts can improve irritability, hyperactivity, and emotional dysregulation in autistic children (Peters et al., 2024a). Similarly, other self-regulation interventions for autistic children have been found to improve self-regulation skills, adaptive behaviors, and anger, and decrease the length and number of emotional outbursts (Reyes et al., 2019; Scarpa & Reyes, 2011; Sofronoff et al., 2006; Weiss et al., 2018). Although potentially difficult for autistic children, engaging in self-regulation-focused interventions can lead to better outcomes and quality of life (Reyes et al., 2019; Scarpa & Reyes, 2011; Sofronoff et al., 2006; Weiss et al., 2018). Therefore, it is important to find ways to develop self-regulation interventions that are more acceptable and enjoyable to autistic children.

4.2. Suggestions to Improve Acceptability of Self-Regulation Interventions

Integrating a horse into therapeutic activities may be one such tool to improve the acceptability of self-regulation interventions, as the participants of this study described a primarily positive attitude toward and interest in riding horses. They cited many preferred elements of riding, including trotting, playing mounted games, the sensory experience of riding the horse, and the horse’s calmness. They also found that it was an easy or medium level of difficulty to ride the horse. Best practices for working with autistic children include integrating autistic children’s strengths and interests into interventions (Tomchek & Koenig, 2016). Research has also found that including their interests can increase engagement in an intervention (Baker et al., 1998) and improve social interaction (Corbett et al., 2014). Llambias et al. (2016) found that involving a horse during an occupational therapy intervention increased engagement in autistic children. Thus, integrating horses into self-regulation interventions may be an acceptable option to some autistic children to increase engagement and enjoyability of the intervention. Future research should focus on how to best integrate horses into therapeutic interventions to support autistic children’s participation.

The children proposed diverse suggestions to improve the acceptability of OT-ZOR-Equine, including having comfort items on the horse, increased speeds of the horse, or shorter, less messy riding sessions. One participant preferred riding backward, while it made another participant feel uncomfortable. These unique preferences and non-preferred factors expressed by the children further underscore the importance of maintaining client-

centeredness in occupational therapy. Occupational therapy practitioners implement client-centered practices by respecting and including clients' choices and values throughout the therapy process (Law et al., 1995; Sumsion, 2000). A review by Law et al. (1995) found that client-centered care across multiple disciplines resulted in increased client satisfaction and compliance with healthcare interventions. Additionally, in a critical review of client-centered care, Whalley Hammell (2013) emphasized the importance of the intentional implementation of client-centered care by occupational therapists within systems that often emphasize standardization, to ensure that clients are satisfied and engaged in the therapy process. Therefore, to increase the acceptability of OT-ZOR-Equine, we recommend that occupational therapists make client-centered modifications as needed to increase each participant's engagement and enjoyment.

Additionally, many of the children's varied preferences, dislikes, or emotions they experienced during the intervention related to increased sensory input (e.g., trotting, feeling the saddle or dirt, etc.). This highlights the sensory differences often present in autistic individuals, including both heightened and diminished responsiveness to sensory input (APA, 2013). It also further emphasizes the need for modifying interventions to meet each client's sensory needs and preferences.

Participants appreciated their relationship with the occupational therapists throughout the intervention, even though the occupational therapists guided participants through less-preferred aspects of OT-ZOR-Equine, such as the Zones of Regulation™ curriculum. Although some participants felt negative emotions (i.e., nervous, uncomfortable, dirty, bored) at times, they mentioned the kindness and safety that they felt in the occupational therapists' presence. This highlights the impact that therapeutic relationships between a client and occupational therapist can have on a client's experience. This was confirmed in a meta-ethnography by Gagne-Trudel et al. (2023) that found therapeutic relationships between children, caregivers, and occupational therapists supported participation in therapy and occupational performance results. This suggests that therapeutic relationships play a role in intervention acceptability to participants.

Some participants in this study had difficulty understanding more abstract concepts, such as confidence, during interviews. There were fewer responses given to questions related to confidence compared to other topics. This may reflect autistic individuals' challenges with communication, specifically with understanding speech and use of "overly literal language" (APA, 2013, p. 53). According to Gabriels and Hill (2007), it is considered best practice to avoid using abstract concepts when communicating with autistic children. Future acceptability studies should aim to utilize concepts that are more concrete or further modify the language to be more appropriate for this population.

4.3. Comparison to Acceptability of Other Healthcare Interventions

The children experienced many positive emotions while riding. This aligns with a review of animal-assisted interventions that found including animals in interventions increased positive emotions in autistic individuals (O'Haire, 2017) and a meta-analysis of equine-assisted services that found across several studies that participating autistic youth had decreased irritability (Xiao et al., 2023). In the current study, participants also noticed a difference in their self-regulation, noting that riding helped to improve their emotional state when they were uncomfortable or upset. They felt calmer, more focused, or happier after riding the horse. Similar findings occurred in the study of Tan and Simmonds (2018) in which caregivers reported improved self-regulation in their autistic child after engaging in equine-assisted services. Gabriels et al. (2015) also found that autistic youth who participated in adaptive horseback riding experienced decreased irritability and hyperactivity. Therefore, in the current study, children perceived OT-ZOR-Equine to be

effective in improving various aspects of self-regulation, which is consistent with the extant literature focused on the efficacy of equine-assisted services.

The general acceptability of the OT-ZOR-Equine intervention is consistent with previous studies on OT-ZOR-Equine and occupational therapy in equine environments in which caregivers of autistic youth and the providing occupational therapists found occupational therapy interventions that integrated horses to be acceptable (Peters et al., 2021, 2024b; Kalmbach et al., 2020). This study's data collection methods were also similar to another autism acceptability study on a virtual nutrition intervention for autistic adolescents. Buro et al. (2023) used focus groups and interviews to understand the participants' and caregivers' attitudes towards the intervention. In contrast, an acceptability and feasibility study on the Emotional Awareness and Skills Enhancement (EASE) program for autistic adolescents used the "treatment satisfaction scale" in which adolescents rated their perspectives of the intervention using a ten-item, five-point scale (Conner et al., 2019, p. 1280). However, acceptability studies that include the perspectives of autistic children who participate in the intervention seem to be rare, as most of the acceptability studies that we found for this population only included the perspectives of their caregivers or intervention providers (Peters et al., 2021, 2024b; Kalmbach et al., 2020; Garcia et al., 2024; Shaffer et al., 2019). It is vital to prioritize the perspectives of autistic children who receive therapeutic interventions to ensure the acceptability of the interventions to this population (Autistic Self Advocacy Network, 2022). Therefore, future autism research needs to include the voices of this population throughout the development and evaluation of all interventions that autistic children engage in.

4.4. Limitations

This study is limited by the reliance on verbal interviews that asked participants to recall past events, particularly given the difficulty with verbal communication that many autistic children experience. Some participants had challenges remembering aspects of the intervention and may have benefited from images portraying the intervention activities in which they engaged. Additionally, we included questions that were less concrete in the interview, as some of the children were able to understand and answer them. However, not all participants may have understood the more abstract questions (e.g., "How confident did you feel about riding your horse?"), which may have impacted the accuracy of their responses. Further, it is possible that children were providing answers that they perceived the interviewer wanted to hear, which may have impacted the accuracy of responses. To protect against this, we selected an interviewer (JB) who was not involved in intervention delivery, and she began each interview by letting participants know there were no right or wrong answers. Notwithstanding, the possibility remains that children expressed more favorable views of the intervention because they perceived it as the socially desirable response. For all of these reasons, we recommend future research include other methods of assessing acceptability that do not only rely on verbal recall, such as use of an in-the-moment affect rating scale during the intervention.

Additionally, the combination of the inherent social communication challenges of the autistic individuals in this study and the use of an interviewer who was novel to the participants may have also impacted the participants' ability to answer questions. The use of a familiar interviewer in future research may support the participants' comfortability and ability to share their perspective. We also did not look at all aspects of The Framework of Acceptability by Sekhon et al. (2017, 2022) in this study, as we believed some concepts from the framework would be too abstract for participants to understand. Future research could address the ethicality, intervention coherence, and opportunity costs (Sekhon et al., 2022) of OT-ZOR-Equine or similar interventions.

Finally, this study was also limited by its small sample size of children recruited from only one cohort of the larger RCT. While $n = 6$ is consistent with other interview-based studies of autism intervention acceptability from a parent (Im-Bolter & de la Roche, 2023) or provider perspective (Chrétien-Vincent et al., 2023), it is not without limitations. Children in different cohorts may have had different opinions of the intervention. Similarly, most children in this study came from relatively higher income households, likely a reflection of the requirement that a parent or caregiver be available to attend the intervention with them (thus biasing the sample against single working parent households or families with two working parents). Future research should examine acceptability of OT-ZOR Equine and other interventions for autistic children in a larger, more diverse sample.

5. Conclusions

OT-ZOR-Equine was generally acceptable to autistic children in this study. Most children expressed enjoyment and confidence in riding horses during OT-ZOR Equine and believed that riding helped them feel calm. Acceptability towards learning about self-regulation skills was more varied, with mixed attitudes towards the curriculum and their confidence engaging in it, despite most children endorsing its effectiveness in helping them to manage their emotions. Findings from this study underscore the importance of client-centered care in occupational therapy, particularly adapting standardized interventions to maximize autistic children's enjoyment and engagement. Horses may be one such tool for increasing autistic children's engagement in potentially difficult interventions. Overall, findings support the continued use and research of OT-ZOR-Equine to address self-regulation in autistic children, with individualized adaptations to maximize participant acceptability of the intervention.

Author Contributions: Conceptualization, B.C.P.; data curation, J.M.B. and B.C.P.; formal analysis, J.M.B., S.J.R. and B.C.P.; methodology, J.M.B., A.A.S. and B.C.P.; project administration, E.M.R.; supervision, B.C.P.; writing—original draft, J.M.B.; writing—review & editing, S.J.R., E.M.R., A.A.S. and B.C.P. All authors have read and agreed to the published version of the manuscript.

Funding: The clinical trial NCT05846932 was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number R21HD109957. The current study would not have been possible without the funding support from R21HD109957 to provide the OT-ZOR-Equine intervention to the children in the study. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The Carl and Caroline Swanson Foundation provided additional funding for the qualitative interviews.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Colorado State University (IRB #5574, 5 June 2024).

Informed Consent Statement: Informed consent was received from all parents. All six children provided either verbal or non-verbal assent.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Acknowledgments: We express our gratitude to the participants and their families for making this study possible. We are also grateful to the staff at Temple Grandin Equine Center at CSU Spur. Finally, thank you to Carley Getz for reviewing and providing suggested revisions to previous iterations of this manuscript.

Conflicts of Interest: The authors declare 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. [CrossRef] [PubMed]
- American Psychiatric Association (APA). (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing. [CrossRef]
- Autistic Self Advocacy Network. (2022). *For whose benefit? Evidence, ethics and effectiveness of autism interventions*. Autistic Self Advocacy Network. Available online: <https://autisticadvocacy.org/policy/briefs/intervention-ethics> (accessed on 1 April 2025).
- Baker, M. J., Koegel, R. L., & Koegel, L. K. (1998). Increasing the social behavior of young children with autism using their obsessive behaviors. *Journal of the Association for Persons with Severe Handicaps*, 23(4), 300–308. [CrossRef]
- Beck, K. B., Conner, C. M., Breitenfeldt, K. E., Northrup, J. B., White, S. W., & Mazefsky, C. A. (2020). Assessment and treatment of emotion regulation impairment in autism spectrum disorder across the life span: Current state of the science and future directions. *Child and Adolescent Psychiatric Clinics of North America*, 29(3), 527–542. [CrossRef]
- Bhattacharya, K. (2017). *Fundamentals of qualitative research: A practical guide*. Routledge/Taylor & Francis Group. [CrossRef]
- Bottema-Beutel, K., Kapp, S. K., Lester, J. N., Sasson, N. J., & Hand, B. N. (2021). Avoiding ableist language: Suggestions for autism researchers. *Autism in Adulthood*, 3(1), 18–29. [CrossRef]
- Buro, A. W., Gray, H. L., Kirby, R. S., Marshall, J., Rolle, L., & Holloway, J. (2023). Parent and adolescent attitudes toward a virtual nutrition intervention for adolescents with autism spectrum disorder. *Advances in Neurodevelopmental Disorders*, 7, 94–106. [CrossRef]
- Cai, R. Y., Richdale, A. L., Uljarevic, M., Dissanayake, C., & Samson, A. C. (2018). Emotion regulation in autism spectrum disorder: Where we are and where we need to go. *Autism Research*, 11, 962–978. [CrossRef] [PubMed]
- Centers for Disease Control and Prevention. (2023) April 4. *Data & statistics on autism spectrum disorder*. Available online: <https://www.cdc.gov/autism/data-research/index.html> (accessed on 16 October 2024).
- Chown, N., Robinson, J., Beardon, L., Downing, J., Hughes, L., Leatherland, J., Fox, K., Hickman, L., & MacGregor, D. (2017). Improving research about us, with us: A draft framework for inclusive autism research. *Disability & Society*, 32(5), 720–734.
- Chrétien-Vincent, M., Grandisson, M., Desmarais, C., & Milot, É. (2023). Supporting the participation of autistic children: Development, acceptability and feasibility of an intervention to build capacity of early childhood educators. *Journal of Early Childhood Teacher Education*, 44(4), 1002–1023. [CrossRef]
- Conner, C. M., White, S. W., Beck, K. B., Golt, J., Smith, I. C., & Mazefsky, C. A. (2019). Improving emotion regulation ability in autism: The emotional awareness and skills enhancement (EASE) program. *Autism*, 23(5), 1273–1287. [CrossRef]
- Corbett, B. A., Mendoza, S., Abdullah, M., Wegelin, J. A., & Levine, S. (2006). Cortisol circadian rhythms and response to stress in children with autism. *Psychoneuroendocrinology*, 31, 69–68. [CrossRef]
- Corbett, B. A., Swain, D. M., Coke, C., Simon, D., Newsom, C., Houchins, J. N., Jenson, A., Wang, L., & Song, Y. (2014). Improvement in social deficits in autism spectrum disorders using a theatre-based, peer-mediated intervention. *Autism Research*, 7(1), 4–16. [CrossRef] [PubMed]
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design* (4th ed.). SAGE.
- Doehring, P., Reichow, B., Palka, T., Phillips, C., & Hagopian, L. (2014). Behavioral approaches to managing severe problem behaviors in children with autism spectrum and related developmental disorders: A descriptive analysis. *Child and Adolescent Psychiatry Clinics*, 23, 25–40. [CrossRef]
- Gabriels, R. L., & Hill, D. E. (Eds.). (2007). *Growing up with autism: Working with school-age children and adolescents*. Guilford Press.
- Gabriels, R. L., Pan, Z., Dechant, B., Agnew, J. A., Brim, N., & Mesibov, G. (2015). Randomized controlled trial of therapeutic horseback riding in children and adolescents with autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 54(7), 541–549. [CrossRef]
- Gagne-Trudel, S., Therriault, P. V., & Cantin, N. (2023). Exploring therapeutic relationships in pediatric occupational therapy: A meta-ethnography. *Canadian Journal of Occupational Therapy*, 91(1). [CrossRef]
- Garcia, J. M., Perry, C., Murray, M., Shurack, R., Brazendale, K., & Fukuda, D. H. (2024). The evaluation of a family-based judo program for youth with autism spectrum disorder. *Advances in Neurodevelopmental Disorders*, 8(3), 488–498. [CrossRef]
- Harrison, P. L., & Oakland, T. (2015). *Adaptive Behavior Assessment System* (3rd ed.). Western Psychological Services.
- Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, 16(3), 174–180. [CrossRef]
- Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277–1288. [CrossRef]
- Im-Bolter, N., & de la Roche, L. (2023). What parents want: A qualitative analysis of a parent-implemented intervention for autistic children. *Autism & Developmental Language Impairments*, 8, 23969415231189606.

- Jahromi, L. B., Meek, S. E., & Ober-Reynolds, S. (2012). Emotion regulation in the context of frustration in children with high functioning autism and their typical peers. *Journal of Child Psychology and Psychiatry*, 53(12), 1250–1258. [CrossRef]
- Kalmbach, D., Wood, W., & Peters, C. (2020). Parental perspectives of occupational therapy in an equine environment for children with autism spectrum disorder. *Occupational Therapy in Health Care*, 34(3). [CrossRef]
- Kim, H., Sefcik, J. S., & Bradway, C. (2016). Characteristics of qualitative descriptive studies: A systematic review. *Research in Nursing & Health*, 40, 23–42. [CrossRef]
- Konstantareas, M. M., & Stewart, K. (2006). Affect regulation and temperament in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 36, 143–154. [CrossRef] [PubMed]
- Kuypers, L. M. (2011). *The zones of regulation*. Think Social Publishing Incorporated.
- Laurent, A., & Gorman, K. (2018). Development of emotion self-regulation among young children with autism spectrum disorders: The role of parents. *Journal of Autism and Developmental Disorders*, 48, 1249–1260. [CrossRef]
- Law, M., Baptiste, S., & Mills, J. (1995). Client-centred practice: What does it mean and does it make a difference? *Canadian Journal of Occupational Therapy*, 62(5), 250–257. [CrossRef] [PubMed]
- Lindley, O. J., Thorburn, S., Heisler, K., Reyes, N., & Zuckerman, K. (2018). Parents' use of complementary health approaches for young children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 48(5), 1803–1818. [CrossRef]
- Llambias, C., Magill-Evans, J., Smith, V., & Warren, S. (2016). Equine-assisted occupational therapy: Increasing engagement for children with autism spectrum disorder. *The American Journal of Occupational Therapy*, 70(6), 7006220040p1–7006220040p9. [CrossRef]
- Martini, C., Cramm, H., Egan, M., & Sikora, L. (2016). Scoping review of self-regulation: What are occupational therapists talking about? *American Journal of Occupational Therapy*, 70(6), 7006290010p1–7006290010p15. [CrossRef]
- Mazefsky, C. A., Borue, X., Day, T. N., & Minshew, N. J. (2014). Emotion regulation patterns in adolescents with high-functioning autism spectrum disorder: Comparison to typically developing adolescents and association with psychiatric symptoms. *Autism Research*, 7, 344–354. [CrossRef]
- Mazefsky, C. A., & White, S. W. (2013). Emotion regulation: Concepts & practice in autism spectrum disorder. *Child and Adolescent Psychiatry Clinics of North America*, 23(1). [CrossRef]
- McDaniel Peters, B. C., & Wood, W. (2017). Autism and equine-assisted interventions: A systematic mapping review. *Journal of Autism and Developmental Disorders*, 47, 3220–3242. [CrossRef]
- Nader-Grosbois, M., & Mazzone, S. (2014). Emotion regulation, personality and social adjustment in children with autism spectrum disorders. *Psychology*, 5, 1750. [CrossRef]
- O'Haire, M. E. (2017). Research on animal-assisted intervention and autism spectrum disorder, 2012–2015. *Applied Developmental Science*, 21(3), 200–216. [CrossRef] [PubMed]
- Peters, B. C., Gabriels, R., Schmid, A. A., Lassell, R. K. F., Pan, Z., Hoffman, A., & Hepburn, S. (2024a). Occupational therapy using Zones of Regulation™ concepts: A feasibility study. *Occupational Therapy Journal of Research*, 44(4), 597–609. [CrossRef]
- Peters, B. C., Gabriels, R. L., Schmid, A. A., Pan, Z., Merritt, T., Hoffman, A., & Hepburn, S. (2024b). The feasibility of occupational therapy using Zones of Regulation™ Concepts in an equine environment. *Frontiers in Psychiatry*, 15, 1401222. [CrossRef] [PubMed]
- Peters, B. C., Wood, W., Hepburn, S., & Merritt, T. (2021). The feasibility and acceptability of occupational therapy in an equine environment for youth with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 80, 101695. [CrossRef]
- Peters, B. C., Wood, W., Hepburn, S., & Moody, E. J. (2022). Preliminary efficacy of occupational therapy in an equine environment for youth with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 52, 4114–4128. [CrossRef]
- Reyes, N. M., Pickard, K., & Reaven, J. (2019). Emotion regulation: A treatment target for autism spectrum disorder. *Bulletin of the Menninger Clinic*, 83(3), 205–234. [CrossRef]
- Rieffe, C., Terwogt, M. M., & Kotronopoulou, K. (2006). Awareness of single and multiple emotions in high-functioning children with autism. *Journal of Autism and Developmental Disorders*, 37(3), 455–465. [CrossRef]
- Roid, G., Miller, L., Pomplun, M., & Koch, C. (2013). *Leiter international performance scale* (3rd ed.). Stoelting.
- Rutter, M., & Bailey, A. (2003). *Social communication questionnaire*. Western Psychological Services.
- Samson, A. C., Hardan, A. Y., Podell, R. W., Phillips, J. M., & Gross, J. J. (2015). Emotion regulation in children and adolescents with autism spectrum disorder. *Autism Research*, 8(1), 9–18. [CrossRef]
- Samson, A. C., Well, W. M., Phillips, J. M., & Hardan, A. Y. (2014). Emotion regulation in autism spectrum disorder: Evidence from parent interviews and children's daily diaries. *Journal of Child Psychology and Psychiatry*, 56(8), 903–913. [CrossRef]
- Sandelowski, M. (2000). Whatever happened to qualitative description? *Research in Nursing & Health*, 23(4), 334–340. [CrossRef]
- Sandelowski, M. (2010). What's in a name? Qualitative description revisited. *Research in Nursing & Health*, 33, 77–84. [CrossRef]
- Scarpa, A., & Reyes, N. M. (2011). Improving emotion regulation with CBT in young children with high functioning autism spectrum disorders: A pilot study. *Behavioural and Cognitive Psychotherapy*, 39(4), 495–500. [CrossRef]
- Sekhon, M., Cartwright, M., & Francis, J. J. (2017). Acceptability of healthcare interventions: An overview of reviews and development of a theoretical framework. *BMC Health Services Research*, 17, 88. [CrossRef]

- Sekhon, M., Cartwright, M., & Francis, J. J. (2022). Development of a theory-informed questionnaire to assess the acceptability of healthcare interventions. *BMC Health Services Research*, 22, 279. [CrossRef]
- Shaffer, R. C., Wink, L. K., Ruberg, J., Pittenger, A., Adams, R., Sorter, M., Manning, P., & Erickson, C. A. (2019). Emotion regulation intensive outpatient programming: Development, feasibility, and acceptability. *Journal of Autism and Developmental Disorders*, 49, 495–508. [CrossRef]
- Sidani, S., & Braden, C. J. (2011). Testing the acceptability and feasibility of interventions. In S. Sidani, & C. J. Braden (Eds.), *Design, evaluation, and translation of nursing interventions* (pp. 163–196). Wiley. [CrossRef]
- Sofronoff, K., Attwood, T., Hinton, S., & Levin, I. (2006). A randomized controlled trial of a cognitive behavioral intervention for anger management in children diagnosed with Asperger syndrome. *Journal of Autism and Developmental Disorders*, 37, 1203–1214. [CrossRef]
- Spratt, E. G., Nicholas, J. S., Brady, K. T., Carpenter, L. A., Hatcher, C. R., Meekins, K. A., Furlanetto, R. W., & Charles, J. M. (2012). Enhanced cortisol response to stress in children with autism. *Journal of Autism and Developmental Disorders*, 42, 75–81. [CrossRef]
- Sumsion, T. (2000). A revised occupational therapy definition of client-centered practice. *British Journal of Occupational Therapy*, 63(7), 304–309. [CrossRef]
- Swain, D., Scarpa, A., White, S., & Laugeson, E. (2015). Emotion dysregulation and anxiety in adults with ASD: Does social motivation play a role? *Journal of Autism and Developmental Disorders*, 45, 3971–3977. [CrossRef]
- Tan, V. X.-L., & Simmonds, J. G. (2018). Parent perceptions of psychosocial outcomes of equine-assisted interventions for children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 48, 759–769. [CrossRef]
- Tomchek, S., & Koenig, K. (2016). *Occupational therapy practice guidelines for children and adolescents with autism spectrum disorders*. AOTA Press. [CrossRef]
- Weiss, J. A., Thomson, K., Burnham Riosa, P., Albaum, C., Chan, V., Maughan, A., Tablon, P., & Black, K. (2018). A randomized waitlist-controlled trial of cognitive behavioral therapy to improve emotion regulation in children with autism. *Journal of Child Psychology and Psychiatry*, 59(11), 1180–1191. [CrossRef] [PubMed]
- Whalley Hammell, K. R. (2013). Client-centred practice in occupational therapy: Critical reflections. *Scandinavian Journal of Occupational Therapy*, 20(3), 174–181. [CrossRef]
- Xiao, N., Shinwari, K., Kiselev, S., Huang, X., Li, B., & Qi, J. (2023). Effects of equine-assisted activities and therapies for individuals with autism spectrum disorder: Systemic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 20(3), 2630. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

Perceived Benefits and Barriers for Autistic Adults Accessing Therapeutic Horse Riding for Mental Health

Hannah Louise Brumpton ¹ and Niko Kargas ^{1,2,*}

¹ School of Psychology Sport Science & Wellbeing, College of Health and Science, University of Lincoln, Lincoln LN6 7TS, UK; hannah.brumpton@hotmail.co.uk

² Department of Cognitive Sciences, College of Humanities and Social Sciences, United Arab Emirates University, Al Ain P.O. Box 15551, United Arab Emirates

* Correspondence: nkargas@uaeu.ac.ae

Abstract

Therapeutic horse riding (THR) is a non-traditional intervention that may support mental well-being in individuals with autism spectrum conditions. Despite growing interest, most research has focused on children and has tended to privilege practitioner or caregiver perspectives, leaving autistic adults underrepresented. This qualitative study explores the psychological benefits and systemic barriers associated with THR among Autistic adults, drawing on perspectives from both clients and practitioners. Semi-structured interviews were conducted with six Autistic clients and four practitioners, and the data were analysed using reflexive thematic analysis. Five overarching themes were constructed: Facing the Puissance: barriers to accessing THR, Pathways to Participation, Embodied Engagement, To Understand and To Be Understood, and Beyond the Arena—Impacts That Last. Participants described enjoyment, increased confidence, and a sense of achievement, with effects accumulating over time and often extending beyond the riding arena into daily life. Barriers included cost, accessibility, and limited availability of appropriately trained staff and facilities. These findings add to the limited evidence base on THR for Autistic adults by providing an in-depth, contextually grounded account of participants' experiences. They suggest that, for verbally fluent Autistic adults who choose to access THR in similar settings, THR can enhance well-being, self-agency, and relationship-building, whilst also revealing structural obstacles that restrict equitable access.

Keywords: autism; autistic adults; therapeutic horse riding; mental well-being; access barriers; embodied engagement; relational safety

1. Introduction

Equine-assisted services (EAS) is increasingly used as an umbrella term for structured human–horse programmes, encompassing therapeutic riding, equine-assisted learning, equine-assisted psychotherapy, and related activities. Recent American consensus work has recommended adopting EAS as a field-level descriptor, with more specific terms used for distinct service models (e.g., equine-assisted psychotherapy, therapeutic riding). In line with this terminology, we use EAS to refer to the broader field and therapeutic horse riding (THR) to describe mounted, psychologically focused sessions in which the horse–human relationship is used intentionally to support mental well-being rather than physical rehabilitation (Wood et al., 2021). Positioning THR within this framework facilitates comparison with emerging EAS research internationally and clarifies that the present study focuses

on a mental-health-oriented, rather than purely recreational or sport-focused, form of riding. While EAS have gained increasing recognition, existing research has predominantly focused on children and young people, often emphasizing the perspectives of caregivers or practitioners rather than those of Autistic individuals themselves (Malcolm et al., 2018). Previous studies have highlighted the need for research that directly incorporates the voices of Autistic people (Botha & Cage, 2022; Holt et al., 2022; McDaniel Peters & Wood, 2017; Saunders, 2018; Silberman, 2017). Moreover, the limited qualitative literature in EAS that does engage Autistic participants has largely concentrated on young females, with minimal attention given to adults (Warner et al., 2022). Accordingly, the present study aimed to explore the perceived benefits and barriers encountered by Autistic adults in accessing therapeutic horse riding (THR) as a means of supporting mental well-being. To address this gap in the literature, the study foregrounds first-person narratives from Autistic adults, complemented by professional insights from THR practitioners. By integrating these perspectives, the research offers a more comprehensive understanding of THR's potential to enhance psychological well-being, while also highlighting the relational and structural challenges that may affect access. This approach situates THR within broader discourses on neurodiversity, accessibility, and the provision of mental health services for Autistic adults, a population that remains underrepresented in mainstream research, healthcare provisions and relevant support systems (Jones et al., 2025 Kargas et al., 2023; Moore et al., 2024; UK Parliament, 2023).

Autism Spectrum Disorder (ASD) is characterised in diagnostic systems such as the ICD-11 (World Health Organization, 2022) and DSM-5-TR (APA, 2025) by social demands that exceed the individual's adaptive capacities and by restricted and repetitive patterns of behaviour. There are an estimated 700,000 Autistic people in the UK (Buescher et al., 2014; Centres for Disease Control and Prevention, 2022; National Autistic Society, 2024), with higher estimates when including those without formal diagnosis. Autistic adults face enduring disadvantages compared to typically developing peers (Howlin & Magiati, 2017), including lower self-esteem (Nguyen et al., 2020), reduced confidence, particularly in those diagnosed in adulthood (Corden et al., 2021; Darazsdi & Bialka, 2023; Milton & Sims, 2016), and wider economic and social barriers (Fletcher-Watson, 2024; Rogge & Janssen, 2019; Seltzer et al., 2003; Zhao et al., 2023). Horses have been domesticated for much of recorded history, and in recent years, they have increasingly been recognised as valuable partners in therapeutic interventions aimed at supporting mental health and well-being (Anastasya et al., 2024; Cleary et al., 2024; Hatcher et al., 2019; Ward et al., 2022; Xiao et al., 2023). Equine-assisted services are expanding, with approximately 280 individuals currently registered with the Athena practitioner register (Athena, 2025), and nearly 200 businesses and associates listed on the Human Equine Interaction Register (HETI, 2025). However, many practitioners operate outside these formal registries, reflecting the growing scope and diversification of the field (Seery & Wells, 2024).

The therapeutic potential of human–animal interactions has long been acknowledged, with documented inclusion of animals in treatment settings dating back to 1792 (McCulloch, 1983; Morrison, 2007). Empirical research has demonstrated that interactions with horses can enhance self-confidence, self-esteem, and overall psychological well-being (Bizub et al., 2003; Burgon, 2011; Cantin & Marshall-Lucette, 2011; Karol, 2007; Hatcher et al., 2019). For instance, participants often report initial apprehension when engaging with horses, which can evolve into increased self-efficacy and a sense of empowerment through participation in equine-assisted programmes (Bizub et al., 2003). Feelings of calmness, enjoyment and confidence have also been reported by autistic children when riding horses (Browne et al., 2025). Within autism research, equine-assisted programmes have most commonly been studied with children and adolescents. Quantitative and mixed-method studies of therapeutic

riding and related equine-assisted activities report improvements in social communication, adaptive behaviour, and motor skills, alongside reductions in anxiety and challenging behaviours (e.g., Gabriels et al., 2015; Xiao et al., 2023). Qualitative and mixed-method work with autistic children similarly highlights increased enjoyment, confidence, and emotion regulation, as well as the perceived kindness and safety offered by practitioners and horses (Burgon, 2011; Malcolm et al., 2018; Browne et al., 2025; Cleary et al., 2024). However, autistic adults' own accounts of engaging with THR remain sparse, and adult-focused studies have tended to privilege practitioner or caregiver perspectives (McDaniel Peters & Wood, 2017; Warner et al., 2022). There is therefore limited understanding of how Autistic adults themselves perceive the benefits, challenges, and broader life impacts of THR.

Despite the promising outcomes associated with equine-assisted interventions, research in this area faces several methodological and conceptual challenges. Studies often rely on small sample sizes, yield inconsistent findings, and employ varied definitions and delivery models of equine-assisted services (Bachi, 2012; Lentini & Knox, 2009). Moreover, much of the existing literature focuses on structured, therapy-oriented sessions, leaving the potential benefits of broader, informal horse–human interactions underexplored (Burgon, 2011; Cantin & Marshall-Lucette, 2011; Karol, 2007). Access to therapeutic horse riding is further constrained by financial and logistical barriers. Sessions can be prohibitively expensive (Burgon, 2011; Kendall et al., 2014), and funding opportunities remain limited (Kendall et al., 2014). These challenges are particularly salient for Autistic adults, who are disproportionately affected by unemployment and economic disadvantage (Farkas et al., 2021; Harmuth et al., 2018; NICE, 2025). As such, it is essential to investigate both the benefits and barriers associated with therapeutic horse riding (THR) for this population, in order to inform equitable service provision and support evidence-based funding decisions.

In this context, the current study focuses specifically on THR, conceptualised as a mental-health-oriented equine-assisted service, delivered by practitioners with qualifications in mental health and extensive equestrian experience. We explore the perceived benefits and barriers of THR among Autistic adults who have chosen to access a THR programme at a single UK centre, alongside the perspectives of practitioners delivering the service. The Autistic participants were all verbally fluent and able to provide informed consent, reflecting a subgroup of adults who are already engaged with support. Rather than evaluating the efficacy of THR or seeking statistically generalisable findings, the study offers an in-depth, contextually grounded account of how THR is experienced and understood by these Autistic adults and the practitioners who work with them.

2. Materials and Methods

2.1. Design

The study employed a qualitative design using semi-structured interviews to enable participants to reflect on and elaborate upon their experiences of THR for mental health (Kallio et al., 2016). The flexible format and adaptable sequencing of questions facilitated in-depth discussions and the generation of rich, nuanced data, while allowing participants autonomy over the extent to which they engaged with specific topics, thereby respecting individual comfort levels. Furthermore, the semi-structured format enabled researchers to tailor the phrasing and delivery of questions to accommodate participants' communication preferences and potential verbal processing needs, thereby enhancing the accessibility and inclusivity of the interview process.

2.2. Setting and THR Programme

Data were collected at a single UK THR centre that offers equine-assisted services for adults and young people with mental health difficulties and/or neurodivergent condi-

tions. The service is delivered within a small, not-for-profit setting that combines mental-health training and extensive equestrian experience. THR sessions are explicitly framed as mental-health-oriented rather than sport- or rehabilitation-focused, and are delivered by practitioners with relevant professional backgrounds (e.g., counselling, psychotherapy, psychology, and equine-assisted practice). A typical THR session at the centre involves meeting the horse and practitioner, grooming and preparing the horse, mounted work in an arena, and a period of reflection and discussion. Sessions are tailored to the needs and goals of each client, with attention paid to sensory preferences, communication styles, and emotional safety. Clients usually attend on a regular basis, although frequency varies (e.g., weekly, fortnightly, or monthly) depending on personal circumstances and funding. All Autistic clients and practitioners in this study were recruited from this single centre, and the implications of this single-site design for transferability are considered in the Discussion.

2.3. Researcher Position

The primary researcher for this study was a white British female enrolled in the MSc Developmental Psychology programme at the University of Lincoln. As Braun and Clarke (2013) note, researchers may occupy both insider and outsider positions within the research context. In this study, the researcher held a dual positionality. Her involvement as a therapeutic riding practitioner at the THR facility attended by some participants positioned her as an insider with detailed contextual knowledge and pre-existing relationships with several clients and all practitioners. Conversely, as someone without a formal Autism diagnosis and who does not self-identify as Autistic, she also occupied an outsider position in relation to participants' lived experiences of autism. In the context of practitioner interviews, her primary role as a therapeutic riding practitioner further reinforced her insider status.

This dual role has potential advantages and challenges. The existing trust and familiarity may have facilitated open conversation, but may also have made participants more likely to emphasise positive aspects of THR or to downplay criticisms, particularly among practitioners whose employment is tied to the programme. To address these issues, the researcher engaged in ongoing reflexive practice (see Section 2.6), explicitly considered how her practitioner role, values, and expectations might shape the research process, and used supervision meetings to critically examine emerging assumptions and interpretations. During interviews, she actively invited participants to discuss challenges, barriers, and negative or ambivalent experiences, and emphasised that participation was voluntary, confidential, and independent of their access to services.

2.4. Ethics and Recruitment

Ethical approval was granted by the University of Lincoln (Approval No. UoL2025_19424), and the study was conducted in accordance with the Declaration of Helsinki. All participants were recruited via a gatekeeper at the THR centre to ensure ethical recruitment and to protect clients from feeling pressured to participate. Theoretical sampling was used to ensure that participants' experiences were relevant to the research questions, focusing on Autistic adults who had accessed THR for mental health and practitioners who delivered such sessions. Seven Autistic clients expressed interest and six consented to be interviewed. Five practitioners expressed interest and four consented. No financial incentives were offered. Accessibility and participant welfare were prioritised before, during, and after the interviews. Participants were informed that they could pause, stop, or resume the interview at any time, decline to answer any questions, or bring another person for support if desired. All participants provided written informed consent and were reminded that they could withdraw their data up to seven days after their interview, at which point transcripts

were finalised and anonymised. At the end of each interview with Autistic adults, the researcher checked that the participant felt comfortable leaving and provided a debrief sheet with mental-health signposting. All participants were recruited from the same THR centre described in Section 2.2. This single-site recruitment enhances contextual specificity but limits variation in service models and organisational cultures; the implications for transferability are discussed later.

2.5. Participants

2.5.1. Autistic Adults

Six Autistic adult women who had accessed THR participated in the study. In line with the inclusive, neurodiversity-affirming ethos of the project, participants were eligible if they either had a formal diagnosis of autism spectrum condition ($n = 5$) or self-identified as Autistic ($n = 1$); both groups are therefore included under the term “Autistic adults” in this paper. All were aged over 18 years (range 25–57 years; $Mdn = 30$, $IQR = 12$). All Autistic participants were able to provide written informed consent and engage in a semi-structured interview, indicating average or above-average intellectual and verbal functioning. However, no formal psychometric or clinical data were collected to specify participants’ cognitive profiles or to categorize them within traditional diagnostic frameworks. Consequently, the findings primarily reflect the perspectives of Autistic adults with relatively strong verbal and cognitive skills who were already engaged with a specialist THR service. As discussed later, this limits the extent to which the results can be transferred to Autistic individuals with higher support needs or significant communication challenges.

Eligibility criteria required participants to be over 18 years of age and to have attended a minimum of three THR sessions within the previous twelve months. In addition, four THR practitioners who had experience delivering sessions to Autistic adults were interviewed.

2.5.2. Practitioners

Four female THR practitioners who had experience delivering sessions to Autistic adults were also interviewed. Practitioner participants were required to be over 18 years of age and to have provided THR services to Autistic adults at the centre. Their experience in THR with Autistic adults ranged from approximately three months to five years. Practitioner participants were also required to be over the age of 18 and to have provided THR services to Autistic adults; their experience ranged from three months to five years. Practitioners came from a range of professional backgrounds (e.g., counselling, psychology, equine-assisted services) and were actively engaged in efforts to develop a more evidence-based approach to THR. Their investment in the programme and interest in generating an evidence base may have contributed to a generally positive orientation towards THR in their accounts; this potential bias is considered in the Reflexivity, Analysis, and Discussion sections. The researcher aimed to achieve data saturation while acknowledging the potential limitations imposed by the small sample size, which reflects the broader challenges associated with participant recruitment in this field.

2.6. Interview Guide: Development and Content

The semi-structured interview protocol was developed collaboratively with input from multiple stakeholder groups. The Principal Investigator drafted the initial topic guide based on the existing literature on equine-assisted interventions and autism, the aims of the study, and clinical experience in THR. This draft guide was then reviewed by colleagues at the Autism Research Innovation Centre (ARIC) at the University of Lincoln, by members of the Progressive Autism Group, a user-led group comprising Autistic university students and by experienced THR practitioners at the centre. Their feedback focused on

ensuring that questions were clear, non-patronising, and respectful of Autistic perspectives, avoiding deficit-based language, and to ensure that the questions were meaningful and acceptable from a service-delivery perspective. Together, these iterative consultations led to refinements in wording, ordering, and emphasis, and helped ensure that the guide was both clinically relevant and aligned with Autistic priorities.

The same core semi-structured guide was used across both participant groups to support consistency, with adaptations in emphasis and follow-up prompts to reflect participants' roles (Autistic client or practitioner). Initial questions with Autistic clients aimed to ease into the interview with simple questions such as "Can you start by telling me how you first learnt about and accessed THR for mental health?" and from there building a rapport with the participant. Further questions such as "Are there any short-term impacts, either positive or negative from attending THR?" were based on previous literature findings which found a range of both positive and negative emotions may be felt (Burgon, 2011; Hatcher et al., 2019; Karol, 2007). For practitioners, parallel questions explored their role, experiences working with Autistic adults in THR, perceived benefits and harms, and systemic and practical barriers to access, including their views on the evidence base and what might be needed to strengthen it. In line with best practice in autism research, the interview questions were shared with all participants in advance (e.g., via email or as part of the information pack). This was intended to reduce anxiety, allow time for processing and preparation, and support participants in deciding what they did and did not wish to discuss. To enhance transparency, the full set of interview questions is provided as Supplementary Materials.

2.7. Interview Procedure

All interviews were conducted in person in private rooms at the stables, chosen to maximise participant comfort by situating conversations in a familiar, low-demand environment close to where THR sessions typically take place. Interviews were scheduled at times that suited participants and, where possible, avoided busy yard periods to minimise sensory overload. We recognise that conducting interviews on-site may have influenced responses (for example, by reinforcing participants' identification with the centre or making them less likely to express criticism), and we consider this in interpreting the findings.

Interviews were audio-recorded via Microsoft Teams on a secure laptop. Automated transcripts were generated by the platform and subsequently reviewed and manually corrected by the researcher to ensure accuracy. Interviews were completed on different days to avoid interviewer fatigue and to allow time for reflexive noting between sessions. Interview lengths ranged from 19 min 7 s to 44 min 43 s.

Prior to the interview, the participants were given a participant consent form to read and sign. This was an opportunity to ask the researcher any questions. The consent form contained information on withdrawal, which could be requested up to 7 days after the completed interview. Following this window, transcripts were anonymised by removing identifying information such as names and locations. Participants were informed that they were not required to answer any questions they did not want to, and they could go into as much or as little detail as they desired. Participants were also invited to raise any additional issues they considered important. The current study also explored longer-term effects of THR on the well-being of Autistic adults. Practitioners received the same consent form and participant information sheet; however their questions differed. Firstly, asking them to outline their role and experiences working with Autistic adults in the context of THR, to allow the interviewer to understand their role. The interview then moved on to what barriers the practitioners felt were preventing, or making access to THR harder for Autistic adults, before discussing ways of working with or removing these barriers where

possible. Practitioners were also asked to expand on short- and long-term impacts of THR, and finally given the opportunity to share any thoughts they felt were valuable.

2.8. Reflexivity

Reflexivity was embedded throughout data collection and analysis. The researcher kept brief reflexive notes after each interview, documenting initial impressions, emotional responses, and emerging ideas about how her dual practitioner–researcher role might be shaping interactions and interpretations. These notes, together with supervision discussions, were used to question overly positive readings of the data and to consider how participants’ ongoing relationships with the centre, and practitioners’ desire for a stronger evidence base for THR, might influence what was said. The researcher noted considerable variability in how forthcoming participants were. Some autistic participants provided minimal initial answers (for example, “yes,” “no,” “I don’t know”). Gentle probing sometimes yielded limited additional detail, and on reflection the researcher considered whether further elaboration of prompts could have helped. The researcher also reflected on recruitment challenges and on the decision to revise the minimum-session inclusion criterion from ten to three sessions. This informed a cautious approach to claims about typicality and long-term effects.

2.9. Method of Analysis

Data were analysed using reflexive thematic analysis (RTA; Braun & Clarke, 2019). This process enabled the researcher to engage deeply with the data and reflect on their interpretations. The analysis began with the researcher listening to the audio recordings while reading the corresponding transcripts to become immersed in the data and to begin noting initial analytic observations. Transcripts were then read multiple times and coded inductively using qualitative software, with codes capturing both semantic content (what participants said) and more latent meanings (how they positioned THR, themselves, and others).

Codes were iteratively reviewed, and those judged less relevant to the research questions were set aside. The remaining codes were then clustered into candidate themes and sub-themes, which were refined through repeated movement between coded data extracts, the full data set, and the developing analytic narrative. Throughout this process, the researcher maintained analytic memos and evolving theme maps to document key decisions, providing an audit trail of the analysis. Emerging themes were discussed in supervision to consider alternative readings and to ensure that they remained grounded in the data while acknowledging the inherently interpretive nature of RTA. Consistent with reflexive thematic analysis, inter-rater reliability was not sought; instead, rigour was pursued through depth of engagement, transparency of decision-making, and ongoing reflexive awareness of the researcher’s influence on the knowledge produced.

3. Results

The analysis generated five overarching themes, each with related sub-themes: (1) Facing the Puissance: barriers to accessing THR, (2) Pathways to Participation, (3) Embodied Engagement, (4) To Understand and To Be Understood, (5) Beyond the Arena—Impacts That Last.

3.1. Facing the Puissance: Barriers to Accessing THR

The term *puissance* refers to a high wall-jumping event in showjumping. Here, it is used metaphorically to capture the formidable, sometimes intimidating barriers that Autistic adults encounter when trying to access THR. Participants described a range of structural, systemic, and practical obstacles that made THR difficult to access or sustain.

The metaphor of facing the puissance reflects how these barriers were experienced as high and sometimes daunting and challenging, but in some cases surmountable with the right support. Costs, funding, and finances were consistently described by both clients and practitioners as substantial barriers, alongside issues of physical and sensory accessibility and confusion about what THR actually involves. One participant emphasised this point directly:

“One of the barriers, like a really obvious barrier, is cost”. (Participant 1, practitioner)

Much like the puissance, some barriers were challenging but ultimately surmountable, whereas other accessibility issues were viewed as more flexible, with solutions available to mitigate their effects. For example, Participant 2 (practitioner) described how busyness around the yard could be managed:

“If it is a bit busy, then the other staff tend to not like hang around the arena.”

Participants also shared some apprehension around starting THR “It’s quite scary. It’s a big thing to do” (Participant 8, client).

These accounts illustrate that while certain barriers are entrenched, others can be negotiated or adapted, reflecting the dynamic ways in which participants navigate participation. Within the overarching theme Facing the Puissance, such experiences informed the development of three sub-themes: Accessibility, Defining THR, and Finance and Funding. Together, these sub-themes highlight how practical, cognitive, and structural factors interact with participants’ engagement, shaping both the experience of THR and the extent to which clients can fully benefit from the service.

3.1.1. Accessibility

The first sub-theme, Accessibility, explores participants’ experiences of Autistic adults navigating factors such as busy environments, physical abilities, and sensory needs. One consideration raised by practitioners was the physical needs of clients:

“Autistic adults that don’t have that same physical capability and would still benefit from it in terms of a mental health sense, but actually, we don’t have the set up for them to access it in a way we’d like, we can’t make them as safe”.
(Participant 1, practitioner)

Centres providing THR may not always have the appropriate facilities to meet these needs, creating a physical barrier, whether that’s safely assisting with mounting or simply accessing the yard area. Accessibility considerations also extended to sensory aspects of Autism. For example, when discussing typical riding school environments, Participant 2 (practitioner) shared what clients had previously told her:

“It’s too noisy, there’s too much going on, there’s shouting and you know, so that’s a big sensory overload.”

To address this, Participant 2 suggested offering quieter times, similar to “Autism-friendly hours” in supermarkets, as a way for riding schools to make THR more accessible for clients with heightened sensory needs.

The aforementioned examples illustrate how practical, environmental, and sensory factors impact on Autistic adults’ engagement with THR. Within the overarching theme Facing the Puissance, these findings show that navigating THR requires negotiating both physical and sensory challenges to fully benefit from the service. Taken together, these accounts show that access to THR is shaped not only by individual motivation but by the physical layout of centres, availability of appropriate equipment, and management of sensory demands. For Autistic adults in this study, quieter environments, flexible yard

management, and attention to mobility needs were key to whether THR felt possible and safe.

3.1.2. Defining Therapeutic Horse Riding

The second sub-theme, Defining THR, highlights how preconceptions, expectations, and lack of understanding of THR due to the difficulty in defining it, shaped early experiences for Autistic adults. Participant 1 (practitioner) reflected on how lack of definition leads to lack of clarity around what to expect:

“Because it’s really difficult to define. It’s quite niche. . . a lot of people confuse it with riding for physical health rather than mental health.”

Preconceptions often assumed THR would involve cantering, jumping, or controlling the horse, reflecting the broader equestrian culture.

“Preconception that it’s going to be about cantering around and jumping and making the horse do what’s expected. . . well, it is the culture in the equestrian world”. (Participant 1, practitioner)

“when I had horse riding lessons before, like they would always tell me to be louder because the horse couldn’t hear me. So I was, I guess I was scared of that happening again. But then that made me quieter.” (Participant 9, client)

Rigid thinking tendencies in Autistic adults could make adapting to THR challenging particularly for those who have previously ridden; however in Participant 1’s experience, once expectations were adjusted, participants reported rapid shifts in mindset, whilst this is considered a barrier, openness to change seems to be noticed by practitioners:

“Combined with the rigid thinking of autistic adults. . . once you can help them to do that, they’re very quickly then in a new mindset”. (Participant 1, practitioner)

Participant 1 (practitioner), spoke about how some benefits especially around feeling, can be more challenging to measure and actually having a physical representation of progress, achievement and change may be beneficial to help clients to really recognise what has happened as a result of THR.

“We can talk about feeling more confident and feeling heard and feeling a sense of belonging, but that’s actually quite hard to measure and put your finger on.”

“Something like the rosettes. . . something you can hold that you’ve done and achieved.”

The suitability and responsiveness of horses were also central to defining THR and the ways in which it works, some conversation took place around the level of challenge that was relevant and acceptable for the horse to present to the client. Sourcing horses that fit this, proved harder for centres, but were perceived to have more benefit for the clients.

“Not any horse can be a therapeutic riding horse. . . horses that are willing to kind of attune to what the client’s needing in that session. . . probably has more benefit for the client.” (Participant 1, practitioner)

Practitioners gave examples of ethical considerations for the horse and the adaptability of instructors, illustrating the intricate complexities revolving around the triad of practitioner—horse—client and ensuring all needs are safely and reasonably met.

“How can we genuinely help the horse to carry us and do that in a way that’s ethical and prioritises that relationship with them?” (Participant 1, practitioner)

“there’s a lot of riding schools that offer therapeutic riding sessions. But I would question whether some of them are actually therapeutic riding sessions”.
(Participant 2, practitioner)

To provide some clarity to prospective clients about THR and their understanding of how the sessions may look, Participant 1 shared how she provides information on the website:

“We try and have it like a really solid description on the website of what it is and what people can expect.”

THR is often not clearly defined, or differs largely between centres and practitioners. Providing a clear explanation of what it is is not only beneficial to clients but also to practitioners and researchers who are exploring and delivering a cohesive version of THR. This subtheme illustrates how definitional ambiguity around THR can itself become a barrier to access. When Autistic adults and referrers confuse THR with sport riding or physical rehabilitation, expectations may not align with the more relational, emotionally focused work offered. Practitioners’ efforts to clarify what THR is, and is not, are therefore central to helping potential clients decide whether the service is right for them (Kerulo et al., 2020).

3.1.3. Finance & Funding

The significant role of cost in shaping access to THR for Autistic adults was addressed by all participants, sharing both systemic challenges and varying individual experiences of affordability. Practitioners primarily focused on the cost of running and evidencing a niche service, whereas clients spoke about the affordability of session fees and how these constrained how often they could attend. Participant 1 (practitioner) emphasised:

“Cost is the biggest barrier to therapeutic riding. . . particularly in terms of winning funding because it doesn’t fit very neatly into therapy and counselling. . . and it also doesn’t fit into riding in terms of sport and physical activity, which is then a huge barrier to winning funding.”

Even when funding is secured, additional challenges arise.

“I just guess that a lot of that actually just relies on funding.” (Participant 2, practitioner)

“Even when we do have funding, the reporting requirements are massive. So then we’re not likely to renew the funding, which means we’re going to have to put our costs back to the standard price.” (Participant 1, practitioner)

Clients were acutely aware of financial limitations, particularly when costs impact frequency of attendance.

“I would do it every week if I could. . . But if there’s help out there to support, then probably you could get more because I’ll have it once any other week instead of once every month.” (Participant 7, client)

Despite the challenges, some clients expressed that current pricing was manageable, relative to the benefits they experienced.

“I’m putting the bridle on. I’m learning lots of different things. . . So I think it’s a good price.” (Participant 6, client)

Practitioners acknowledged that even small costs could disproportionately affect clients who are inherently disadvantaged:

“If people don’t have any spare money, £25 a month is between like a food shop for one person or not. . .there is definitely a huge amount of people who would love to come weekly but can’t afford it, so they come fortnightly or monthly. . .with any therapeutic intervention, the more consistent and the more regular . . ., the more effective it is, so it’s naturally less effective for them”. (Participant 1, practitioner)

Systemic constraints were also reflected in the time and resources required to make THR measurable and tangible, such as producing rosettes for clients to recognise their achievements as previously mentioned in Defining THR.

“the amount of time, like unpaid time that goes into that then becomes another barrier. . .we don’t exactly have a lot of funding. . .very systemic issues, a vicious cycle”. (Participant 1, practitioner)

Finance and funding are not simply individual barriers but are embedded within systemic and structural challenges faced by clients and providers alike. Within the overarching theme Facing the Puissance, these findings demonstrate how practical and financial realities shape access, engagement, and the effectiveness of THR, particularly for a client group that may be economically disadvantaged. While some clients find the current costs manageable, others are constrained in how frequently they can participate, which may limit the therapeutic impact. Overall, finances and funding operated as barriers at multiple levels. For clients, even relatively low fees could mean choosing between THR and essential expenses. For providers, limited and short-term funding streams, coupled with heavy reporting requirements, made it difficult to offer subsidised sessions consistently. These intertwined pressures meant that those who might benefit most from THR were often least able to attend regularly.

3.2. Pathways to Participation

3.2.1. Opening the Gateway

Participants’ experiences of initial access to THR highlighted a number of factors that either facilitated or impeded engagement, including ease of booking, clear communication, predictable scheduling, and staff patience. Accessible systems and supportive practices helped clients to engage from the outset. For example, initial assessments that did not require riding but instead focused on explaining what to expect gave clients a chance to understand how future sessions might look. Although online booking is useful, flexibility in this process was also appreciated:

“Initial assessment where they don’t necessarily ride. . .have a chat about what to expect. . .that’s quite helpful as well.” (Participant 1, practitioner)

“it’s easy to get in touch with us in whatever way feels safest.” (Participant 4, practitioner)

“reminders and things are a massive help. . .also offers you the predictability. . .you know you’ve got your appointment.” (Participant 5, client)

“I just find it better to book in person because then it’s done.” (Participant 7, client)

Practitioners shared how THR was intentionally structured to support accessibility and inclusion noting the consideration of neurodivergent and mental health needs from the programme’s foundations:

“Very much geared for them from the start. . .we are going to be welcoming clients who maybe don’t see the world in the way we all do, but might have different needs.” (Participant 1, practitioner)

Accessibility was further enhanced by practical considerations such as staff patience in delivering instructions and feedback. The supportive, inclusive environment provided by practitioners and the centre as a whole was also a defining feature of THR.

"I really...think it is a very accessible and inclusive place...being patient and allowing extra time...just that kind of kindness." (Participant 5, client)

"Guidance I've had has been really nice because as I say, I might forget. Okay. And it's nice to just repeat it." (Participant 6, client)

Collectively, these accounts share how THR providers create an environment that actively opens the gateway for participation. By addressing practical, cognitive, and social needs, the programme facilitates engagement for Autistic adults, ensuring that initial barriers do not prevent them from experiencing the therapeutic benefits of riding. In combination, these practices "open the gateway" to THR by reducing uncertainty and practical effort at the point of first contact. For the Autistic adults in this study, straightforward booking routes, consistent reminders, and a visibly welcoming ethos were not incidental details but core elements of what made the service feel reachable and worth trying.

3.2.2. Predictably Unpredictable

Participants shared experiences of consistency and unpredictability within THR, the careful balance between routine and variability that influences engagement and therapeutic benefit. Clients emphasised the importance of a predictable environment in supporting their participation and consistency of their attendance and how changes can be made easier by the predictability.

"It's so easy to get overwhelmed...you end up not doing things or...having to let go of things. But I mean, how long have I been coming here? Over 18 months now. The fact that I've consistently still come here." (Participant 5, client)

"I was the only one to turn up because it was snowing, happily I'm here". (Participant 10, client)

"Even if the horses change, I will still be doing the same thing every time. So that really helps." (Participant 5, client)

Practitioners shared the careful management of predictability, noting that consistent routines, familiar horses, and a small, stable team all contributed to a safe and supportive environment.

"But there's something about the consistency of that being true in terms of someone can come every time and having the same sort of experience...even if it's more difficult some weeks, there's always that environment that supports them to still achieve those things". (Participant 1, practitioner)

"I like to start each session by talking with the rider about how they're feeling, how their week has gone, and how they're feeling about the session ahead." (Participant 3, practitioner)

"Horses in therapeutic riding in general, you can sort of manage an unpredictable horse because the focus is on the communication and relationship with the horse and that's OK. But in my experience, autistic adults have found that a little bit harder to deal with just because if you don't quite know what you're coming to...even if you're riding the same horse, you don't know how that horse is going to feel". (Participant 1, practitioner)

Too much unpredictability could also shift the focus away from the client, reducing the therapeutic benefit:

“When the instructors just have to manage the horse because the horse has become unpredictable or difficult, that actually then the focus is taken away from the client. Clients can deal with that to an extent, but at some point, it becomes quite damaging”. (Participant 1, practitioner)

For Autistic adults, predictable routines and familiar environmental cues provide a sense of safety, while unpredictable elements, particularly relating to horse behaviour, require careful management by practitioners. Within the overarching theme “Pathways to Participation”, “Predictably Unpredictable” highlights the nuanced interplay between stability and variability, illustrating how delivering THR in a way that provides a level of predictability for the client allows them to safely engage with unpredictability which is something that Autistic adults may usually be averse to. This subtheme highlights the delicate balance between routine and variability in THR. Predictable structures, familiar horses, and consistent staff made it possible for Autistic adults to keep attending, while carefully managed, low-level unpredictability offered opportunities to practise coping with change. When unpredictability became too great, however, the focus shifted away from the client and therapeutic benefits were weakened.

3.2.3. Tailored and Personalised

The importance of instructors’ ability to adapt THR to meet the individual needs of clients is described by participants sharing how personalised approaches, both in communication and environmental structuring, made participation more accessible and meaningful. Processes such as meeting people at the gate and having clear guidance contributed to predictability and reduced anxiety:

“spent some time on the website and read that. . .and it gave a very warm and friendly feel to the place, which is always important to me. . .Just the way something’s written and the vibe it kind of gives matters. So it felt very friendly.” (Participant 5, client)

“I just came down here and it’s also good that you meet people at the gate. . .all of that worked very well for me, in terms of. . .finding it and accessing it on the first appointment.” (Participant 5, client)

Practitioners described being able to actively adapt sessions to clients’ communication preferences, sensory needs, and learning styles; clients also reiterated practitioners’ ability to do this.

“things still need to be repeated a bit more? . . .That repetition was actually very helpful. . .It helps me. . .remember what I’m doing.” (Participant 6, client)

“you’re inclusive of people with different communication styles, and I think that’s the most important thing”. (Participant 9, client)

“Guess the way I structured my sessions would be I asked the client what they need. I asked the client how and where they prefer to be, how they prefer to communicate, what sensory issues they may have. . . I will always try to adapt as best as I can.” (Participant 2, practitioner)

“Actually when when they’re in the riding sessions and we’re able to adapt the sessions and facilitate those choices . . . those additional needs are met.” (Participant 4, practitioner)

“We adapt to clients that need more black and white language and more clear-cut instructions. . .but very rarely has the client to teach us anything in terms of what they need.” (Participant 1, practitioner)

Tailoring both the physical and procedural elements of THR is hugely impactful for supporting engagement among Autistic adults. By prioritising individual needs, THR providers create an environment in which clients can confidently participate, learn, and experience the therapeutic benefits of the sessions. Structured flexibility allows clients to feel understood and supported, enhancing the accessibility and effectiveness of THR. These accounts emphasise that tailoring is not an “add-on” but central to making THR usable for Autistic adults. Adjustments in language, pacing, meeting arrangements, and sensory input allowed clients to feel understood and in control. For participants here, feeling that the service would flex around their needs was a precondition for engaging with the more challenging aspects of the work.

3.3. Embodied Engagement

Embodied Engagement explores how THR enables Autistic adults to experience their bodies as sites of awareness, tuning in to physical sensations and movement. Through multisensory processes and the unique movement of the horse, participants described reconnecting with bodily sensations and finding space for emotional release, alongside moments of enjoyment and belonging.

3.3.1. Reconnect & Release

Participants repeatedly emphasised the multisensory nature of THR, and its capacity to draw attention to the body. Participants described how grooming and riding provided a rich, positive sensory environment, creating a present-moment awareness, which was an important step to becoming ready to ride.

“That responsibility to be present in the moment to ride gives like a purpose to that calming.” (Participant 4, practitioner)

“On a sensory level. . .the smell of the horses, the different textures of their coats. . .some of them are softer than others, that lovely warm snuggly bit underneath their mane.” (Participant 5, client)

“tune into body, tune into the horse’s body, tune into how the two are interacting,” (Participant 5, client)

Participant 7 described how mounted mindfulness practices fostered physical release:

“Walking around and then at the end we’d stop. . .deep breath, heavy breath. . .mind emptying. . .and you can feel it falling out and coming out. . .It’s like you just pull the plug out of the bath. . .all the heaviness has just dropped out of you. . .you’re ready for the next battle.”

“I think it, it gives me like a purpose to sort of, leave the house and go somewhere where there’s other people. . .”. (Participant 8, client)

Practitioners intentionally created the conditions for this somatic reconnection, ensuring the space held was safe for the client to do so.

“We brush the horse, we chat about how we’re feeling, how the horse may be feeling. . .then we get on when the client feels they’re happy. . .it feels very natural and relaxed.” (Participant 2, practitioner)

“Many of these adults have learned to disconnect from the body because it feels overwhelmed all the time. This gives them a space where they can come

back to connecting with their body in a really safe way. . . huge outpouring of emotion. . . in a really positive way, kind of released a lot of that.” (Participant 1, practitioner)

Here, the horse’s rhythmic movement and the supportive environment together create a safe and contained space in which Autistic adults can re-inhabit their bodies and release accumulated tension, a process that may be difficult to access in more conventional therapeutic settings. Overall, “Reconnect & Release” captures how THR provided a structured opportunity to tune into bodily sensations in a way that felt safe rather than overwhelming. Through grooming, riding, and guided reflection, Autistic adults described becoming more aware of their own bodies and emotions and experiencing moments of relief from accumulated tension that could be hard to access in more traditional, verbal therapies.

3.3.2. Unbridled Joy

Alongside quiet release, participants also described moments of spontaneous pleasure and playful freedom. Participant 5 captured the “instant sense of happiness” she felt on arriving and “watching the horses and seeing them and catching up on what they’ve been up to.”, for some, this instant impact could be seen once on the horse.

“feel quite calm when I’m on horses,” (Participant 6, client)

“quite a few clients, once they get on the horse, or even once they’re just with the horse, appear to relax a bit more. . . they appear to seem happier within themselves around the horses.” (Participant 2, practitioner)

Participant 1 highlighted that within this atmosphere of acceptance, clients “can thrive, they enjoy it. . . they can unmask and just relax into that relationship”.

Participants suggest that THR offers more than therapeutic release: it provides opportunities for unguarded and unmasked enjoyment, for reconnecting with a child-like sense of play, and for experiencing belonging and self-expression without social demands.

“it kind of is healing in that way if that’s not too cheesy to say, your younger self just getting back in touch with that and doing silly things and taking all the adult stresses off”. (Participant 1, practitioner)

The theme Embodied Engagement shows how THR supports Autistic adults to engage with their bodies in ways that are at once both restorative and liberating. By combining mindful, sensory attuning with the simple pleasure of being with horses, THR creates an embodied therapeutic experience where participants can both let go of tension and rediscover the joy of inhabiting their own bodies. Alongside calmer states, participants described THR as a source of uncomplicated pleasure and playfulness. These moments of “unbridled joy” (e.g., arriving at the yard, spending time with horses, and temporarily setting aside everyday pressures) contributed to well-being in their own right and sat alongside more explicitly therapeutic processes such as emotional release or insight.

3.4. *To Understand and to Be Understood*

Participants discussed the importance of authentic relationships and relational reciprocity within therapeutic horse riding (THR), “having time to experience the relationship either with the horse or with myself or both.” (Participant 4, practitioner). Central to this theme was the experience of both understanding and being understood by the horse, the instructor, and oneself. Participant 8 (client) noticed this was possible with guidance despite previously having negative experiences, “I’ve always been told that I’m not very good at reading body language, but actually I can read their body language when I know what I’m looking for I can”.

3.4.1. Authenticity in Relationships

Participants highlighted how authentic, reciprocal connections with both horses and practitioners were important to their therapeutic experience. Clients described the process of cultivating these bonds as one that required patience and gentle persistence; initial anxieties about whether a horse would “like” them often gave way to recognition of the horse’s individuality and communication style. As they learnt to read cues and respond accordingly, they began to experience the relationship as mutual “they know me and I know them” (Participant 5, client) rather than one-sided. One client described her evolving relationship with “Holly” (a mare), illustrating how patience and gentle persistence helped transform initial anxiety into mutual trust.

“Oh no, she doesn’t like me, you know? . . . patience had to come into. . . that kind of cultivating that relationship with Holly (mare) and then a lot of gentleness.” (Participant 5, client)

“You know, trying to learn her way of communicating so that that could help our relationship, connection.” (Participant 5, client)

“I’m able to understand horses a little bit better. I’m able to understand their behaviour. Yeah. Because no horse is the same”. (Participant 10, client)

Clients were often able to recognise the two-way process between the horses’ experiences and their own, facilitated by practitioners creating opportunities for reflection, empathy and connection. Helping clients both understand and feel understood by the horse was described as a deliberate aim of the sessions.

“that relationship is really nice.” (Participant 6, client)

“It can be quite a nice two-way process for the client and the horse to understand each other a bit better”. (Participant 2, practitioner)

“But when you get on there. . . you’re concentrating on what you’re doing. . . It’s just you two, you and the horse.” (Participant 7, client)

These developing relationships brought an emergent self-awareness and agency that extended beyond the riding arena. Working in real time with a responsive animal requires clarity and presence, requiring them to “find a way” rather than rely solely on verbal communication. For some, this fostered confidence and even a sense of discovering a “new me,” suggesting an evolving self-concept through the embodied experience.

“You can talk about it endlessly in therapy and actually therapeutic riding makes. . . it happening in the here and now, and you’re going to have to deal with it and find a way.” (Participant 1, practitioner)

Learning to communicate effectively with the horses was experienced as both experiential and embodied. Clients described a growing competence in giving clear instructions and recognising the horse’s feedback, which practitioners interpreted as evidence of developing leadership and relational attunement. This physical, here-and-now engagement allowed therapeutic insights to be enacted rather than merely discussed, reinforcing a felt sense of efficacy and mutual trust.

Clients described the significance of building genuine connections with the horses and practitioners, emphasising patience, gentleness, recognition and learning about the horses as catalysts to creating meaningful relationships.

Clients also valued the experience of understanding the horse’s behaviour and adapting their communication accordingly, which was central to feeling effective and competent.

“So it was understanding that...the instructions that I was giving needed to be quite clear. So it understood me and what I wanted to do with it.” (Participant 6, client)

“What do they want to do? What do they not want to do? Are they tired? Are they in pain?” (Participant 10, client)

“Found that kind of sense of leadership in herself...Holly (mare) did listen, and she was effective. And then she was able to work through it.” (Participant 1, practitioner)

In sum, this subtheme illustrates how authentic, reciprocal relationships with horses and practitioners enabled Autistic adults to experiment with new ways of communicating, leading, and being with others. Clients’ growing sense that they were both understanding and understood by the horse seemed to support emerging feelings of competence, agency, and “a new me” beyond the arena.

3.4.2. Herd, Held and Supported

The sense of being heard, held, supported, and safe within the THR environment was created within the context of the relationships, as well as the physical space—which some described as a “bubble”, offering a pressure-free and anxiety-reducing space.

“Even as soon as you pull into the car park, it’s like this bubble.” (Participant 5, client)

“When I come here...all the stress...you get in the driveway, it’s like...the whole place is like...a bubble.” (Participant 7, client)

This slow, gentle, and predictable space helped clients feel safe and supported, enabling engagement at their own pace.

“there’s no hurry to this session, the whole session is very slowly done...very much at that person’s pace at the horse’s pace as well.” (Participant 2, practitioner)

“If you can just sit there and be at one with the horse and understand the horse, you can get through the day.” (Participant 7, client)

Together, these accounts suggest that THR offered more than a series of sessions. It provided a containing “bubble” in which clients felt held by the environment, the herd of horses, and the human staff. The combination of predictable pacing, attuned relationships, and a low-pressure atmosphere allowed Autistic adults to drop their guard, contributing to a felt sense of safety that underpinned other therapeutic gains.

3.5. Beyond the Arena: Impacts That Last

Participants described how THR produced effects that extended beyond the immediate session, highlighting the enduring influence of the relational, emotional, and practical experiences they had with horses and practitioners. These impacts were felt in clients’ daily lives, contributing to confidence, well-being, and a sense of competence, demonstrating that the benefits of THR are not confined to the arena.

3.5.1. Carried by Connection

A central aspect of lasting impacts was the connections formed with both horses and instructors. Participants described these relationships as reciprocal and emotionally sustaining, providing a sense of support that could be carried into everyday life, reinforcing that clients have the autonomy to communicate their needs, and ask for them to be met.

“The joy as well of connecting with them...reading their placement of their body, how they communicate to you.” (Participant 5, client)

“Communication skills improve too, both verbal and non-verbal.” (Participant 3, practitioner)

“What the horse might be communicating to them. . .helping them to also communicate their needs better.” (Participant 2, practitioner)

These relationships also fostered a sense of belonging and continuity, built around the consistent and containing experiences provided by the centre environment, horses and practitioners.

“They’ve become part of the centre. . . , it’s like that real sense of belonging. . .to be able to come in, know all the horses and find out how they’ve been doing. . .and have that on a long-term basis.” (Participant 1, practitioner)

“I like the therapeutic side because I get to groom them, I get to take them out. . .they really know me now and they know me as a rider.” (Participant 6, client)

This subtheme shows how relationships developed in THR were experienced as emotionally sustaining and portable. Clients and practitioners alike described how learning to recognise and express needs in the arena, and having those needs responded to, supported clients to communicate more effectively and to seek support in other areas of life.

3.5.2. Every Single Time

Clients reported that the positive effects of THR were consistent and cumulative, with each session building on previous gains and contributing to ongoing feelings of confidence and well-being

“I feel the benefits every single time I come. . .it drips into my week and that’s important.” (Participant 5, client)

“I can volunteer. . .that’s given me more confidence in myself and the group sessions. . .I’m finding the new me.” (Participant 7, client)

“You can see they feel and see their confidence grow while they’re around the horses. . .the enormous amount of well-being I see within the clients.” (Participant 2, practitioner)

The repetition and continuity of sessions reinforced learning and self-assurance, demonstrating that THR provides sustained rather than transient benefits, along with transferable skills that can be felt within daily living contexts.

“A little bit like happier as they leave. Maybe a little bit more relaxed or even kind of proud of themselves for giving them that space for a bit of self-care and time for themselves as well.” (Participant 4, practitioner)

“Every Single Time” captures participants’ sense that the benefits of THR were reliable and cumulative. Rather than isolated “good sessions”, clients described a steady accrual of confidence, self-care, and willingness to try new roles (such as volunteering), suggesting that, for this group, repeated participation produced changes that extended into daily routines and self-concept.

3.5.3. Skills in Practice

THR facilitated practical skill development, from riding techniques to horse care, which translated into real-life competence and personal growth.

“You’re responsible for this horse at that moment. . .but I never felt unsafe.” (Participant 5, client)

“grooming, checking the horse, picking their feet out. . .they’re learning all about horse care as well.” (Participant 2, practitioner)

“I’ve been able to apply that to different things. . .take what I’ve learned and use it in other places in my life.” (Participant 6, client)

THR appears to function as a self-efficacy laboratory in Bandura’s (1977) terms. Through developing skills of riding and horse-care tasks, clients met challenges, from picking out a horse’s feet to guiding the horse safely, within a scaffolded context of safety, support and acknowledgements of those achievements.

“At the end, we always talk about what went well and I make sure to praise any achievements, big or small.” (Participant 3, practitioner)

“There’s usually like multiple, like small achievements throughout the sessions as well, which seems to kind of help people feel a little bit better. They’ve achieved something.” (Participant 4, practitioner)

These experiences foster a belief in personal competence that participants report transferring to other life domains, for example asking things of others, which previously may have felt uncomfortable.

“recently they have spoken about how they’ve been able to go out and ask for someone to maybe do something for them or express their needs a bit more confidently.” (Participant 4, practitioner)

In turn, the act of caring for the horse provides a vicarious model of care and responsibility, reinforcing an emerging narrative of themselves as capable and self-caring. Thus, the THR setting cultivates not only practical skill but the psychological mechanism of self-efficacy that underpins adaptive functioning and personal growth.

“So I think from being more assertive, I think it’s helped with my confidence. . .I do have the confidence to be able to see lots of different things.” (Participant 6, client)

“By caring for the animals, they’re also learning to care for themselves better. . .taking care of themselves is also very important.” (Participant 2, practitioner)

Overall, this subtheme illustrates how THR functioned as a kind of self-efficacy laboratory. Within a scaffolded environment, Autistic adults practised concrete skills, experienced success, and received explicit recognition for their achievements. Participants and practitioners linked these experiences to increased assertiveness and self-care in other domains, although we remain cautious about generalising beyond this self-selecting, verbally fluent group.

4. Discussion

This study explored how Autistic adults and THR practitioners understand the benefits, barriers, and broader life impacts of THR delivered as a mental-health-oriented equine-assisted service (EAS) at a single UK centre. Using semi-structured interviews and reflexive thematic analysis (RTA), we constructed five themes: *Facing the Puissance: barriers to accessing THR*, *Pathways to Participation*, *Embodied Engagement*, *To Understand and To Be Understood*, and *Beyond the Arena—Impacts That Last* (see Table 1). In line with the aims of qualitative inquiry, the goal was to offer an in-depth, contextualised understanding of how THR is experienced by a specific group of Autistic adults and practitioners, and explore the benefits, barriers and broader impacts of participation in THR for autistic adults. By foregrounding the perspectives of both clients and practitioners, this research contributes to a limited evidence base that has historically prioritised the views of carers or focused on children and adolescents (McDaniel Peters & Wood, 2017; Warner et al., 2022). The findings highlight the therapeutic potential of THR as an embodied, relational, and

accessible intervention while also revealing significant physical and systemic barriers that limit its potential reach.

Table 1. Themes and sub-themes produced from a reflexive thematic analysis of the data.

Main Themes	Sub-Themes
Facing the Puissance barriers to accessing THR	Accessibility Defining Therapeutic Riding Finances and Funding
Pathways to Participation	Opening the Gateway Predictably Unpredictable Tailoring and Personalisation
Embodied Engagement	Reconnect and Release Unbridled Joy
To Understand, and To Be Understood	Authenticity in Relationships Herd [SIC], Held, Supported
Beyond the Arena—Impacts That Last	Carried by Connection Every Single Time Skills in Practice

4.1. Summary of Main Findings

Autistic adults in this study described THR as a valued source of enjoyment, calm, and confidence, with perceived benefits that accumulated over time and, for some, extended into everyday life (e.g., increased willingness to leave the house, volunteering, and asking others for support). These accounts are consistent with research showing that equine-assisted programmes can enhance self-esteem, self-efficacy, and psychological well-being in other populations, including young people experiencing social and emotional difficulties and adults with psychiatric diagnoses (Bizub et al., 2003; Burgon, 2011; Cantin & Marshall-Lucette, 2011; Karol, 2007; Hatcher et al., 2019). Participants highlighted three interlinked features as central to THR’s perceived value: (a) an explicitly structured, predictable environment that accommodated sensory and communication needs; (b) authentic, reciprocal relationships with horses and practitioners; and (c) opportunities to practise leadership, communication, and self-advocacy in a scaffolded, embodied way. These findings complement and extend the largely child-focused equine-assisted autism literature, which has identified improvements in social communication, adaptive behaviour, and emotional regulation (Gabriels et al., 2015; Cleary et al., 2024; Xiao et al., 2023; Browne et al., 2025), by foregrounding Autistic adults’ first-person perspectives on similar processes in adulthood.

At the same time, both clients and practitioners emphasised substantial barriers to accessing and sustaining THR, particularly costs, definitional ambiguity, and limited facilities and staffing. These barriers mirror broader structural inequities experienced by Autistic adults in healthcare and employment (Howlin & Magiati, 2017; UK Parliament, 2023; Harmuth et al., 2018), and sit alongside longstanding concerns about the cost, availability, and standardisation of equine-assisted services (Bachi, 2012; Kendall et al., 2014; Lentini & Knox, 2009; Seery & Wells, 2024).

4.2. Relational Dynamics and Embodied Engagement as Therapeutic Mechanisms

Across themes, participants located much of THR’s perceived therapeutic value in relational dynamics among horse, client, and practitioner. Autistic adults described feeling “heard,” “held,” and “understood” within the THR environment, and emphasised the importance of trust and reciprocity in their relationships with horses and instructors. These relational dynamics were perceived as contributing to emotional regulation, enhanced self-awareness, and increased confidence. These findings align with previous research

emphasising the relational basis of equine-assisted interventions, where non-verbal communication, mutual responsiveness, and attunement form the foundation of therapeutic outcomes, which support emotional regulation and a sense of being “met” by another (Bizub et al., 2003; Burgon, 2011; Gabriels et al., 2015; Karol, 2007; Ward et al., 2022).

The human–horse relationship appears to offer a unique context for self-exploration and growth as well as for practising leadership, boundary-setting, and clear communication. Horses’ sensitivity to emotional states provides immediate feedback, fostering self-regulation and social-emotional learning (McCrea et al., 2025). Autistic adults described learning to give unambiguous cues, interpret horses’ responses, and adjust their own behaviour accordingly, often with practitioners explicitly framing this as leadership or collaborative problem-solving. This echoes studies highlighting horses’ sensitivity to human affect and behaviour and their role as responsive partners in therapeutic work (Hatcher et al., 2019; Anastasya et al., 2024; Ward et al., 2022), as well as theoretical accounts that emphasise co-regulation and embodiment as mechanisms of change in equine-facilitated psychotherapy /learning (Karol, 2007; Garcia, 2013). In the current study, these dynamics extended beyond the horse-client relationship to include the practitioner, findings which were also seen within Browne et al.’s (2025) study where children expressed the kindness and safety felt when with their practitioner.

Participants also emphasised embodied engagement as central to their experience. Grooming, riding, and simply being in close proximity to horses created a multisensory environment in which Autistic adults reported “tuning into” their bodies, noticing tension and release, and experiencing both calming and “unbridled” enjoyment. These narratives resonate with broader evidence that equine-assisted activities can foster bodily awareness, self-confidence, and empowerment (Bizub et al., 2003; Burgon, 2011; Cantin & Marshall-Lucette, 2011), and with literature on embodied therapies that conceptualise bodily experience as central to emotional processing and trauma integration (Fuchs & Koch, 2014). For some clients, THR functioned as a “self-efficacy laboratory”: within a safe, scaffolded context, they encountered concrete challenges (e.g., mounting, riding independently, caring for the horse), succeeded, and had those achievements explicitly recognised. This maps closely onto Bandura’s (1977) account of self-efficacy, whereby mastery experiences and positive feedback strengthen beliefs in one’s own capabilities, and is consistent with reports that equine-assisted interventions can enhance confidence and agency in both Autistic and non-Autistic populations (Hatcher et al., 2019; Ward et al., 2022; Browne et al., 2025).

4.3. Environmental Structure, Predictability, and Engagement

The themes *Pathways to Participation* and *Embodied Engagement* highlight the centrality of environmental structure and predictability in enabling Autistic adults to access and sustain THR. Participants valued clear information about what sessions would involve, straightforward booking routes, reminder systems, and initial assessments that did not require immediate riding. Within sessions, consistent routines, familiar staff and horses, and clearly defined expectations created a safe and contained therapeutic space, reducing anxiety and supporting sustained participation. These results are consistent with literature for autistic children accessing THR which emphasised the need for adaptable, sensory-aware environments and flexible approaches to communication (Browne et al., 2025; Cleary et al., 2024). The findings are also consistent with broader literature on autism and service accessibility, which emphasises the value of predictability and routine in reducing cognitive load and sensory overwhelm (Howlin & Magiati, 2017; Lord et al., 2018; Pellicano et al., 2022).

Interestingly, a degree of unpredictability, such as minor behavioural variations in horses, was also described by the practitioners as therapeutically beneficial when managed carefully. This aligns with the concept of “graded exposure” within autism support, where

safe encounters with variability can promote resilience and flexibility (Langdon et al., 2024). However, when unpredictability increased beyond a certain threshold—such as in busy yard environments or when horses became highly reactive—participants felt that the focus shifted away from the client and therapeutic benefits diminished, underscoring the need for tight environmental and ethical management in THR settings (Bachi, 2012; Ward et al., 2022). Practitioners must therefore strike a careful balance, creating environments that are structured enough to support participation but flexible enough to allow for growth.

4.4. Accessibility, Equity and the Challenge of Systemic Barriers

The theme *Facing the Puissance* foregrounds systemic, structural, and practical barriers that constrain Autistic adults' access to THR. The puissance metaphor captures how these barriers were experienced as tall, sometimes intimidating obstacles that had to be negotiated before any potential benefits could be realised. Financial barriers were salient at both client and provider levels. Clients described weighing THR fees against essential expenses and, in some cases, reducing the frequency of sessions, with potential implications for the continuity and depth of therapeutic work. Practitioners highlighted the difficulty of sustaining a resource-intensive, labour-heavy service for a socio-economically disadvantaged client group in the context of short-term funding cycles and substantial reporting requirements. These accounts are consistent with evidence that Autistic adults face disproportionate unemployment and economic hardship (Buescher et al., 2014; Harmuth et al., 2018; Farkas et al., 2021) and with findings that equine-assisted interventions are often expensive to deliver and poorly integrated into mainstream funding systems (Burton, 2011; Kendall et al., 2014; Bachi, 2012). Specifically, due to its hybrid nature as both a therapeutic intervention and a recreational activity, THR is frequently excluded from mainstream funding streams. This lack of institutional recognition not only limits affordability but also contributes to inconsistent provision and variable quality across centres (Bachi, 2012; Kendall et al., 2014).

Participants also pointed to definitional ambiguity as a barrier. Potential clients and referrers frequently conflated THR with sport riding or physical rehabilitation, complicating decisions about suitability and funding. This mirrors long-standing concerns that inconsistent terminology and heterogeneous practice models within equine-assisted interventions impede both research and commissioning (Kerulo et al., 2020; Lentini & Knox, 2009; McDaniel Peters & Wood, 2017; Ward et al., 2022). Recent consensus work in the United States has recommended adopting “equine-assisted services” (EAS) as an umbrella term, with specific labels (e.g., THR, equine-assisted psychotherapy) reserved for clearly defined practice models (Wood et al., 2021). Situating the present THR programme within this EAS framework may aid comparison with other studies and support clearer communication with commissioners and clients about what is being offered and evaluated.

These intertwined economic and conceptual challenges suggest that, without structural changes in funding and regulation, THR is likely to remain accessible only to a small subset of Autistic adults with sufficient financial and logistical resources, despite potential benefits. This sits uneasily with policy concerns about inequities in access to healthcare and support for Autistic people and those with learning disabilities (NICE, 2025 UK Parliament, 2023; Jones et al., 2025).

4.5. Methodological Strengths and Limitations

Several strengths of the study enhance its contribution. First, it focuses explicitly on Autistic adults, a group underrepresented in both autism and EAS research, where children and adolescents often viewed through caregiver or practitioner lenses predominate (McDaniel Peters & Wood, 2017; Warner et al., 2022; Botha & Cage, 2022). Second, the

interview guide was co-developed with Autistic university students from the Progressive Autism Group, colleagues at the Autism Research Innovation Centre, and experienced THR practitioners, supporting content validity, alignment with Autistic priorities, and sensitivity to clinical realities (Kallio et al., 2016; Holt et al., 2022; Moore et al., 2024). Third, the guide was shared in advance and is provided in full as Supplementary Materials, reflecting best practice for accessible research with Autistic people (Botha & Cage, 2022; Jones et al., 2025). Finally, the use of RTA allowed for a rich, interpretive engagement with the data and explicit attention to the researcher's dual practitioner–researcher role (Braun & Clarke, 2013, 2019). However, several limitations must be acknowledged. The sample may reflect a participant group with relatively positive experiences, as all Autistic participants had continued to engage with THR. Furthermore, all participants were recruited from a single THR centre, sharing a specific organisational culture and way of conceptualising THR. This single-site design enhances contextual specificity but limits transferability to other settings or practice models (Bachi, 2012; Ward et al., 2022). Recruitment challenges also highlight potential selection bias, as individuals with negative or neutral experiences may have been less inclined to participate. Also, all practitioners were invested in the programme and expressed a desire for THR to become more evidence-based, which may have encouraged them to emphasise positive aspects and under-report challenges, a well-recognised issue in practitioner-led evaluations (Bachi, 2012; Seery & Wells, 2024). Additionally, the dual role of the researcher as both practitioner and interviewer introduces the possibility of bias, although reflexive practices were employed to mitigate this, and a relationship that sought to foster open conversation was actively maintained.

The characteristics of the Autistic sample further constrain transferability. All Autistic participants were able to give informed consent and engage in semi-structured interviews, suggesting average or above-average intellectual and verbal functioning, but no formal diagnostic or psychometric data were collected to specify support needs or position participants within conventional severity levels. Experiences of Autistic people with higher support needs, co-occurring learning disabilities, or significant communication challenges may differ substantially, both in relation to THR and to service accessibility more broadly (Moore et al., 2024). The cross-sectional design also limits inferences about durability and causality. Participants were asked about short- and longer-term effects, but we did not track change over time or compare THR with alternative interventions. As in other qualitative work, themes represent the researcher's interpretive reading of the data rather than objective categories, and different analytic lenses could have generated different emphases (Braun & Clarke, 2013, 2019). Taken together, these limitations mean that the findings should be treated as offering in-depth, situational insight, rather than generalisable evidence of THR's efficacy across the Autistic population.

4.6. Implications for Practice, Policy & Future Research

The findings have several important implications for practice. First, they highlight the need for THR providers to adopt neurodiversity-informed approaches that prioritise: (a) predictable, clearly communicated structures for referral, booking, and attendance; (b) sensory-aware environments, including quieter yard times and minimisation of competing demands; and (c) proactive tailoring of sessions to individual communication preferences, sensory profiles, and goals. These suggestions are consistent with neurodiversity-affirming approaches to mental health care (Botha & Cage, 2022; Jones et al., 2025; Moore et al., 2024) and with emerging guidelines for autism-informed adaptations of therapeutic interventions more broadly (Moore et al., 2024). Additionally, practitioners should be mindful of the therapeutic balance between structure and variability, ensuring that sessions are both predictable and appropriately challenging.

In policy and commissioning terms, these qualitative findings alone are not sufficient to justify widespread integration of THR into UK healthcare and social care frameworks. Commissioning decisions must consider not only perceived efficacy but also cost-effectiveness, scalability, and comparative advantage over other interventions (Buescher et al., 2014; Rogge & Janssen, 2019; Zhao et al., 2023). THR is resource-intensive, dependent on specialist facilities, horse welfare, and highly trained staff, and is currently unevenly distributed (Hatcher et al., 2019; Ward et al., 2022; Seery & Wells, 2024). The present study suggests that, for a subgroup of verbally fluent Autistic adults accessing a particular kind of THR service, participation can be experienced as meaningful and helpful. However, robust evaluations, including economic analyses and comparative trials, are needed before THR can be responsibly positioned alongside, or within, mainstream services (Xiao et al., 2023; Cleary et al., 2024; Ward et al., 2022).

Future research can extend this work in several directions. Qualitative studies with more diverse Autistic samples, including people with higher support needs, alternative communication modes, and those who declined or discontinued THR, would help to clarify for whom THR is acceptable or beneficial (Moore et al., 2024; Warner et al., 2022). Mixed-methods and quantitative studies could explore specific outcomes such as anxiety, self-efficacy, and social participation over time, and compare THR with other interventions or activities (Gabriels et al., 2015; Xiao et al., 2023; Ward et al., 2022). Mechanism-focused research informed by theories of sensory processing, embodied cognition, and attachment or co-regulation could deepen understanding of how equine-assisted services exert their effects (Fuchs & Koch, 2014; Karol, 2007). Finally, studies of cost-effectiveness and sustainable service models would be particularly valuable in informing decisions about whether, and how, THR might be integrated into mental health provision in an equitable way (Buescher et al., 2014; Rogge & Janssen, 2019; UK Parliament, 2023).

5. Conclusions

This study contributes valuable new knowledge to an emerging area of therapeutic practice, shedding light on how Autistic adults experience and benefit from therapeutic horse riding within a mental-health-oriented programme. Autistic clients and practitioners described THR as a uniquely embodied, relational, and accessible approach to supporting mental well-being, one that can foster confidence, emotional regulation, and a sense of belonging that extends beyond the arena into everyday life. At the same time, participants highlighted substantial financial, logistical, and definitional barriers that restricted who could access and continue THR, raising questions about equity and sustainability in the current landscape of provision (Burgon, 2011; Kendall et al., 2014; Bachi, 2012). Within the constraints of a small, single-centre sample of verbally fluent Autistic adults, the findings suggest that THR can align with neurodiversity-affirming principles when intentionally designed with Autistic needs in mind, offering predictable, sensory-aware environments; privileging client choice and agency; and valuing diverse communication styles (Botha & Cage, 2022; Jones et al., 2025; Moore et al., 2024). Rather than presenting THR as a universal solution, we propose that it should be understood as a potentially valuable option for some Autistic adults in particular contexts. Realising its potential will require not only further research and close attention to horse welfare and practitioner training, but also critical engagement with issues of access, cost, and standardisation across the broader field of equine-assisted services (Kerulo et al., 2020; McDaniel Peters & Wood, 2017; Ward et al., 2022; Seery & Wells, 2024).

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/bs16010084/s1>, Interview Schedule.

Author Contributions: Conceptualisation, H.L.B. and N.K.; methodology, H.L.B. and N.K.; validation, H.L.B. and N.K.; formal analysis, H.L.B.; investigation, H.L.B.; resources, H.L.B. and N.K.; data curation, H.L.B.; writing—original draft preparation, H.L.B.; writing—review and editing, H.L.B. and N.K.; visualisation, N.K.; supervision, N.K.; project administration, H.L.B. and N.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of University of Lincoln (UoL2025_19424, 15 July 2025).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the participants to publish this paper.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy of the participants who continue to attend sessions.

Acknowledgments: We would like to thank the clients at the centre for their participation in the study. Special thanks also to the CEO who assisted with recruitment, and to the therapeutic riding instructors who contributed their time to taking part in the study.

Conflicts of Interest: H.L.B. has a professional relationship at the centre where participants were recruited from.

Abbreviations

The following abbreviations are used in this manuscript:

EAS Equine Assisted Services
THR Therapeutic Horse Riding

References

- American Psychiatric Association. (2025). *Diagnostic and statistical manual of mental disorders* (5th ed., text rev.; DSM-5-TR). American Psychiatric Publishing.
- Anastasya, K. S., Syamsuddin, I. G., Faradilla, M. A., Aminurrohman, A., & Imawan, I. A. (2024). Mechanisms and benefits of equine therapy for enhancing mental health. *Research & Development*, 5(1), 40–43. [CrossRef]
- Athena. (2025). *APR members map* | ATHENA® Herd Foundation. Athena Herd Foundation. Available online: <https://athenaherd.org/awarding/member-map> (accessed on 20 October 2025).
- Bachi, K. (2012). Equine-facilitated psychotherapy: The gap between practice and knowledge. *Society & Animals*, 20(4), 364–380. [CrossRef]
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behaviour Research and Therapy*, 1(4), 139–161. [CrossRef]
- Bizub, A. L., Joy, A., & Davidson, L. (2003). “It’s like being in another world”: Demonstrating the benefits of therapeutic horseback riding for individuals with psychiatric disability. *Psychiatric Rehabilitation Journal*, 26(4), 377–384. [CrossRef]
- Botha, M., & Cage, E. (2022). “Autism research is in crisis”: A mixed method study of researchers’ constructions of autistic people and autism research [Original research]. *Frontiers in Psychology*, 13, 1050897. [CrossRef]
- Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. Sage.
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589–597. [CrossRef]
- Browne, J. M., Reega, S. J., Rankins, E. M., Schmid, A. A., & Peters, B. C. (2025). The acceptability of occupational therapy using zones of Regulation™ concepts in an equine environment to autistic children. *Behavioral Sciences*, 15(4), 495. [CrossRef]
- Buescher, A. V., Cidav, Z., Knapp, M., & Mandell, D. S. (2014). Costs of autism spectrum disorders in the United Kingdom and the United States. *JAMA Pediatrics*, 168(8), 721–728. [CrossRef] [PubMed]
- Burton, H. L. (2011). ‘Queen of the world’: Experiences of ‘at-risk’ young people participating in equine-assisted learning/therapy. *Journal of Social Work Practice*, 25(2), 165–183. [CrossRef]
- Cantin, A., & Marshall-Lucette, S. (2011). Examining the literature on the efficacy of equine assisted therapy for people with mental health and behavioural disorders. *Mental Health and Learning Disabilities Research and Practice*, 8(1), 51–61. [CrossRef]

- Centres for Disease Control and Prevention. (2022, March 28). *Signs and symptoms of autism spectrum disorders*. Centres for Disease Control and Prevention. Available online: <https://www.cdc.gov/autism/signs-symptoms/index.html> (accessed on 28 October 2025).
- Cleary, M., West, S., Thapa, D. K., Hungerford, C., McLean, L., Johnston-Devin, C., & Kornhaber, R. (2024). A scoping review of equine-assisted therapies on the mental health and well-being of autistic children and adolescents: Exploring the possibilities. *Issues in Mental Health Nursing*, 45(9), 948–960. [CrossRef]
- Corden, K., Brewer, R., & Cage, E. (2021). Personal identity after an autism diagnosis: Relationships with self-esteem, mental wellbeing, and diagnostic timing. *Frontiers in Psychology*, 12, 699335. [CrossRef]
- Darazsdi, Z., & Bialka, C. S. (2023). “Oh, you couldn’t be autistic”: Examining anti-autistic bias and self-esteem in the therapeutic alliance. *Autism*, 27(7), 2124–2134. [CrossRef]
- Farkas, T. N., Kargas, N., & Mendy, J. (2021). Autism and employment: Challenges and strategies for a bright future. In *Emerging programs for autism spectrum disorder* (pp. 285–302). Academic Press.
- Fletcher-Watson, S. (2024). What’s in a name? The costs and benefits of a formal autism diagnosis. *Autism*, 28(2), 257–262. [CrossRef]
- Fuchs, T., & Koch, S. C. (2014). Embodied affectivity: On moving and being moved. *Frontiers in psychology*, 5, 508. [CrossRef] [PubMed]
- Gabriels, R. L., Pan, Z., Dechant, B., Agnew, J. A., Brim, N., & Mesibov, G. (2015). Randomized controlled trial of therapeutic horseback riding in children and adolescents with autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 54(7), 541–549. [CrossRef]
- Garcia, D. (2013). *Intelligent horses: A cybersemiotic perspective* [PDF]. Available online: https://www.researchgate.net/publication/271527923_Intelligent_Horses_A_Cybersemiotic_Perspective (accessed on 28 October 2025).
- Harmuth, E., Silletta, E., Bailey, A., Adams, T., Beck, C., & Barbic, S. P. (2018). Barriers and facilitators to employment for adults with autism: A scoping review. *Annals of International Occupational Therapy*, 1(1), 31–40. [CrossRef]
- Hatcher, J., Cavinder, C., Heaton, C., Figueiredo, L., Holtcamp, A., & Dinh, T. (2019). Psychological and physical benefits of interactions with horses. *Journal of Extension*, 57(3), 11. [CrossRef]
- HETI. (2025). *Member directory | HETI federation*. Hetifederation.org. Available online: <https://hetifederation.org/member-directory/> (accessed on 28 October 2025).
- Holt, A., Bounekhla, K., Welch, C., & Polatajko, H. (2022). “Unheard minds, again and again”: Autistic insider perspectives and theory of mind. *Disability and Rehabilitation*, 44(20), 5887–5897. [CrossRef] [PubMed]
- Howlin, P., & Magiati, I. (2017). Autism spectrum disorder. *Current Opinion in Psychiatry*, 30(2), 69–76. [CrossRef]
- Jones, F., Hamilton, J., & Kargas, N. (2025). Accessibility and affirmation in counselling: An exploration into neurodivergent clients’ experiences. *Counselling and Psychotherapy Research*, 25(1), e12742. [CrossRef]
- Kallio, H., Pietilä, A.-M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, 72(12), 2954–2965. [CrossRef]
- Kargas, N., Mason, R., Smith, L., Rogers, J., & Hogue, T. (2023). *Independent review of services for adults with a learning disability and autistic adults in Midlands prisons: Report of findings for NHS England*. Available online: <https://hdl.handle.net/10779/lincoln.24959559.v2> (accessed on 28 October 2025).
- Karol, J. (2007). Applying a traditional individual psychotherapy model to equine-facilitated psychotherapy (EFP): Theory and method. *Clinical Child Psychology and Psychiatry*, 12(1), 77–90. [CrossRef]
- Kendall, E., Maujean, A., Pepping, C. A., & Wright, J. J. (2014). Hypotheses about the psychological benefits of horses. *Explore*, 10(2), 81–87. [CrossRef]
- Kerulo, G., Kargas, N., Mills, D. S., Law, G., VanFleet, R., Faa-Thompson, T., & Winkle, M. Y. (2020). Animal-assisted interventions: Relationship between standards and qualifications. *People and Animals: The International Journal of Research and Practice*, 3(1), 4. [CrossRef]
- Langdon, P. E., Apanasionok, M. M., Scripps, E., Barrowcliff, A., Biswas, A., Bunning, K., Burbidge, C., Byron-Daniel, K., Cookson, A., Croom, S., Filipczuk, M., Gillespie, D., Hastings, R. P., Jahoda, A., McNamara, R., Patterson, L., Rai, D., Steward, R., & Gray, K. M. (2024). Behavioural interventions to treat anxiety in adults with autism and moderate to severe intellectual disabilities: The BEAMS-ID feasibility study. *Journal of Applied Research in Intellectual Disabilities*, 37(5). [CrossRef] [PubMed]
- Lentini, J. A., & Knox, M. (2009). A qualitative and quantitative review of equine facilitated psychotherapy (EFP) with children and adolescents. *The Open Complementary Medicine Journal*, 1(1), 51–57. [CrossRef]
- Lord, C., Elsabbagh, M., Baird, G., & Veenstra-Vanderweele, J. (2018). Autism spectrum disorder. *The Lancet*, 392(10146), 508–520. [CrossRef] [PubMed]
- Malcolm, R., Ecks, S., & Pickersgill, M. (2018). ‘It just opens up their world’: Autism, empathy, and the therapeutic effects of equine interactions. *Anthropology & Medicine*, 25(2), 220–234. [CrossRef]
- McCrea, C. E., Tibbets, G., Smith, L. W., & Campbell, C. G. (2025). At-risk youth receive similar benefits from equine-assisted psychotherapy and traditional psychotherapy; an applied analysis. *Frontiers in Psychiatry*, 16. [CrossRef] [PubMed]

- McCulloch, M. J. (1983). Animal-facilitated therapy: Overview and future direction. In A. H. Katcher, & A. M. Beck (Eds.), *New perspectives on our lives with companion animals* (pp. 410–426). University of Pennsylvania Press.
- McDaniel Peters, B. C., & Wood, W. (2017). Autism and equine-assisted interventions: A systematic mapping review. *Journal of Autism and Developmental Disorders*, 47(10), 3220–3242. [CrossRef]
- Milton, D., & Sims, T. (2016). How is a sense of well-being and belonging constructed in the accounts of autistic adults? *Disability & Society*, 31(4), 520–534. [CrossRef]
- Moore, L., Larkin, F., & Foley, S. (2024). Mental health professionals' experiences of adapting mental health interventions for autistic adults: A systematic review and thematic synthesis. *Journal of Autism and Developmental Disorders*, 54(7), 2484–2501. [CrossRef]
- Morrison, M. L. (2007). Health benefits of animal-assisted interventions. *Complementary Health Practice Review*, 12(1), 51–62. [CrossRef]
- National Autistic Society. (2024). *What is autism*. Autism.org.uk. Available online: <https://www.autism.org.uk/advice-and-guidance/what-is-autism#How%20many%20autistic%20people%20are%20there?> (accessed on 28 October 2025).
- National Institute for Health and Care Excellence. (2025). *Evidence-based recommendations for the health and social care sector*. NICE. Available online: <https://www.nice.org.uk/> (accessed on 28 October 2025).
- Nguyen, W., Ownsworth, T., Nicol, C., & Zimmerman, D. (2020). How I see and feel about myself: Domain-specific self-concept and self-esteem in autistic adults. *Frontiers in Psychology*, 11, 913. [CrossRef]
- Pellicano, E., Fatima, U., Hall, G., Heyworth, M., Lawson, W., Lilley, R., Mahony, J., & Stears, M. (2022). A capabilities approach to understanding and supporting autistic adulthood. *Nature Reviews Psychology*, 1(11), 624–639. [CrossRef] [PubMed]
- Rogge, N., & Janssen, J. (2019). The economic costs of autism spectrum disorder: A literature review. *Journal of Autism and Developmental Disorders*, 49(7), 2873–2900. [CrossRef]
- Saunders, P. (2018). Neurodivergent rhetorics: Examining competing discourses of autism advocacy in the public sphere. *Journal of Literary & Cultural Disability Studies*, 12(1), 1–17. [CrossRef]
- Seery, R., & Wells, D. (2024). An exploratory study into the backgrounds and perspectives of equine-assisted service practitioners. *Animals*, 14(2), 347. [CrossRef]
- Seltzer, M. M., Krauss, M. W., Shattuck, P. T., Orsmond, G., Swe, A., & Lord, C. (2003). The symptoms of autism spectrum disorders in adolescence and adulthood. *Journal of Autism and Developmental Disorders*, 33(6), 565–581. [CrossRef]
- Silberman, S. (2017). Neurotribes: The legacy of autism and the future of neurodiversity. *Psychiatry*, 30(2), 120–123.
- UK Parliament. (2023). *Inequalities in healthcare and employment for people with a learning disability and autistic people—Women and equalities committee*. Parliament.uk. Available online: <https://publications.parliament.uk/pa/cm5804/cmselect/cmwomeq/134/report.html> (accessed on 28 October 2025).
- Ward, J., Hovey, A., & Brownlee, K. (2022). Mental health benefits of mounted equine-assisted therapies: A scoping review. *Health & Social Care in the Community*, 30(6), e4920–e4935.
- Warner, K., Keville, S., Hockley, J., & Ludlow, A. (2022). Experiences of equine assisted therapy for females with autism spectrum disorders. *Advances in Autism*, 9(2), 150–164. [CrossRef]
- Wood, W., Alm, K., Benjamin, J., Thomas, L., Anderson, D., Pohl, L., & Kane, M. (2021). Optimal terminology for services in the United States that incorporate horses to benefit people: A consensus document. *The Journal of Alternative and Complementary Medicine*, 27(1), 88–95. [CrossRef] [PubMed]
- World Health Organization. (2022). *ICD-11: International classification of diseases* (11th revision). Available online: <https://icd.who.int/> (accessed on 28 October 2025).
- Xiao, N., Shinwari, K., Kiselev, S., Huang, X., Li, B., & Qi, J. (2023). Effects of equine-assisted activities and therapies for individuals with autism spectrum disorder: Systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 20(3), 2630. [CrossRef] [PubMed]
- Zhao, Y., Luo, Y., Zhang, R., & Zheng, X. (2023). Direct and indirect costs for families of children with autism spectrum disorder in China. *Autism*, 27(8), 2337–2347. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Article

Veterans Training Service Dogs for Other Veterans: An Animal-Assisted Intervention for Post-Traumatic Stress Disorder

Cheryl A. Krause-Parello ¹, Erika Friedmann ^{2,*}, Deborah Taber ², Haidong Zhu ³, Alejandra Quintero ⁴ and Rick Yount ⁵

¹ Division of Research, Florida Atlantic University, Boca Raton, FL 33431, USA; ckrausep@health.fau.edu

² School of Nursing, University of Maryland Baltimore, Baltimore, MD 21201, USA; dtaber@umaryland.edu

³ Georgia Prevention Institute, Medical College of Georgia, Augusta University, Augusta, GA 30912, USA; hzhu@augusta.edu

⁴ Department of Biomedical Sciences, Florida Atlantic University, Boca Raton, FL 33431, USA; aquintero2014@fau.edu

⁵ Warrior Canine Connection, Boyds, MD 20841, USA; rick@warriorcanineconnection.org

* Correspondence: friedmann@umaryland.edu

Abstract

Research on the post-deployment reintegration needs of women veterans is limited. Non-traditional support may enhance mental health. Relationships with animals and volunteering may aid those with post-traumatic stress disorder (PTSD). Using the biopsychosocial model, we examined whether participation in an 8-week service dog training program (SDTP) affected telomere length (TL), heart rate variability (HRV), PTSD symptom severity, perceived stress, and anxiety in female veterans with PTSD, as well as whether combat exposure influenced these relationships. Female veterans (ages 32–72, $M = 45.9$, $SD = 11.8$) with PTSD were randomized to either the SDTP group ($n = 13$) or a comparison group ($n = 15$) that received dog training video content. The interventions lasted one hour weekly for 8 weeks. Outcomes were assessed pre-, mid-, and post-intervention. Linear mixed models with random intercepts examined changes from pre- to post-intervention and compared changes by group and combat exposure. TL changes differed [$F(1,11.65) = 3.543$, $p = 0.085$] by intervention. In the SDTP group, TL increased, indicating reduced cellular senescence (i.e., slower biological aging), whereas TL decreased in the CI group. Combat exposure moderated these changes [$F(1,12.36) = 5.41$, $p = 0.038$]. HRV changed by intervention group [$F(1,389.08) = 10.623$, $p = 0.001$]. HRV decreased (stress increased) in the SDTP group but not in the CI group. Combat exposure did not moderate HRV changes. PTSD symptom severity [$F(1,48.04) = 19.22$, $p < 0.001$], perceived stress [$F(1,48.48) = 14.65$, $p < 0.001$], and anxiety [$F(1,47.30) = 6.624$, $p = 0.013$] decreased significantly from pre- to post-interventions; the decreases did not differ by intervention or combat exposure.

Keywords: female veterans; telomere; cellular aging; heart rate variability; combat exposure

1. Introduction

Female veterans represent a unique perspective on the effects of the military lifestyle; however, they have been underrepresented and understudied in research (Yano et al., 2006). Female veterans have always played a role in the military, in various forms (Smith, 2022). Historically, women served as nurses, clerks, and support staff, but over the decades their

roles have expanded significantly to include leadership positions, combat assignments, and special operations. Although female veterans were granted permanent status in the military in 1948 with The Women's Armed Services Integration Act, military research has remained predominantly focused on the experiences of male service members and veterans (Goldzweig et al., 2006). However, rates of PTSD are significantly higher in female veterans compared to their male counterparts and the general population (Lehavot et al., 2018). Women often face higher rates of PTSD due to the nature of trauma exposure, particularly interpersonal traumas such as sexual assault and domestic violence (Lehavot et al., 2018). The literature indicates that differences in exposure to combat, pain, depression, PTSD, and military sexual trauma exist between the genders, according to data from Operation Enduring Freedom and Operation Iraqi Freedom (Haskell et al., 2010; Street et al., 2009). This has led female veterans to experience greater isolation than their male counterparts (Cotten et al., 2000). There is subsequently an increased demand for research to inform clinical practice and build effective public policies for female veterans (Yano et al., 2006). Female veterans are often underrepresented in substance use disorder and intervention studies, emphasizing the necessity of providing access to evidence-based treatments tailored for this demographic due to the implications of trauma type on PTSD prevalence and treatment efficacy (Gilmore et al., 2016).

In this Special Issue, PTSD is recognized as a neurodivergent condition due to the profound and lasting changes that it can cause in brain structure and function. These changes can lead to symptoms that overlap with those seen in neurodivergent conditions (e.g., autism, ADHD), such as difficulties with emotional regulation and interpersonal relationships (Sherin & Nemeroff, 2011). Post-deployment reintegration continues to be difficult for both genders, as evidenced by the fact that the proportion of national daily deaths by suicide among veterans is greater than the proportion of the population of veterans (CDC, 2025). Nonetheless, utilizing different forms of social support may help to mitigate the mental health sequelae of service (Cotten et al., 2000). The development and continuation of social support networks have been shown to reduce the severity of PTSD and be protective against suicide (Danish & Antonides, 2013; Malone et al., 2000). There can be no doubt that the experience of serving in the military differs between most male and female service members; however, little research has been conducted on the unique post-deployment reintegration and readjustment demands that female veterans and their families face (Bean-Mayberry et al., 2011; Danish & Antonides, 2013). Traditional interventions for PTSD involve a combination of general therapeutic approaches such as Cognitive Behavioral Therapy (CBT) and Prolonged Exposure (PE) therapy, medication, self-care strategies, and service dog programs (O'Haire & Rodriguez, 2018; Rodriguez et al., 2020; Whitworth et al., 2019). Indeed, most service dog programs for veterans involve the veteran training their own service dog. Other traditional interventions for PTSD specifically in female veterans include the SHE (Sexual Health Empowerment) program, which targets female veterans with a history of sexual trauma. However, the lives of female veterans are far from traditional (Cotten et al., 2000), which may indicate that nontraditional or unexamined forms of social support may be especially beneficial. Similarly, there is increased effectiveness of alternative therapeutic approaches, including trauma-conscious yoga therapy, which demonstrated a notably higher treatment completion rate compared to traditional cognitive processing therapy (Zaccari et al., 2023). This suggests that traditional therapeutic modalities may not be fully meeting the needs of this unique veteran population.

Neurodivergent individuals often benefit from robust social support due to the challenges that they may face in social interactions and forming connections. Social support—whether from family, peers, community, or animals—has been linked to successful reinte-

gration (Cotten et al., 2000). Animals are known to provide humans with a sense of security and safety, social integration with individuals who have a common interest and concern for animals, the opportunity for nurturance, reassurance of worth from the human–animal relationship, and a sense of reliable alliance and relational consistency (Krause-Parello, 2012). A relationship developed with an animal differs from a relationship with a human due to the lack of judgment that exists between humans and animals (e.g., a person rarely feels that an animal is judging perceived inadequacies; Pickering, 2003). These aspects may make relationships with animals particularly meaningful, especially in the case of returning veterans who may feel dissociated from loved ones to whom they return (Street et al., 2009). Research on gender differences in pet attachment bonds reveals that gender is a significant predictor of the strength of pet–owner bonds, with women demonstrating a higher degree of attachment compared to men. This may be associated with women’s generally greater empathy levels, which frequently translate into deeper emotional connections with pets (Wells & Treacy, 2024). Studies indicate that pet ownership encourages nurturing behaviors, with women’s perceptions of pets often aligning with their roles as caretakers and empathetic individuals (Archer & Monton, 2011). It has been posited that women cope with stress through caring for offspring, joining social networks, and organizing social gatherings in order to create an exchange of supportive resources and responsibilities (Cacioppo et al., 2002). It may be that when a disruption in human social support occurs, individuals seek to replace that support through a relationship with an animal (Collis & McNicholas, 1998). This phenomenon may partially account for the number of young women choosing dog ownership over child-rearing (Antenucci & Li, 2014). Furthermore, a significant percentage of pet owners, predominantly women, consider their pets to be integral to their happiness and social interactions, highlighting the relationship between the quality of pet attachments and mental health outcomes (Mueller et al., 2018). Thus, animal attachment as a form of social support may be a manifestation of support-seeking among female veterans. However, not all female veterans may have the time, space, or means to care for their own dogs (Post, 2011). This population often faces unique challenges, including higher rates of single parenthood, housing instability, or limited income during reintegration. The potential stressors associated with managing a service animal, including challenges in training and public integration, may create barriers to positive experiences (Rodriguez et al., 2020). These factors can make pet ownership impractical or inaccessible.

Furthermore, a growing body of theoretical and empirical evidence reveals that volunteering and altruistic action—as long as they are not overwhelming to the individual—are associated with better psychological, mental, and physical health (Post, 2011; Schwartz et al., 2003). Volunteerism may be beneficial in veterans’ reintegration into civilian life, providing a sense of purpose and replacing previous service-related roles while serving in active duty (Black & Living, 2004; Morgan et al., 2020). Moreover, the veterans in this study volunteered to train a service dog for other veterans.

These relationships have not been fully understood in female veterans. Therefore, the objectives of this research were (1) to examine whether the SDTP led to changes in biological (telomere length, HRV) and psychological (PTSD symptom severity, perceived stress, anxiety) indicators of stress in female veterans with PTSD, and (2) to examine whether combat exposure moderates the above relationships.

2. Materials and Methods

2.1. Design

This randomized controlled trial with a repeated-measures design was guided by the biopsychosocial model (Engel, 1981).

2.2. Participants

The rights of human subjects were protected by receiving approval from a university institutional review board prior to data collection (University of Maryland Baltimore IRB HP-00083872). Military veterans were recruited from the community and the Warrior Canine Connection Program (WCC; <http://warriorcanineconnection.org/>, accessed on 1 February 2025; accredited by Assistance Dogs International) dog training waiting list. All the veterans met the WCC criteria for participation in their SDTP. The study's inclusion criteria also included (1) female, (2) diagnosis of PTSD, and (3) able to give informed consent. The exclusion criteria for participation in the study were a fear of dogs, allergies to pet dander, active substance abuse, or history of animal abuse.

Once informed consent was signed, the participants were randomized to the SDTP or CI intervention group in blocks of 4. The sample consisted of 28 female military veterans with PTSD. Their ages ranged from 32 to 72 years (mean = 45.9, SD = 11.8). Thirteen participants were assigned to the SDTP group and fifteen to the CI group. The branches of the military represented included the Army (50%), Air Force (25%), Navy (10.7%), and Marine Corps (7.1%). A plurality of the participants was White (60.7%), followed by Black or African American (28.6) and Other Race (10.7%). Most of the participants were married or in a domestic partnership (46.4%), followed by previously married (32.1%) and single (21.4%). Some of the participants had been engaged in direct combat (35.7%). More than half of the participants owned their own homes (60.7%); others rented (28.6%) or resided with a friend or family (10.7%). An overwhelming majority (78.6%) of the participants had a pet dog as a child, and 57.1% currently lived with a pet (e.g., dog or a cat). All the participants had at least a high school diploma or equivalent. There were no significant differences in the demographics of the two intervention groups (see Table 1).

Table 1. Demographic descriptions of the participants according to random intervention group assignment: service dog training program (SDTP, N = 13), control (CI, N = 15).

	All Freq	All %	SDTP Freq	SDTP %	CI Freq	CI %	(df) ChisSq	p=
Race							(2) 0.99	0.61
African American/Black	8	29.6	5	38.5	3	21.4		
White	17	63.0	7	53.8	10	71.4		
Other	2	7.4	1	7.7	1	7.1		
Ethnicity							(1) 0.23	0.63
Non-Hispanic	25	89.3	12	92.3	13	86.7		
Hispanic	3	10.7	1	7.7	2	13.3		
Education							(4) 4.29	0.37
Some College	3	10.7	2	15.4	1	6.7		
Associates	3	10.7	1	7.7	2	13.3		
Bachelors	6	21.4	4	30.8	2	13.3		
Masters	13	46.4	6	46.2	7	46.7		
Doctorate	3	10.7	0	0	3	20.0		
Marital Status							(2) 0.61	0.45
Married/Partner	13	46.4	6	46.2	7	46.7		
Never Married	6	21.4	4	30.8	2	13.3		
Previously Married	9	32.1	3	23.1	6	40.0		
Residence							(2) 0.25	0.88
Rent	8	28.6	4	30.8	4	26.7		
Own	17	60.7	8	61.5	9	60.0		
Family/Friend	3	10.7	1	7.7	2	13.3		

Table 1. Cont.

	All Freq	All %	SDTP Freq	SDTP %	CI Freq	CI %	(df) ChisSq	p=
Has Children							(1) 2.23	0.14
No	18	64.3	8	61.5	10	66.6		
Yes	10	35.7	5	38.5	5	33.3		
Lives with a Pet							(1) 0.28	0.60
No Pet	3	15.8	1	11.1	2	20.0		
Pet	16	67.9	9	88.9	8	80.0		
Dog when Child							(1) 0.05	0.82
No Dog	5	17.9	2	16.7	3	20.0		
Dog	22	78.6	10	83.3	12	80.0		
Service Branch							(3) 3.70	0.34
Air Force	7	25.0	2	18.2	5	33.3		
Army	14	50.0	6	54.4	8	53.3		
Navy	3	10.7	1	9.1	2	13.3		
Marines	2	7.1	2	18.2	0	0.0		
Initial Military Classification							(1) 2.07	0.15
Enlisted	20	71.4	11	84.6	9	60.0		
Officer	8	28.6	2	15.4	6	40.0		
Direct Combat Exposure							(1) 0.61	0.44
No	18	64.3	9	69.2	9	60.0		
Yes	10	35.7	4	30.8	6	40.0		
Age (Years)	45.9	11.8	43.2	8.1	48.3	14.0	(1, 26) 1.37	0.253
PTSDSS * at entry	43.6	16.7	47.2	17.2	41.3	16.6	(1, 26) 0.60	0.444

* PTSDSS = Score on the PCL-5.

2.3. Study Setting

This study took place at a service dog training facility in a semi-rural community near a major city in the mid-Atlantic region of the US. The participants were responsible for getting to and from the facility, which is not accessible by public transit, for all sessions. After a COVID-19-related pause in research, participants in the SDTP group conducted dog training sessions outdoors, rather than at the indoor training facility, and met the study team member for assessments at picnic tables or at their cars at the WCC site. Those in the CI group completed the video training in their homes and met the study team member outdoors at a community site or at their cars in parking lots for their assessments.

2.4. Study Interventions

2.4.1. SDTP Intervention

Veterans randomly assigned to the dog training intervention worked closely with an experienced WCC Mission-Based Trauma Recovery (MBTR) Trainer (MBRT-T) to train a service dog for another veteran in need of a highly skilled service animal. Each of the eight training sessions lasted approximately one hour. The training followed the prescribed modules based on the Warrior Canine Connection Program (WCC; <http://warriorcanineconnection.org/> accessed on 1 February 2025; accredited by Assistance Dogs International). The modules included the following: I. Warrior Ethos; II. The Human–Animal Bond; III. Shaping the Dog’s/Warrior’s Behavior; IV. Emotional and Physical Synchronization; V. Teaching New Commands; VI. Socialization; VII. Connecting to Family; and VIII. Gain thorough Loss.

2.4.2. Control Intervention (CI)

Veterans randomly assigned to the CI participated in weekly online training sessions (<https://e-trainingfordogs.com>, accessed on 1 February 2025) delivered by experienced SD trainers. The module's content was like the content provided in the WCC SDTP. Each training session was approximately one hour over the course of 8 weeks. The participants in the CI had no interaction with the dogs. However, at the end of the CI, participants were offered the opportunity to participate in the SDTP.

2.5. Study Assessments

Cellular aging was assessed by telomere length analysis obtained through saliva before the first and after the eighth intervention session for both groups. Saliva includes buccal cells and leukocytes suitable for use in telomere length analysis. An extra-gentle DNA extraction method was used to minimize oxidative damage to the DNA during the extraction process. We used the published protocol (O'Callaghan et al., 2008) and obtained absolute telomere length using ScienCell's Absolute Human Telomere Length Quantification (AHTLQ) qPCR Assay Kit (ScienCell Research Laboratory, Carlsbad, CA, USA). AHTLQ is designed to directly measure the average telomere length of a human cell population. The telomere primer set recognizes and amplifies telomere sequences. The single-copy reference primer set recognizes and amplifies a 100 bp-long region on human chromosome 17 and serves as a reference for data normalization. The reference genomic DNA sample with known telomere length serves as a reference for calculating the telomere length of target samples. The comparative $\Delta\Delta Cq$ (Quantification Cycle Value) method was used for quantification. The total telomere length of the target sample per diploid cell = reference sample telomere length $\times 2^{-\Delta\Delta Cq}$. There are 92 chromosome ends in one diploid cell; therefore, the average telomere length on each chromosome end was calculated as follows: total telomere length of the target sample/92. The lower limit of quantification was around 2 kilobase pairs (Kb), and the upper limit was around 20 kb. For quality control, the pre- and post-intervention DNA samples from the same participant were measured in the same plate in duplicates. If the standard deviation of Ct values was above 0.5, the samples from the same participants at both timepoints were repeated at the same time. Telomere length was positively skewed; therefore, natural log transformation was used to achieve normality. Higher values of the transformed value indicate less cellular aging.

The heart rate variability (HRV) of veterans was measured with a Polar H10 heart rate sensor, worn around the chest, along with a matching Polar V800 GPS Sports Watch worn around a wrist to save data from the heart rate sensor. Polar monitors were applied prior to each intervention session and removed immediately afterward. HRV was not collected continuously throughout the 8-week study period; rather, recordings were obtained only during the in-person intervention sessions (i.e., the 8 h of training) at weeks 1, 4, and 8. Thus, the data reflect acute HRV recordings during training sessions, not the average HRV across the entire intervention period. Veterans were ambulatory during the intervention activities, and the duration of the sessions varied. To standardize HRV reporting, each intervention session was divided into eight equal segments. However, fewer segments were created when the average time per segment fell below three minutes. The HRV metric analyzed was the root-mean-square of successive differences (RMSSD). For each segment, average RMSSD values were downloaded from the Polar software. Polar employs proprietary algorithms for automatic filtering of RR intervals to remove outliers and improve data quality. While these algorithms are not publicly disclosed, studies suggest that Polar's filtering methods are validated by comparison with ECG-generated data, except during intense exercise (Schaffarczyk et al., 2022), which did not occur in the current study. HRV

was positively skewed and, therefore, natural log-transformed to achieve normality. For the transformed outcome, higher values are better.

Post-traumatic stress disorder symptom severity (PTSDSS) was assessed prior to session 1 and after sessions 4 and 8 with the PTSD Checklist for DSM-5 (PCL-5). This 20-item scale is based on the DSM-5 criteria for PTSD. It demonstrates strong reliability ($\alpha = 0.94$) and convergent validity ($r = 0.74$ to 0.85) (Blevins et al., 2015; Forkus et al., 2023). According to the U.S. Veterans Administration, scores of 31–33 or above indicate a need for increased PTSD care (Veterans Administration).

Perceived stress (PS) was assessed prior to session 1 and after sessions 4 and 8 with the Patient-Reported Outcomes Measurement Information System (PROMIS) Perceived Stress Fixed Form v2.0 (PROMIS, PS). This is a 10-item scale measuring one's subjective experience of stress in the past month. Seventy-three items related to PS have demonstrated excellent reliability (Cronbach's $\alpha = 0.91$) and modest validity (coefficient range = 0.10 – 0.30) in the general population and meet the NIH Toolbox criteria (Salsman et al., 2013).

Anxiety (A) was assessed prior to session 1 and after sessions 4 and 8 with the PROMIS Anxiety-Short Form 8a, an 8-item scale measuring self-reported fear and anxious misery. This scale has established reliability ($\alpha > 0.97$) and validity (Schalet et al., 2014).

2.6. Statistical Analysis

Data were cleaned and assumptions checked prior to analysis. Descriptive statistics were summarized for the entire sample and for the participants in the two groups. Chi-squared tests or ANOVAs were used to compare the characteristics of the groups. Missing data were completely at random (Little's MCAR $p = 0.826$). Examination of the normality of outcomes revealed significant skews in telomere length and heart rate variability. These were corrected with natural log transformations.

Linear mixed models (LMMs) with random intercepts for participants were used to assess differences in changes in the biological and psychological stress outcome measures between the SDTP and CI group participants. Separate sets of analyses were conducted for each outcome. Fixed effects included group (SDTP or CI), week (1, 8), and their interaction. The hypothesized effect of the intervention was tested with the week-by-group interaction. Interactions of combat exposure with group and time were explored to provide information about its relationship to changes.

3. Results

We aimed to examine whether the SDTP led to changes in biological stress outcomes (telomere length and heart rate variability). Telomere length did not change significantly from before the first to after the last intervention session in the two groups combined. There was a tendency for a difference in changes between the two intervention groups [$F(1,11.65) = 3.543$, $p = 0.085$]. The trajectories showed that telomere length decreased (indicating increased aging) in the CI group and increased (indicating decreased aging) in the SDTP group from baseline to 8 weeks later. When combat exposure was examined as a moderator of changes in telomere length between the two groups, there was a significant moderation effect [$F(1,12.36) = 5.41$, $p = 0.038$; Figure 1]. Changes in telomere length from the beginning to the end of the intervention depended on intervention group and combat exposure. Telomere length decreased from week 1 to 8 in the CI group, with faster decreases among veterans who had combat exposure than those who did not have exposure. The largest improvement in telomere length was in the SDTP group members who had combat exposure, and the largest decrease in telomere length (increase in cellular aging) occurred in the CI group members who had combat exposure. Telomere length increased in the SDTP group, indicating that cellular aging decreased; in members of the SDTP group,

the increases did not differ significantly according to combat exposure. Telomere length decreased in the CI group, indicating that cellular aging increased; in members of the CI group, the increases in cellular aging were greater in those who had experienced combat exposure than in those who had not.

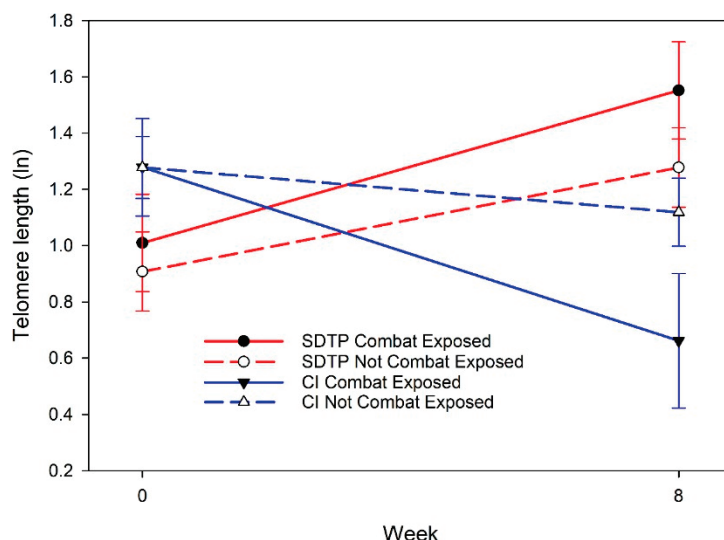


Figure 1. Changes in telomere length according to week, intervention group, and combat exposure estimated from analysis of linear mixed models. Lower telomere length indicates greater cellular aging. SDTP = service dog training program; CI = dog training video control intervention.

Heart rate variability changed differently from before to after the intervention according to the intervention group [$F(1,389.08) = 10.623$, $p = 0.001$; Figure 2]. Heart rate variability decreased, indicating increased stress, in the SDTP intervention group, while it did not change in the CI group. Combat exposure did not moderate the relationship between changes in HRV from baseline to week 8 and intervention group.

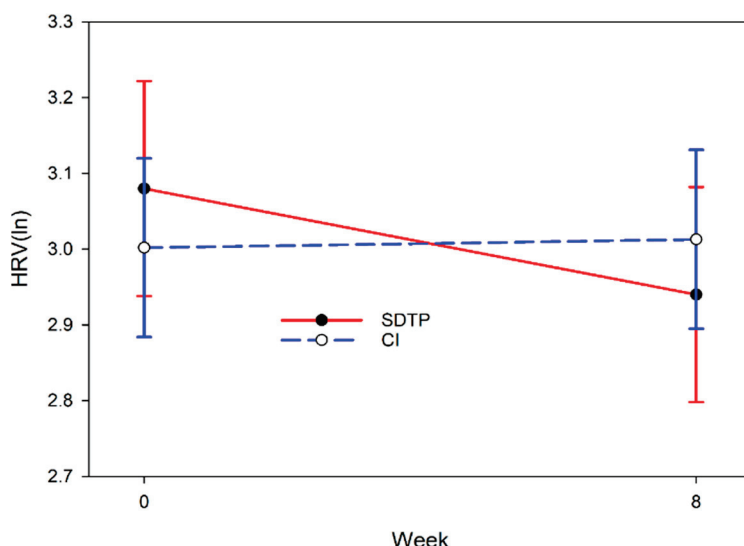


Figure 2. Changes in heart rate variability according to week and intervention group estimated from analysis of linear mixed models. Lower heart rate variability indicates less stress. SDTP = service dog training program; CI = dog training video control intervention.

We aimed to examine whether the SDTP led to changes in psychological (PTSD symptom severity, perceived stress, anxiety) indicators of stress in female veterans with PTSD, as well as whether combat exposure moderates these changes.

PTSD symptom severity decreased significantly from baseline to 8 weeks [$F(1,48.04) = 19.22$, $p < 0.001$]; however, the decrease did not differ significantly between the two intervention groups [$F(1,48.04) = 0.327$, $p = 0.570$].

Perceived stress decreased significantly from baseline to 8 weeks [$F(1,48.48) = 14.65$, $p < 0.001$]; however, the decrease did not differ significantly between the two intervention groups [$F(1,48.48) = 0.001$, $p = 0.972$]. Anxiety decreased significantly from baseline to 8 weeks [$F(1,47.30) = 6.624$, $p = 0.013$]; however, the decrease did not differ significantly between the two intervention groups [$F(1,47.30) = 0.060$, $p = 0.808$]. The decreases in PTSD symptom severity, perceived stress, and anxiety did not depend on the intervention group. Combat exposure did not moderate these changes.

4. Discussion

The current study is groundbreaking in two ways: (1) it focuses on the understudied group of female veterans with PTSD, and (2) it examines cellular aging in this population. The inclusion of both biological and psychological stress indicators in this population indicates that perceptions may not reflect physiological indicators of stress. Physiological stress indicators changed differently in the two intervention groups. The SDTP intervention reduced stress indicators, particularly in female veterans with combat exposure. The reduction in cellular aging, demonstrated by increased telomere length, provided initial evidence that non-pharmacological intervention can reduce cellular aging in female veterans. Both interventions led to decreases in psychological stress indicators; however, the decreases did not differ between the two intervention groups. This suggests the possibility that the attention that the female veterans received from being in the study may have provided support that lessened their perceptions of being stressed.

When examining the physiological outcome of HRV, we anticipated that the control group would show minimal change across sessions, whereas the intervention group might show evidence of adaptive shifts over time. Contrary to expectations, the intervention group exhibited decreases in RMSSD, while the control group remained stable, from week 1 to week 8. Our primary intent was not to compare absolute HRV values between groups but, rather, to explore patterns of within-group change over time. HRV is a highly sensitive physiological measure that can vary on a beat-to-beat basis and is susceptible to contextual influences. In our study, contextual stressors related to the introduction of revised COVID-19 safety protocols (e.g., mask wearing, physical distancing, outdoor data collection at picnic tables with limited privacy, changes in personnel contact when chest straps had to be self-placed) may have introduced unanticipated stress and variability into the HRV responses. These factors likely contributed to the unexpected directional change in HRV observed in the intervention group.

It is also possible that learning how to train a service dog led to increased interactions with their own dogs for the members of both intervention groups. Acquiring skills in positive reinforcement, reading pet body language, and establishing consistent routines may have enhanced the human–animal bond at home, contributing to secondary therapeutic benefits. Service dog training uniquely combines emotional healing with the formation of a close bond between veterans and their animals, offering therapeutic mechanisms distinct from those of broader volunteer activities (Rodriguez et al., 2020). While volunteering activities typically allow for broader community engagement, service dog training intricately intertwines the veteran’s emotional healing with the process of forming a bond with the animal, providing distinct therapeutic mechanisms that other forms of volunteering may not offer.

Future studies could explore how dog training education affects personal pet relationships, whether these effects persist over time, and whether they contribute to long-term

improvements in mental health, social engagement, or daily functioning among veterans with PTSD. The data point to the promise of human–animal relationships in supporting PTSD and related neurodivergent conditions through improved social and emotional engagement. Attachment to animals may promote empathy not only towards pets but also towards other humans (Faner et al., 2024). Additionally, this research underscores the value of integrating environmental, biological, and relational factors into holistic treatment strategies for neurodivergent populations.

The current study evaluated whether combat exposure was related to responses to the SDTP intervention among women. However, it did not evaluate the potential differential impact of other sources of trauma among the female veterans. Although we did not formally inquire about the sources of trauma for the study participants, several women volunteered that their PTSD stemmed from military sexual trauma. This opens a question of whether the source of the trauma is related to the effectiveness of the SDTP intervention. This would be an important area for future research, since one in every three female veterans reports sexual harassment or abuse (U.S. Department of Veterans Affairs).

Limitations

The results of this study should be viewed with caution due to the small sample size and being underpowered. However, due to the small sample size, if the results support clinically meaningful significance or are trending in the right (positive) direction but not statistically significant, that does not mean that the outcomes are not worthy of consideration. We also acknowledge that eight weeks may be too short to detect the changes in telomere length, and the positive signal detected in our study needs to be validated in independent studies. We also agree that examining telomerase activity would be a better approach. However, no live cells were preserved in our study; therefore, we were unable to measure telomerase activity. Future studies examining telomerase activity are warranted. It should also be noted that because the intervention and control conditions necessarily involved different behavioral activities (ambulatory training exercises with dogs versus sitting to watch control videos), direct comparisons of absolute HRV values between groups are confounded. For this reason, the HRV findings should be interpreted as exploratory and focused on within-group change over time rather than between-group differences. Furthermore, this study was started before the COVID-19 pandemic and had to be halted in its entirety. Once the study resumed, the protocols had to be revisited and revised due to public safety health guidelines. The pandemic may have had a serious negative effect on stress levels that had nothing to do with the study itself. We nonetheless believe that these findings are important to report, as they provide valuable methodological insights for future researchers attempting to integrate HRV measurement into field-based interventions.

5. Conclusions

This study shed light on the effects of the SDTP on biological and psychological indicators of stress in female veterans with PTSD and combat exposure moderating these relationships. Female veterans who participated in the SDTP displayed a decrease in stress, and combat exposure moderated the changes. Therefore, it is suggested that future fully powered studies should examine the efficacy of service dog training programs as therapeutic interventions for female veterans with PTSD symptoms.

Author Contributions: Conceptualization, E.F. and C.A.K.-P.; methodology, E.F., C.A.K.-P. and H.Z.; validation, D.T.; formal analysis, E.F. and H.Z.; investigation, D.T., E.F., C.A.K.-P. and R.Y.; resources, E.F. and R.Y.; data curation, E.F.; writing—original draft preparation, C.A.K.-P. and E.F.; writing—review and editing, C.A.K.-P., E.F., A.Q., H.Z. and R.Y.; visualization, E.F.; supervision, E.F. and

C.A.K.-P.; project administration, E.F. and C.A.K.-P.; funding acquisition, E.F. and C.A.K.-P. All authors have read and agreed to the published version of the manuscript.

Funding: The research reported in this publication was supported by the Eunice Kennedy Shriver National Institute Of Child Health & Human Development of the National Institutes of Health under Award Number R21HD097763. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Institutional Review Board Statement: The rights of human subjects were protected by receiving approval from a university institutional review board prior to data collection (University of Maryland Baltimore IRB HP-00083872). This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the University of Maryland (IRB HP-00083872, date of approval 15 January 2019).

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors upon request.

Conflicts of Interest: R.Y. is the director of the service dog training program. All other authors report no potential conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Abbreviations

The following abbreviations are used in this manuscript:

PTSD	Post-Traumatic Stress Disorder
SDTP	Service Dog Training Program
TL	Telomere Length
HRV	Heart Rate Variability
CI	Comparison Intervention
ADHD	Attention-Deficit/Hyperactivity Disorder
WCC	Warrior Canine Connection
MBTR	Mission-Based Trauma Recovery
MBTR-T	Mission-Based Trauma Recovery Trainer
PTSDSS	Post-traumatic Stress Disorder Symptom Severity
PS	Perceived Stress
PROMIS	Patient Reported Outcome Measurement Information System
A	Anxiety
LMM	Linear Mixed Model

References

- Antenucci, A., & Li, D. K. (2014, April 10). *More young women choosing dogs over motherhood*. New York Post. Available online: <https://nypost.com/2014/04/10/more-young-women-choosing-dogs-over-motherhood/> (accessed on 1 February 2025).
- Archer, J., & Monton, S. (2011). Preferences for infant facial features in pet dogs and cats: Infant facial features in pet species. *Ethology*, 117(3), 217–226. [CrossRef]
- Bean-Mayberry, B., Yano, E. M., Washington, D. L., Goldzweig, C., Batuman, F., Huang, C., Miake-Lye, I., & Shekelle, P. G. (2011). Systematic review of women veterans' health: Update on successes and gaps. *Women's Health Issues*, 21(Suppl. S4), S84–S97. [CrossRef] [PubMed]
- Black, W., & Living, R. (2004). Volunteerism as an occupation and its relationship to health and wellbeing. *The British Journal of Occupational Therapy*, 67(12), 526–532. [CrossRef]
- Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The posttraumatic stress disorder checklist for DSM-5 (PCL-5): Development and initial psychometric evaluation. *Journal of Traumatic Stress*, 28(6), 489–498. [CrossRef] [PubMed]
- Cacioppo, J. T., Hawkey, L. C., Crawford, L. E., Ernst, J. M., Burleson, M. H., Kowalewski, R. B., Malarkey, W. B., Van Cauter, E., & Bertson, G. G. (2002). Loneliness and health: Potential mechanisms. *Psychosomatic Medicine*, 64(3), 407–417. [CrossRef] [PubMed]

- CDC. (2025, March 26). *Facts about suicide*. Suicide Prevention. Available online: <https://www.cdc.gov/suicide/facts/index.html> (accessed on 1 February 2025).
- Collis, G. M., & McNicholas, J. (1998). A theoretical basis for health benefits of pet ownership: Attachment versus psychological support. In C. Wilson, & D. Turner (Eds.), *Companion animals in human health* (pp. 105–122). SAGE Publications, Inc. [CrossRef]
- Cotten, S. R., Skinner, K. M., & Sullivan, L. M. (2000). Social support among women veterans. *Journal of Women & Aging*, 12(1–2), 39–62. [CrossRef]
- Danish, S. J., & Antonides, B. J. (2013). The challenges of reintegration for service members and their families. *The American Journal of Orthopsychiatry*, 83(4), 550–558. [CrossRef]
- Engel, G. L. (1981). The Clinical Application of the biopsychosocial model. *Journal of Medicine and Philosophy*, 6(2), 101–124. [CrossRef]
- Faner, J. M. V., Dalangin, E. A. R., De Leon, L. A. T. C., Francisco, L. D., Sahagun, Y. O., & Acoba, E. F. (2024). Pet attachment and prosocial attitude toward humans: The mediating role of empathy to animals. *Frontiers in Psychology*, 15, 1391606. [CrossRef]
- Forkus, S. R., Raudales, A. M., Rafiuddin, H. S., Weiss, N. H., Messman, B. A., & Contractor, A. A. (2023). The posttraumatic stress disorder (PTSD) checklist for DSM-5: A systematic review of existing psychometric evidence. *Clinical Psychology*, 30(1), 110–121. [CrossRef]
- Gilmore, A. K., Davis, M. T., Grubaugh, A., Resnick, H., Birks, A., Denier, C., Muzzy, W., Tuerk, P., & Acierno, R. (2016). “Do you expect me to receive PTSD care in a setting where most of the other patients remind me of the perpetrator?”: Home-based telemedicine to address barriers to care unique to military sexual trauma and veterans affairs hospitals. *Contemporary Clinical Trials*, 48, 59–64. [CrossRef]
- Goldzweig, C. L., Balekian, T. M., Rolón, C., Yano, E. M., & Shekelle, P. G. (2006). The state of women veterans’ health research. Results of a systematic literature review. *Journal of General Internal Medicine*, 21(Suppl. S3), S82–S92. [CrossRef]
- Haskell, S. G., Gordon, K. S., Mattocks, K., Duggal, M., Erdos, J., Justice, A., & Brandt, C. A. (2010). Gender differences in rates of depression, PTSD, pain, obesity, and military sexual trauma among Connecticut War Veterans of Iraq and Afghanistan. *Journal of Women’s Health*, 19(2), 267–271. [CrossRef] [PubMed]
- Krause-Parello, C. A. (2012). Pet ownership and older women: The relationships among loneliness, pet attachment support, human social support, and depressed mood. *Geriatric Nursing*, 33(3), 194–203. [CrossRef] [PubMed]
- Lehavot, K., Katon, J. G., Chen, J. A., Fortney, J. C., & Simpson, T. L. (2018). Post-traumatic stress disorder by gender and veteran status. *American Journal of Preventive Medicine*, 54(1), e1–e9. [CrossRef] [PubMed]
- Malone, K. M., Oquendo, M. A., Haas, G. L., Ellis, S. P., Li, S., & Mann, J. J. (2000). Protective factors against suicidal acts in major depression: Reasons for living. *The American Journal of Psychiatry*, 157(7), 1084–1088. [CrossRef]
- Morgan, N. R., Aronson, K. R., Perkins, D. F., Bleser, J. A., Davenport, K., Vogt, D., Copeland, L. A., Finley, E. P., & Gilman, C. L. (2020). Reducing barriers to post-9/11 veterans’ use of programs and services as they transition to civilian life. *BMC Health Services Research*, 20, 525. [CrossRef]
- Mueller, M. K., Gee, N. R., & Bures, R. M. (2018). Human-animal interaction as a social determinant of health: Descriptive findings from the health and retirement study. *BMC Public Health*, 18(1), 305. [CrossRef]
- O’Callaghan, N. J., Dhillon, V. S., Thomas, P., & Fenech, M. (2008). A quantitative real-time PCR method for absolute telomere length. *BioTechniques*, 44(6), 807–809. [CrossRef]
- O’Haire, M. E., & Rodriguez, K. E. (2018). Preliminary efficacy of service dogs as a complementary treatment for posttraumatic stress disorder in military members and veterans. *Journal of Consulting and Clinical Psychology*, 86(2), 179–188. [CrossRef]
- Pickering, T. G. (2003). Men are from Mars, women are from Venus: Stress, pets, and oxytocin. *Journal of Clinical Hypertension*, 5(1), 86–88. [CrossRef] [PubMed]
- Post, S. G. (2011). It’s good to be good: 2011 fifth annual scientific report on health, happiness and helping others. *International Journal of Person Centered Medicine*, 1(4), 814–829. [CrossRef]
- Rodriguez, K. E., LaFollette, M. R., Hediger, K., Ogata, N., & O’Haire, M. E. (2020). Defining the PTSD service dog intervention: Perceived importance, usage, and symptom specificity of psychiatric service dogs for military veterans. *Frontiers in Psychology*, 11, 519718. [CrossRef] [PubMed]
- Salsman, J. M., Butt, Z., Pilkonis, P. A., Cyranowski, J. M., Zill, N., Hendrie, H. C., Kupst, M. J., Kelly, M. A. R., Bode, R. K., Choi, S. W., Lai, J.-S., Griffith, J. W., Stoney, C. M., Brouwers, P., Knox, S. S., & Cella, D. (2013). Emotion assessment using the NIH toolbox. *Neurology*, 80(11)(Suppl. S3), S76–S86. [CrossRef]
- Schaffarczyk, M., Rogers, B., Reer, R., & Gronwald, T. (2022). Validity of the Polar H10 sensor for heart rate variability analysis during resting state and incremental exercise in recreational men and women. *Sensors*, 22(17), 6536. [CrossRef]
- Schalet, B. D., Cook, K. F., Choi, S. W., & Cella, D. (2014). Establishing a common metric for self-reported anxiety: Linking the MASQ, PANAS, and GAD-7 to PROMIS anxiety. *Journal of Anxiety Disorders*, 28(1), 88–96. [CrossRef]
- Schwartz, C., Meisenhelder, J. B., Ma, Y., & Reed, G. (2003). Altruistic social interest behaviors are associated with better mental health. *Psychosomatic Medicine*, 65(5), 778–785. [CrossRef]

- Sherin, J. E., & Nemeroff, C. B. (2011). Post-traumatic stress disorder: The neurobiological impact of psychological trauma. *Dialogues in Clinical Neuroscience*, 13(3), 263–278. [CrossRef]
- Smith, H. (2022). The women airforce service pilots of WWII: A tactical necessity with strategic implications. *Air Power History*, 69(1), 21–28.
- Street, A. E., Vogt, D., & Dutra, L. (2009). A new generation of women veterans: Stressors faced by women deployed to Iraq and Afghanistan. *Clinical Psychology Review*, 29(8), 685–694. [CrossRef]
- Wells, D. L., & Treacy, K. R. (2024). Pet attachment and owner personality. *Frontiers in Psychiatry*, 15, 1406590. [CrossRef]
- Whitworth, J. D., Scotland-Coogan, D., & Wharton, T. (2019). Service dog training programs for veterans with PTSD: Results of a pilot controlled study. *Social Work in Health Care*, 58(4), 412–430. [CrossRef]
- Yano, E. M., Bastian, L. A., Frayne, S. M., Howell, A. L., Lipson, L. R., McGlynn, G., Schnurr, P. P., Seaver, M. R., Spungen, A. M., & Fihn, S. D. (2006). Toward a VA women's health research agenda: Setting evidence-based priorities to improve the health and health care of women veterans. *Journal of General Internal Medicine*, 21(Suppl. S3), S93–S101. [CrossRef]
- Zaccari, B., Higgins, M., Haywood, T. N., Patel, M., Emerson, D., Hubbard, K., Loftis, J. M., & Kelly, U. A. (2023). Yoga vs cognitive processing therapy for military sexual trauma-related posttraumatic stress disorder: A Randomized Clinical Trial. *JAMA Network Open*, 6(12), e2344862. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

MDPI AG
Grosspeteranlage 5
4052 Basel
Switzerland
Tel.: +41 61 683 77 34

Behavioral Sciences Editorial Office
E-mail: behavsci@mdpi.com
www.mdpi.com/journal/behavsci



Disclaimer/Publisher's Note: The title and front matter of this reprint are at the discretion of the Guest Editors. The publisher is not responsible for their content or any associated concerns. The statements, opinions and data contained in all individual articles are solely those of the individual Editors and contributors and not of MDPI. MDPI disclaims responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.



Academic Open
Access Publishing

mdpi.com

ISBN 978-3-7258-8752-1