

Animal-Assisted Interventions in Special Needs Schools: What Works?

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Presentations resulting from this thesis

Work within this thesis has been presented at three conference:

- July (2019) “Results from an RCT investigating AAI with children in mainstream and special needs schools (including animal welfare, screening)” (Meints, K., Brelsford, V.L., **Dimolareva, M.**, Gee, N. & Rowan, E) Animal-Assisted Interventions and Human Welfare Networking Day, The York Medical Society, York, UK (presented by Meints, K.)
- July (2018) “LEAD Risk Assessment Tool” (Brelsford, V.L., **Dimolareva, M.**, Meints, K., & Gee, N.) International Society for Anthrozoology (ISAZ), Sydney, Australia (presented by Gee, N.)
- July (2017) “Animal-assisted interventions in special educational needs schools: What works?” International Society for Anthrozoology (ISAZ), Davis, California (**Dimolareva, M.**)

Abstract

The present research set out to answer the question of what impact does a dog-assisted intervention have on children with special educational needs and if there are benefits, how long do they last for. The project was underpinned by previous research which for well over 30 years has indicated many benefits (Friesen, 2010; Fine, 2015). In addition, theories supporting the beneficial effects of animals such as Biophilia Hypothesis (Wilson, 1984), Attachment (Bowlby, 1969), Social Buffer (McNicholas & Collis, 2006) and Biopsychosocial Model (Engel, 1981) were also discussed. Literature reviews in the area of Animal-Assisted Interventions (AAIs) have established the lack of scientific rigour and consistency in the literature (e.g. O'Haire, 2013; O'Haire, 2017 Brelsford, Meints, Gee & Pfeffer, 2017), which this thesis set out to address. A Randomised Control Trial (RCT) design was employed with three conditions: dog intervention, relaxation intervention and no-treatment control group. The interventions were provided either as one-to-one or in a group setting. Measures were taken on academic factors (cognition and language) and well as physiological (cortisol) socioemotional (anxiety, self-esteem) and behavioural (behaviour at school and home, empathizing and systemizing) factors. The project included any 8-10-year-old children (N=157) who attended the special educational needs schools taking part, regardless of ability or diagnosis. The findings indicated that overall children benefitted from the dog and relaxation intervention but the benefits differed between tasks. There were also differences in progress between children of high and low ability. Some benefits lasted for 6 weeks after the intervention but were no longer present at 6-months or 1-year after the end of the intervention. This would indicate that children benefit from having a dog (or relaxation) intervention but the effects were not permanent so the intervention would need to be reintroduced. Future research needs to consider dosage of the AAI and exactly when the re-introduction needs to occur for optimum benefits.

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Chapter 1: Introduction

Research in the area of Human Animal Interaction (HAI) and Animal-Assisted Interventions (AAI) has been conducted for well over 30 years and has established a range of emotional, social and physical benefits for children (e.g. Friesen, 2010; Fine, 2015). Despite this it has been highlighted that much of the research lacked scientific rigour and has had contradictory findings (Herzog, 2011), and unclear extent of the benefits of the animal interventions assessed (McNicholas & Collis, 2006). In addition to this, research has also not investigated whether there are differences in the effect of AAI on children depending on the family's socioeconomic background (Westgarth et al., 2010). Some research has concentrated on children with special needs, and the majority of this work has included only those who are close in ability to their typically developing peers (e.g. O'Haire, McKenzie, Beck & Slaughter, 2015). Children with lower ability have often not been included.

1.1 Aims and Objectives

The aim of the current thesis is to investigate the effect of a Dog-Assisted Intervention (DAI) on the ability and behaviour of children with special educational needs, as research to date has not systematically established the effects of Animal-Assisted Interventions (AAIs) on their language and cognition, wellbeing (anxiety and self-esteem) and behaviour.

Hence this research closes this gap and children with special educational needs were tested on language, cognition, socio-emotional, physiological and behavioural measures. This was a Randomised Control Trial (RCT) design where children took part in either the DAI, an active control (relaxation intervention) or a no treatment control. The measures were administered before and after the intervention period and over time, up to 1-year post-intervention.

Such longitudinal testing established whether the benefits were maintained over time. This research provides a detailed understanding of the effects of DAI due to the large range of measures completed by the children. This allows for conclusions to be made about which

area benefits most from such intervention. Further to this the question of the effectiveness of any intervention (i.e. would a non-dog intervention have the same effect) was also answered due to the design including children in the relaxation intervention. Another knowledge gap which this research answered was how long did the effects last for post-intervention as the children completed the same measures 6-weeks, 6-months and 1-year after the intervention. The effects of group compared to individual intervention were also addressed here as both the DAI and relaxation intervention had children taking part on one-to-one basis or as part of a group.

Conducting this research is vital for improving the lives of children with special educational needs (SEN) as they often do not develop at the same rate as children without SEN, so it is important to establish interventions to further their development. It is also crucial to be inclusive and involve children regardless of their IQ or ability to ensure improvements for all. Providing such interventions could enhance children's learning, cognitive, language, socio-emotional skills and behaviour and improve quality of life in the long term. These changes are likely to have an impact on the child but also on the teachers and staff at school as well as parents and carers who interact with and care for the child. If DAIs are found to be effective, there would be a large impact as there are 1033 special educational needs' schools in England alone and over 1.2 million children with special educational needs in SEN and mainstream schools (Department of Education, 2018).

To clarify, this research will employ the definitions used by Pet Partners and Society for Companion Animal Studies. The following terminology definitions have been stated (SCAS Terminology, 2013; Pet Partners Terminology, n.d.):

- Animal-Assisted Interventions (AAI): A goal-directed and structured interventions which includes animals aiming to achieve therapeutic gains and improve areas of health and wellbeing. AAT, AAE and AAA are seen as forms of AAI.

- Animal-Assisted Therapy (AAT): A structured, planned and documented therapeutic intervention directed by a health professional (e.g. physician, occupational therapist, speech therapist) as part of their profession.
- Animal-Assisted Education (AAE): A structured intervention with academically related targets. It is directed by a professional working in education.
- Animal-Assisted Activities (AAA): More informal than AAI, AAT and AAE, but delivered by trained professionals or volunteers.
- Animal-Assisted Psychotherapy (AAP): A qualified psychotherapist using an Animal-Assisted Intervention within their practise.

All of the above aim to improve quality of life.

In this thesis, the terms will be used as defined above. In addition, where necessary, the terms of dog-assisted intervention (DAI) and dolphin-assisted therapy (DAT) will be used.

When addressing the project presented in this thesis DAI will be used to ensure reporting is specific.

1.2 Thesis Outline

The theory underpinning the current research is presented next in Chapter 2. The chapter begins with the historical perspective of why animals are likely to be beneficial to humans, followed by the most used theories to describe AAI benefits, namely Biophilia Hypothesis, Attachment Theory, Social Buffer/ Support and Biopsychosocial Model. These theories are also evaluated. It is not the aim of the thesis to portray at length language, cognitive and socio-emotional theories but to establish the effects of DAI. As a result, such theories will not be discussed at length. Following this is Chapter 3: Systematic Review. Here, the literature investigating AAI for children with special educational needs who attend school is presented; this is followed by the details on the current research as well as hypotheses, uniqueness and importance of this research. Next, Chapter 4 describes the method in detail, followed by the results chapters: Chapter 5: Language Results, Chapter 6: Cognition Results; Chapter 7:

Physiology and Behaviour Results. Finally, Chapter 8 discusses the current results, relating them back to the theory, previous research and the hypothesis. Chapter 9 presents the conclusions.

Chapter 2: Theory

Historically, early excavations provided evidence of human-animal interaction as early humans were known to have avoided predators, scavenged or hunted (DeLoache, Pickard & LoBue, 2011). Excavations from 12000-14000 years ago showed that humans have been burying or ritually disposing of dogs in a way they would do with family members, suggesting a special social relationship (Morey, 2010) and a long standing, mutually beneficial relationship between dogs and humans (Serpell, 2010). From an evolutionary perspective, people and animals lived together closely throughout history (Gordon, 2017) due to their dependence on each other for food and protection, with different animals being employed for different purposes. For instance, cats kept rodents away while dogs protected the home (Gordon, 2017). Animals were the centre of many ancient theories relating to sickness and disease such as shamanism and animism (Serpell, 2015).

Over time, through co-evolution and domestication, animals such as dogs and cats learnt to communicate with humans (Amiot, Bastian & Martens, 2016) as humans provided the essentials such as food and safety for the animals to survive while pets supported the human's health and wellbeing (Collis & McNicholas, 1998). Early research into health benefits of pets found that children had lower blood pressure when resting and when reading in the presence of a dog (Friedmann, Katcher, Thomas, Lynch & Messent, 1983; Friedmann, Barker & Allen, 2011). More recent research showed that pet owners display lower levels of stress in the presence of their pets (Sugawara et al., 2012) and had fewer visits to the doctors (Headey, Grabka, Kelley, Reddy & Tseng, 2002). Furthermore, cortisol has also been reduced in the presence of an animal, indicating reduction of stress (e.g. Gabriels, Agnew, Pan, Holt, Reynolds & Laudernslager, 2013; Beetz, Kotrschal, Turner, Hediger & Uvnas-Julius, 2011).

However, not all research established beneficial effects. Some research has also shown poorer outcomes for heart-attack pet owners (Parker, Gayed, Owen, Hyett, Hilton & Heruc, 2010) and no improvement was visible in pet owners' loneliness after getting a pet

(Gilbey, McNicholas & Collis, 2007). These contradictory results in areas of the animal-assisted intervention literature could be due to issues such as small sample sizes and major design flaws in the research, which are well documented (e.g. Herzog, 2011). Research to date still often has small sample sizes or a case-study design (Anderson & Olson, 2006; Bassette & Taber- Doughty, 2013; Kogan, Granger, Fitchett, Helmer & Young 1999), with information such as gender not always reported (Le Roux, Swartz & Swart, 2014; Loukaki & Koukoutsakis 2014). In terms of methodological issues and design, there are differences across research when considering the inclusion of a control group with some research having independent control groups (Beetz, 2013), some having participants acting as their own control (O'Haire, McKenzie, McCune & Slaughter, 2013; O'Haire McKenzie, McCune & Slaughter, 2014; Kotrschal & Ortbauer, 2003; Gee, Belcher, Grabski, DeJesus, & Riley 2012a; Gee, Gould, Swanson & Wagner 2012b; Gee, Crist & Carr, 2010a; Gee, Church & Altobelli 2010b; Gee, Sherlock, Bennett, & Harris, 2009; Gee, Harris & Johnson, 2007) or others not having any form of control group (Becker, 2014; Loukaki & Koukoutsakis, 2014). In addition to this difference in design across studies, some research has also not collected baseline measures before the animal intervention (Becker, 2014; Beetz, 2013) and very few studies have assessed long-term effects (Bassette & Taber- Doughty, 2013; Le Roux, et al., 2014; Tissen, Hergovich & Spiel, 2007). Furthermore, animal-assisted intervention sessions often differ in structure with some research including the animals in the room while a task was completed which lasted 5-15 minutes (Gee, et al., 2012a; Gee, et al., 2012b; Gee, et al., 2007; Gee, et al., 2009) while others scheduled a one-off session lasting 25 minutes (Beetz, et al., 2011; Beetz, Julius, Turner & Kotrschal, 2012), 45-60 minute sessions per week (Kogan, et al., 1999) or 90 minute sessions per week (Tissen, et al., 2007).

Contradictory findings in research involving pets and children were also found depending on the research question. One review investigating animal interventions for paediatric patients found that research reported decreased anxiety and pain (Goddard & Gilmer, 2015). However, other reviews warn that there is likely to be a publication bias

towards positive findings as non-significant results in the review were mostly from the “grey” literature searched (e.g. Brelsford, Meints, Gee & Pfeffer, 2017).

Overall, some benefits are evident, but it remains unclear if and for which areas of human functioning AAI shows robust effects, hence rigorous research design is needed as well as sound methodological basis. A range of theories with different foci have been used to explain why animals in AAls may help children in different areas of development and adults in different areas of life. The following theories will be presented and evaluated next:

Biophilia Hypothesis, Attachment Theory, Social Buffer/ Support theory and Biopsychosocial Model.

2.1 Biophilia Hypothesis

The Biophilia hypothesis was proposed by Wilson (1984) who stated that biophilia was the innate ability humans have to focus on life-like processes. According to this hypothesis humans depend on nature for material and physical nourishment, but also aesthetically, intellectually, cognitively and spiritually (Kahn, 1997). It was suggested that there was an inherent, evolutionary need for this connection (Kellert & Wilson, 1993). This would suggest that humans are naturally attracted to animals as they are part of nature and therefore it is an innate attraction. The Biophilia hypothesis was supported by early research by Kaplan and Kaplan (1989) showing that people preferred natural environments to built-up areas and if the built-up areas had natural features they were preferred to the built-up areas without those features. This suggested that people choose the option which has most nature in it perhaps due to their desire to connect with other living things (Frumkin, 2008).

In support of the Biophilia hypothesis, research with new-borns showed that they preferred to look at biological motion as opposed to non-biological point light animations (Simion, Regolin & Bulf, 2008) indicating a potential innate interest to natural stimuli. Research by LoBue and colleagues specifically relating to animals found that children interacted with, talked more about and asked more questions about animals compared to inanimate toys. Parents were also observed to spend more time with the animal and divert

the child's attention to the animal rather than the inanimate toy, indicating that adults had an affinity to animals (LoBue, Pickard, Sherman, Axford & DeLoache, 2013), supporting the Biophilia hypothesis. Such research could explain why an estimated 45% of households in the U.K. owned a pet in 2018, with 26% owning a dog (Statistica, 2018; Pet Food Manufacturing Association, 2018). Furthermore, pet ownership in households with children under the age of 16 was 73% in 2017. This was significantly higher than the national average (BBC, 2017). In addition, over 90% of owners said that their pet made them happy and 88% thought pet ownership increased their quality of life (Statistica, 2018).

However, some research has also found limitations relating to the Biophilia hypothesis. For instance, one limitation in the supporting research investigating the Biophilia hypothesis was that the sample of participants taking part in such research consisted of people who like animals. Furthermore, when children were brought up in a household where pets were looked after well, they were likely to learn the appropriate behaviours towards animals from their parents. In research conducted by LoBue et al. (2013) parents were observed to direct the attention of their child towards the animal, thereby inadvertently guiding the child to attend more to the animal rather than the toys. The research has not actively recruited participants who were indifferent to animals or perhaps did not like them.

Research has found that the number of pet owners varies across the globe with South American countries having the most pets and Asian countries least likely to have pets (GfK, 2016). The Biophilia hypothesis suggests we have an innate attraction towards nature and animals, but it alone cannot explain why pet ownership is not high across the world. Furthermore, in different cultures and depending on people's religious beliefs, animals are viewed differently and therefore their treatment varies (Lawrence, 1994). As such, rather than everyone having an affiliation to nature and animals, there may be cultural differences and perhaps it is more specifically pet owners who are attracted to animals and have an attachment to their pet. In line with this suggestion, attachment may be an important mediator in human's attraction to animals. As a result, the Attachment theory in relation to HAI is discussed next.

2.2 Attachment Theory

Attachment theory was first devised by Bowlby (1969) and later furthered by Ainsworth (1989). Attachment was defined as a lasting emotional bond towards others, formed in early childhood. The behaviour was defined as being exhibited to maintain proximity to someone who is seen to be coping better with the surroundings, making the individual feel protected. Although the original theory envisaged a caregiver and baby attachment, Rynearson (1978) has suggested that both humans and pets can act as attachment figures. More recent research has supported this idea as children reported being attached to their pets (Hawkins & Williams, 2017). However, the attachment to humans may be different to that of attachment to pets. Smolkovic and colleagues found no relationship between pet interactions and interpersonal relationships (Smolkovic, Fajfar & Mlinaric, 2012), perhaps due to the different feelings people have towards pets and humans. Hawkins and colleagues (2017) stated that children's attachment to pets was associated with caring and friendship behaviours towards their pet and compassionate views towards other animals. These behaviours and views were specific to animals and not transferrable to humans, especially not from child to adult (Hawkins & Williams, 2017). This is further support for the attachment towards pets being different compared to the attachment towards humans.

Earlier research found that college students with positive attitudes towards dogs had lower cardiovascular stress responses in the presence of a dog compared to students who had less-positive attitudes towards dogs (Friedmann, Locker & Lockwood, 1993). This could be explained by the fact that positive attitudes towards animals were correlated with attachment. Therefore, students who had positive attitudes were more likely to become attached to the animals they spent time with.

Further to this theory, Bowlby (1973) suggested that attachment was a protective system acting as a buffer for the infant, balancing external environment demands and the infant's ability to regulate their physiological functions, if the attachment functioned well (Goldberg, 2000). Research indicated that children with Autism may not show the same

attachment to parents as typically developing children. In light of the suggestion that secure attachment provides a balance for dealing with external factors, this difference may contribute to the problems children with Autism have due to their inability to balance external environmental demands. It has been suggested that attachment to animals may provide this support for children and act as a buffer. Research from Carlisle (2014) provided support for this idea. Children with Autism who had a pet dog were attached to the animal and showed increased age-appropriate social skills which children with Autism without a dog did not show. Although this research did not measure attachment to adults, it showed that attachment to animals for children with Autism is beneficial.

The theory of attachment provided an explanation of some of the beneficial effects of pets on adults and children. However, research using therapy animals has also shown beneficial effects for children on cognitive tasks in an educational environment such as better compliance (Gee, et al., 2009), less need of prompts (Gee, et al., 2010) and faster performance (Gee, et al., 2007). On these occasions, children were not likely to be attached to the dog who took part in the project as they spent very limited time together. As a result, such beneficial effects cannot be clearly explained through Attachment theory, but it may have been the presence of the dog acting as support which had influence on the results. To explore this the social buffer/ support theory will be represented and discussed next.

2.3 Social Buffer/ Support Theory

Social support has been defined differently by different researchers (Dolan & Brady, 2012). Overall, it is used as an umbrella term to encompass positive actions and person-to-person social provisions that were accepted to enhance a person's health and well-being and arise from social relationships (McNicholas & Collis, 2006). The social support theory suggests that a person provides a sense of social belonging which enhances an individual's quality of life and is thought to act as a buffer during adverse life events. This support includes the perceived and actual help the person receives from the people around them (Cohen & Wills, 1985). Although initially this theory was proposed with human-to-human support,

researchers have suggested that the dog-human relationship was similar and the animal provided comfort and positive social outlet (Bonas, McNicholas & Collis, 2000).

Evidence for this notion is apparent from research which has found that children who lacked social support from adults gain emotional support from their pets (Melson, 2003). It was therefore proposed that pets are an important source of social support (McConnell, Brown, Shoda, Stayton & Matrin, 2011). However, as other research has found no significant correlation between social support and attachment to pets (Smolkovic et al., 2012), it was then suggested that any animal was likely to act as social support, not just the person's pet. This idea was supported by Beetz and colleagues who found that children with insecure/disorganised attachment gained social support from a real dog, but not from a toy dog or human (Beetz et al., 2011; Beetz et al., 2012). Furthermore, oxytocin among other physiological factors has been found to increase after a positive human-animal interaction (Odendaal & Meintsjes, 2003). Recent research has also found that university students showed an improvement in their wellbeing, including perceived social support, after a one-off session with a therapy dog. This was measured by pre- and post-interaction measures and 10 hours later (Ward-Griffin, Klaiber, Collins, Owens, Coren & Chen, 2018). The findings indicated strong effects immediately after, but these reduced after 10 hours suggesting that they were not maintained in the long run. However, such results may be due to a novelty effect of spending time with a dog, rather than there being an effect of the dog per se.

When relating the social support to stressful situations, research concluded that animals were able to provide support and act as a buffer (McNicholas & Collis, 1995; Serpell, 1996; Siegel, 1990). Recent research also found that it was not merely the presence of a dog which reduced the levels of stress (as measured by cortisol) but rather how much the child stroked the dog, with more interaction resulting in larger decrease in cortisol (Beetz et al., 2011; Beetz et al., 2012). In line with this, when investigating the effect of pets on the elderly it appeared that the animals offered a protective buffer against adversity. This was measured by the number of visits made to see a medical practitioner over a year (Siegel, 1990). Furthermore, dog walking was thought to generate positive social interaction which

eliminated geographic and cultural boundaries, acting as a facilitator of human social support as the owner/dog minder interacted with more people (e.g. Antonacopoulos & Pychul, 2014).

The idea of dogs facilitating social interaction is also relevant for children with special educational needs such as Autism. Carlisle (2015) suggested that animals acted as a catalyst for social interactions which led to forming relationships. This is particularly crucial for children with diagnoses such as Autism, as by definition, they have an impairment of their social interaction and have difficulty developing and sustaining relationships. O'Haire et al., (2013) supported this as children with ASD engaged in more social behaviours with humans when the animals were in the room.

This Social support theory provides a plausible explanation why animal-assisted interventions can be effective for children and adults with special needs. Furthermore, the research in support of this theory comprised of different measures, including physiological differences (Beetz et al., 2011, Beetz et al., 2012), which are an unbiased representation of the effect of the intervention. The research presented here established social support and buffering to be a plausible theory for a range of different participants, with the potential of affecting different areas of development in children.

However, this theory does not consider external factors such as people's attitudes towards animals and cultural differences and beliefs. The theoretical explanation presented next, Biopsychosocial model, takes these factors into account as it includes biological, psychological and social factors to explain the effects of AAI.

2.4 Biopsychosocial Model

Perhaps the most detailed model in terms of encompassing many factors is the Biopsychosocial model. First proposed by Engel (1981), this model explains how biological measures and psychological and biological challenges are related to each other. In more recent years, this model has been used to describe how the three different realms - biological, social and psychological interact to influence and determine health outcomes (Friedmann & Gee, 2017).

Here, this model is used to establish how the three domains intertwined and affected the influence AAls had on the development of children with special educational needs. One part of the model relates to biological factors. Previous research highlighted the physiological impact that animals have on humans (Odendaal, 2000; Johnson, Odendaal & Meadows, 2002). In more detail, people were found to nearly double the level of oxytocin and reduce the levels of cortisol when stroking their pet dog (Odendaal & Meintjes, 2003). Furthermore, children's cortisol awakening response reduced by 48% when a dog was introduced in the family and increased again to the same level when the dog was removed (Viau et al., 2010). Lower levels of cortisol in the presence of a dog were also found for children with insecure attachment who took part in a stress test (Beetz et al., 2011). Such findings suggested that spending time with an animal resulted in the reduction of biological responses associated with stress. This conclusion was also made by Fine and Beck (2015) after they reviewed biological research into Human-Animal Bond and stated that spending time with pets has a calming and relaxing effect in terms of physiological changes.

This model also encompasses psychological influences. It considers the child's cognitive ability which would be affected by their diagnosis and the difficulties (namely physical or mental) associated with it. The ability to take these factors into account results in the model being appropriate in explaining research finding. For instance, a child with low cognitive ability who is still exploring through touch and other senses is likely to be influenced by touching a dog. In addition to this, it is well documented that children with certain learning difficulties had repetitive motor and vocal behaviours which were seen to interfere with new skill acquisition (Morrison & Rosales-Ruiz, 1997). These behaviours were found to be more frequent and intense in children with Autism (Bodfish, Symons, Parker & Lewis, 2000). However, research has shown that children taking part in a dog intervention group exhibited fewer repetitive behaviours following the intervention compared to children in a control group (Becker, Rogers & Burrows, 2017).

The model also considers social factors such as attitudes towards pets and family relationships as they are likely to vary depending on the environment the child is being

brought up in. Research has for instance shown that dog owners in the USA were more likely to report keeping their German Shepherd dogs at home during the day and at night as well as label them as pets compared to owners of German Shepherds in Hungary (Wan, Kubinyi, Miklosi & Champagne, 2009). This different view of dogs could suggest that some families had different attitudes towards animals perhaps preventing them from being able to relate as closely to the animals and therefore not wish their children to interact with them. Such views can also have an impact on the way the child sees animals and can therefore affect interactions.

Another social aspect which may be a contributing factor when assessing the usefulness of animal-assisted interventions for children with special educational needs is inclusion and understanding of social situations. For instance, children who are not feeling included and struggle with social situations with peers may find it easier to interact with an animal. Children with Autism who took part in a social skills program with dogs showed significantly fewer deficits in social skills and better communication skills after the intervention compared to the children who undertook the same training but without the dog (Becker et al., 2017), indicating that dogs can help facilitate social interaction. In support, research assessing the effect of therapeutic horseback riding (THR) for children with Autism also found a significant improvement in their social communication due to the THR (Gabriels et al., 2015).

2.5 Research Rationale and Theory

All of the factors discussed above, as part of the Biopsychosocial Model are likely to influence the effect of an intervention. The Biopsychosocial Model is currently the most detailed and clear explanation of the effect of AAls on different areas of children's development and wellbeing. As a result, the current research is based on this theory and measures were collected on all aspects of the model to establish the impact of the AAI provided. Next, a systematic review was undertaken to investigate specifically the latest developments and research within AAI for children with special educational needs.

Chapter 3: Systematic Review

3.1 Systematic Review of AAI with children with special educational needs

Systematic literature reviews have concentrated on specific areas of Animal-Assisted Interventions (AAIs) and children with special educational needs in an attempt to develop the field and provide guidance for future direction. Three reviews included research for children with special educational needs where one focused on Equine Assisted Therapy (EAT) for children with Autism Spectrum Disorder (ASD) (Mapes & Rosen, 2016); the others presented research into AAI for children with ASD (O'Haire, 2013; O'Haire, 2017). A review which included both typically developing children and children with special educational needs included the current literature of AAI in the classroom setting (Brelsford et al., 2017).

Most of the research in the reviews reported some beneficial effects of AAI, including improvement in physical and social functioning, sensory sensitivity and motivation, self-regulation, areas affecting the daily functioning of the participants, severity of symptoms, and behaviour (Mapes & Rosen, 2016). Furthermore, an improvement in participants' social interaction, communication, reduction of problem severity, stress and ASD severity has also been established (O'Haire, 2013, O'Haire, 2017). In relation to the AAI research completed in the classrooms, Brelsford and colleagues concluded that most of the studies reported some beneficial effects on cognitive and social-emotional behaviour as well as in physiological measures (Brelsford et al., 2017).

Despite the presented beneficial effects, the reviews have emphasised similar limitations for the research conducted so far. There was a lack of consistency across the studies when evaluating the information, including the animals selected to participate, settings and interventions (O'Haire, 2013; O'Haire, 2017; Mapes & Rosen, 2016; Brelsford et al., 2017). Furthermore, some of the reviews have called for future research to determine which method of AAI is most effective (Mapes & Rosen, 2016; Brelsford et al., 2017) as well as provide more detail to enable the true understanding of why AAI benefits some participants but not others (Brelsford et al., 2017). Similarly, there was also a call for further

research to be more systematic and rigorous and produce high quality studies (O'Haire, 2013; O'Haire, 2017; Brelsford et al., 2017) as well as to explore different areas including positive emotions, stress, language and communication (O'Haire, 2017).

Perhaps due to the reported beneficial effects, there is great demand for animals to work in places such as schools and activity centres, to take part in tasks with children with special educational needs. As a result, in this project, a novel systematic review was conducted at the start to assess and evaluate the quality and value of research into AAI for children with various special educational needs across different settings, an overview which has previously been overlooked. The aim was to collate the research conducted so far and provide guidance for best practise in future research. As the research into HAI has established many benefits due to Animal Assisted Interventions (AAI), Animal-Assisted Activities (AAA), Animal-Assisted Education (AAE) and Animal-Assisted Therapy (AAT) (see Fine, 2015 for overview), this review will include articles which use all of these terms.

3.2 Materials and Methods

PRISMA Guidelines and Checklist which provides a minimum list of items to report in a systematic review were used when reporting the results of this review (Liberati et al., 2009). Eligibility criteria were established prior to commencing the literature search and was as follows: (1) All articles must be written in English (2) Participating children had to have a formal diagnosis of any special educational needs (3) Research with children who only had mental health issues were excluded, unless the findings were relevant to education (4) Participants were of school age. (5) Only published, peer-reviewed studies were included, excluding newspaper/magazine articles or anecdotal evidence.

Seven databases were searched from their start date until present. The searches were completed on 23.08.2017. The databases searched were: Academic Search Complete, Anthrozoöes, Autism Data, PsychArticles, PsychInfo, Science Direct, Web of Science.

The search terms were pre-determined. The terms "Animal-Assisted Intervention", "Animal-Assisted Activities", "Animal-Assisted Therapy", "Canine-Assisted Intervention",

“Canine-Assisted Activities”, “Canine-Assisted Therapy”, “Dog-Assisted Intervention”, “Dog-Assisted Activities”, “Dog-Assisted Therapy”, “Equine-Assisted Intervention”, “Equine-Assisted Activities”, “Equine-Assisted Therapy” were paired with “special educational needs”, “learning difficulties”, “developmental delay”, “special educational needs”, “Autism Spectrum Disorder”, “Attention Deficit Hyperactivity Disorder”, “language delay”, “language disorder”.

3.3 Results

The search returned 1 447 articles, duplicates were removed, leaving 1 160 articles. The returned searches were screened for suitability. The exclusions were due to the articles not being educationally related, only reporting mental health findings; participants were above 18 years of age or below school age; an intervention was not provided (i.e. one-off task with the animal) (Figure 1).

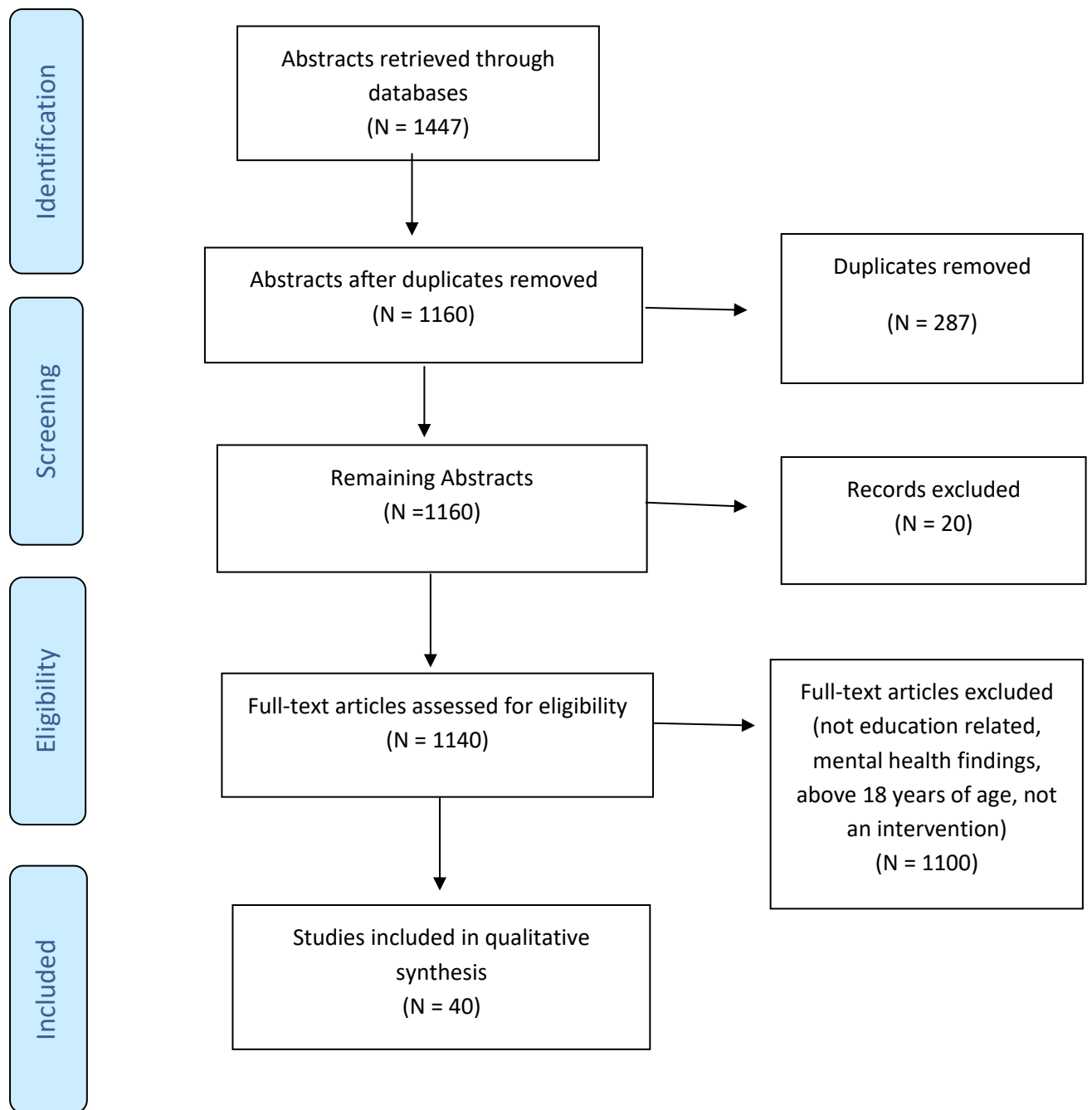


Figure 1: Flow chart adapted from PRISMA, showing selection process and criteria of papers included in this review.

The selected articles were assessed for their quality using the criteria in Table 1 below.

Some articles (10%) were also assessed by a supervisor using the same criteria to check for accuracy.

The articles found from the search predominantly recruited children with Autism Spectrum Disorder (ASD) (N=21), with some research into Attention Deficit Hyperactivity Disorder (ADHD) (N=5), Down's Syndrome (N=3), multiple and profound learning difficulties (N=2), children with insecure/disorganised attachment (N=3), childhood trauma and mental health issues (N=1) and severe emotional disorders (N=1). In addition, some of the articles in this review included children with different diagnoses (N=12). In order to discuss this research in detail, articles were categorised into the following subsections: Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), Down's Syndrome, and Other Diagnosis. Overview of results is given in Table 2 and the findings discussed below.

Table 1

Criteria Used to Assess the Quality and Value of the Papers Included in This Review

<i>Criteria</i>	<i>Yes</i>	<i>No</i>	<i>N/S</i>	<i>N/A</i>
<u>Participant Recruitment and Selection</u>				
Has the research been inclusive of children with various comorbidities and difficulties (e.g. ASD with comorbid disorders; challenging behaviour)?				
Has the research adopted limited exclusion criteria to ensure sample is representative of general population with the special educational needs concerned?				
Has the study got a large sample size to enable generalisation of findings with confidence?				
Has recruitment been undertaken to ensure recruitment of participants from different backgrounds (e.g. low and high SES, living in different geographical area)?				
<u>Intervention Sessions</u>				
Were sessions available for all children (e.g. was transport provided; were sessions available at the school/ care institution the participant attended or did participants needing to make their own way to a specialist centre the interventions took place)?				
<u>Animals</u>				

Have the animals been tested for suitability (e.g. temperament testing; therapy animal certification)?				
Was a handler solely responsible for the animal? Was a handler present during the interventions?				
Was training provided to handlers with regards to animal welfare and stress signal recognition?				
Were welfare considerations stated and observed at all times?				
<i>Participants</i>				
Were rules set on appropriate interaction and participants taught how to interact/handle animals?				
<i>Design</i>				
Were participants randomly allocated across conditions?				
Was there a control group or waitlist control?				
Was there a pre- and post- intervention assessment with the use of wide range of tests and methods?				
<i>Reporting of Information</i>				
Has the article included information on recruitment success and participant drop out, as well as success in data collection and missing data?				
Has the article included information on the protocols used (e.g. risk assessments, animal welfare protocol etc)				
<i>Results</i>				
Have all results, including non-significant findings been reported clearly?				
Have observable differences which were not significant been stated with the view of further exploration, not as anecdotal evidence?				

Note: N/S= Not Specified; N/A= Not applicable

Table 2

Extracted Information from Research Articles Included in Literature Review

First Author and Year	Aim/ AAI detail	Participant Information	Measure of AAI effect	Design and Control Group	Findings
Anderson & Olson 2006	The effect of a dog on emotional stability and learning	N= 6; 6-11-years; 3 M, 3 F; Various diagnosis	Crisis behaviours	Pre-post design; Observations during presence of dog; No control	Dog in classroom contributed to students' overall emotional stability. Improved attitudes towards school, facilitated children's learning lessons in responsibility, respect and empathy.
Anderson & Meints 2016	The effect of THR on Social Functioning	N=15; 5-16-years; 11 M, 4 F; ASD	AQ VABS EQSQ	Pre-post design; No control	Improvements in maladaptive behaviours and empathising, but not in systemising, communication and socialisation.
Ajzenman et al. 2013	The effect of hippotherapy on daily functioning and task participation	N= 7; 5-12-years; 4 M, 3 F; ASD	VABS CACS Changes in posture	Pilot study; pre-post design; No control	Postural control, adaptive behaviours and participation in activities improved for children with ASD.
Balluerka et al. 2015	The effect of AAP on behaviour	N= 67; 12-17-years; 42 M, 25 F mental health and other difficulties	BASC	Pre-post design; 43 treatment group, 24 control	Higher scores on school adjustments; higher adaptive skills at school scores with improved social skills for interacting with peers and teachers on the skills for group work. Teachers: Progress in school adjustment after AAP: increased motivation and attention in classroom; reduced hyperactive behaviour.

					Children: Improvement in aspects of personal adjustment: social relationships, but not family relationships; self-esteem and self-resilience.
Becker et al. 2017	Implementing a Social Training Program for children with ASD	N= 32 8-14-years; 28 M, 3 F; ASD, PDD-NOS	CARS-2 CDI-2 RMET SLDT SRS-2	RCT Yes, 7-8 children in each group (treatment and control- traditional social skills)	Significant group differences in teacher ratings of social behaviour and self-report ratings of interpersonal problems. Participants in AASS intervention: fewer social skills deficits overall, fewer restricted and repetitive behaviours, more typical social communication following the intervention. Rated themselves as having significantly fewer symptoms than those in control group.
Beetz et al. 2011	Social support of toy, real dog or human in a stressful situation	N= 31; 7-12-years; 31 M; Insecure attachment	“My pet and I” Pet attachment; Cortisol; SAM; SAT; TSST-C; Observations of behaviour	Active control only: toy dog and human conditions	Lower cortisol for children in dog group - the more contact (strokes) children had with the dog, the lower their cortisol levels.
Borgi et al. 2016	The effect of EAT on adaptive and executive functioning	N=28; 6-12-years; 28 M; ASD	VABS; TOL	RCT Yes, 15 EAT, 13 wait-list control	Children in EAT showed improved social functioning and ameliorated executive abilities, namely reduced latency of the first move during a problem-solving task. Positive effects of riding on motor skills.

Chardonnes 2009	The effect of AAI on a farm as a therapy	N=1; 8-years; 1 M; Serious mental illness, behaviour disorder, intellectual disability	Observation of behaviour during a 1 year stay as a resident at a farm	Case study	Improvements such as respecting authority & private physical space of animals, increased patience.
Cuypers et al. 2011	The effect of THR on behaviour, quality of life and motor skills	N=5; 10-11-years; 5 M, ADHD	SDQ; KINDL- HqoL; MABC; MNFU	Pre-post design No control	A treatment effect on behaviour and on quality of life was seen after intervention but not in the non-treatment phase. Positive change in motor performance post-intervention
Dilts et al 2011	DAT as a facilitator for other interventions	N=37; Age not specified 18 M, 19 F; Various diagnosis	BDRS- parent report from	Pre-post design No control	Positive changes in behaviour on the socially withdrawn and fearful/anxious subscales post DAT.
Ewing et al. 2007	The effect of equine facilitated learning	N=28; 10-13-years; M & F (N not specified); Severe emotional disorder	Self-perception profile for children, Empathy questionnaire, CNSIE, CDI, Children's	Pre-post design Waitlist control	No significant results. Some observable differences reported as case studies.

			loneliness questionnaire		
Funahashi et al. 2014	Measuring smiles during AAA as an indication of social positive behaviour	N=2; 10-years; 2 M; N= 1 ASD N= 1 TD	Children wore device to measure smiles through muscle movement during AAA	Yes, TD child acted as control	Child with ASD smiles less than control child but child with ASD smiles more during AAA, especially in session 4.
Gabriels et al 2015	The effect of THR on behaviour	N= 116; 6-16-years; 101 M, 15 F; ASD	ABC-C PPVT SRS SALT BOT SIPT VABS	Pre- post- design; Yes Control: Barn Activities	Self-regulation (ABC-C)- Irritability and Hyperactivity: THR had improved from pre to post test, significant from week 5 of intervention. Social Measure (SRS): THR had improvement on the social cognition and communication subscales. Communication (SALT): Post-intervention, children in THR used more words and spoke more.
Gabriels et al. 2012	Measure the effect of THR on behaviour	N=42; 6-16-years; 36 M, 6 F; ASD	SIPT BOT VABC ABC-C	Waitlist Control	The significant changes for THR group were on Irritability, Lethargy, Stereotypic Behaviour and Hyperactivity subscales of ABC-C. There was a trend towards significance for the communication raw score of the adaptive scale.

Garcia-Gomez et al. 2013	The effect of THR on social skills and behaviour	N= 32; 7-14-years; 13 M, 3 F; ASD	BASC Quality-of-Life Model	RCT, Yes	Riding group improved on aggressiveness and hyperactivity scale. Interpersonal relations and social inclusions.
Griffioen & Enders-Slegers 2014	The effect of DAT on cognitive and social development	N= 45; 6-10-years; 26 M, 19 F; DS IQ>40	MESSIER	Yes, waitlist control and voluntary swimming pool	Verbalization and recognition of persons improved during the 6-week intervention. At follow-up (4-6 months) verbalization effect remained. Impulsiveness decreased during intervention, more concentration on a task.
Grigore & Rusu 2014	Teach social skills with social story method	N= 3; 7-8-years; 2 M, 1 F; ASD	Observation	Case study No, baseline assessments and observation during sessions	One participant- increased frequency of appropriate social interaction Two participants needed significantly less prompts when with the dog All 3 participants- significant increases in the frequency of social initiations in the presence of a therapy dog.
Harris & Williams 2017	The effect of THR on behaviour	N=26; 6-9-years; 22 M, 4 F; ASD	MOPI CARS ABC-C	RCT, Yes	Horse riding- improved social functioning and reduced severity of ASD symptoms
Heimlich 2001	AAI effect on student functioning	N=14; 7-19-years; 8 M, 6 F; Severe disabilities	MOPI, DOF, TRF, CBC, BDRS	Pre- Post, No control	Positive trend with the effect of AAT but due to small sample and trial size no generalisations can be made

Holm et al. 2014	The effect of THR on behaviour	N= 3; 5-13-years; 3 M; ASD	ABC-C, CARS SRS SP-CQ	Pre- post- design; measures taken throughout intervention period too, No control.	Increasing the dose of the intervention: no impact on the number of positive behavioural changes; impact on the magnitude of changes The target behaviours exacerbated by excitement during sessions but the effect seen in the home and community
Holmes et al. 2011	The benefits of EAA	N= 11; 12-14 years; 10 M, 1 F; Emotional, behavioural, learning difficulties	Observations of interaction frequency, SCAS, Rosenberg self- esteem scale.	Pre- post- design after every session; Control: modal horse	Positive behaviours towards the real horse increased and towards model horse decreased at time 2 The avoidance behaviours towards real horse decreased at time 2 and towards model horse stay the same.
Hyun et al. 2016	EAAT effect on gait balance and brain connectivity	N= 40; After selection: N=24; 9-11 years; 17 M, 7 F; 12 ADHD (9 male), 12 TD (8 male)	Clinical symptoms, balance during intervention, Changes in brain connectivity.	Pre- post- design Yes- typical children	Clinical symptoms and gait balance improved in children with ADHD after 4 weeks of EAAT. Brain functional activity was increased in children with ADHD and typically developing (TD) children TD children showed greater connectivity changes from cerebellum to the frontal cortex compared to children with ADHD.

Jenkins & DiGennaro Reed 2013	The effect of THR on behaviour	N=7; 6-14-years; 6 M, 1 F; ASD	Observations- happiness, communication, behaviour, commands to direct horse, posture	Waitlist Control	No clinically significant effects. Noted improvements on posture but no control group for comparison. THR was not perceived as being effective for addressing problem behaviours or language deficits. Anecdotal verbal reports from some parents – improved language at home and school.
Kern et al. 2011	The effect of EAA on severity of ASD symptoms	N=41 (24 after drop out); 3-12-years; 18 M, 6 F; ASD	CARS, TCFES, Sensory Profile Questionnaire, QLES-Q, Treatment Satisfaction Survey	Waitlist Control	THR- Reduction in severity of ASD symptoms at 3 and 6 months Quality of parent-child interactions, significant change for mood and tone. Trends for improvement in sensory profile Improvement in quality of life Parents were satisfied with program and considered it beneficial
Lanning et al. 2014	The effect of EAA on behaviour	N=25; 4-15-years; 21 M, 4 F; ASD	PedsQL CHQ	Pre- post- and during intervention, Comparison Group	EAA: improvement in quality of life domains. Parents reported improvement in general behaviour, school and physical functioning, less difficulty doing chores, more attentive in class, better school attendance, keeping up with school work.
Limond et al 1997	Behaviour change in the presence of a real and toy dog	N=8; 7-12-years 2 M, 6 F; DS	Observational- recorded sessions.	No	Children looked more and for longer at the real dog Children ignored adult more in the imitation condition More positive responses to handler in real dog condition

Malcolm et al 2017	The effect of THR on behaviour	SEN at centre for equine therapy	Observations and interviews	No	Horses were seen as facilitators for emerging social behaviours.
Martin & Farnum 2002	Effect of dog interactions on behaviour	N= 10; 3-13-years 8 M, 2 F; PDD	Video recording of behavioural and verbal interactions.	Within subject repeated measures design, no control.	Dog condition: More, longer hand flapping; looked at therapist least; laughing more; looked more at dog than room; less prompting when answering questions; less talk about therapist and unrelated topics; comply with instructions more More touching of ball and stuffed dog; more likely to give treat to real dog, more likely to talk about dog than ball
O'Haire et al. 2014	The effect of AAI on social functioning	N= 64; 5-12-years; 50 M, 14 F; ASD	PDDBI SSRS	Pre- Post-assessment Waitlist Control	AAI program demonstrated increases in social functioning Teachers and parents reported increases in social approach behaviours decreases in social withdrawal behaviours and increases in social skills.
O'Haire et al. 2015	Physiological arousal during AAA	N=114; 99 post exclusion; 5-12-years 66 TD (42.4% M) 33 ASD (72.7% M)	Skin response measure	Assessment during interaction Yes, typically developing children	Children with ASD showed significantly higher skin conductance at baseline (greater social anxiety)-consistent with parent and teacher reports. ASD: reduced physiological arousal during peer interaction when animals were present.
Prothmann et al. 2009	Measuring social interaction	N=14; 6-14 years 11 M, 3 F;	Video recording of interactions	Within subject design, no control group	Most frequent and longest interaction with the dog and least interested in objects

ASD

Schuck et al. 2015	Teaching social skills with and without CAI	N=24; 7-9-years 20 M, 4 F; ADHD	Social skills. Social competence	RCT. Comparison of 2 interventions	Children in both groups (with and without CAI) showed improvements in social skills, prosocial behaviours and problematic behaviours. The severity of ADHD symptoms in both groups declined during treatment BUT group with CAI showed greater reductions - showing that CAI may facilitate CBT
Silva et al. 2011	Influence of dog presence on behaviour	N= 1; 12-years 1 M; ASD	Observation of behaviours	Case study; Control: session without dog	Dog condition: child was more engaged with therapist, had lower levels of negative behaviours, i.e. aggressive and obsessive manifestations.
Somervill et al. 2009	Effect of dog interaction on physiological reaction	N= 22; 17 with complete data 7-12-years 13 M, 4 F ADHD, ODD	Blood pressure and heart rate	Within subjects design	Increase in blood pressure while child was with the dog but decrease in heart rate. Teachers: No changes in behaviour
Stevenson et al. 2015	Intrinsic motivation and social engagement	N=3; 7-13-years; 3 M; ASD	ADOS	Pre-post design. Observations during sessions. No control.	Dog sessions: increase in levels of interaction, visual interest and meaningful vocalisations. Some effects generalised to the classroom.

Stumpf & Breitenbach 2014	The effect of DAT on skills development	N= 47; 7-9-years; 27 M, 20 F; DS	Questionnaires: Communication, Social-emotional behaviour, Quality of life	Pre-, post-test design. Yes, non-treatment control group.	Vocalisations increased in the sessions with the dolphin and teacher
Voznesenskiy et al. 2016	The effect of EAA on gross motor development	N=40; 1-6-years; 24 M, 16 F; DS	GMFM-88	RCT Yes	EAA: Higher improvement on the gross motor measure.
Ward et al. 2013	The relationship between THR social communication and sensory processing	N=21; 8-years (mean); 15 M, 6 F, ASD	GARS SPSC	Within Subjects design No control	Therapeutic riding can be effective for children with ASD and impact transfers to classrooms. Teachers improved social communication, attention, tolerance, reaction to sensory input in classroom. Improved in social interaction resulted in the overall change on the autism index.
Wedl et al. 2015	Support of dog in a stressful situation	N=19; 7-11-years 19 M; Insecure-avoidant or disorganised attachment	SAT, TSST-C, Cortisol, Behaviour observations	Within subject design, No control	Interaction with unfamiliar dog similar to an avoidant attachment representation during a stressful situation- interacted less with dog during and after stress test. Behaviour observations- during and after stressful situations the dog was more sought out for interactions by the boys with disorganised attachment.

Yoo et al. 2016	The effect of EAA/T on resting state brain function	N=21; 10 took part 8.3-years (mean); 9 M, 1 F ADHD	MRI scan	Pre- post- design No control	Clinical Global Impression (CGI-I): 6 much improved; 4 minimal improvement Developmental coordination disorder questionnaire (DCDQ): No difference EAA/T: Significant changes of local connectivity in ADHD Significant clinical improvement.
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Note: The abbreviations in this table are as follows: M= Male; F= Female; ASD= Autism Spectrum Disorder; TD= Typically Developing; DS= Downs Syndrome; ADHD= Attention Deficit Hyperactivity Disorder; PDD= Pervasive Developmental Disorder; ODD= Oppositional Defiant Disorder.

The abbreviations for the measures used: ABC-C: Abberant Behaviour Checklist- Community; AQ: Autism Spectrum Quotient; BASC: Behaviour Assessment System for Children; BDRS: Behaviour Dimentions Rating Scale; BOT: Bruininks-Oseretsky Test of Motor Proficiency; CACS: Child Activity Card Sort; CARS: Childhood Autism Rating Scale; CBC: Child Behaviour Checklist; CDI: Children's Depression Inventory; CHQ: Child Health Questionnaire; CNSIE: Nowicki-Strickland International External Control scale for children; DOF: Direct Observation Form; EQSQ: Empathizing Quotient-Systemizing Quotient; GARS: Gillian Autism Rating Scale; GMFM-88: Gross Motor Function Measure; KINDL-HQoL: Health Related Quality of Life Questionnaire; MABC: Movement Assessment Battery for Children; MESSIER: Matson Evaluation of Social Skills for Individuals with severe Retardation; MNFU: Modified Function Neurological Assessment; MOPI: Measurement of Pet Intervention Checklist; PDDBI: Pervasive Developmental Disorder Behaviour Inventory; PedsQL: Pediatric Quality of Life; PPVT: Peabody Picture Vocabulary Test; QLES-Q: Quality of Life Enjoyment and Satisfaction Questionnaire; RMET: Reading the Mind in the Eyes Test; SAM: Self-Assessment Manikin; SAT: The Separation Anxiety Test; SALT: Systematic Analysis of Language Transcripts; SCAS: Spence Children's Anxiety Scale; SDQ: Strengths and Difficulties Questionnaire; SIPT: Sensory Integration and Praxis Test; SLDT: Social Language Development Test; SP-CQ: Sensory Profile- Caregiver Questionnaire; SPSC: Sensory Profile School Comparison; SRS: Social Responsiveness Scale; SSRS: Social Skills Rating System; TCFES: Timberlawn Parent-Child Interaction Scale; TOL: Tower Of London; TRF: Teachers Report Form; TSST-C: Trier Social Stress Test for Children; VABS: Vineland Adaptive Behaviour Scales;

Table 2 Continued

Extracted Information from Papers Included in the Literature Review Continued

First Author and Year	Animal Intervention and dosage	Animals	Animal Welfare	Animal Suitability
Anderson & Olson 2006	Dog present in the classroom; 1-to-1 sessions for 30 mins/ day; additional time with dog roaming free in classroom. Children who struggled to bond with the dog were given more interaction time.	1 Dog: 2- year-old toy poodle	During a child's tantrum dog was locked in crate in the same room as child to protect the dog. Dog was roaming around freely.	Not certified therapy dog; limited prior exposure to children
Anderson & Meints 2016	5-weeks with 1x3 hours/week Goals were set by staff at the riding facility	Horses	Lessons have been run for 20 years at stables. Horses supervised at all times.	Stables offered "Riding for the disabled", experienced horses and team
Ajzenman et al 2013	1x week for 12 weeks, 45 mins mounted on therapy horse	Horses	Path guidelines followed; horses supervised at all times.	PATH certified
Balluerka et al. 2015	Animal-Assisted Psychotherapy sessions were devised- animals to assist achieving the targets 12-week program, 2 consecutive days at the farm. Group (N= 23) and individual (N= 11) sessions.	1 dog, 9 horses; cats and farm animals (N unknown)	Support from veterinary ethologist and vet expert horse trainer. All interactions were supervised	Yes, by an ethologist.
Becker et al. 2017	Social Training Program. Every session had a set target. 1 hr per week for 12 weeks	Multiple Dogs (N unknown)	EAGALA model of EAT. Handler solely responsible for animal.	Certified through Pet Partners, The Good Dog Foundation or Therapy Dogs International.

			Other adults responsible for therapy. Children taught how to interact with the dogs appropriately	
Beetz et al. 2011	Children took part in one of 3 conditions; completed stress test in the presence of a dog, toy dog or human.	Dogs (N unknown)	Safety and wellbeing of animals and participants approved by university	Therapy or Certified School Dogs.
Borgi et al. 2016	1x week for 6 months. 25 sessions, 60-70 mins/ each Participation in small groups (3-4 per group)	20 medium sized horses	Horses welfare was guaranteed by vet for duration of the study including health care, living conditions, work schedule and equipment requirements.	Yes. Suitable for morphology, biomechanics and behaviour.
Chardonnes 2009	Observation only, not a specific intervention.	Farm animals, horses (N unknown)	Not Specified	Not Specified
Cuypers et al. 2011	THR instructions in a group, 2x week for 8 consecutive weeks, 60 mins/ lesson	5 Horses	Not Specified	Selected by owner (qualified trainer); paired to suit each individual
Dilts et al. 2011	2-week dolphin intervention- main focus is quality of interaction between animal and client. Therapist acts as mediator to facilitate interaction. Alpha-therapy provided.	Dolphins (N unknown)	Not Specified	DolphinSwim was an established program for people with various disabilities

Ewing et al. 2007	9-week intervention, 2x 2h per week- teaching cooperation, trust and responsibility with aim to transfer to everyday life. All aspects of lessons were related to the equine theme. Every child paired with 1 horse to encourage the feeling of ownership and connection.	Horses (N unknown)	Not Specified	Structured program. Maintained by assistance of North American Riding for the Handicapped Association certified therapeutic instructors
Funahashi et al. 2014	30-40 mins per session, 7 months	6 Dogs	Trained employing animal welfare rules	Therapy dogs were judged to enjoy interaction
Gabriels et al. 2015	THR: equine related information for 10-weeks, minimum of 45 min per session. 2-4 participants took part at a time with at least 1 volunteer per participant. 2-part teaching focus: therapeutic riding skills and horsemanship.	Horses (N unknown)	PATH guidelines followed	PATH certified instructors
Gabriels et al. 2012	Small groups: 10 consecutive weeks, 1hr per week riding sessions. Therapeutic and horsemanship sessions	Horses (N unknown)	PATH guidelines followed	PATH centre with trained instructor.
Garcia-Gomez et al. 2013	3-month intervention 2x week for 45 mins/ session (24 sessions in total). 4 pupils in each group. Sessions had set aims- tailored for individuals	Horses	PATH guidelines followed	PATH certified instructors

Griffioen & Enders-Slegers 2014	Very structured 1-hour sessions for 6 weeks (1 per week)	17 Bottlenose dolphins	Yes- behaviour monitored before the study at rest, during training and during a pilot therapy session.	Children did not swim with dolphins so no direct contact
Grigore & Rusu 2014	Child was allowed to greet the dog. Dog then sat in front of the child and near therapist. Handler sat next to the dog and near the camera. Child was then could interact more with the dog after the story has finished.	1 Dog	Not Specified	Yes, certified by Romanian Association of Animal Assisted Therapy and Activities.
Harris & Williams 2017	7-5 riding sessions, 45 mins each Instructor accredited by British Horse Society Every session had a purpose	Horse (N unknown)	Instructor closely monitored child's behaviour to ensure safety of the horse.	Trainer was accredited by British Horse Society
Heimlich 2001	Structured therapy session. 30 min sessions per week for 8 weeks.	1 Dog	Not Specified	Not Specified, but sessions classed as therapy
Holm et al. 2014	Therapeutic riding- either 1,3 or 5 sessions per week (randomly assigned), 4 weeks	Horse (N unknown)	Not Specified location was a Therapeutic Riding Centre	Not Specified- Director of centre has equine facilitated therapeutics degree; instructors are certified and registered.
Holmes et al. 2011	4 consecutive 3-hour sessions All students interacted with model horse and one of the two real horses every session	2 Horses	Not specified, location was a race horse rehabilitation centre	Retired thoroughbred racehorses, chosen to be low risk to students safety; easy to handle

Hyun et al. 2016	4-week intervention, 12-sessions, 70 min per session, 3 times per week	Horses (N unknown)	Not Specified	Not Specified- team included specialists from Professional Association of Therapeutic Horsemanship International
Jenkins & DiGennaro Reed 2013	Weekly sessions- 60 mins each for 9 weeks.	Horse (N unknown)	PATH guidelines followed.	Not specified- experienced professionals
Kern et al. 2011	Special program- Goals of team and needs/interests of students were reflected in every lesson 1 lesson per week for 60 mins over 6-month period Child was mostly kept with same horse/pony	Horses and ponies (N unknown)	Not Specified	Docile and calm animals
Lanning et al. 2014	12 weeks- 1 hour per week. Sessions were specific to each child to develop riding and horsemanship. Sessions were either one-to-one or with 2 children	Horses (N unknown)	Followed PATH guidelines.	Horse chosen for child by therapeutic riding team based on size and physical ability of child.
Limond et al 1997	6 sessions- 1 per week. Every participant spent 7 mins with real dog and 7 mins with stuffed dog. This was counterbalanced each week	Dog	Not Specified	Therapy dog

Malcolm et al 2017	Horse riding- observed of children already attending centre	Horses	Not specified, horses were at centre for riding for children with disabilities.	Not Specified
Martin & Farnum 2002	15 weeks- 3 sessions per week 1 in every condition- real dog, toy dog and ball	3 Dogs (each child only saw 1)	Not Specified	Temperament tested by People- Pet Partnership
O'Haire et al. 2014	8 weeks of exposure in the classroom with 16x 20 min animal interaction sessions	Guinea Pigs (N unknown)	Guinea pigs were kept as a pair as they are social animals.	Not Specified
O'Haire et al 2015	10 mins of free play with guinea pigs and children in the group (3 children)	Guinea Pigs	Children were taught how to handle animals. Animals had a spacious cage, dry bedding, water and food.	Acquired early to get used to human contact
Prothmann et al. 2009	20 mins sessions per child	3 Dogs	Not Specified	Therapy dogs
Schuck et al. 2015	12 weeks, 2x week- 1x weekday eve- 2hrs and 1x Saturday-2.5 hours for each child Parent completed 2hr group based behavioural training during the child's evening session	3 Dogs	Not Specified	Therapy dog
Silva et al. 2011	Structured activities with the therapist while in the presence of a dog.	1 Dog	Trained using positive reinforcement and follow minimum standards and ethic developed by ADI standards and ethics committee	Therapy dog, temperament and vet check

Somervill et al. 2009	Dog on child's lap. Child not given instruction how to interact with dog.	1 Dog	Not Specified	Dog temperament and health tested week before project start. Dog was used to being handled by different people.
Stevenson et al. 2015	5 x 20 min intervention sessions per child over 10 weeks. Structured interactions	1 Dog	Handler was responsible for noticing if dog is distressed. Adults involved worked together to ensure a safe environment before start of study.	Not a trained therapy dog, no specialist training. Dog previously took part in obedience classes and had introduction to specialised school environment.
Stumpf & Breitenbach 2014	25-30 min sessions Diagnostic interview, Therapeutic sessions, discussion with parents to reflect progress, parents involvement in therapeutic sessions and reflection on how to transfer skills to home environment.	Dolphins (N unknown)	Dolphins kept together in a pool to avoid stress from separation, while one dolphin was part of the therapy the others were being trained in the opposite end of the pool. Trainer was solely responsible for dolphin's behaviour. Dolphin worked a maximum of 30 min/ day.	Not Specified
Voznesenskiy et al. 2016	2x30 mins per week for 3 months	Horses (N unknown)	Not Specified	Selection of horses not specified. Activities carried out by trained instructors in accordance with

				guidelines published by AM-EN Foundation, funded by United Nations Voluntary Fund for Disability.
Ward et al. 2013	18 weeks riding, 1-hour sessions- 10+8 weeks with break in-between	Horses (N unknown)	PATH guidelines followed	Not Specified instructors were certified by PATH.
Wedl et al. 2015	Children took part in stress test while with dog	1 Dog	Safety and wellbeing of animals and participants approved by university	Not Specified
Yoo et al. 2016	2x week for 12 weeks Sessions have specific tasks	Horse and ponies (N unknown)	Up to 2 consecutive classes, max. 2-hours of work	Well trained for therapy

3.3.1 Effects of AAI on children with Autism Spectrum Disorder (ASD)

Twenty-one of the forty papers which met the review's eligibility criteria involved children with a primary diagnosis of ASD. The research varied in how ability was measured and included children with IQ above 70/ 80 (N=4); with mild/moderate autism (N= 1); limited verbal and/or social delay (N= 3). Some research classified children as low functioning (N=1) or included children with various abilities (N=4). Other research did not specify the level of ability of the children taking part (N= 4) but some researchers stated that the children with ASD attended a mainstream school (N=4), suggesting High Functioning Autism. Investigations focused around three main areas of research; social skills and functioning (N= 8), behaviour (N= 7) and daily functioning (N= 6). The animals taking part included dogs (N= 6), horses (N= 13) and guinea pigs (N= 2).

3.3.1.1 Effects of AAI on children with ASD: social skills, ability and functioning

Eight of the studies (summarised in Table 2) investigated social skills and functioning for children with ASD (Becker, et al., 2017; Grigore & Rusu, 2014; O'Haire et al., 2014; Anderson & Meints, 2016; Stevenson, Jarred, Hinchcliffe & Roberts, 2015; Funahashi, Gruebler, Aoki, Kadone & Suzuki, 2014; Prothmann, Bieners & Ettrich, 2006; Garcia-Gomez, et al., 2013).

Two studies investigated whether teaching social skills with and without a dog would influence the effect of the training program. Becker et al. (2017) adapted a social training program from a program for children with ASD, where children were allocated into either an experimental or control group based on their age. For the experimental group, the dogs were involved in the training and every lesson was different depending on the target set. Although this was a group intervention, children were able to say hello and goodbye individually by stroking the dog. The findings indicated significant group differences in both teacher ratings of social behaviour and self-report ratings of interpersonal problems. Participants who received animal-assisted social skills intervention exhibited fewer social skills deficits overall, fewer restricted and repetitive behaviours, and more typical social communication following

the intervention. In addition, they rated themselves as having significantly fewer symptoms than those in the control group. Another project, with the same aim, to teach social skills, was completed by Grigore and Rusu (2014). Each child participated in both conditions- with and without a dog. In the dog condition the children were told that they can greet the dog when they enter the room, then the dog sat in front of the child and near the therapist, while the handler sat next to the dog and near the camera. The child was then told that he/she will be allowed to interact with the dog more after the story. All three participants showed statistically significant increases in the frequency of social initiations in the presence of a therapy dog. However, it is also important to note that there were individual differences with one participant showing an increase in frequency of appropriate social interaction while the other two needed significantly fewer prompts when in the presence of the dog.

O'Haire et al. (2014) reported on the effect of guinea pigs in the children's classroom for 8 weeks. Children also spent 2x20 minutes per week in another classroom with the animals. The 20-minute sessions included groups of three children, one child with ASD and two typically developing children. The findings demonstrated increases in social functioning for children with ASD with teachers and parents reporting increases in social approach behaviours; decreases in social withdrawal behaviours and increases in social skills.

Similarly, Anderson and Meints (2016) investigated social functioning but used a therapeutic horse-riding/ horsemanship intervention over 5 weeks. The aims of each session were set by the staff at the riding facility. It was concluded that there were improvements in empathising and reduction in maladaptive behaviours but the AAI did not improve communication and socialisation or systemising scores.

Other research investigated social ability, but from an intrinsic motivation perspective. One research which used props within the sessions, introduced all materials in the first dog intervention session. Following this, the child could choose how the session was run. It was concluded that all three students increased their levels of interaction, visual interest and meaningful vocalisations during the sessions with the dog. The teacher questionnaires

suggested that, children interacted more and were more involved in the classroom after the intervention, so this effect generalised to the classroom setting (Stevenson et al., 2015).

Although not implementing a social skills program, Funahashi et al. (2014) measured the amount a child smiles as a measure of social communication. Analysis of the data indicated that the child with ASD smiled less overall than the control child, but the child with ASD smiled more during AAA, especially in session 4. Similarly, Prothmann et al. (2006) investigated the social interactions of children and found that children interacted most frequently with the dog and least frequently with the objects. Frequency was measured based on number and duration of interactions. Garcia-Gomez et al. (2013) investigated the effects of horse riding on two groups with 4 children per intervention group. A further eight children were in the control condition. Although able to change the sessions to suit individuals, there was clear structure and aims. Findings for the children in the riding group indicated an improvement on the teacher scales with lower aggressiveness and hyperactivity scores. Furthermore, there were beneficial changes on the interpersonal relations and social inclusions on the quality of life measure, however, these were not sufficient to make a difference to the overall scores.

In sum, the research has implemented different programs and included different animals (dogs, guinea pigs and horses), but beneficial effects have been reported across all articles, although benefits were not evident on all measures. For instance, the research by Garcia-Gomez et al. (2013) found that the horse-riding intervention improved interpersonal relationships and social inclusion but this did not impact the overall quality of life score. Similarly, Anderson and Meints (2016) established an improvement in empathising and reduction in maladaptive behaviours but not on communication and socialisation. The varying benefits established in this research could be due to the difference in interventions as some were structured with clear aims (e.g. Garcia-Gomez et al., 2013, Anderson & Meints, 2016) while others were not (Stevenson et al., 2015; Funahashi et al., 2014). In addition, some included the animal as part of the session (e.g. Becker et al., 2017) while others had the animals present and interaction was only allowed before and after the

session (e.g. Grigore & Rusu, 2014). Best practice and therefore reduced likelihood of positive bias was reported by the research where children were either in the AAI experimental group or the control (Becker et al., 2017; Garcia-Gomez et al., 2013) compared to research where children took part in the experimental and control conditions (Grigore & Rusu., 2014) or employed a case-study design (Funahashi et al., 2014).

3.3.1.2 Effects of AAI on children with ASD: behaviour

Seven studies investigated the effect of animal interventions on the behaviour of children with ASD (Silva, Correia, Lima, Magalhaes & de Sausa, 2011; Jenkins & Di Gennaro Reed, 2013; Lanning, Matyastik Baier, Ivey-Hatz, Krenek & Tubbs, 2014; Holm et al., 2014; Gabriels et al., 2012; Harris & Williams, 2017; Malcolm, Ecks & Pickersgill, 2017).

A case study design was used by Silva et al. (2011) and explored whether dogs would positively influence the behaviour of a child with ASD. The child acted as their own control as they took part in activities with the therapist, both with and without a therapy dog. The findings indicated that the child was more engaged with the therapist and had lower levels of negative behaviours (mostly aggressive and obsessive manifestations) when taking part in the dog condition. Two additional articles returned in the search investigated the effect of different horse interventions on the behaviour of children with ASD. Investigating differences due to Therapeutic Horseback Riding (THR), Jenkins and DiGennaro Reed (2013) concluded that THR did not produce clinically significant effects on participant affect, off-task behaviour, problem behaviour, compliance or language. Improvements on posture during THR were noted but lack of experimental control meant that these potential benefits may not be due to the THR. As a result, THR was not perceived as an effective therapy for addressing problem behaviours or language deficits. Verbal reports from some parents indicated changes in their child's language at home and in school. However, this was not captured in the data collected, so the addition of knowledge to the field is only anecdotal.

Another set up of an intervention was used with an Equine-Assisted Activities (EAA) research where sessions were either on one-to-one basis or with two children. The

guidelines from PATH international were followed and all sessions were designed to suit each individual and aimed to develop the child's riding and sportsmanship. The behavioural skills of the child were addressed if they were related to horse riding or horsemanship. The results indicated that children with ASD in an EAA programme demonstrated improvement in quality of life domains. Parents also reported improvement such as general behaviour, school functioning, physical functioning, keeping up with work and better attendance in school (Lanning et al., 2014).

Holm et al. (2014) used a case study design to randomly assign a different number of sessions to each participant. Every participant acted as their own control. Increasing the dosage of the therapeutic intervention affected the magnitude of the changes, but not the number of positive changes. The target behaviours were often exacerbated by the excitement during the riding sessions, but the effect carried over to behaviour in the home and community.

Gabriels et al. (2012) conducted a pilot study to explore the effects of THR. Each session was about 1 hour long and the location of the intervention was a PATH accredited riding centre. Children participated in small groups and the sessions were a mixture of therapeutic interventions and taught horsemanship. The research found many improvements across time; however, some improvements were for all children regardless of the condition they were in. The significant improvement only established for the children in the THR condition were on the Irritability, Lethargy, Stereotypic Behaviour and Hyperactivity Scales of the Aberrant Behaviour Checklist- Community (ABC-C) which assessed problem behaviour in community settings.

Harris and Williams (2017) also investigated the effects of riding intervention but with fewer sessions (5-7 sessions, 45 minutes each) compared to the intervention by Gabriels et al. (2012) (10 sessions, 60 minutes each). Every session had a target to achieve and the instructor closely monitored the child's behaviour to ensure the animals were safe. This research included a control group to enable comparisons. The results indicated a significant improvement in social functioning for low functioning, non-verbal children due to the horse-

riding intervention as well as a significant reduction in severity of ASD symptoms. However, no difference was found for lethargy, irritability, stereotypy or inappropriate speech.

The last study in this section evaluated riding sessions provided to children with ASD. There was limited information on the children taking part in the study and the session itself, but every child was paired with a suitable horse prior to beginning the intervention, indicating insight and consideration for best practice. This research concluded that horses were seen as facilitators for emerging social behaviours (Malcolm et al., 2017).

In sum, the majority of the research presented above has found beneficial effects. Children were more engaged with the therapist in the presence of an animal (Silva et al., 2011), there was a reduction in ASD symptoms (Harris & Williams, 2017), improvement in posture during riding (Jenkins & DiGennaro Reed, 2013) and improvement in a quality of life measure (Lanning et al., 2014). However, some research found no difference as a result of AAI when assessing language deficits (Jenkins & DiGennaro Reed, 2013), inappropriate speech (Harris & Williams, 2017) or overall school functioning (Lanning et al., 2014). This would suggest that AAI has an effect on some factors but it does not improve all areas of behaviour and development.

Furthermore, the type of animal chosen for the intervention and the intervention itself (i.e. duration and number of sessions) would also affect outcome measures. In more detail, children showed fewer negative behaviours when with a dog (Silva et al., 2011) while a riding intervention found no improvement on problem behaviours (Jenkins & DiGennaro Reed, 2013). In contrast, a riding intervention enhanced children's general behaviour (Lanning et al., 2014), while a THR intervention was more specific and showed positive impact on irritability, lethargy, stereotypic behaviour and hyperactivity (Gabriels et al., 2012). Supporting the idea that the length and duration of sessions would have an impact of the outcome measures, research by Harris and colleagues has opposed findings by Gabriels et al (2012). Harris and Williams (2017) suggested that a riding intervention had no impact on irritability, lethargy and stereotypic behaviour. However, the riding provided in this research comprised of shorter duration of sessions and smaller number of sessions compared to

Gabriels et al. (2012). As a result, it is suggested that perhaps more exposure was needed to see an effect on these measures. This explanation is supported by Holm and colleagues who established that more AAI sessions resulted in a stronger effect of the influenced behaviours (Holm et al., 2014). Furthermore, research investigating the effects of a riding intervention concluded that horses facilitated emerging social behaviours (Malcolm et al., 2017), perhaps providing an insight into findings indicating that a riding intervention improves social functioning (Harris & Williams, 2017).

The benefits discussed here are promising, but even more so because of their likelihood of impacting the child's life in the future. Research by Holm and colleagues showed that benefits of AAI transferred to the community and home despite sometimes not being visible in sessions due to the excitement (Holm et al., 2014). However, when assessing the findings, the design of the research needs to be considered to ensure the results are robust, especially as AAI is a developing field where there is currently no gold standard in design practice. For instance, Malcolm and colleagues have provided very little design information (Malcolm et al., 2017), making it difficult to replicate findings. Furthermore, other research has adopted a case study design where the same child is their own control (Silva et al., 2011; Holm et al., 2014) or without a control condition at all (Jenkins & DiGennaro Reed, 2013). Only one of the studies discussed here has included a separate control group in the design (Harris & Williams, 2017) and one study has adopted a waitlist control design (Gabriels et al., 2012). This would therefore cause the findings to be considered with caution as the small sample size results in lack of generalizability while the lack of control results in the inability to be certain that the results are merely due to the AAI provided.

3.3.1.3 Effects of AAI on children with ASD: general/daily functioning

The research in this section established children's ability to complete daily functioning tasks irrespective of their behaviour. As a result, physiological measures were included and tasks related to everyday activities. Six studies within this review investigated the effect of animal

interventions on the general/daily functioning of children with ASD (O'Haire, McKenzie, Beck & Slaughter, 2015; Ajzenman, Standeven & Shurtleff, 2013; Gabriels, Dechant, Agnew, Brim & Mesibov, 2015; Ward, Whalon, Rusnak, Wendell & Paschall, 2013; Kern, Fletcher, Garver, Mehta, Grannemann & Knox, 2011; Borgi et al., 2016).

Research conducted with guinea pigs in a classroom allocated all children into groups of three where one child had ASD and the other two children were typically developing (O'Haire et al., 2015). All children took part in all conditions- reading silently, reading aloud, playing with toys for 10 minutes, spending 10 minutes with guinea pigs. Children's skin conductance was measured in all conditions. Differences between children with ASD and typically developing children showed that children with ASD had significantly higher skin conductance indicative of physiological arousal which was consistent with parent and teacher reports. This indicated greater ongoing social anxiety in children with ASD. The findings from the AAI intervention indicated that children with ASD showed reduced physiological arousal during peer interaction when animals were present (O'Haire et al., 2015), hence this can be interpreted as the children with ASD having a reduction in their ongoing social anxiety.

The remainder of the studies incorporated horses to investigate the effects of AAI on children with ASD. Ajzenman et al. (2013) used structured hippotherapy, conducted by a PATH certified instructor to investigate whether the intervention would help children with ASD in their daily functioning and participation in daily activities. The findings supported the prediction as postural control, adaptive behaviours and participation in activities improved for children with ASD. Similarly, Gabriels et al. (2015) investigated if horse riding taught by a PATH instructor would have an effect on different areas of child development. Participation was in groups consisting of two-to-four children. Half ($N= 58$) of all participants took part in THR. The other half of participants were in the control group ($N= 58$) and took part in barn activities (BA) with equine related information. Every lesson was structured with a set routine. Findings on the self-regulation scale indicated that from five weeks of intervention a significant improvement occurred in terms of children's irritability and hyperactivity.

Improvements were also shown on the social measure, but not on the social cognition and communication subscales. Furthermore, post-intervention, children in THR used significantly more words and spoke significantly more compared to the BA group. Similarly, Ward et al. (2013) also provided a structured intervention with a PATH instructor. Findings indicated that therapeutic riding can be effective for children with ASD and the benefits transferred to the classrooms.

Establishing the effect of AAI in more diagnostic terms Kern et al. (2011) ensured that in the intervention provided, the specific child-horse/pony pairing was the same throughout. The findings indicated a reduction in severity of ASD symptoms with THR at 3 months and 6 months; as well as an improvement in the quality of life measure. However, little change on quality of parent-child interactions was observed with the only significant difference in mood and tone. Although it is reported that parents were satisfied with the program and considered it beneficial, it is vital to remember that they were aware of the aims of the program and therefore were potentially biased. Borgi et al. (2016) investigated the cognitive benefits of Equine Assisted Therapy (EAT) rather than the diagnostic differences. Some of the children ($N= 15$) participated in the therapy condition in small groups consisting of 3-4 children whereas the rest of the children ($N= 13$) were in the control group. The intervention took place at accredited riding centres with 20 horses. The research found that children who attended EAT had an improvement in social functioning and executive abilities. In addition to this, positive effects of riding on motor skills were also observed.

In sum, the research has established benefits of AAI on children's general and daily functioning from reduced social anxiety (O'Haire et al., 2015), to an improvement of behaviour (Ajzenman et al., 2013; Gabriels et al., 2015), increased participation (Ajzenman et al., 2013) and communication (Gabriels et al., 2015). Benefits were also recorded in terms of reduction in symptoms, improvement of the quality of life (Kern et al., 2011), motor skills, social and executive abilities (Borgi et al., 2016), with some findings reported benefits the classroom (Ward et al., 2013).

However, methodological issues are present in these studies which need to be considered while assessing the validity and reliability of the findings. While some of the research has an appropriate sample size to draw conclusions (e.g. O’Haire et al., 2015, N=66; Gabriels et al., 2015, N= 116), some of the research has reported fewer participants (e.g. Borgi et al., 2016, N=28; Kern et al., 2011, N= 24), with one study only having 7 participants (Ajzenman et al., 2013). The lack of consistency results in the difficulty of assessing the appropriate number of participants and the usefulness of the results. In addition, the very small sample size within some research is adding to the issue of the inability to generalise these findings.

Adding to the inconsistency, the provisions vary in terms of the number of sessions from a one-off session (O’ Haire et al., 2015) to 1-weekly session for 6 months (Kern et al., 2011) as well as other lengths in-between such as 10 sessions (Gabriels et al., 2015), 12 sessions (Ajzenman et al., 2013) and 18 sessions (Ward et al., 2013). These differences indicate that there is no clarity on what the optimum intervention dosage should be applied to establish an effect. Furthermore, if there is an effect from a riding intervention after 10 sessions, why are some riding interventions provided over a period of 6 months? The literature has failed to explore the length and dosage of different interventions, potentially resulting in interventions being longer than necessary resulting in more working hours for the animals and their handlers.

3.3.1.4 AAI and ASD in children: selection of animals involved

One important factor to consider within the AAI literature is the selection of animals, to ensure that they are suitable for the intervention, their welfare is considered and safety of both the animal and human participant has been of prime importance. In addition to this, establishing the effectiveness of different animals for different targets will allow for future research to select the most appropriate intervention.

Animals chosen for interventions within the projects reported within this review varied. A comparison was made between studies which included the same type of animal. In

terms of the studies which had dogs to facilitate the AAI, some ensured that the dogs and handlers were certified as a therapy dog and handler team in the country where the project took place (Becker et al., 2017; Grigore & Rusu., 2014; Silva et al., 2011), with one article explaining that the handler was only ever responsible for the dog and the therapist was in charge of providing the therapy and working with the child (Becker et al., 2017). In contrast, others only provided details about the training of the therapy dog and emphasised that the welfare conditions were met (Funahashi et al., 2014). The most concerning description in terms of animal welfare and safety was with research which stated that the dog was not certified for therapy and the researchers were not behaviourists; no specialist training was received (Stevenson et al., 2015). Although the researchers had worked with the dog before, it is recommended for the dog to have passed an assessment to work as a therapy dog and for the handler to be aware of signs of distress the dog may show (Brelsford, Dimolareva, Meints & Gee, in prep.). This is of prime importance as it ensures the dog is not stressed in the environment, ensuring their welfare, not creating a situation where a negative reaction is likely to occur. This in turn protects the human participants from any potential nips or bites as a stressed dog is likely to react and show signs of aggression. Furthermore, negative experiences are likely to result in no effects from the AAI and potential issues in future with the development of phobias for the human participants.

In contrast, Equine-Assisted Interventions (EAI) used PATH guidelines (e.g. Garcia-Gomez et al., 2013; Gabriels et al., 2012; Ajzenman et al., 2013; Gabriels et al., 2015) and specific qualifications as instructors with the British Horse Society (BHS) and Riding for the Disabled (RDA) as well as undergo specialist training to work with children with disabilities and special needs (Anderson & Meints, 2016). This ensured that the riding facility reached and maintained an accepted standard. Researchers have stated that the horses (Anderson & Meints, 2016) or the handlers (Jenkins & DiGennaro Reed, 2013; Anderson & Meints, 2016) they selected had previous experience in similar work. Furthermore, some of the research ensured that the horses were the right choice for each child based on their size and physical ability (Lanning et al., 2014) while other researchers confirmed that the animals

were calm and docile (Kern et al., 2011). However, some research gave no detail on the horses (Harris & Williams, 2017; Malcolm et al., 2017; Ward et al., 2013; Holm et al., 2014). This lack of transparency in publications raises questions about the suitability of the horses and the best protocol for future research.

The remaining two articles (O'Haire et al., 2014; O'Haire et al., 2015) involved guinea pigs. To cater for their welfare, the guinea pigs were always kept as a pair as they were social animals. There was no further detail in terms of how the guinea pigs were selected or if there were any behaviours that the researchers and school staff monitored to ensure the animals were not getting stressed. This would be beneficial for professionals working in a school as small animals are easier to care for and cheaper to maintain and as a result may be a more feasible choice for such a setting.

In conclusion, a variety of animals were selected and the animal selection procedures, welfare considerations and available training varied across the studies and between animals. Procedures and were overall inconsistent. Providing clear information on all these points is particularly important for future research in order to establish a gold standard protocol for AAls.

3.3.1.5 AAI and ASD in children: criteria for the inclusion of human participants

Similarly, variability was also evident when participant recruitment and inclusion for criteria within the studies were considered. The criterion all research had in common was that children must have had a diagnosis of ASD prior to taking part with some researchers asking teachers to confirm the diagnosis (O'Haire et al., 2015; Gabriels et al., 2015; Kern et al., 2011). While there was research which did not specify any further criteria for inclusion and exclusion (Malcolm et al., 2017), most publications provided more information, for example, some specified that children needed a specific level of language/ communication (Becker et al., 2017; Prothmann et al., 2006; Ajzenman et al., 2013; Lannine et al., 2014) and cognitive ability or a specific score on an IQ test (Becker et al., 2017; Borgi et al., 2016; Gabriels et al., 2012). Furthermore, more specific requirements were made such as that participants had to

be able to browse through books and had to have the pre-requisite skills to reading (Grigore & Rusu., 2014), had a deficit in social interactions (Stevenson et al., 2015; Grigore & Rusu., 2014) or spent a significant amount of time engaged in self stimulatory behaviours (Stevenson et al., 2015). Other research chose to compare participants with ASD to typically developing peers and either matched them based on age and gender (Funahashi et al., 2014) or ensured the typically developing children were in the same classroom as the children with special educational needs (O'Haire et al., 2015). Some of the research also specified an age range for the participating children (O'Haire et al., 2014; O'Haire et al., 2015; Anderson et al., 2016; Borgi et al., 2016; Gabriels et al., 2015; Holm et al., 2014; Kern et al., 2011). In addition, another inclusion criterion was that the participant had not taken part in a similar intervention recently (Gabriels et al., 2015; Lanning et al., 2014) or at all (Borgi et al., 2016; Jenkins & DiGennaro Reed, 2013; Kern et al., 2011). In contrast, other researchers included children who had received a similar therapy for at least a year already (Holm et al., 2014). Some criteria were simply based on feasibility as participants needed to be available with their parents for the set sessions (Holm et al., 2014) and lived close to the site where the intervention took place (Jenkins & DiGennaro Reed, 2013).

In addition to the inclusion criteria, some of the research has also stated explicit exclusion criteria. This included phobias (Silva et al., 2011; Borgi et al., 2016; Gabriels et al., 2015; Harris & Williams, 2016) or history of animal abuse (O'Haire et al., 2015; Gabriels et al., 2015; Harris & Williams, 2015), having disorders known to cause or manifest similarly to ASD (Gabriels et al., 2015) as well as diagnosis of other disorders such as severe sensory impairment, cerebral palsy, severe behavioural issues and physical limitations (Ajzenman et al., 2013; Borgi et al., 2016). This was not the case for all of the articles presented here as Gabriels et al. (2012) included children with comorbid disorders. In addition, one article stated issues which would have been a safety concern. For instance, children who were not able or willing to wear a harness for equine interventions were excluded (Harris & Williams, 2016).

Summing up, the literature presented here has had different criteria when selecting the children to take part in the intervention. This was often done to ensure safe practise or to be able to generalise the findings because the children have a similar profile. However, this practice makes it difficult to establish the general benefits of AAls as there is a lack of consistency throughout and recommendations cannot be made to professionals to suit all children they work with, for instance, in a special needs schools.

3.3.1.6 Effects of AAI on children with ASD: Summary of results and conclusions

All of the research discussed within this review reported beneficial effects of AAls, with all but one article (Jenkins & DiGennaro Reed, 2013) reported statistically significant results (See findings in Table 2). Two of the articles which investigated teaching social skills with and without animals found beneficial results when the animals were involved (Becker et al., 2017; Grigore & Rusu, 2014). However, one of those articles had a case study approach as only three participants took part. As a result, generalisations of the effect of the animal intervention could not be made (Grigore & Rusu, 2014).

Furthermore, an intervention with horses indicated that an equine intervention improved maladaptive behaviours but there was no difference on children's communication and socialisation (Anderson & Meints, 2016). Contrary to the research by Anderson and Meints (2016), a case study design with three participants found social communication benefits for all the children after the time spent with the animals (Stevenson et al., 2015). Although this is promising, the case study design only acts as an indication of potential improvements and therefore studies with larger participant groups are needed. Nonetheless, findings indicate a beneficial effect when teaching social skills in a structured program with AAI; with benefits expressed in teacher- and self-reports (Becker et al., 2017) as well as researcher observations (Grigore & Rusu, 2014). Further to this, AAI also improved social skills when provided as a non-structured intervention (O'Haire et al., 2014). These benefits were evident when research involved different animals including dogs (Becker et al., 2017;

Grigore & Rusu, 2014; Stevenson et al., 2015), guinea pigs (O'Haire et al., 2014) and horses (Anderson & Meints, 2016), advocating for the potential benefits of AAI with different species.

Research investigated physical differences indicating improvement in social communication for children in the presence of an animal, measured the smiles during interaction with a dog. The findings indicated that dogs had a different effect on the typically developing child compared to the child with special educational needs. More specifically the typically developing child showed a gradual increase in smiles while the child with special needs showed a larger increase in smiles towards the end of the sessions. This indicated that a dog may have a different effect depending on whether the child has special needs. However, as this research was a case study design, generalisations were not made (Funahashi et al., 2014) and further research with larger sample size is needed. Nonetheless, other research has provided support for the benefits of a dog to facilitate social interaction as children were found to interact for a prolonged period of time with the therapy dog, but not with the other objects (Prothmann et al., 2006).

While much of this research needed to be replicated to establish whether such findings hold for a large number of children with ASD, it was suggested that AAI showed promising preliminary benefits which may improve children's quality of life. Evidence for such conclusions was gathered from recent research which indicated an improved quality of life (Lanning et al., 2014). However, some research only found anecdotal parent report results, rather than statistically significant differences (Jenkins & DiGennaro Reed, 2013). This may be due to the sample size or the length, intensity or structure of the interventions. This is particularly the case as much of the research adopted a case-study design (e.g. Grigore & Rusu., 2014; Silva et al., 2011; Funahashi et al., 2014). Although a limited number of studies have overcome many of the design pitfalls often seen in AAI research such as small sample size and no control group (e.g. Gabriels et al., 2012; Gabriels et al., 2015; Borgi et al., 2016), more methodologically rigorous research is still needed. There is a need for more detail in

reporting and larger sample sizes, ideally using randomised controlled trials. Nonetheless, studies like this are useful starter points into this field of research.

In conclusion, improving scientific rigour as suggested will allow for a better understanding of the programs that had an effect and the measures that were most sensitive to detect a change in behaviour.

3.3.2 Effects of AAI on children with Attention Deficit Hyperactivity Disorder (ADHD)

Four of the papers which met the search criteria and were included in the review involved children with a primary diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) (Cuypers, De Ridder & Strandheim, 2011; Yoo, et al., 2016; Hyun et al., 2016; Schuck, Emmerson, Fine & Lakes, 2015). Research investigated a range of functioning (often within the same study) which included quality of life, brain functioning and connectivity; motor ability/gait ($N= 3$) and cognitive behaviour intervention teaching social skills ($N= 1$). The animals who took part included horses ($N= 3$) and dogs ($N= 1$). It was clear from this search that very few studies were conducted for children with ADHD using AAI.

Three studies provided an equine intervention and investigated the effects on behaviour, quality of life and motor ability as well as brain connectivity and function. Of these, Cuypers et al. (2011) provided a group intervention. Every participant was matched to a suitable horse and the sessions were modified depending on the child's needs. Measures were obtained before and after an 8-week intervention and indicated an improvement in behaviour and quality of life after the intervention. A positive change in motor performance post-intervention was also observed. Yoo et al. (2016) used Equine Assisted Activities or Therapy (EAA/T) in an indoor riding arena. It was led by specialists who worked with horses in a therapeutic setting previously. Significant changes of local connectivity in ADHD participants was observed from MRI scans and were significantly correlated with clinical improvements (Yoo et al., 2016).

Hyun and colleagues used a different intervention altogether – EAAT. It was run by a team of PATH instructors graduate teaching assistants and psychiatrists. Typically developing children showed greater connectivity changes from cerebellum to the frontal cortex compared to children with ADHD. However, clinical symptoms and gait balance were both improved in children with ADHD after 4 weeks of EAA/T. Brain functional activity was increased in children with ADHD and typically developing children (Hyun et al., 2016).

The only study with children with ADHD which did not use horses included dogs for the AAI (Schuck et al., 2015). Half of the children spent 12 weeks in waitlist control prior to taking part in the interventions to account for the influence of time and the child's development on the severity of their symptoms. Children were allocated into a Canine-Assisted Intervention (CAI) or non-CAI intervention group. Both intervention groups had the same sessions but the CAI group had visits from three different certified therapy dogs and their handlers and the non-CAI group used toy dogs for the sessions. During the weekly evening session for children, parents received group-based behavioural training. The children in both groups (with and without CAI) showed improvements in social skills, prosocial behaviours and problematic behaviours. Furthermore, the severity of ADHD symptoms in both groups declined during treatment, however, the group with CAI showed greater reductions than the group without CAI, which indicated that CAI may facilitate CBT (Schuck et al., 2015).

3.3.2.1 Effects of AAI on children with *ADHD*: selection of animals involved

The protocol for animal selection for the research conducted with children with ADHD was investigated and it was evident that there were no gold standard selection protocols, or, the selection criteria for choosing the animals to take part was not reported. From the work which involved horses, one article based the selection of animals on their size and characteristics (Cuypers et al., 2011) while other research selected animals which had previously taken part in a similar intervention (Yoo et al., 2016) and the third did not state how the horses were selected (Huyn et al., 2016). The only research in this subsection

which included dogs for the AAI, selected three certified therapy dogs and handlers which meant that the animals were assessed for their suitability prior to taking part in the study (Schuck et al., 2015). In conclusion, future research should create a gold standard protocol for animal selection for different species to ensure their suitability which will in turn result in optimal intervention benefits without the animal's welfare being compromised.

3.3.2.2 Effects of AAI on children with *ADHD*: criteria for the inclusion of human participants

The participant profiles of the children involved in the projects showed that the inclusion and exclusion criteria varied depending on the aims of the study. All studies ensured that participating children had a previous diagnosis of ADHD, but the approach taken in terms of the medication the children took differed. One article stipulated that children must have reacted positively to a medication (Concerta) and taken it for a year (Cuypers et al., 2011) whereas the others excluded children who took a specific medication 90 days before the intervention (Yoo et al., 2016); ensured that the children had taken no medication at the time of study (Schuck et al., 2015) or 6 months prior to taking part (Hyun et al., 2016). Children were also excluded from taking part if they had other comorbid disorders (Cuypers et al., 2011; Hyun et al., 2016; Schuck et al., 2015). In addition to this, children had an IQ of 80 or above for some research (Hyun et al., 2016; Schuck et al., 2015) and were right-handed (Hyun et al., 2016), completed all the baseline measures (Schuck et al., 2015) and were willing to take part in a scan (Yoo et al., 2016). Furthermore, Cuypers et al. (2011) ensured that children had not been exposed to a similar intervention previously. The study which included dogs ensured that children had no previous history of being cruel to animals (Schuck et al., 2015). This differing criteria for participant selection results in the inability to compare findings directly and as a result it is unclear whether these benefits will be evident for different populations.

3.3.2.3 Effects of AAI on children with *ADHD*: *summary of results and conclusions*

Overall, research which involved horses as an intervention for children with ADHD presented promising findings (Cuypers et al., 2011; Hyun et al., 2016; Yoo et al., 2016). The research has however used different measures to establish these positive benefits. Cuypers and colleagues have used self-, parent- and teacher-report measures (Cuypers et al., 2011). Using such measures can be problematic as there is a risk of bias. However, support from research using more objective measures provides further evidence for these findings. For instance, research established potential differences in brain pathology for children with ADHD compared to typically developing children (Hyun et al., 2016). Furthermore, other research (Yoo et al., 2016) provided findings which indicated that a horse intervention had an effect on brain connectivity which was a physiological measure of the effect of AAI on children with ADHD. These measures advocate for real physiological changes occurring as a result of AAI interventions, supporting the evidence from the research which has more subjective measures.

In addition to the horse intervention findings, benefits of AAI with dogs were found when incorporated in a cognitive-behavioural intervention (Schuck et al., 2015). These were similar to some of the findings of studies which evaluated horse interventions for children with ADHD (Yoo et al., 2016; Hyun et al., 2016). Benefits from such AAI indicated that it was not just one type of animal which impacted on a child taking part; with further research to ensure similar benefits are seen across different animals, more AAI can be provided which are suitable for different environments. This could open possibilities of having animals more regularly for a structured purpose in schools and children's care facilities, potentially benefitting the most vulnerable. To have strong scientific basis, future research needs to have rigorous design and appropriate assessments including physiological measures.

3.3.3 Effects of AAI on children with Down's Syndrome (Trisomy 21)

Three of the papers which met the search criteria and were included in this review related to children with Down's Syndrome (Voznesenskiy, Rivera-Quinatoa, Bonilla-Yacelga & Cedeño-Zamora, 2016; Griffioen & Enders-Slegers, 2014; Limond, Bradshaw & Cormack, 1997). Interventions investigated a range of abilities, including gross motor skills, cognitive and social development, and behaviour during interactions with an adult. The animals taking part in the AAI sessions included a horse ($N= 1$), a dolphin ($N= 1$) and a dog ($N= 1$).

Voznesenskiy et al. (2016) investigated whether equine-assisted physical activities improved gross motor development. The equine-assisted physical activities were led by staff and volunteers who were professionally trained on integrated equine-assisted rehabilitation and recreation. The findings indicated that the children taking part in the equine activities had a significantly higher improvement on the gross motor measure compared to the children who took part in the conventional adapted program.

The second study in this section investigated differences in cognitive and social development using Dolphin-Assisted Therapy (DAT). The children were placed into one of three groups, but not randomly assigned. The first group took part in 1 session (1 hour) per week of DAT for 6 weeks in an open water lagoon. The second group completed a 6-week (1 hour/ week) course in a swimming pool without dolphins and the third group were a waitlist control group who were observed for 6 weeks before taking part in DAT. The children in the no dolphin (control) group knew from the beginning they would not be taking part in DAT. None of the children were ever in direct contact with the dolphins- i.e. swimming with them. It was evident that verbalization and recognition of persons improved during the 6-week swimming course intervention and the effect for verbalisation remained at follow-up (4-6 months). Furthermore, impulsiveness decreased during the intervention and led to more concentration on a task (Griffioen & Enders-Slegers, 2014).

In the remaining research, children took part in conditions with a real dog and a toy dog. Children were allowed to carry out the same activities (e.g. brushing the dog). The handler led these sessions and ensured that there was a natural change from one dog to the

next. The handler followed a protocol and encouraged interaction with the dogs and accessories were provided for the same purpose. These included a collar, lead, brush, biscuits and a toy. If children were interested in something else (e.g. a truck or animal box provided as alternatives) the handler encouraged interaction with the chosen object. The behaviours monitored were decided prior to the sessions and were as follows: looking, responding to the adult and initiating contact. The findings indicated that children looked more and for longer at the real dog than the toy dog. Furthermore, children ignored the handler more in the imitation condition compared to the real dog condition and when the handler made suggestions or asked questions in the real dog condition, the children responded significantly more positively (Limond et al., 1997).

In sum, the research investigating AAI for children with Down's Syndrome is scarce, using different animals and assessing different outcomes. As a result, these findings can only work as a starting point for further research which would need to include rigorous scientific methodology, preferably a randomised controlled trial set up and a well-documented intervention structure to allow for future replication.

3.3.3.1 AAI and Down's Syndrome research: selection of animals involved

The initial process of selection of animals and welfare considerations was not always transparent in the research articles. The structure of the DAT included 17 bottlenose dolphins ($N=6$ male, $N=11$ female) who lived in an environment very close to their natural habitat. Their welfare was observed at all times while in the pool (Griffioen & Enders-Slegers, 2014), but no further information was presented in relation to the living conditions or selection of the dolphins for the intervention. The research with horses took part at the Ambato Special Educational Unit but information on suitability of the horses involved was not provided (Voznesenskiy et al., 2016). The most detailed information on the suitability of the animal was provided by Limond et al. (1997) who stated that the dog was a 7-year-old Labrador Retriever therapy dog registered with Pets As Therapy in the UK. The selection of animals to take part in AAIs is extremely important to ensure welfare of animals in these

environments. This is particularly urgent as these interventions are growing in popularity and a gold standard in the field needs to be established for everyone to follow.

3.3.3.2 AAI and Down's Syndrome research: criteria for the inclusion of human participants

As in the previous subsections, the profile of the participants varied and depended on the research they were taking part in. All of the research in this subsection ensured that the participants had a previous diagnosis of Down's Syndrome. Only one paper specified that children should be 1-6 years of age as well as being able to attend the Education Unit where the activities took place (Voznesenskiy et al., 2016). One of the articles did not specify whether there were exclusion criteria but the children who took part were an opportunistic sample as they attended the same school for children with severe developmental disorders (Limond et al., 1997), whereas the research assessing DAT recruited participants through a website, accepted children from mainstream schools ($N= 19$), special educational needs schools ($N= 22$) and other educational environments ($N= 4$) (Griffioen & Enders-Slegers, 2014). In terms of the exclusion criteria, this varied based on the task of the research as the DAT project excluded children from participation if they had anxiety for water and/or animals; if they had an epileptic disorder, heart failure or severe hearing/ visual impairment (Griffioen & Enders-Slegers, 2014). However, for those taking part in the horse intervention, children who had other disorders or health conditions which would have posed a risk to self or others were excluded. An assessment completed by a physical therapist prior to commencement of the project was also used to assess whether participants were fit to take part in activities (Voznesenskiy et al., 2016). Benefits discovered in research including children with a specific primary diagnosis (e.g. Down's Syndrome) provides important insight into the benefits of AAI but further research needs to include children with comorbid conditions in order to be more representative of children with special needs. In doing so, safety must be of prime importance and extra adult supervision provided where necessary to ensure safeguarding of the children and animals.

3.3.3.3 Effects of AAI on children with Down's Syndrome: summary of results and conclusions

Only three studies in this review have included children with Down's Syndrome and they have all included different animals as part of the AAI provided (Voznesenskiy et al., 2016; Limond, 1997; Griffioen & Enders-Slegers, 2014). The findings from these limited studies are promising indicating improvement in gross motor skills (Voznesenskiy et al., 2016) and communication (Limond et al., 1997; Griffioen & Enders-Slegers, 2014). Although a good starting point, more research is needed to establish the different effect of the various species involved in AAI; more specifically which type of intervention is most effective for which child. This is particularly important for children with diagnosis such as Down's Syndrome as they can be affected differently by the condition with some being more able than others. To tackle this question, studies with larger samples sizes and more explicit assessment of the children's needs is required. This approach will also establish the best intervention for children with different comorbid diagnosis which is of particular importance to special needs schools as children there often have comorbid conditions.

3.3.4 Effects of AAI on children with other diagnoses

Further research which met the search criteria was conducted with children of various diagnoses outside of a specific diagnosis of ASD, ADHD or Down's Syndrome; twelve articles were reviewed here. Interventions investigated a range of areas of research, including but not limited to, adaptive skills, social functioning and relationships, social support, social skills, self-esteem and anxiety, learning, behaviour and verbalisations as well as physiological measurements of interactions (Balluerka, Muela, Amiano & Caldentey, 2015; Chardonens, 2009; Heimlich, 2001; Beetz, Kotrschal, Turner, Hediger, Uvnäs-Moberg & Julius, 2011; Wedl, Kotrschal, Julius & Beetz, 2015; Holmes, Goodwin, Redhead & Goymour, 2011; Stumpf & Breitenbach., 2014; Dilts, Trompisch & Bergquist, 2011; Ewing, MacDonald, Taylor & Bowers, 2007; Anderson & Olson, 2006; Martin & Farnum, 2002;

Somervill, Swanson, Robertson, Arnett & MacLin, 2009). The animals taking part in the AAI sessions included dolphins ($N= 2$), farm animals ($N= 2$), horses ($N= 2$) and dogs ($N= 6$).

Balluerka et al. (2015) investigated Animal-Assisted Psychotherapy (AAP) where the structured psychotherapy sessions included the assistance of farm animals. Children interacted with a range of animals which included a dog, horses and other farm animals. Teachers reported that children who took part in AAP made progress in school adjustment, showed greater motivation and increased attention towards classroom learning. Children also obtained higher scores on adaptive skills at school with improved social skills for interacting with peers and teachers needed for group work. Furthermore, children in the treatment group presented reductions in symptoms of hyperactive behaviour compared to the control group, indicating an improvement in some aspects of personal adjustment. Interestingly, in the same research, children considered their social relationships had improved, but continued to view family relationships in a negative light. These participants also showed higher scores on self-esteem and self-resilience. Similarly, but adopting a case study design, one article reported benefits for a child who lived on a farm (Chardonnnens, 2009). Although the child interacted with other animals most evidence provided stems from equine-assisted psychotherapy with a person-centred approach. Improvements included respecting authority, private physical space of animals and increased patience (Chardonnnens, 2009).

Heimlich (2001) reported evidence of Animal-Assisted Therapy (AAT) with children spending considerably less time with the animal (30 minutes structured sessions per week for 8 weeks) compared to Chardonnnens (2009). The initial plan was for 21 children to take part in 3 trials, but only 14 children in 2 trials were recruited in the end. In addition, the details of the intervention were not provided, but it was made clear that the sessions were structured. There was a positive trend with the effect of AAT in improving the competency of the child in terms of relationship understanding and development. However, due to the small sample and trial size no generalisations were made and this effect required further exploration.

Beetz et al. (2011) included children who did not take part in an intervention per se but rather completed a stress test either with the real dog, toy dog or human acting as social support. The stress test itself lasted around 10 minutes but the whole session lasted over an hour. This time included cortisol collection at various time points, explanation of the procedure and stress test as well as a relaxation period at the end. The findings showed that cortisol was lower for children in the dog group. Furthermore, the more contact children had with the dog (i.e. more stroking) the lower their cortisol levels. Wedl et al. (2015) have published further results from the study conducted by Beetz et al. (2011). It was concluded that the observed interaction of the children overall with an unfamiliar dog was similar to an avoidant attachment representation during a stressful situation. The children interacted less with the dog during and after the stress test. In contrast, the boys with disorganised attachment sought out more interactions with the dog during and after stressful situations compared to the boys with avoidant attachment.

Beneficial effects were also evident in research which included children with different diagnosis within the same project. Holmes et al. (2011) investigated the benefits of Equine-Assisted Activities (EAA) with tasks for each session pre-determined to work on targets such as safety behaviours and grooming. Participants were taught on either the real or model horse, counter-balanced across participants. Once they were taught, participants practised what they had learnt on the other horse. All activities were suitable for the real and model horse. As predicted, participants showed a reduction in anxiety scores from baseline to the last session. However, self-esteem scores were not influenced by the equine intervention. Furthermore, behavioural findings showed that positive behaviours towards the real horse increased and decreased towards the model horse. In addition, avoidance behaviours towards the real horse decreased and stayed the same towards the model horse (Holmes et al., 2011).

Dolphin Assisted Therapy (DAT) was also employed for children with various special educational needs and diagnosis. Stumpf and Breitenbach (2014) based the intervention on a framework developed from previous research about special educational needs

interventions. The findings indicated that vocalisations increased in the sessions with the dolphin and teacher. Another research utilising DAT, conducted by Dilts et al. (2011) ensured all children took part in a 2-week DAT focusing on interaction quality. The therapy provided was called Alpha-Therapy and comprised of other therapies such as cognitive therapy, physiotherapy and art therapy. DAT acted as a facilitator and was thought to encourage development within the other therapies provided. The targets were child-specific as every child was at a different stage in their development. Positive changes in behaviour were found when the pre- and post-test assessments were compared, with gains on the socially withdrawn and fearful/ anxious subscales.

Investigating the effect of animals on participants with severe emotional disorder, Ewing et al. (2007) used an equine-facilitated learning intervention. The sessions were structured and involved teaching skills such as trust, cooperation and responsibility. Every child was paired with a horse and a certified volunteer (the horse owner) which encouraged a relationship and the feeling of ownership. The targets and equine program aims were also incorporated into the classroom as lessons were all related to an equine theme. All participants took part in the intervention as they were their own control. This research did not find any statistically significant differences, however, observational differences for individual children were reported. For example, one child was able to relate to the horse and therefore discussed fears and anxieties, whereas in another instance the horse was used to teach the child about personal care and hygiene (e.g. horse needs grooming, child needs to brush hair). Furthermore, the horse intervention was seen as clearly beneficial for one child who improved their social skills. As a result, the child repeated the program again at the end of the year which resulted in sufficient progress to enable the participant to attend mainstream school (Ewing et al., 2007).

Further research with a similar participant profile of emotional disorders opted for an unstructured intervention which with the dog present in the classroom. The dog, which was not a certified therapy dog was able to roam around freely and children had to respect his space as they had discussed dos and don'ts before the dog entered the classroom for the

first time. Children who struggled to bond with the dog were given more time with him. Results indicated that the dog in the classroom contributed to students' overall emotional stability. Further benefits included improved attitudes towards school and facilitation of children's learning in lessons in terms of responsibility, respect and empathy (Anderson & Olson, 2006).

Two further studies chose a dog intervention to investigate the effect of AAI on participants with different special educational needs. Martin and Farnum (2002) provided an intervention for children with Pervasive Developmental Disorders (PDD) and behaviour of the participants improved as evidenced by laughing more frequently as well as the fact they were more likely to give the real dog a treat. Furthermore, they also spent less time looking around the room and looked at the real dog more often. They were also more likely to answer detailed questions and less likely to talk about unrelated topics to the therapist in the dog condition. Children touched the ball and stuffed dog more than real dog but were more likely to talk about the dog than ball and for longer duration. Lastly, in the dog condition children were most likely to comply with instructions and less likely to ignore question and follow with unrelated statement (Martin & Farnum, 2002). Finally, Somervill et al. (2009) investigated the physiological reaction of children with ADHD and Oppositional Defiant Disorder when interacting with a dog. All children took part in two conditions – blood pressure measured once without a dog and once with a dog. In the dog condition, the dog was placed on the child's lap and the interaction was initiated by the child, no instructions were given on how to interact with the dog. This set up is lacking the consideration for the dog welfare and the safety of child as it did not allow the dog to move away from the situation if unhappy, preventing a natural means of communication. This would therefore potentially put the child and dog at risk. In the no dog condition, the set up was the same, the children were in an empty classroom with the experimenter and a member of staff and the measures were taken. The child was not given any instructions or safety training on dog behaviour and body language so was free to engage in a conversation with the adults. An increase in blood pressure was revealed while the child was with the dog, but there was also

a decrease in heart rate. In terms of teacher feedback, no significant changes in behaviour were reported (Somervill et al., 2009).

In sum, the research here included children with a variety of diagnosis which is representative of children with special educational needs. As a result, it provides a real insight for families and educators of these children as many have various and multiple diagnosis. However, this research can only be taken as a starting point as all the interventions provided and children's profiles are different. More specifically, some research has utilised Animal-Assisted Psychotherapy (Balluerka et al., 2015) while others have used Equine-Assisted Activities (Holmes et al., 2011). Furthermore, horses were not the only therapy animal involved as one research team provided Dolphin-Assisted Intervention (Stumpf & Breitenbach, 2014; Dilts et al., 2011) while an Animal-Assisted Therapy program included the involvement of many farm animals (Chardonens, 2009). These interventions are too diverse to allow any meaningful comparison between them and with having small sample sizes and some even being case-study designs (Chardonens, 2009) the positive findings need to be treated with caution. Furthermore, the fact that children had many diagnosis is also problematic as there will be a variability between them. As a result, some children may benefit more from an intervention than others. In order to establish this, further research will need more in-depth analysis of the benefits and the children who show the greatest benefits.

3.3.4.1 Effects of AAI on children with other diagnoses: selection of animals involved

It was evident from presenting the research in this section that different animals had been selected to take part in the AAIs and not all authors specified the selection criteria in the article. For instance, some research included farm animals and stated the number of some animals involved- one dog and nine horses and that some were excluded from taking part but this information was not provided for all the different types of animals the children interacted with (Balluerka et al., 2015). Furthermore, other research with farm animals failed

to state how the animals were selected or how long the child spent with each different animal (Chardonens, 2009).

Most of the research selected a dog to take part in the intervention, but the selection protocol and its reporting varies from a certified therapy dog (Beetz et al., 2011; Wedl et al., 2015) to dogs who had taken part in a temperament assessment which ensured their suitability for working with children (Martin & Farnum, 2002) or had undergone a vet assessment and were used to being handled by different people (Somervill et al., 2009). However, the research by Anderson and Olson (2006) has also included a dog which was not a certified therapy dog, had not undergone any assessment and was not trained to interact in a certain way with children. In addition, the research by Heimlich (2001) described a dog taking part, but did not specify how the dog was selected or whether he had undergone any assessments.

The research which incorporated horse intervention also provided different level of information. One research did not provide information on the selection of horses but stated that children were paired with a horse and a certified volunteer (Ewing et al., 2007). The other research indicated that the horses chosen for the intervention were retired race horses who had been selected by experienced handlers (Holmes et al., 2011).

The last two research projects evaluated DAT for children with special educational needs. Stumpf and Breitenbach (2014) stated that dolphins taking part in the therapy had been trained by trainers to do certain tricks, and their welfare was considered insofar as all dolphins were in the pool at the same time as separating may cause stress. One dolphin was involved in the therapy (maximum of 30 minutes per day active participation) while the other dolphins were being trained at the opposite end of the pool by their trainer. In contrast the research by Dilts et al. (2011) did not provide details in terms of dolphin welfare or selection but the therapy was led by a company.

To conclude, although the type of animal included may be different, it is paramount that the selection process is thorough. This will ensure the welfare of the animal as well as the safety of the children and adults involved. Currently, a strict selection protocol is not

being followed in all studies with some stating that no prior training was provided and the dog was not assessed (Anderson & Olson, 2006). This is problematic and puts all involved at risk. The amount of information provided regarding the selection of animals and protocols used is inconsistent. This may result in different types of animals being selected and it does not allow for a gold standard procedure to be followed. Such differences make the research findings difficult to compare due to the many variables between studies.

3.3.4.2 Effects of AAI on children with other diagnosis: criteria for the inclusion of human participants

In terms of participant recruitment for children with various diagnosis, some of the research used an opportunity sample. For instance, parents who had signed their children up for a DAT program were asked to take part in the project. From the 40 parents approached, 37 provided consent (Dilts et al., 2011). Furthermore, a case study design was used to establish the effect of AAI on a child who lived on a farm for a year (Chardonnnens, 2009).

A more inclusive recruitment procedure was adopted by researchers who recruited participants from the same school or institution. Children with moderate to severe impairment were recruited from the same residential school (Heimlich, 2001). Similarly, although unclear on the selection criteria, Balluerka and colleagues recruited all participants from the same residential care institution. Further research selected participants from the same school for children with learning difficulties and behavioural issues and asked the teacher to select the children which were to take part based on their IQ and age; where many of the children had below average IQ (Ewing et al., 2007). Having all participants from the same setting can affect the results as the interventions may be effective because of other factors relating to the institution rather than only due to the effect of the animals.

Research which also adopted this teacher-led recruitment method ensured the inclusion criteria was broad, allowing many children to participate, however, children who did not complete all parts of the study were excluded from analysis (Somervill et al., 2009).

Similar criteria were set for children who were unable to access the curriculum within a mainstream classroom and were therefore part of a self-contained classroom (Anderson & Olson, 2006). A different approach was taken by Holmes et al. (2011) as they recruited participants from two schools to ensure that enough children with emotional, behavioural or learning difficulties with a range of abilities were recruited.

Although recruitment widely ensured there was a better representation of children from the general population (provided the sample was large enough), this was not always a suitable way to recruit as it would not answer the research question. As a result, some researchers recruited children based on a particular characteristic. For instance, Beetz et al. (2011) selected children who had insecure/disorganised attachment. Similarly, Wedl et al. (2015) recruited children from a special school for children with social and emotional development problems.

The most inclusive and generalisable sample was provided by studies which recruited children randomly, such as through local physicians and schools (Martin & Farnum, 2002) or indeed countrywide, such as the research conducted by Stumpf and Breitenbach (2014) who recruited children nation-wide in Germany. However, here it is important to state that this is not always possible due to money and time constraints.

3.3.4.3 AAI and other diagnoses research: summary of results and conclusions

In keeping with the research presented in the previous subsection, the studies which provided AAls to children with various diagnoses have found some promising results. Some of the research investigated behavioural changes and indicated an improvement for those taking part in AAls (Holmes et al., 2011; Heimlich, 2001) while others did not find behavioural differences reported (Somervill, 2011). The other research in this section also established differences in social ability and communication (Stumpf & Breitenbach, 2014; Dilts et al., 2011; Balluerka et al., 2015; Chardonens, 2009). However, generalisations were not made due to the sample being smaller than initially intended in some cases (Heimlich, 2001) or a case study design (Chardonens, 2009). Furthermore, attention needed to be

drawn to the design of the projects. Some research presented here was more comprehensive in terms of the number of measures it incorporated in order to establish if and how the AAls affected the participants (Balluerka et al., 2015; Anderson & Olson, 2006) but other research has only reported anecdotal behavioural changes due to there being no statistically significant differences on the measures (Ewing et al., 2007). This indicated that certain AAls may only benefit particular individuals and therefore the effect was not generalisable to a larger group of children.

Future research is required with a larger sample size and more appropriate measures to establish the true effect of AAls on a larger scale. If found not to be effective, then the particular child profile who benefits the most from AAI needs to be established so the interventions can be utilised where most effective. This will ensure that the animals work less as they are not taken to every child and there is optimum benefit from the intervention. Furthermore, research should continue to report non-significant findings to establish the areas where AAls are not an appropriate and effective intervention. With this, anecdotal reports should be omitted within publications as they will not add to the scientific rigour of the effectiveness of AAls, but they should of course be explored further.

3.4 Discussion

The research within this review varied in terms of the hypothesis, intervention and animals' involvement but it was evident that there was a trend of Animal Assisted Interventions (AAI) showing beneficial effects for children with different special educational needs. The improvements were found across different areas of development, including but not limited to social skills (Becker et al., 2017; Grigore & Rusu, 2014; Schuck et al., 2015), social functioning (O'Haire et al., 2014; Anderson & Meints, 2016; Stevenson et al., 2015), social interactions (Funahashi et al., 2014; Prothmann et al., 2006), behaviour (Garcia-Gomez et al., 2013; Holm et al., 2014; Lanning et al., 2014; Cuypers et al., 2017; Limond et al., 1997; Silva et al., 2011; Jenkins & DiGennaro Reed, 2013) and gross motor development (Voznesenskiy et al., 2016), as well as clinical symptoms (Kern et al., 2011; Yoo et al., 2016)

and cognitive functioning (Borgi et al., 2016; Griffioen & Enders-Slegers, 2014). However, much of the research varied in terms of the protocols used including the intervention itself, human recruitment and animal selection. These differences will be discussed next with an aim to guide future research into following more consistent guidelines when devising new studies.

3.4.1 Participant recruitment

As previously stated, the research conducted in the AAI field has had many criticisms when considering the design of the studies. One of the main limitations has been the participant recruitment and selection. Ideally, children of all abilities and from different schools and geographical locations should be recruited. In addition, the socioeconomic status, ability of child and pet ownership should be considered, ensuring a fair representation of all factors within the participant group.

Starting with the participants recruited for the different research in this review, it is important to notice that although they all had special educational needs, their profiles varied greatly. As a result, the first discussion point will be the selection of participants. Much of the research did not include all children with the diagnosis in question, with some excluding children who had challenging behaviours during sessions (Voznesenskiy et al., 2016), sometimes due to their inability to verbally communicate (Prothmann et al., 2006) or lower IQ (Borgi et al., 2016).

While the safety of staff, participants and animals need to be considered, children with challenging behaviour may need the help most as they were least likely to access the curriculum or learn from the environment. It is likely that these children would have gained the most from AAI, if the animals act as a facilitator for learning. As this has not been assessed due to the exclusion of this participant group, there were no results to indicate any potential benefits. With this in mind, it is important to plan research which would be feasible for children with more challenging behaviours perhaps with having more adult support. On the contrary, there was some AAI research which included children who were less able and

had repetitive, sensory and solitary behaviours (Stevenson et al., 2015). Research with such strict criteria for participation ensured that particular children took part, making it more specific for the type of child that AAI benefits. However, the limitation can be that this could result in a small sample size (Ajzenman et al., 2013; Borgi et al., 2016) which in turn makes it difficult to generalise results.

In contrast, researchers working with children with special educational needs showed that there were certain limitations to the research that could be conducted. For instance, as one-to-one support was required, the number of children participating was limited by the availability of the adults, resulting in a small sample size (Cuypers et al., 2011). However, some researchers have overcome this issue and succeeded in conducting studies a fairly large number of participants, which indicated that large scale research with children with special educational needs was possible (Weld et al., 2015; Balluerka et al., 2015; Becker et al., 2017; Beetz et al., 2011; Bilba et al., 2015; Borgi et al., 2016; Dilts et al., 2011; Ewing et al., 2007; Gabriels et al., 2012; Gabriels et al., 2015; Garcia-Gomez et al., 2013; Schuck et al., 2015; Griffioen & Enders-Slegers, 2014; Voznesenskiy et al., 2016; O'Haire et al., 2014; O'Haire et al., 2015; Harris & Williams, 2017; Stumpf & Breitenbach, 2014; Hyun et al., 2016; Kern et al., 2011; Lanning et al., 2014).

One plausible example are Gabriels and colleagues who stated strict inclusion and exclusion criteria but also recruited a large number of participants, ensuring that their conclusions were suitable for a specific profile of participant and were generalised (Gabriels et al., 2015). The selection criteria differences discussed here were often a choice based on the hypothesis itself. It is however important that the articles clearly state the participant selection criteria to inform future research on the participant profile benefitting from the intervention. This was not always the case. For instance, one article concentrated on providing information of the intervention but nothing was stated about participant selection and recruitment (Malcolm et al., 2017).

Further to the diagnosis and deficit selection criteria discussed so far, some research has stipulated additional criteria for participation based on practical implications. For

instance, children had to have the transport to attend the sessions in a specialised unit (Voznesenskiy et al., 2016), potentially excluding some families and as a result, specific subgroups of children. In addition to this, the children who were likely to take part may also be the children who were more likely to take part in other interventions being offered. This could mean that the children likely to attend have already benefitted from extra interventions, not necessarily including children unable to attend other interventions on offer.

Aside from participant criteria for taking part, the research here also differed in terms of where the participants were recruited from. Some of the research presented here has used an opportunity sample (Limond et al., 1997; Cuypers et al., 2011; Dilts et al., 2011; Grigore & Rusu, 2014; Anderson & Meints, 2016; Ward et al., 2013) or recruited from the same school or institution (Prothmann et al., 2006; Harris & Williams, 2017). In addition to the different recruitment, the researchers often omitted to state recruitment success rates how many parents were approached for consent and how many provided consent (Griffioen & Enders-Slegers, 2014), and how many children then took part. Increased clarity in published articles on the recruitment and participant profile can be useful to ensure inclusivity and future direction of research.

3.4.2 Conditions: participant allocation

Research designs vary based on many different factors and this impacts on the participant allocation. The most scientifically rigorous approach is to use randomised control trials (RCTs). This requires the project to have sufficient funding and research staff to facilitate this design. As with many research projects this is not always possible but a desirable alternative would be a waitlist control or cross-over design. This will allow for less participants to be involved compared to an RCT design as each participant takes part in each condition, but there is still the ability to compare the findings to a control condition. This allows for a clear assessment of the benefits of the AAI. This design is also beneficial and often preferred in educational settings as it allows for the children to take part in every condition, ensuring no children are missing out. On some occasions this design is not a feasible option due to, for

example, time limitations. If an intervention takes place in a school, during a school term, there is a limited amount of time that the intervention can be scheduled for. Furthermore, if it is with a specialist population (e.g. children with special needs) there may be other challenges such as having to have all children involved at the same time to prevent behavioural outbursts. In these situations, a cross-sectional design such as pre-, post-intervention assessment may be more appropriate. Although not having the ability to compare the findings to a separate control group, any benefits can be assessed against the same child before the intervention as a baseline measure is taken. On some occasions, however, this design is not possible either and researchers opt for observations, case studies and qualitative assessments with a small sample size. Although these findings would not be generalisable, they act in an exploratory fashion allowing for new avenues to be explored with future research. All of these designs serve a purpose in enhancing the field of AAI, but it is important for studies to be clearly designed ensuring that the findings are not confounded in any way and the true effect of the intervention is measured from the beginning. The research presented so far varies in terms of the participant allocation and design. This will be discussed in more detail next.

Some research placed children in different conditions based on their age and this did not always result in the same age between the intervention group and control group (Becker et al., 2017). Although this makes the research easier to undertake, it is confounding the results as a different age group could benefit more or less than the age group in the intervention condition, making it difficult to draw conclusions.

Similarly, Lanning et al. (2014) gave participants the option to choose to be in the AAI or the control group. This poses questions of whether participants' views and feelings towards animals played a part in the effectiveness of the intervention. Furthermore, the lack of randomisation may confound the findings as any benefits may be related to a specific type of child- i.e. a child that would choose to spend time with the animal. Furthermore, sometimes participants were not randomly assigned into the intervention and control groups (Griffioen & Enders-Slegers, 2014; Balluerka et al., 2015), but participants were stratified

based on their profile (Balluerka et al., 2015). However, the criteria for children to be distributed across conditions was not always clearly defined (Stumpf & Breitenbach, 2014).

A different approach was taken by Martin and colleagues when all children took part in all conditions every week, including the control condition (Martin & Farnum, 2002). Participants taking part in control and AAI condition simultaneously was likely to result in the benefits from the intervention being evident during the control part of the research too. An alternative option to randomised controlled trials could be waitlist controls. Here, instead of being randomly allocated to different experimental and control groups, participants via a waitlist control design take part in all conditions over time (Ewing et al., 2007). This is feasible for studies which have a small sample size and not enough power for a repeated measures design. In addition, research with particular participants such as school children would also lend itself well to the waitlist design. This would result in all children taking part in the interventions, ensuring children feel included.

However, while it is preferable to aim for RCTs, it is not always possible due to logistic or monetary restrictions on research. Other authors compared children before and after intervention, with children being their own control (e.g. Dilts et al., 2011; Anderson & Meints, 2016). Future research should ideally incorporate a control group into the design to ensure the benefits can be assigned to the AAI with more confidence. Furthermore, to ensure participants were not disappointed that they did not spend time with the animals, a waitlist control design should be used where possible.

3.4.3 Reporting of participant data and intervention assessment

Aside from the differences in allocating the children to the different conditions not all articles reported all the necessary information. For instance, the age of the children taking part (Dilts et al., 2011) and number of male and female participants (Ewing et al., 2007) was sometimes omitted. This could be of great importance as the benefits of the intervention could be different based on the participants' age and gender.

Length and evaluation of the effectiveness of the AAI differed across the research presented, with most research completing immediate follow-up testing. However, some intervention programs were as long as 3 months, which could have been strenuous on the animal and the adults having to ensure the child attends. As a result, it would be helpful to have an ongoing assessment throughout the intervention to establish whether there were differences which occur earlier than the end of the intervention. For example, the benefits may occur after a month and then are just maintained. If this is the case the intervention may not be needed for longer (e.g. 3 months) (Voznesenskiy et al., 2016; Garcia-Gomez et al., 2013). In contrast, other research only established the effect of the intervention by assessing the child's behaviour while the dog was present (Limond et al., 1997) which did not answer the question whether these differences were seen after the session with the animal and if the behavioural changes were generalised to other situations after the intervention has finished. Furthermore, in the case of Limond et al. (1997) it was not clear whether there were behavioural differences when the children spent time with the real dog first or last compared to the times when they spent time with the toy dog first or last. Another issue with establishing progress was when the only benefits were through parent-report measures (Dilts et al., 2011; Holm et al., 2014). This could be biased, for example, children from an opportunity sample whose parents had already signed them up for the intervention were likely to believe in the beneficial effects of AAI and therefore reported anecdotal benefits which may not be supported in a more objective measure such as a standardised test or physiological measure. This point is also relevant for teachers who were present during the AAI sessions and completed questionnaires based on the child's behaviour in the classroom (Stevenson et al., 2015). The risk of bias is a general weakness with person-report measures. Furthermore, Kern et al. (2011) only used parent and clinician reports of the benefits, without direct observation or assessment of the children. This may also have resulted in potentially inaccurate results as the due to the child behaving differently in a clinical assessment setting.

Although it was promising to read beneficial findings from AAls, some need to be treated with caution as they may not be representative. Future research should include completion of baseline and post-intervention measures using observations and standardised tests where feasible as well as physiological measures where appropriate. Ideally, testing should be carried out by an experimenter blind to the condition the child has taken part in, however, due to limitations in research funding and practicalities of experimental testing, this may not always be possible.

When evaluating the intervention provided, it is important to emphasise the different degrees of involvement of the animal handler (Ewing et al., 2007). As a result, it is difficult to assess how much of the benefit was due to the animal and how much of it was due to the handler and whether the same effect was seen across different handlers. In addition to this, research by O'Haire and colleagues also had children take part on a one-to-one basis with the animals but then had extra interaction within the classroom (O'Haire et al., 2014). This structure makes it difficult to separate the effect of the one-to-one intervention and the exposure in the classroom. This was also true for the research by Holm and colleagues where children taking part in the equine intervention had been riding for the previous year (Holm et al., 2014). It was unclear whether any benefits would have been present if the participants had not got used to and progressed in similar intervention during the last year.

Although the evidence for AAls indicates benefits for the participating children, much research is still needed. The emphasis needs to be placed on well-methodologically designed studies in the natural settings of children, to ensure findings are appropriate to generalise to everyday life. Furthermore, the measures used should be comprehensive and objective where possible to ensure the true effect of the AAI is captured. In addition, any areas which show no effect should also be published to ensure the interventions are tailored towards what works rather than being available regardless of whether they are beneficial or not.

3.4.4 Protocol for animal selection and welfare considerations

Aside from the intervention itself it is also important to focus on the selection protocol of animals to ensure they are suitable to take part. Some of the researchers explained clearly their animal selection protocols, including welfare considerations of the animals and additionally used organisations which have clear rules and regulations to follow such as PATH International for horses (Ajzenman et al., 2013; Gabriels et al., 2012). In contrast, others have conducted the research at a location experienced in and approved for providing an animal intervention for children with different needs (Anderson & Meints, 2016; Bilba et al., 2015; Dilts et al., 2011).

When considering the selection of dogs to take part, much of the research chose therapy dogs, certified by different organisations depending on which country the research was conducted in (e.g., Becker et al., 2017; Funahashi et al., 2014; Grigore & Rusu, 2014; Limond et al., 1997; Martin & Farnum, 2002; Prothmann et al., 2006; Schuck et al., 2015; Silva et al., 2011). However, some researchers conducted their own assessment to ensure the animals were suitable for the project (Balluerka et al., 2015; Borgi et al., 2016; Holmes et al., 2011) or indeed chose a suitable animal for each individual participant (Lanning et al., 2014).

Only a minority of researchers provided no information on the selection procedure for the intervention (Voznesenskiy et al., 2016; Dilts et al., 2011) and some stated that the dogs were not therapy dogs, and had no assessment or any training on how to interact with children (Anderson & Olson, 2006). This is particularly concerning as there was no independent assessment of the suitability of the dog for the intervention, nor was monitoring of the dog's signalling reported. Indeed, the dog may have been unhappy or stressed while taking part leading to safety concerns for the children and staff as well as being an animal welfare issue. This concern is further enhanced as Anderson and Olson stated that in case of a child's tantrum, the dog was locked in his kennel, but from the paper it appears that the kennel was not moved into another room (Anderson & Olson, 2006). As a result, the dog would be in a confined space, unable to move away from noise and upheaval, which would

be the dog's natural reaction especially in a situation where there is a lot of loud noise when their hearing is very sensitive. Again, there is no mention of monitoring the dog in its kennel. In addition to such welfare and safety considerations, the effects of AAI may be diminished if an animal is not happy in the AAI environment and benefits may not be seen. To prevent such issues, it is proposed here that a clear selection protocol should be used and the welfare considered, including the assessment of the intervention and monitoring of the animal, and the human participants throughout.

Further to this lack of emphasis on animal selection and therefore information on the suitability of the animals, some researchers did not teach children how to interact with the animal taking part. Somervill et al. (2011) simply placed the dog in the child's lap. Children were not given any instructions on how to behave around and handle the dog. It is proposed here that the best practise for future research is to teach children appropriate behaviour before the intervention and their interaction with the animals. Such teaching was completed by some researchers prior to conducting their research (Anderson & Olson, 2006; Anderson & Meints, 2016).

Further to the suitability of the animal it was also important that there was a person (typically the handler) solely responsible for the animal to ensure the welfare needs were met and the animal was not put under unnecessary stress. If when animal's behaviour is monitored signs of distress are present, then the intervention should be terminated. However, this was not always the case as in AAP some therapists also acted as dog handlers (e.g. Silva et al., 2011). While this has the above disadvantages, having the therapist as a dog handler is closer to a real-life one-to-one therapy session. Despite this, safety and welfare of the human and animal participants needs to take priority and should not be compromised at any cost. Nonetheless, where possible, the research should keep to an environment close to real life.

3.4.5 Findings: statistical significance and anecdotal evidence

To make generalisable conclusions, the evidence of any benefits in AAI should be produced using rigorous empirical designs and appropriate statistical procedures. Much of the research found statistically significant differences in different areas of child development and behaviour. Having dogs in the classroom was beneficial for children's learning (Anderson & Olson, 2006; Ward et al., 2013) concentration on a task (Griffioen & Enders-Slegers, 2014), motivation and attention towards learning (Balluerka et al., 2015). Furthermore, animal interventions also increased social skills (Becker et al., 2017) and functioning (Borgi et al., 2016; Harris & Williams, 2017), improved maladaptive (Anderson & Meints, 2016) and adaptive behaviours (Ajzenman et al., 2013) and skills (Bilba et al., 2015). Positive changes in general behaviour (Cuypers et al., 2011; Dilts et al., 2011) and behaviour towards the real animal (Holmes et al., 2011) as well as an improvement in certain parts of self-regulation (Gabriels et al., 2015; Gabriels et al., 2012), aggressiveness and hyperactivity (Garcia-Gomez et al., 2013) and empathy (Anderson & Meints, 2016) were also established. Further support for benefits of AAI was also established through the physiological measure of cortisol as children taking part in an animal intervention had significantly lower cortisol than the control (Beetz et al., 2011) acting as evidence that the animal intervention is the cause of the reduction of the stress hormone.

However, not all research found significant differences. For instance, Anderson and Meints (2016) did not find a difference in the participants' communication and socialisation, nor in systemising behaviours. Furthermore, after an animal intervention, family relationships continued to be seen in a negative light even when participants considered their other social relationships to have improved (Balluerka et al., 2015). Although these findings have established that an animal intervention is not effective for these measures, reporting the non-significant findings is particularly important as they provide valuable knowledge on what doesn't work. This in turn enhances the field by adding to the knowledge base, ensuring future research concentrates on potential trends and other areas which animal interventions may be a successful solution for. The trends and potential new areas where animal

interventions may be beneficial are often discovered from previous research. For instance, Ewing and colleagues failed to find a significant difference on the measures they used but have reported improvements due to anecdotal evidence, i.e. observations and opinions of parents and staff (Ewing et al., 2007). Similarly, other case study designs also reported the results in a descriptive manner (Funahashi et al., 2014; Jenkins & DiGennaro Reed, 2013). These are useful observations which can be followed up in a systematic way using scientifically rigorous and methodologically strong research projects. Following these reports is important as it is not clear whether these differences will be seen if the design on the research included a quantifiable measure in a large sample or whether they are specific to the small number of individuals. From this it is important to note that further exploration is also needed when research included few participants (Grigore & Rusu, 2014; Stevenson et al., 2015) or adopted a case study design (Ewing et al., 2007; Funahashi et al., 2014; Silva et al., 2011).

In sum, future research needs to be designed in a scientifically rigorous way, and reported appropriately. It is important to state effects sizes and lack of effects. If beneficial effects are seen, this could be used for future, more in-depth research building on, for example, initial case study research (Ewing et al., 2007).

3.4.6 Recommendations for future research

From the evidence presented in this systematic review it can be concluded that overall AAls for children with special educational needs with different animals had an effect on different factors, for example improvement in behaviour (Anderson & Meints, 2016; Ajzenman et al., 2013; Chardonnnes, 2009; Cuypers et al., 2011; Dilts et al., 2011; Gabriels et al., 2012; Gabriels et al., 2015), social skills and relationships (Balluerka et al., 2015; Becker et al., 2017; Borgi et al., 2016), stress (Beetz et al., 2011) and motor skills (Borgi et al., 2016; Cuypers et al., 2011).

Concerning the method, overall, future research should aim to have stricter and clearer protocols and design to strengthen the knowledge base and provide a more informed and

specific picture of the effects of AAI. In order to do so the following recommendations are made:

- Inclusion of children with various special educational needs, challenging behaviours and comorbid disorders, but ensuring strict supervision so safety and animal welfare are not compromised.
- Limiting the exclusion criteria to recruit a sample of participants representative of the special educational needs population.
- Sufficiently large sample size to ensure that findings are meaningful and can be generalised to similar populations.
- Recruitment from a wide socio-economic and geographical area ensuring a variety of participants are able to take part (i.e. high/low SES; living in town/village/rural area).
- AAI sessions to be available where the child attends the educational/care setting, during the time the institution is open to ensure children that live in more rural communities can take part in AAI interventions.
- Transparency with all detail needed for replication in reporting information on participants, recruitment, drop out and protocols, safety and welfare issues.
- Participants to be randomly allocated to conditions to ensure effect from AAI sessions is not biased or use stratified randomisation if appropriate.
- Pre- and post- assessment of AAIs must be completed as a minimum requirement to establish whether there is an effect. It is suggested that the researcher testing the children should be blind to the research aims and which condition the child has taken part in. In addition to this, assessment data should be collected through self-, parent- and teacher-reports where possible. Observational data of the AAI sessions should also be obtained. This will ensure that the results will show a complete picture of the intervention.
- Ideally there will be a control group, or, a waitlist control where possible to ensure participants taking part in the study. A waitlist control would give participants a chance to take part in the interaction with the animals and avoid disappointment.

- Animals which can cause serious injury such as dogs and horses must be assessed for suitability by an independent assessor prior to taking part in an AAI.
- An animal handler who is aware of the animal's stress signals should be present at all times during AAI sessions for all animals taking part in interventions.
- Animal welfare considerations should be written and communicated to all involved in the research prior to the research commencing and these must be observed at all times.
- Participants must be taught about safe behaviour with the animals and, ideally, also about their distress signalling. If allowed to handle animals, they must be instructed how to conduct themselves safely. This does not replace monitoring of all interactions by the handler.
- All results should be reported, even if they are non-significant. This will ensure that a large, robust evidence base is created with significant findings instead of anecdotal evidence.

3.4.7 Consequences for current research

In light of the research presented here and the strengths and limitations emphasised, this PhD thesis aims to enhance the findings within the field of AAI and more specifically dog-assisted interventions. Children with higher and lower ability from special educational needs schools were included. They were assessed on a range of measures and in different areas of development prior to taking part in the intervention sessions.

In addition to the methodological concerns highlighted above, gaps in child development research with special needs' populations also became evident. Open questions concern the effects of AAI on receptive and expressive language, cognitive abilities, self-esteem and anxiety, empathy and systemising as well as children's stress levels. Furthermore, longitudinal evidence is scarce and little evidence exists as to the effectiveness of group versus individual interventions. Hence, the current research addresses these areas of research to provide a more comprehensive image of the effects of AAI.

The details of the current research areas and related background research on the research topics of language, cognitive development, self-esteem and anxiety, empathy and systemising and children's stress levels will be presented next in this chapter, culminating with the hypotheses for this project.

3.5 The Current Research in Detail

The current research aimed to investigate the effect of a dog-assisted intervention (DAI) on different measures and in different areas of child development for children attending special educational needs schools. Children's baseline cortisol was measured, and they were assessed on their language and cognitive ability, executive functioning and socioemotional factors (anxiety and self-esteem). Data was also collected from parents on socioeconomic status, pet ownership, empathy and systemizing ability and behaviour. Teachers completed a questionnaire relating to each child's behaviour in the classroom. Further details on the research of these measures for children with special educational needs and the rationale for choosing these measures will be presented in section 3.6 below ("Purpose of Current Research").

The children who took part in the DAI were compared to an active control, where they followed a relaxation intervention. The relaxation sessions were similar in length and structure to the DAI. There was also an additional no-treatment control group, which both intervention groups were compared to. In addition, both the DAI and relaxation intervention were provided on one-to-one or group basis to two different cohorts to establish if there were any differences between treatment types. Aside from assessing pre- to post-intervention differences, the children were also assessed longitudinally at 6-weeks, 6-months and 1-year after the initial interventions to establish any short, mid- and long-term effects. The longitudinal effect was important in terms of longevity of the intervention effects. Findings will enable professionals to schedule AAls to be administered again once the effect is no longer present. This will prevent unnecessary working hours to dogs and handlers. Figure 2 shows a flow chart of the current research.

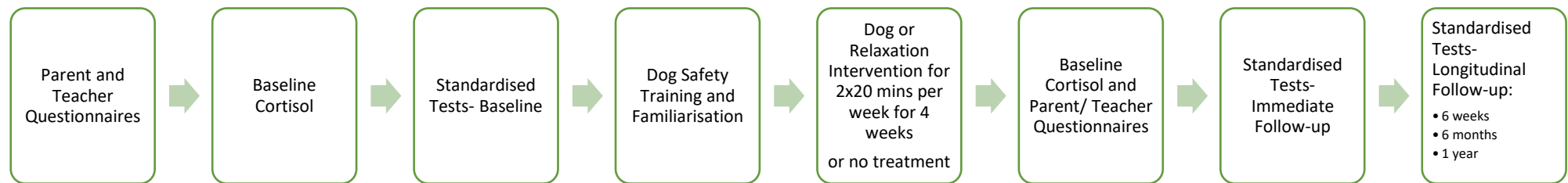


Figure 2: A flow chart of the current research

3.6 Purpose of Current Research

The main purpose of the research was to establish if a DAI provides benefits for children with various special educational needs (SEN) compared to other interventions and a no-treatment control group. As the systematic review (Chapter 3) has shown, there is limited research with this population. The current study examines cognitive and language abilities as well as behaviour, socio-emotional and physiological measures and the effect of DAI on these. As longitudinal data is lacking overall, this research project was carried out longitudinally. In addition, as effects of group and individual interventions are also unclear, these were also assessed.

Children were not excluded on basis of their ability in order to gain findings representative of children attending SEN schools. The project included children with any impairment as there may be potential beneficial effects from the interventions for all children, including children who were least likely to progress. This has implications for future provisions within schools. This was also particularly important as any improvement may also affect educational attainment, disorder prognosis and quality of life for the children as well as their families and carers.

Some measures were only collected pre- and post-intervention: teacher questionnaires establishing behaviour at school; parent questionnaires on family background, pet ownership, behaviour at home, empathizing/ systemizing ability, child's disorder and behaviour; saliva samples taken from the children to measure baseline cortisol. The remaining measures were collected longitudinally: children completed standardised tests to assess their language and cognitive tasks. Questionnaires on self-esteem and anxiety were administered. Children also completed experimental tasks: Fruit Stroop to measure executive functioning and a reaction-times categorisation task. Overall, these measures were selected to provide a comprehensive understanding of the child's level of development as well as measure potential changes due to the interventions with standardised tools and other tasks. The research and measures within each area of

investigation chosen for this project will be presented next in relation to children with special educational needs.

3.6.1 Language

Due to the limited evidence of the effects of AAI on children with special educational needs' language, in the current PhD thesis, language comprehension tasks for children of all ability were administered as well as a production grammar task for the more able children.

Substantial research evidence indicated that children with special educational needs were delayed in the area of language and communication despite the importance of the ability to communicate. The research relating to children with special educational needs and language will be presented here.

Language is a complex domain including phonetics and phonology, morphology, syntax, semantics and pragmatics, and both, the reception and/or production of language can be affected for various reasons. As a result, children can show different deficits and/ or delays relating to language development even if they have a somewhat similar diagnosis. For instance, one study has compared the profile of young children with Autism Spectrum Disorder to children with wider Autism Spectrum Disorder traits and children with other language / developmental difficulties. Children with Autism performed significantly worse on the receptive and expressive language tasks from the Muller Scales of Early Learning (MSEL) standardised measure at 18 and 24 months compared to the other groups (Barbaro & Dissanayake, 2012). Furthermore, differences between children with ASD and children with Asperger's Syndrome have also been established, suggesting that development differs for children depending on their place on the Autism Spectrum. In support, previous research found that when children with ASD develop a certain level of language fluency, they showed similar patterns of language learning to children with Asperger's Syndrome who showed these patterns of learning at a younger age (Szatmari et al., 2000). Furthermore, research by El Sady and colleagues compared children with ADHD and language impairment to children who are delayed in their language only, without a diagnosis of ADHD. The findings

suggested that children who have ADHD and a language delay have poorer receptive language skills compared to children with language delay who did not have ADHD. However, when investigating children with an IQ of 90 or above on the expression of sentence formulation, the children with ADHD and language impairment had better expression (90%) compared to the children with language delay only (58%) (El Sady, Nabeih, Mostafa & Sadek, 2013). Further support for language ability being affected by on the underlying disorder is shown from research with children with Down's Syndrome and typically developing peers. Participants were matched using the mean vocabulary size and a mean chronological age of the typically developing children with the mean developmental age of the children with Down's Syndrome. When comparing these participants, children with Down's Syndrome had a simpler vocabulary composition, used higher number of transitional forms and a less frequent production of multi-word utterances. Furthermore, children with Down's Syndrome were able to produce word combinations but used less morphologically complete sentences (Zampini & D'Odorico, 2011).

The research selected here demonstrated examples of variability across language ability for children with various special educational needs. While this cannot be covered exhaustively within the limits of this PhD thesis, these examples are important to highlight the importance of language and how it can be differentially affected. It is also crucial to be aware of the association of language ability to other developmental areas. For instance, expressive language and nonverbal cognition at the mean age of 30 months can be a predictor for reading performance at a mean age of 5 years and 6 months in typically developing children, supporting the hypothesis that early language skills are a foundation for reading and academic ability in the future for children with ASD (Davidson & Ellis Weismer, 2014). In addition, language skills may facilitate other improvement of social impairment in children with ASD – for example, children with early language advantages were likely to engage more in social situations which provided them with the opportunity to better understand these situations in the future (Bennett et al., 2013).

Further support for language facilitating other skills comes from research which indicated that early language as well as nonverbal skills predict the outcomes of adaptive behaviour and communication in children with ASD until at least the pre-adolescent stage of development (Szatmari, Bryson, Boyle, Streiner & Duku, 2003). When investigating language ability and other developmental areas for children with Down's Syndrome, Zampini and D'Odorico (2009) established that the gestures children communicate with at 36 months were related to their psychomotor development and word comprehension, but not production. However, when following children up, it became apparent that the gestures at 36 months were significantly correlated with vocabulary production at 42 months, but this relationship appeared to be mediated by the child's word comprehension.

Due to the link between language and other areas of development, understanding language development for children with special educational needs is vital. This will enable the provision of early intervention which is likely to positively affect the rate the child develops at (Rogers et al., 2012). More specifically, children with a hearing impairment have shown better vocabulary and verbal reasoning when enrolled earlier onto a language program (Moeller, 2000). These early interventions to improve children's language ability were also likely to reduce the challenging behaviours as children with ASD and severe speech impairment expressed themselves in school using challenging behaviours (Chiang, 2008). Lecavalier, Leone and Wiltz (2005) showed that reducing these behaviours as a result of improved language also had an impact on teachers and parents as behavioural problems were strongly associated with parent and teacher stress.

Despite the importance of understanding language development in children with special needs in order to create effective interventions and improve outcomes, empirical and scientifically rigorous research for AAI to facilitate language and communication development is still lacking. For instance, Animal-Assisted Intervention (AAI) research so far has shown some significant improvements for children who were delayed in different areas of development. Children identified as having a language deficit, learning deficit or underdeveloped social skills followed instructions better to complete the tasks when in the

presence of a dog (Gee et al., 2009). Furthermore, there is limited evidence to date on the positive effect of AAI on expressive language for children with ASD, with research indicating that horses elicit positive improvements on language development (Gabriels, et al., 2012). However, research has not yet investigated the direct effect of dog-assisted interventions on language development.

As a result, the current project investigated the effect of dog-assisted intervention on language development, more specifically comprehension (receptive skills) and grammar/production (expressive skills) for children with various special educational needs with a range of abilities. As the research was set up in schools it lends itself to replication. If any effects should be found, providing an alternative intervention such as DAI to aid the development of children who are delayed compared to their typically developing peers would be very beneficial.

Furthermore, research with children with special educational needs to date has not established how improvement in one area where the participant was established to have a delay would affect other areas of development. It was not clear whether, if an improvement in language comprehension was evident, this would also be visible in language production and vice versa. As a result, it is important to investigate both areas of language development in children with various special educational needs.

The current research has utilised the standardised measures British Ability Scales-3 (BAS-3) and Assessment of Comprehension and Expression (ACE) to assess language in child participants with special educational needs. The results of the children who took part in a DAI or relaxation intervention were compared with the results of the children who continued to attend their lessons as usual (control). Some of the children were severely delayed in their language ability while others were working at a level appropriate for their chronological age. The aim was to investigate whether the interventions impacted on children's language and if this effect was similar for children of all abilities. Furthermore, for the children working at the level close to their chronological age, the question of whether both comprehension and grammar/production improve similarly with the interventions

provided was also asked. These results will enable recommendations to be made to schools of which intervention was most beneficial and the children with which profile were most likely to benefit.

3.6.2 Cognition

As there is also limited evidence of the effects of AAI on children with special educational needs' cognitive abilities, the current research addresses this. More specifically, verbal and fluid reasoning as well as spatial ability was investigated through standardised tasks in the British Ability Scales. Executive functioning and inhibition will be measured through a Fruit Stroop task.

Research emphasised the difference in cognitive ability across children with various special educational needs. Previous research has found that the diagnosis of the child influenced their ability on cognitive tasks. For instance, children with Down's Syndrome had better visuo-spatial ability than verbal ability (Silverman, 2007). In contrast, children with disabilities such as Williams Syndrome had a visual-spatial impairment (Atkinson et al., 2001). Some findings would suggest that these impairments were maintained throughout the lifespan as children diagnosed with a mild cognitive delay who had functional language and cognitive ability have shown similar non-verbal ability across all ages (Joseph, Tager-Flusberg & Lord, 2002). However, research for children with Down's Syndrome indicated that a therapy encouraging the practise of the skills in deficit resulted in their improvement which boosted the children's academic ability (Nadkarni, S & Ashok, 2012).

Further to this, research established cognitive differences for children with the same diagnosis possibly due to factors other than the diagnosis itself. For instance, when investigating the cognitive profiles of children with ASD, there was no evidence of a modal profile. Research by Mayes and colleagues established that children with ASD with low IQ showed significant verbal and non-verbal increases in IQ over time, whereas those in the high IQ group only showed significant increases in verbal IQ over time (Mayes & Calhoun, 2003). Aside from the variation seen in children with ASD, children with maths and reading learning disabilities showed different maths-related deficits to children who only had a maths

learning disability which indicated a different developmental pattern (Geary, Hamson & Hoard, 2000). This emphasises the fact that despite both groups having a maths learning disability, there was a difference in development. Further to these between and within condition cognitive differences, research also suggested that deficits differ with the child's age of development. Preschool age children's verbal IQ showed a lag, which was no longer seen by the time children reached school age (Mayes & Calhoun, 2003).

The differences discussed so far emphasised the varying cognitive challenges of children with special educational needs on cognitive ability. The current research has included children of all abilities and with various special needs and diagnosis. Although this will result in more individual variations it was important to establish which children the AAI interventions would be most beneficial for, taking into account their personal difficulties. This is particularly important as AAI may not benefit all children in the same way and the improvement may be related to the child's individual profile. In light of these differences in cognitive profile, the research which established the more specific cognitive areas of development, assessed in the current project will be discussed next.

3.6.2.1 Executive functioning

An area of cognitive ability which is under-researched for AAI and which was investigated in the current study was executive functioning. Executive functioning is a set of processes including multiple neural networks which aid the achievement of future goals (Welsh & Pennington, 1988).

Previous research in this area established the difference between children with Down's Syndrome and children with other learning disabilities (non-Down's Syndrome). The children with Down's Syndrome performed significantly worse on some of the executive functioning measures (Rowe, Lavender & Turk, 2006). This advocated for the idea that different diagnoses inevitably showed a difference in levels of development, leading to different outcomes. However, this was not true for all diagnosis, with some deficits not being diagnosis specific, as found by research conducted with participants with ASD, ADHD, ODD

(Oppositional Defiant Disorder)/ CD (Conduct disorder) for those with ADHD and ASD (Carter Leno et al., 2017).

On the contrary, research with children with 22q11.2 deletion syndrome which incorporated the severity of ADHD and ASD found that children's deficits of executive functioning were dependent on their disorder and severity. For instance, children with higher severity of ASD had poor cognitive flexibility, inhibition and high distractibility, whereas poor quality of sustained attention and high distractibility were related to severity of ADHD symptoms (de Sonnevile et al., 2018). In addition to this, research which investigated executive functioning in children who used to have ASD but no longer met the criteria: optimum outcome group (OO), children with High Functioning Autism (HFA) and typically developing (TD) children found that all children had average executive functioning. However, children in the OO and HFA groups scored higher in terms of impulsivity and were less efficient when planning and problem-solving compared to the TD group. The participants with HFA showed below average inhibition compared to the OO and TD groups. The parent-report measures indicated that the OO group showed more difficulty on the set-shifting and working memory compared to TD group. Furthermore, HFA group demonstrated more difficulty on all parent-report executive functioning (Troyb et al., 2014). These results indicated differences of executive functioning for children with underlying learning difficulties even when children show average functioning overall, perhaps suggesting that certain tasks which lack sensitivity may not pick up the difference between children with different diagnosis but similar ability profile.

Although the research presented so far investigated children with different diagnosis, children with the same diagnosis can also vary in terms of their cognitive profile. For example, children with Down's Syndrome have varying cognitive profiles when considering severity and type of cognitive area affected (Lott & Dierssen, 2010). The same was evident for children with high functioning Autism and Asperger's Syndrome who completed a processing task. Children with High Functioning Autism were equally fast at completing the tasks in the visuospatial and visuospatial and semantic conditions, when visuospatial

strategies were available. However, children with Asperger's Syndrome and typically developing controls were faster at the visual and spatial condition (Sahyoun, Soulières, Belliveau, Mottron & Mody, 2009). In contrast, research using an executive functioning task found that young children with ASD did not have a different pattern of impairment compared to children with developmental delay (Dawson et al., 2002). This supported the previous point that profiles may not be diagnosis specific, or that they begin to appear different in later life. Further support for this notion was evident from executive functioning research between children with ASD and those with an intellectual disability, which found no significant between-group differences (Roelofs et al., 2015). Although the research discussed so far has not been consistent in finding between-group differences, van Eylen, Boets, Steyaert, Wagemans and Noens (2015) suggested that most of the differences were likely to be due to the tasks presented.

The research presented here establishes the deficit which children with special needs show in terms of their executive function. As executive functioning is an important area of development, children should be provided with suitable interventions in an attempt to enhance this skill. Within the area of AAI, research has not established whether Dog-Assisted Interventions can enhance the executive functioning skills of children with special educational needs and if so, how long the effects last for. The current research closes this knowledge gap.

3.6.2.2 Fluid reasoning

Another area of cognitive development research which is thought to be linked to executive functioning is fluid reasoning (Engle, Kane & Tuholski, 1999). It has been established that children with Asperger's Syndrome performed better on a task compared to typically developing children, which indicated superior fluid intelligence (Hayashi, Kato, Igarashi & Kashima, 2008). Such ability enabled children to think logically and problem solve, without considering any prior knowledge (Cattell, 1987). However, in a research where children with ASD were matched to typically developing children by age and IQ, the performance for both

groups was the same on reasoning tasks requiring analogical reasoning, real-world knowledge and inhibition of salient distractors (Morsanyi & Holyoak, 2010). Such differences indicated that children with varying profiles who completed different reasoning tasks show diverse patterns when compared to typically developing children. However, this does differ based on the participants taking part and the task itself. Research has established that children with ADHD were faster but less accurate in the fluid reasoning condition compared to non- ADHD controls. In addition to this, children with ADHD showed hypoactivation in regions critical for fluid reasoning on an fMRI scan (Tamm & Juranek, 2012), suggesting that performance on such tasks can be related to physical differences in the brain. However, further research into the activation of different brain areas is needed to establish if they are task/ ability specific.

Support for this comes from research which has established that providing a non-verbal reasoning intervention to young children improved their fluid intelligence (Bergman-Nutley et al., 2011). This indicated that areas of cognition influence each other and as a result, similar areas of the brain may be activated. An investigation using mental rotation tasks established that children with Down's Syndrome presented with similar patterns to typically developing children. In more detail, children's results on the task indicated that there was a relationship between mental rotation task, children's fluid intelligence and spatial activities (Meneghetti, Toffalini, Carretti & Lanfranchi, 2018).

The various aims and tasks used within the research discussed here showed that cognition is a complex ability to investigate, where some areas were improved with interventions for some individuals which was not always the case for other areas. Furthermore, cognitive development of a child is important as it is also linked to language development and communication. In addition, the assessment of children's verbal and non-verbal skills were relevant to diagnostic differences between the subtypes of ASD when diagnosing very young children (Chawarska, Klin, Paul, Macari & Volkmar, 2009). This relevance to other areas of development and clinical diagnosis emphasised the importance

of conducting research into the area of cognitive development and the search for potential interventions to enhance it.

One such intervention which could enhance cognitive development for children with special educational needs is AAI. Research has already established some benefits of such interventions on areas of cognitive development, such as memory (e.g. Gee et al., 2010a), but the body of research is limited. The current research investigated different areas of cognitive development for children with various special educational needs, using standardised tests and experimental tasks. These areas of development were non-verbal reasoning, spatial awareness, verbal reasoning and executive functioning. The findings were used in providing guidance on the effect of AAI in schools in relation to cognitive improvement for children with various special needs. Other areas of development have also been found to be affected for children with special needs which have been measured through physiological and behavioural factors which were presented next.

3.6.3 Socio-emotional factors, behaviour and physiology

Children, particularly those with special educational needs can show differences and/or deficits in socio-emotional areas, for example self-esteem, anxiety and behaviour. They can also show different or elevated stress levels. These measures lack longitudinal exploration and were therefore collected in this research through questionnaires and physiological data for children with developmental and learning difficulties. The aim was to clarify the effects of DAI on socio-emotional measures over time, and for individual versus group interventions.

3.6.3.1 Self-esteem research

Children with learning difficulties which have no impact on the child's IQ (e.g. dyslexia) had significantly lower self-esteem compared to children without learning difficulties (Shah & Irshad, 2016). Looking specifically at children with dyslexia, but relating the self-esteem to different areas of academic learning, research found differences between children with dyslexia in mainstream schools compared to those attending units for pupils with specific

learning difficulties (SpLd). In more detail, children with dyslexia in mainstream schools had significantly lower levels of self-esteem relating to reading and writing ability compared to the children in SpLd and the control group. There was no significant difference in scores for the children with dyslexia in SpLd and the typically developing control group. Further to this, when investigating self-esteem related to spelling ability the only significant difference was between the children with dyslexia in mainstream schools, who had lower scores and the typically developing control group (Humphrey, 2002). In addition to these established differences, the findings between groups may also differ depending on the external environment of the child rather than the diagnosis they had. Support was evident from previous research which established that self-esteem has been linked to the individual's belief of how they were perceived by others (Leary, Haupt, Strausser & Chokel, 1998). This would in turn advocate for the children who had dyslexia in a mainstream school having lower self-esteem as they feel the children around them perceive them differently compared to children with dyslexia in a SpLd (Humphrey, 2002). Lower self-esteem was also established for children with Autism Spectrum Disorder (ASD) when compared to children without ASD (McChesney & Toseeb, 2018).

The selected research presented here would suggest that self-esteem is a complex area to research and findings may differ depending on the type of self-esteem measured and whether the participants had a disability or not. Further support for this complexity was evidenced in exploratory research which established the likelihood of a link between communication difficulties and self-esteem for adults with Down's Syndrome (Jackson, Cavenagh & Clibbens, 2014). It is likely that these links are present in children with special educational needs, too, so improving in certain areas of development (e.g. communication) may increase children's self-esteem which could be maintained into adulthood. Alternatively, improving children and adults' self-esteem may have an impact on other areas of functioning such as communication. As the direction of this relationship has not been investigated in detail, more research is needed in this area.

Nonetheless, the research indicated that some of the children with special needs have lower self-esteem which calls for appropriate intervention to improve this. Self-esteem research has shown benefits when using an interpersonal relationships intervention on perceived self-esteem and interpersonal relationships for college students (Chen, 2018). Further to this, a meta-analysis investigating the effect of physical activity interventions on self-esteem found that they were effective for children and adolescents, especially as school- and gymnasium-based interventions (Liu, Wu & Ming, 2015). Further research is needed to better understand the different types of self-esteem for children with different diagnosis. Using such findings will enable the creation of specific, target-based interventions, relevant for the individuals. To date, research within AAI has not assessed whether an intervention with therapy animals can lead to the improvement of children's self-esteem. This is a knowledge gap which needs addressing to enhance the understanding of all aspects of life that animals can help children with.

3.6.3.2 Anxiety

Researchers have also investigated anxiety in children with different issues and disabilities which will be presented next. Higher anxiety was found for children who stutter and have ASD or learning difficulties (Smith et al., 2017). Previous research found that children with learning difficulties have significantly higher levels of anxiety compared to children without learning difficulties (Shah & Irshad, 2016). This finding was also highlighted through a meta-analysis which established that children with Autism had higher anxiety than typically developing peers and this increased with IQ, emphasising that participants with high functioning Autism may be more at risk of developing anxiety disorders (van Steensel & Heeman, 2017).

However, it is also important to establish the type of anxiety being investigated. Earlier research investigated different types of anxiety for a cohort of higher education pupils with and without dyslexia, finding differences between the groups. Pupils with dyslexia had higher state, academic and social anxiety, but not appearance anxiety compared to pupils

without dyslexia (Carroll & Iles, 2006). This was similar to the self-esteem research where different types of the concept indicate a different outcome for participants with a learning difficulty. Furthermore, it was evident that for anxiety there was a significant difference for participants with a learning difficulty, but this was dependent on other factors. Research found that participants with Borderline Intellectual Functioning (BIF) and Specific Learning Disorder (SLD) had a significant positive correlation between age and anxiety, indicating higher levels of anxiety with age. However, there was also a difference between the participants with different disability as those with SLD had significantly higher levels of anxiety than those with BIF (Panicker & Chelliah, 2016). Further support was evident from another meta-analysis which found that children with ASD had higher levels of anxiety compared to a clinically referred sample and those with externalising or developmental problems (van Steensel & Heeman, 2017). This indicated that there were differences between participants with certain disorders even if they appeared to be on a similar trajectory overall.

One conclusion from these findings is that anxiety is prevalent in children with special needs and interventions are needed to reduce it. Research which established interventions to improve childhood anxiety for children with Autism and intellectual and developmental disability was limited. Some research adopted a case study design using Positive Behaviour Support and Cognitive Behavioural Therapy (CBT) to devise the treatment, which has indicated a reduction in children's anxiety (Moskowitz et al., 2017). Research has indicated that CBT interventions provided to parents only can also be effective for managing childhood anxiety (Salari, Shahrivar, Mahmoudi-Gharaei, Shirazi & Sepasi, 2018), placing emphasis on considering environmental factors.

The AAI research to date has not investigated whether spending time with animals can reduce the anxiety of children with special needs. This is particularly important as many schools have the ability to arrange animals to visit if this would be effective for those with particularly high levels of anxiety. Furthermore, this intervention would be cost effective and easy for the teachers to organise. Importantly, the benefits of reducing anxiety in children is

likely to impact on other aspects of their school life including behaviour, social interaction with others and even academic work.

3.6.3.3 Behaviour

Aside from issues with anxiety, children with different conditions and disorders can show behaviour which has been described as challenging and as a result has been investigated in different populations. Children with learning and developmental disabilities can present with challenging behaviours (Murphy et al., 2005), with diagnoses such as Autism often being accompanied by at least one challenging behaviour (Matson & Nebel-Schwalm, 2007). However, the manifested behaviours differ between children. Children with Autism for instance, showed challenging behaviours in different ways (Murphy, Healy & Leader, 2009) which can include but are not limited to compulsive, self-injurious and restricted behaviours (Gabriels et al, 2013).

The challenging behaviours (CBs) children exhibit may in part be related to anxiety or self-esteem which have been presented above. As CBs can be difficult to deal with, therefore, the importance of useful interventions is even more prominent. A meta-analysis indicated that self-management interventions for children with ASD were effective for the reduction of CBs regardless of whether the child was described as high or low functioning (Carr, 2016). Another systematic review and meta-analysis found that antipsychotic medication reduced CBs for children with intellectual disabilities in the short term but there were significant side effects (McQuire, Hassiotis, Harrison & Pilling, 2015). As with the previous areas of research presented in this chapter, further research leading to specific, effective interventions to improve CBs is paramount. To date, animal interventions to combat challenging behaviours have not been assessed. However, if challenging behaviours are likely to be connected to anxiety and self-esteem at least in some instances it is possible that AAls may be effective in improving those areas. Reducing the challenging behaviours of children with special needs is likely to impact on their and their family's wellbeing and quality of life as well as better their relationships.

3.6.3.4 Empathizing and systemizing

In addition to challenging behaviours, research has also been conducted to investigate the empathizing and systemizing behaviours, relating to the theory developed by Baron-Cohen, which attempted an explanation for Autism and autistic traits. More specifically, empathising is described as the ability of a person to understand the social world, identifying and responding appropriately to others' thoughts and emotions. In contrast, systemizing is defined as people's understanding of inanimate phenomena such as the interest in technical, motor and abstract systems. The theory suggested that a high level of systemizing paired with low empathizing predicts Asperger's traits and in some cases Autism traits (Auyeung et al., 2009). Much of the research supported this theory, comparing individuals with Asperger's Syndrome and/or Autism to typically developing peers (Baron-Cohen, Ricjler, Bisarya, Gurunathan & Wheelwrigth, 2003; Grove, Baille, Allison, Baron-Cohen & Hoeksta, 2013). Interestingly, research revealed that overall women scored higher on empathizing and men scored higher on systemizing (Wright & Skagerberg, 2012). Recent research further investigated this in the general population focusing on Autistic traits. The findings largely supported the theory as it was found that a lower score on empathizing was related to Autism social difficulties while systemizing was associated with the non-social aspects of Autism. However, this research also stated that Autism traits were more strongly related to reduced empathizing than to systemizing (Svedholm- Häkkinen, Halme & Lindeman, 2018).

Further to empathizing and systemizing being connected, other factors are also likely to be correlated with people's empathy. Research has found that empathy was related to vocabulary and executive function for participants with ASD (Cascia & Barr, 2017). In addition, a systematic review investigating empathy in women with ASD concluded that they had lower levels of empathy compared to typical males and females, but a similar level of empathy to men with Autism (Kok, Groen, Becke, Fuermaier & Tucha, 2016).

As demonstrated in the research people with Autism tend to show less empathy which can be important for interpersonal relationships. Animals may act as a facilitator for

learning about empathy, but this has not been investigated well within AAI. Further exploration will allow for the better understanding of children's ability to learn to empathise and will help to clarify whether animals can facilitate this process, potentially helping develop future human-to-human relationships.

3.6.3.5 Cortisol

Cortisol is used as physiological measure of stress with higher levels of cortisol indicating higher stress levels. As a result, it can provide support for some of the differences discussed so far and indeed be affected by them (see systematic review for overview and recommendations on best practice Dimolareva et al., 2018). Research into cortisol levels of children with high and low functioning Autism found that there was no difference in the diurnal pattern compared to typically developing peers. However, children in the low ability Autism group had significantly higher mean cortisol levels compared to the children in the high ability Autism and typically developing groups (Putnam, Lopata, Thomeer, Volker & Rodgers, 2015). Similarly, research found higher cortisol levels in children with Autism who had lower IQ scores (Kidd, Corbett, Grangerm Boyce, Anders & Tager, 2012). Furthermore, when measuring cortisol in a specific social situation for children with Autism, research indicated that younger children with Autism were more willing to approach others and have lower cortisol levels compared to older children with Autism (Schupp, Simon & Corbett, 2013). When investigating children's response to stress and novel stimuli, children with ASD had higher cortisol levels (Spratt et al., 2011). In addition, research found that although there was an association between cortisol and social motivation (motivation an individual has to engage in social-interpersonal behaviour), it was only the case when other changes occurred. More specifically, cortisol was only higher at a time when there was a lack of teacher-driven social allocation to peer groups, which in turn took away the similarity and predictability of the situation (Bitsika, Sharpley, Agnew & Andronicos, 2015). Further support for external factors and lack of consistency increasing cortisol levels for children with Autism was evident from other research which investigated cortisol in social situations. In detail,

Lopata and colleagues found that children with high functioning Autism had higher cortisol levels in a social situation with an unfamiliar peer, especially when the interaction was the day after the participants spent time with a familiar peer. This effect was not present if the participants spent time with the unfamiliar peer first. This finding based on order of interaction suggested that the change and unexpected occurrence may play a part in the increase of cortisol secretion rather than the social situation with a stranger alone (Lopata, Volker, Putnam, Thomeer & Nida, 2008).

Researchers also manipulated the same social situations to establish when cortisol would be lower. When investigating stress situations for typically developing children and the effect of their social support, children who had no social support, had increased cortisol and perceived stress levels compared to the children who completed the tasks with a parent or with their pet dog. Furthermore, it was found that the pet dog significantly buffered the findings of the perceived stress measure. The only difference for the cortisol measure was that the cortisol response levels were associated with more child-initiated petting of the dog for the children in the pet dog condition (Kertes et al., 2017).

As a potential measure of stress, cortisol has been discussed here. Most of the research presented indicated higher cortisol for children with special educational needs (e.g. Putnam et al., 2015; Kidd et al., 2012), as a result it was important to understand when cortisol rises and the interventions to reduce it. Research found that exercise and relaxation interventions reduced cortisol levels in adolescents and young adults with Autism (Hillier, Murphy & Ferrara, 2011). However, more recent research also found that mental training, more specifically teaching intersubjective skills via socio-affective and socio-cognitive routes reduced cortisol levels, potentially reducing chronic social stress related illnesses (Engert, Kok, Papassotiriou, Chrousos & Singer, 2017).

Within the area of AAI some research has investigated the effect of animals on cortisol changes (e.g. Beetz et al., 2011; Gabriels et al., 2013), but no-one to date has provided an intervention within a school to assess the changes in cortisol. It is suggested

that the calming nature of the animals in school are likely to make the environment less stressful, but this hypothesis requires rigorous assessment.

The research here emphasised the differences in development in children with various special educational needs. Furthermore, limited interventions have shown an improvement in certain areas of development, but research has omitted to assess different areas of development and how these may be affected by the same intervention. This is particularly the case for areas which appear to affect each other (e.g. challenging behaviours, anxiety, stress measured by cortisol) and their impact on other areas of development (e.g. cognitive and language ability/ communication). This gap is particularly prominent when assessing the AAI literature. Further to this, such extensive research has not been done in an educational setting, neither has it been done longitudinally, or for group versus individual AAls.

3.7 Uniqueness and Importance of Research

The current research provided findings followed by recommendations for future research and practise. By including standardised and objective physiological measures as well as parent, teacher and child reports, a comprehensive picture of the effect of the interventions provided was established. Furthermore, this allowed for the ability to establish how one intervention affected areas which were connected such as anxiety, challenging behaviour and stress (measured by cortisol).

The comparison of individual and group interventions further clarified when the interventions were most effective. The research findings established best implementation practice with highest efficacy, less working hours for the animals and overall best cost-effectiveness of AAls. This will inform future practise for AAI professionals and school staff who incorporate AAls in order to aid children's development and enhance their lives.

3.8 Hypotheses

Having reviewed the research and presented the theory upon which the current research is based, the following hypothesis are proposed:

- Intervention effects are expected to be strongest in the dog-intervention group and intermediate in the relaxation intervention, with no effects or only maturation effect occurring in the no treatment control group.
- Immediate improvements after interventions will be stronger than longitudinal effects.
- Both individual and group DAIs will have a beneficial effect on the tested measures for children with special educational needs.
- Pet ownership will not have an effect on the benefits of AAI and relaxation intervention.

Chapter 4: Method

4.1 Overview

This research adopted a longitudinal design to assess whether the interventions provided had an impact on different areas of children's development. The assessments were completed pre-intervention (baseline measure) and immediately after the intervention period. The participants were then followed up 6 weeks, 6 months and 1 year after the intervention period to assess any longitudinal benefits. Children took part either in a dog intervention, relaxation intervention or a control group (attending lessons as usual). One of the aims was to provide more detail of which areas of development an animal intervention was likely to enhance and whether this differed when compared to a relaxation intervention.

4.2 Participants

4.2.1 School Children with Special Educational Needs (SEN)

Participants ($N= 157$, 8-11-year-olds, $M= 9.12$, $SD= 0.91$) included 128 male ($M= 9.09$, $SD= 0.91$; range: 8.0- 11.5 years) and 29 female ($M= 9.28$, $SD= 0.92$; range 8.6- 10.9 years) students from schools in Lincolnshire and Gloucestershire. All participants had a statement of special educational needs and / or a healthcare plan. From the participating children whose parents provided information on their diagnosis: primary diagnosis of ASD ($N= 43$); ADHD ($N= 15$); ASD and ADHD ($N= 18$); multiple and profound learning difficulties ($N= 11$); other severe special needs such as severe learning difficulties due to another primary diagnosis ($N= 25$); Global Developmental Delay ($N= 16$); Down's Syndrome ($N= 5$); Attachment Disorder ($N= 4$). For 20 of the children parents did not provide information on their diagnosis. From the parents who returned the family and pet questionnaire, 70 parents answered the question regarding SES; 33 children were from families classed as low SES (yearly household income below £24 000) and 37 children were from families classed as high SES. Some parents ($N= 85$) provided information about pet ownership, 67 children had a pet at home and 34 children had a pet dog.

4.2.2 Dog and handler team

All of the dogs except for one had been previously assessed and were certified and insured as therapy dogs through one of two charity organisations: Pets As Therapy (PAT) and Therapy Dogs Nationwide (TDN). For one dog, a separate assessment and insurance was obtained. In addition, all dogs who were assessed via PAT or TDN, also underwent another, thorough assessment with an experienced dog behaviourist prior to taking part in the project. Behaviour and temperament of the dogs were assessed in a busy environment, when they were interacting with strangers - both children and adults. The breeds and sizes of the dogs varied. They included, but were not limited to Labradors, Greek Hound cross, Cavalier King Charles Spaniel cross Poodle and Tibetan Mastiff.

To ensure the safety and welfare of children taking part all dog handlers had a current enhanced Disclosure and Barring Service (DBS) check. The researcher was always present during the dog intervention sessions, so the handlers were never alone with any of the children.

4.2.3 Experimenter

The experimenter (MD) had 2-years-experience working with children with special educational needs on one-to-one basis as Applied Behaviour Analysis Therapist and Senior Therapist. Continuity in testing and all procedures was ensured as the researcher completed all baseline and follow-up testing sessions as well as intervention sessions.

4.3 Materials and Measures

4.3.1 Language standardised assessment: Assessment of Comprehension and Expression (ACE)

The Assessment of Comprehension and Expression (ACE) (Adams, Coke, Crutchley, Hesketh & Reeves, 2001) is designed to measure language abilities in children and can be

used to identify any language delay for children aged 6-11-years. It was suitable for the children with special educational needs in the higher cognitive and language ability group. The standardised scores, percentile ranks and confidence bands are available for each subsection, allowing flexibility and choice for the researchers. Two subscales of the ACE were of interest for this study: one to measure comprehension (Verbal Comprehension) and one to measure grammar/ production (Syntactic Formulation). These tasks were administered to each child individually and the answers recorded on the scoring sheets as per the manual. The children had to continue with each task until the end, there were no options to finish early. Children were aided on both tasks by picture representations. For every correct answer the child received the correct number of points as per the instruction manual. The total number per task was then converted to a standardised score, using the age appropriate scale provided.

4.3.2 Cognitive standardised assessment: British Ability Scales (BAS-3)

The British Ability Scales (BAS-3) (Elliot & Smith, 2011) is a comprehensive and standardised cognitive ability test which allows assessment of a range of aspects of cognition and learning as well as comparison of these aspects with the child's educational progress and is often used to assess children, including those with behavioural and learning difficulties. It is suitable for an age range of 3 years to 17 years and eleven months. This test battery has different tasks which combine to provide a standardised cluster score, allowing for the most relevant tasks to be chosen without having to complete all tasks. The tasks here were from both the Early-Years and School-Aged scales to account for children of lower cognitive ability. The more able children completed the following School-Age scale: Matrices, Quantitative Reasoning, Recognition of Designs and Pattern Construction. These tasks were chosen as they combine to provide a standardised cluster score. Children who were less able completed the following tasks from the Early Years Scale: Verbal Comprehension, Picture Similarity, Matrices and Pattern Construction. These tasks were chosen as they were the pre-requisites to the tasks in the School-Age Scale. The tasks were administered as per

the manual and the appropriate stopping points were adhered to and children completed as much of each task as they were able to, accounting for the variety in ability. It was not appropriate to calculate standardised scores for the Early Years scale as children were significantly delayed compared to typically developing peers. In addition, for the pattern construction there are two scoring methods. The alternative scoring was based on whether the child replicated the pattern correctly (i.e. 0= incorrect, 1= correct). The standard scoring was based on the time it took to complete the pattern, with scores ranging from 0 to 5 (the faster completion resulted in a higher score). The scores for the children in the high ability group could be calculated either using the alternative or standard scores. For the very low functioning children from the low ability group (those using the wooden blocks), it was only possible to use alternative scoring.

Using both test batteries Early-Years and School-Aged ensured that children with lower cognitive ability were able to take part. As the children taking part had various special educational needs and abilities, each child completed the tasks suitable for their ability.

4.3.3 Physiological measure of salivary cortisol

Samples were obtained to assess whether treatment conditions (dog/relaxation/ no treatment control) had an effect on children's baseline cortisol in children. Recommendations from a systematic review assessing cortisol collection in schools and setting guidelines by Dimolareva et al. (2018) were followed together with the guidelines from Salimetrics. A strict protocol for the current study was devised prior to collecting saliva samples with clear instructions.

Baseline salivary cortisol was collected at school from children before baseline testing sessions. This was done on 3 consecutive days at roughly the same time for each child, between 9.30am and 10.15am. The collection was then repeated, following the same protocol, straight after the 4-week intervention and before the immediate post-intervention assessment (Test 2). Some children only provided 2 samples at the second time, for example, due to sickness or other commitments such as trips and pre-booked holidays. At

times the large distance between different schools made it impossible for the researcher to commute between schools within the timeframe to collect all three saliva samples. Where possible teachers were trained to assist with the saliva sample collection.

First, all children who were going to provide a saliva sample rinsed their mouth with water and waited around 3 minutes before providing the saliva sample. During this waiting period, children were asked to spit into a 4ml cryovial and attempt to fill it to the line which indicated 1.0ml. While doing this, children were asked to hold the vial at the bottom and not touch the top. The researcher closed the lid to ensure that the children were not touching the inside of it and thereby potentially contaminating it. Attempts to get saliva samples were made for all children. To ensure the children understood, verbal explanation was given to some children, while others needed the spitting to be imitated. For other children it was a case of collecting the saliva from the children's mouth before drooling. As some children were anxious around new people, teachers and teaching assistants helped with the collections of the samples having received instruction on how to do it and while the researcher was present or after having read the strict protocol. All cryovials were placed in a pathology bag which contained ice blocks. Samples were transported to the lab as soon as possible (usually around an hour after collection but no later than 6 hours after collection) where they were stored at -20° C for up to 5 working days before being transported to be stored at The University of East Anglia specialised cortisol analysis labs until analysis were conducted there. Samples were destroyed after analysis. The protocol (Appendix 1) was devised based on the advice given by Salimetrics and recent literature (Saliva Collection and Handling Advice, Salimetrics, 2015; Dimolareva et al., 2018).

4.3.4 Standardised self-report Culture-Free Self-Esteem Inventory (CFSEI-3)

The Culture-Free Self-Esteem Inventory (CFSEI-3) (Battle, 2002) is a standardised self-report measure (yes/no answers) consisting of 29 questions for establishing children's level of self-esteem. It is standardised for pupils aged 6 years to 18 years 11 months and can be administered to individuals or groups. On this occasion it was administered on one-to-one

basis and the researcher read out the questions to the children. A score was given for the questions which indicate higher self-esteem. The total score could be compared to the score of other children's self-esteem.

4.3.5 Standardised self-report Revised Children's Manifest Anxiety Scales (RCMAS-2)

The Revised Children's Manifest Anxiety Scales (RCMAS-2) (Reynolds & Richmond, 2008) is a standardised self-report measure (yes/no answers) which assesses the level of individual children's anxiety. It is standardised for children aged 6 years to 19 years. In this project, the short form of the measure was used, which consisted of 10 questions. The researcher administered this questionnaire on one-to-one basis with each child, reading out the questions. A score was given for any positive response to a question relating to anxiety. Children could score between 0 and 10, with zero meaning low/ no anxiety and 10 indicating high anxiety.

4.3.6 Teacher-report: Child Behaviour Rating Scale (CBRS)

The CBRS (Bronson, Goodson, Layzer & Love, 1990) is a standardised teacher questionnaire to establish the behaviour and attitudes of children within the classroom. A questionnaire was completed for each child before and after the intervention to establish change in behaviour at school due to the interventions. The questionnaire consisted of 17 questions where 10 related to self-regulation and 7 questions related to social skills. The final scores were calculated by the researcher by adding together all the points. The higher score represented better self-regulation and social skills- i.e. better behaviour.

4.3.7 Parent-report: Empathizing/ Systemizing Quotient (EQSQ)

The EQSQ (Auyeung et al., 2009), is a standardised questionnaire comprising of 55 questions. It measures children's tendency towards empathising and systemising activities. The questions give 4 options ('definitely agree', 'slightly agree', 'slightly disagree', or

‘definitely disagree’) for parents to choose from. Parents completed this questionnaire before and after the intervention allowing the researcher to investigate whether there was a change in children’s tendencies as a result of the intervention, they took part in. From the 55 questions, 27 questions gave an EQ score to assess empathising and 28 questions provided a score relating to the SQ part of the questionnaire, measuring the child’s ability to systemize. The higher score for the EQ represented greater ability to empathise while a higher score as SQ represented greater ability to systemize.

4.3.8 Parent-report: Family Questionnaire

Parents completed this before the baseline testing to provide information of family background such as parental education and socioeconomic status (SES) and also the child’s health and development. There were 12 questions in total (see Appendix 2) enabling further analysis beyond this thesis. This questionnaire was used to enable stratified randomisation and allocate children equally across the three conditions based on their SES, aiming to have roughly half low SES and half high SES in each condition: dog, relaxation and control.

4.3.9 Parent-report: Pet Ownership Questionnaire

This questionnaire was completed by parents before the intervention and consisted of 13 questions asking parents about family pets, dog ownership, parent’s and child’s experience with animals (see Appendix 3). Children were assigned equally across the three conditions (dog, relaxation, control) based on their family’s dog ownership. The aim was to stratify into each condition half of the children who live with a dog and the other half who do not.

4.3.10 Parent-report: Behaviour at Home

This questionnaire (Appendix 4) was devised by the research team and questions were split into three sections: attitudes towards school, being cooperative and accepting social rules at home and social-emotional ability in general; with 6 questions in each section, totalling to 18 questions. The questions were presented on a Likert scale where 1= never and 5= always.

This enabled the researcher to have a score for each area as well as a total score. A standardised questionnaire was not used as they were often too lengthy, especially as an addition to the other questionnaires for parents. Furthermore, the standardised questionnaires were not asking all of the questions of interest for this research. Parents completed this questionnaire before and immediately after the 4-week intervention period, to establish any behavioural differences at home due to the interventions.

4.3.11 Experimental categorisation task

This experimental task investigated categorisation abilities in children and was amended from Gee et al. (2012b). Children were randomly presented with pictures they had to categorise as farm or ocean. Half of each category (farm/ ocean) were animate and half inanimate, with half of each typical and half atypical. As a result, each image belonged to one of four categories typical-animate, atypical-animate, typical-inanimate, and atypical-inanimate. Adobe Photoshop Elements 6.0. was used to ensure all 600 x 450 pixel jpeg images were placed on 5% grey scale background. All images were previously rated for typicality by University students ($N= 32$). The rating was completed online through Qualtrics. The most and least typical items were chosen to represent typical and atypical items.

The task was presented through Superlab Version 5. The children were asked to categorise the items using a Cedrus serial button port. The reaction time and whether the children made the correct choice were recorded within Superlab. The task was presented on a 15.6" Laptop. The children were sitting approximately 40 cm from the screen. Each child was presented with 48 images in a randomised order.

All instructions were shown on the laptop screen and read to the children. Children were asked to place the hand they normally write with on the button box provided. The button box had only 2 colour buttons which worked (the rest were white) - a blue and a green one. Children were asked to press the blue button for images that they thought belong in the ocean and the green button for images which could be found on the farm. Children were told that the game would begin when they press any button and the aim was to do it as quickly

and correctly as they can. If they were not sure which category the picture belonged to, children were encouraged to guess. The scores for each child were based on their speed-reaction times for the items accurately placed in the categories. The pictures which were inaccurately placed were not taken into account for the calculation.

4.3.12 Experimental Fruit Stroop task

The Stroop Task (Stroop, 1935) is used to assess mental processing, attention and inhibition. Participants were required to inhibit a more dominant response and provide a response for an incongruent task as a measure of inhibition. The Fruit Stroop version was adapted in this research from Okuzumi et al., (2015) and was used to ensure that children took part regardless of their reading ability as some children with special educational needs were not as academically able. The fruit used were: banana (yellow); pear (green); strawberry (red). Children were asked to recognise the fruit beforehand and what colour they should be. If children associated pears with yellow then that was taken as their correct answer instead of green. There were 3 different conditions:

- Canonical colour task: The outline of the three fruits (bananas, pear, strawberry) with tick boxes of 3 different colours (yellow, green, red) were presented. The participants had to tick the colour the fruit usually is.
- Interference colour task: The three fruits (bananas, pear, strawberry) were presented coloured in the incorrect colour, again with tick boxes next to each fruit with the correct colour options (yellow, green, red). Children were told to ignore the colour the fruit was coloured in and tick the colour the fruit normally was.
- Control: This condition presented three shapes (triangle, circle, rectangle) coloured in the same 3 colours as the other conditions (red, green, yellow). Children had to simply match the colour of the shape to the colours presented next to each shape.

For each condition children had 30 seconds to tick as many colour boxes as they can. There were 52 items in each condition which ensured children could not get to the end and therefore there would not be ceiling effects.

Each correct answer that the children gave were scored with a 1 and the total score for each condition tallied. Interference scores were calculated for Congruency (congruent and incongruent condition) and Colour congruency (shape and incongruent fruit) as well as Speed of processing (congruent fruit, incongruent fruit and shape).

Protocol for data collection is attached in Appendix 5

4.4 Design

4.4.1 Conditions

Stratified randomisation considering ability, SES and dog ownership was used to assign children into one of three conditions: dog intervention, relaxation intervention, and a no-treatment control group. This was to ensure that the children in the different conditions were similar in terms of their profile and any effects were not due to ability or external factors.

Table 3

Number of Participants per Condition

<i>Intervention Condition</i>	<i>Total (N)</i>
Dog Individual	34
Relaxation Individual	29
Control	30
Dog Group	30
Relaxation Group	34

4.4.1.1 Dog intervention

This condition consisted of sessions where participants spent time with one of the participating dogs either on a one to one basis or as part of a group. A specific protocol was followed for each session. All dogs and handlers were familiarised with the room prior to the children arriving to ensure that they were familiar and happy with the environment. The dogs

had water available at all times, and a blanket and/or toy/s were bought by the handler as appropriate for each dog. Following this, the dogs left the room and entered again together with the child/ children. This was done to avoid a situation in which a dog may protect their environment (i.e. protect the room they were in) as advised by the behaviourist who assessed the dogs for the project.

The interventions varied in terms of the content. Some sessions included the child playing a game with the dog including hiding a toy/ball, teaching the dog a new trick (e.g. to roll over), talking to the dog, learning about how to care for the dog (e.g. bathing, brushing, feeding) or what the dog likes doing (e.g. long walks, agility). The content of the session depended on the dog and handler visiting and the ability of the child. Some dogs loved playing games and being trained while others preferred to lay down and relax. Similarly, some children were able to understand the rules and purpose of the games such as hiding a toy for the dog to find, while other children were not able to do so.

The aim was for each child to have 2 x 20 minutes per week for 4 weeks with the dog on one-to-one or group basis. The scheduled number of sessions per participant (N= 8) were decided after reviewing the literature of beneficial effects from AAls. It was found that the number of sessions varied from one-off sessions where the child completed the task in the presence of a dog (e.g. Gee et al., 2007; Gee et al., 2012) to different length intervention sessions. For instance, 24 hours per week as the animals were present in the classroom (e.g. O'Haire et al., 2014) to 2x20 minutes per week for 8 weeks (O'Haire, 2015). The length of the sessions (20 minutes) was chosen so there could be 5 minutes initial greetings and contact, then 10 minutes of being with the dog and handler and talking about the dog, and another 5 minutes of potential interaction and good-bye. Twenty minutes were also suitable in terms of the intervention not getting boring and in terms of missing lesson times, ensuring a child did not miss the whole lesson. Furthermore, this duration ensured that the sessions could be completed within 4 weeks and still provided time for the cognitive, language, socio-emotional and physiological in-person assessments and measures immediately before and after the intervention, without having a school holiday interrupting the intervention and

assessment period. This was of particular importance as teachers within the participating special needs schools reported that children attending these schools often show an increase in challenging behaviours and decrease in attention after a school holiday. This can be due to various reasons, for example, family structure and problems or lack of routine and structure in everyday life compared to the predictable structure of the school day. Most children took part in more than half of the sessions (4 out of 8). Sessions were missed due to children's other health or learning commitments or due to sickness. The sessions for children varied overall between 3 and 8. Children who took part in less than half of the scheduled sessions (N=4) were excluded from the final analysis.

4.4.1.2 Relaxation intervention

This condition consisted of sessions of a calm environment, outside of the classroom, in a separate room where participants were guided through a relaxation session either one-to-one or as part of a group. A relaxation CD: Enchanted Meditation for Kids (Kerr, 2005) for children with two gender-neutral stories lasted approximately 20 minutes, narrated by the same author. One story was taking a child through an enchanted garden (butterfly story) while the other asked the children to imagine being in the ocean (jellyfish story). The stories introduced approximately 5 minutes of children gently moving parts of their body (e.g. wriggling toes) to relax, followed by about 10 minutes of listening to a story and imagining it and finally finishing with about 5 more minutes of gentle movements. This timing matched the set-up of the dog intervention. The aim was for children in this condition to have 2 x 20-minute sessions each per week for 4 consecutive weeks, with the stories being alternated. This was achieved for the majority of children. Due to sickness and some other commitments, not all children took part in the full number of sessions; the total number of sessions varied between two and eight but children who attended less than half of the sessions (four) were excluded from the final analysis. Finally, although the CD gave the children instructions of things to do, not all children followed through with them. However, all children were happy to listen to the recording in full.

4.4.1.3 Control condition

Some children were placed in the control condition. They completed their normal lessons instead of spending time with the dog or taking part in the relaxation intervention, but took part in all assessment measures, and learnt about dog safety. Everyone also met the dogs during the familiarisation. A special visit with the dogs was arranged for the children in the control condition after the end of the study.

4.4.2 Ethics

This research was approved by the University of Lincoln, School of Psychology Research Ethics Committee (SOPREC) (Appendix 6) and also by the MARS/ WALTHAM Ethics Committee.

4.4.3 Procedure

First, a timeline was prepared to ensure all involved were aware of the commitment and timescales including schools, dog handlers and parents. Due to the large number of children taking part, it was essential that there were different “waves” of testing to ensure children could take part in the assessments and intervention sessions within the school day as well as including the intervention and pre- and post-test within one half term. This minimised the likelihood of attrition and ensured that the school holidays did not affect the results of the intervention (i.e. for participants with special educational needs a holiday could be challenging and result in more pronounced behaviour issues as the routine of the school and expectation is not present within the home environment). The follow-up times were selected to capture mid- to long-term benefits.

Schools: Special educational needs schools in Lincolnshire and Gloucestershire were approached via telephone with information on the project and asked whether they would like to take part. From the 13 schools who were contacted, 11 expressed an interest to take part so face-to-face meetings were arranged with the head teachers and some of the

teachers. A detailed explanation together with an information letter was provided explaining the project and the timeline.

Dog handlers and dogs: In the meantime, Pets as Therapy and Therapy Dogs Nationwide were contacted and asked whether they would like to take part in the project. Dog handlers were recruited and scheduled for an independent assessment with a behaviour specialist to ensure they were suitable for work with children with special educational needs. In addition, all dog handlers went through an additional dog body language training based on Meints, Brelsford and de Keuster (2018) before the interventions started and were asked to monitor their dogs at all times during the intervention.

Parents: Letters were sent home via school to parents/guardians of children of the age range 8-10 years which required the parent/guardian to return the form in order for the child to take part (Appendix 7). However, two of the 11 schools insisted on sending opt-out letters instead of opt-in. Specific permission was obtained from the University of Lincoln Ethics Committee (SOPREC) before this special request was granted. This request was made due to schools' procedural mechanisms and issues of inclusion.

Risk Assessment: An extensive Risk Assessment and a Dog Care Plan were also created and observed (see Appendix 8 and 9).

4.4.3.1 Pre-intervention (baseline) assessments

Once consent was obtained, parents were sent the first set of parent questionnaires (family background and pet ownership, EQSQ, behaviour at home), teachers were given the behaviour in class questionnaire (CBRS) and children were informed about the project before the study started by their teachers at first. Then, the researcher (MD) met with students as a group and explained that they will learn about how dogs communicate, get to meet a dog and complete tasks in the form of activities and games. Children were told that some of them will then see the dog or do a relaxation activity twice a week until a week before the holidays. Those who do not get to see the dogs during these weeks were reassured that they will get the chance to see the dogs later on.

It was also made clear in the briefing that they did not have to take part and could stop whenever they wanted, without any consequences. The first task they were asked to do was to provide saliva samples by spitting into Cryovials, on 3 consecutive mornings as described above, following the rules of the protocol. Having completed this task, the children were then invited to take part in playing different games with the experimenter, i.e. in testing sessions which varied in content and timing based on the child's ability. These sessions consisted of tasks from BAS-3, ACE, CFSEI-3, RCMAS-2 as well as the experimental categorisation task and the Fruit Stroop. All children completed these tasks individually. Tasks were selected to be suitable for their ability rather than their chronological age. For children with higher abilities who could take part in both the BAS-3 and ACE, the order of these tests was alternated between children and from one test session to the next. The order was only rotated for these two measures as they took the longest time to complete, so by rotating them, it was unlikely that participants would complete one test better than another due to for example being tired. The children with lower abilities were only able to complete BAS-3 tasks.

4.4.3.2. Teaching Safe Behaviour with Dogs and Dog Body Language

All children taking part in the project, regardless of the condition they were placed in were taught dog body language and how to behave appropriately around dogs through a PowerPoint presentation delivered by the researcher. Videos of dogs' body language (Meints et al., 2018) were shown displaying different behaviours for different stages of distress. Children were asked to answer how the dog was feeling and to spot what the dog was signalling that could indicate the dogs' state. The researcher (MD) discussed the correct answer with the children as well as presenting a list of rules (Do's and Don'ts) for children to follow in the sessions (Appendix 10).

4.4.3.3 Familiarisation

In small groups, children met all dogs who were visiting their school. All children taking part in the project spent roughly 2 x 30 minutes with each dog, getting to know them and the handlers before start of assessments. This ensured children were familiar with the dogs and potential effects would not be due to the novelty of the dog being in school (Protocol in Appendix 11).

4.4.3.4 Interventions

The interventions were run as described above (section 4.4.1.1 and section 4.4.1.2). Half of the children in the dog condition took part on one-to-one basis and the other half interacted with the dogs as part of a group. The same was true for the children in the relaxation condition. A schedule was made for each child to ensure that there were eight dog or relaxation sessions for each participant in those conditions. Teachers ensured as much as possible that this did not conflict with any other interventions the children were receiving. If there were conflicts the researcher updated the timetable.

Individual intervention: Children took part in the dog and relaxation individual interventions. For the dog individual intervention, children who took part were in the room with the dog, dog handler, the researcher and sometimes a member of staff as required. Whether there was another member of staff depended on the needs of the child as well as the preference of the school. The same holds for the relaxation intervention.

Group intervention: The number of children per group varied between 5 to 9 children depending on the class sizes. Children classed to be of lower ability did not take part in the group interventions due to the need for extra members of staff to be present to ensure the safety of the dog and child. As schools did not have available members of staff to support the children, they were unable to participate as part of a group.

4.4.3.5 Post-intervention (immediate and longitudinal) assessments

Following the interventions all children provided saliva samples again over 3 consecutive days and completed the same testing session again individually, as they did at baseline. Parents were also asked to complete the second set of parent questionnaires (EQSQ and behaviour at home) and teachers were given the classroom behaviour questionnaire (CBRS) to complete again.

The children were then followed up 6 weeks, 6 months and 1 year after the interventions had finished and asked to take part in the same individual game session again. This was to track their progress and see whether any effects of the interventions were sustained mid- or long-term.

Below is a summary diagram of the design (Figure 3), more specifically the data collection and intervention order. Following it, Table 4, shows the different measures employed.

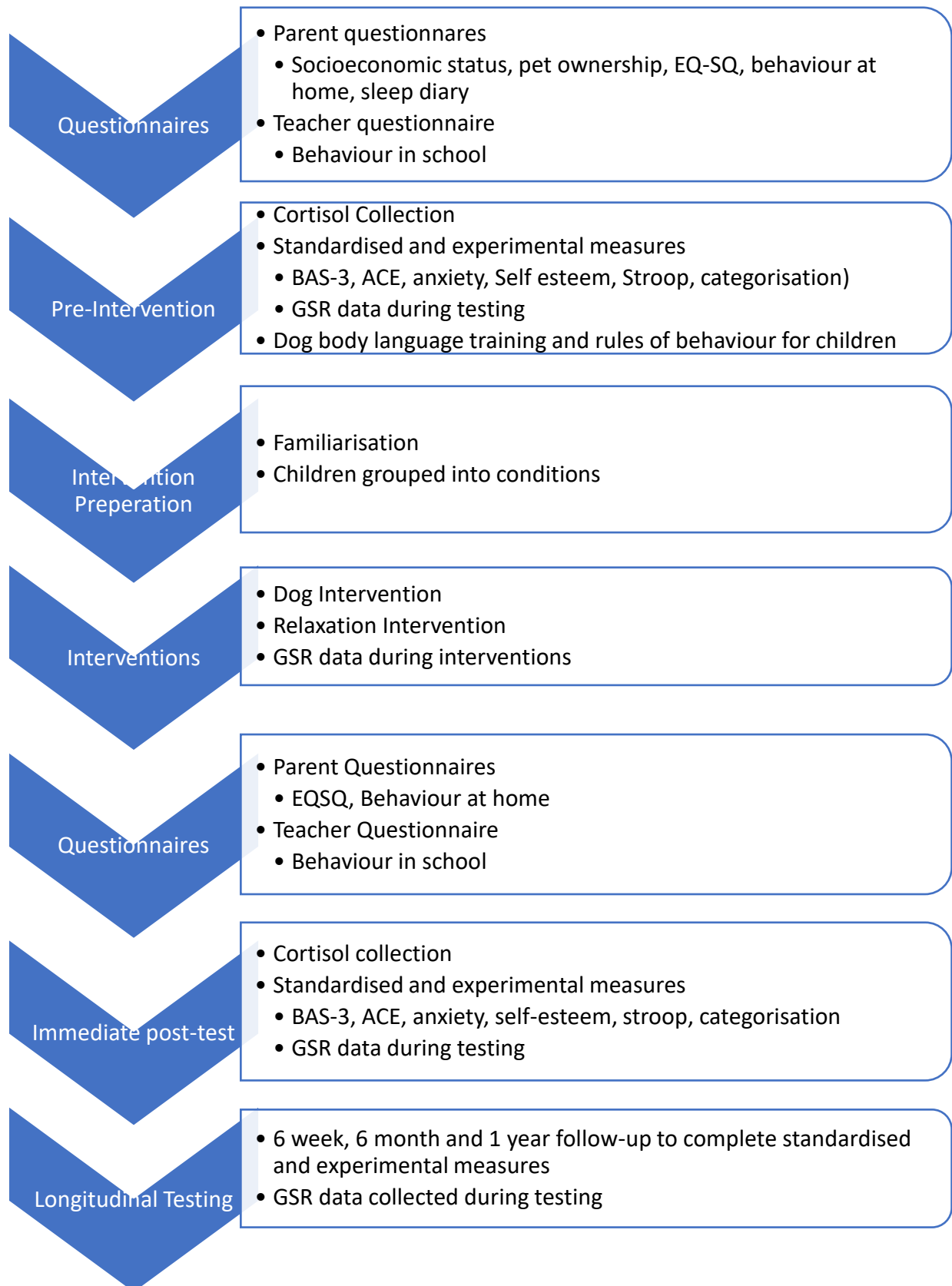


Figure 3: The design of the project, specifically the data collection and intervention.

Table 4
Summary of measures used in different chapters

Measures	Chapters		
	5 Language	6 Cognition	7 Physiology & Behaviour
Family Questionnaire	✓	✓	✓
Behaviour at home			✓
EQSQ			✓
CBRS			✓
Cortisol			✓
BAS	✓	✓	
ACE	✓		
CFSEI-3			✓
RCMAS-2			✓
Categorisation	✓		
Fruit Stroop		✓	

The following chapters will present the results of the current research. Chapter 5 established the effect of the interventions on the language measures, Chapter 6 presented the cognitive measures and Chapter 7 showed the behavioural and physiological findings. Finally, Chapter 8 discussed the results in relation to the theories presented earlier (Chapter 2) and Chapter 9 included the concluding remarks.

Chapter 5: Language Results

As previously presented in Chapter 3, children with special educational needs (SEN) are often delayed in their language and communication, needing more interventions. One potential beneficial intervention could be AAI, but findings to date are limited. This chapter presents the findings of the effect of DAI on the language ability of children with special educational needs. The results are presented in terms of children's ability. Summary table of results in Appendix 12.

5.1 Effects of AAI on Language - Children with High Ability

Results are presented using descriptive and inferential statistics per measure. The number of children who took part at the different test points varied. Table 5 provides more detail.

Table 5

The number of children in the high ability group taking part at the different language assessment points for each condition

Task	Condition	Test 1 Baseline N	Test 2 After Intervention N	Test 3 6-week N	Test 4 6-month N	Test 5 1-year N
ACE Sentence Comprehension	Dog Individual	10	10	8	10	9
	Relax Individual	9	9	8	9	9
	Control	11	11	10	9	8
	Dog Group	18	18	18	8	8
	Relax Group	19	19	18	11	10
ACE Syntactic Formulation	Dog Individual	9	9	8	9	8
	Relax Individual	7	7	6	6	7
	Control	8	8	8	7	6
	Dog Group	10	10	10	5	5
	Relax Group	11	11	11	6	5
Experimental Task: Categorisation	Dog Individual	7	7	6	7	7
	Relax Individual	7	7	6	7	7
	Control	16	16	15	13	15
	Dog Group	19	19	19	8	9
	Relax Group	19	19	18	13	13

Attrition was mainly due to children moving schools. Retention was between 100% and 42% across all time points. Some children did not complete the tasks at one assessment point but

completed subsequent assessment points. This was due to absence (illness or appointments) or a child not taking part due to showing an increased number of challenging behaviours. The judgement of challenging behaviour and whether the child could take part in the sessions was taken by the teacher.

5.1.1 ACE Sentence Comprehension raw scores: Descriptive statistics

This task tested the comprehension skills of children working at a level close to their typically developing peers. Here the raw scores of the test were used for the calculations. Table 6 shows the descriptive statistics (Mean and SD) of the ACE Sentence Comprehension (raw scores) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 6

Descriptive statistics (Mean and SD) of the ACE Sentence Comprehension (raw scores) for all assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1- year	SD Test 5 1- year
DI	19.13	4.88	21.63	5.88	21.38	5.9	22.5	4.75	21.75	9.44
RI	19.5	6.12	18.75	5.9	19.75	5.92	19.25	5.01	21	4.34
C	18.8	6.3	22.4	7.23	21.7	5.14	18.7	9.08	18.2	10.5
DG	23.38	4.93	22.63	2.77	23.38	4.1	23	3.02	23.25	2.49
RG	23.5	3.21	23.1	2.33	23.6	2.84	24.2	1.81	20.5	10.85

DI= Dog Individual; RI= Relaxation Individual; C= control; DG= Dog Group; RG= Relaxation Group

The means indicated that the children in the dog individual intervention and control group showed an improvement from pre- to post-interventions. At the follow-up assessments, only the children in the individual dog intervention maintained this improvement, while the children in the control group showed a decrease in scores (worse performance), resulting in

the performance level being the same as to pre- intervention. During the year of follow-up assessments, the children in the individual relaxation intervention showed an improvement, while the children in the dog group intervention maintained the same scores. The participants in the relaxation group intervention showed a small increase at the 6-month follow-up point but then scores were at their lowest at the 1-year follow-up point, indicating worse performance.

5.1.2 ACE Sentence Comprehension raw scores: Inferential statistics

To investigate whether the differences in means were significant, analyses of variance (ANOVAs) and t-tests were conducted next. ANCOVAs were calculated using information on SES, Pet and Dog Ownership as covariates where enough parents returned the questionnaires and the groups did not become too small to calculate. For every analysis, the sphericity was taken into account. When the sphericity was not violated the sphericity assumed was reported. When the sphericity was not assumed, Greenhouse-Geisser or Huynh-Feldt were reported depending on the Epsilon value. Independent samples t-tests were calculated to ensure the different conditions had children of similar ability before the intervention. The calculation revealed that there were no significant differences between conditions at baseline. The raw data was negatively skewed at baseline for the children in all interventions, so it was log transformed using log10 and tended towards normality before calculating the ANOVAs.

5.1.2.1 Longitudinal effects of dog and relaxation interventions

3x5 ANOVAs were calculated to investigate Condition (dog, relaxation, control) x Test Time (pre-intervention, post-intervention, 6-week, 6-month, 1-year follow-up) for the individual and the group interventions. This was to establish any effects lasting up to 1 year after the intervention. No main effects for Test Time or for Condition reached significance, showing that overall, children did not improve in their learning scores. However, there was a significant Condition x Test Time interaction effect for the children in the group intervention

as shown in Table 7. The means indicate that the children in the dog group and relaxation group interventions had higher mean scores to start with compared to the control condition and maintained these scores through all test sessions. In contrast, children in the control condition showed worse performance overall (lowest scores). Bonferroni post-hoc calculations indicated no significant differences.

Table 7

Condition (dog, relaxation, control) x Test Time (pre- post-intervention, 6-week, 6-month, 1-year follow-up) ANOVA for Sentence Comprehension Raw Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	2.508, 50.155	1.51	0.229	0.07
(B) Condition	2, 20	0.45	0.647	0.65
A x B (interaction)	5.015, 50.155	2.06	0.086	0.17
Group Intervention				
(A) Test Time	2.660, 58.524	0.34	0.775	0.02
(B) Condition	2, 22	0.05	0.949	0.01
A x B (interaction)	5.320, 58.524	2.68	0.028*	0.20

Note: ** Indicates highly significant result; * Indicates a significant result

To further investigate the difference in comprehension raw scores between the different assessment points, planned comparisons using paired samples t-tests for each condition (dog, relaxation, control) were calculated.

For the children taking part in the dog group or relaxation group interventions, there were no significant differences between any of the assessment time points. For the children taking part in the individual interventions, there was a highly significant difference from pre- to post-intervention for the children in the individual relaxation intervention ($p= 0.002$) with children performing worse post-intervention. For the children in the individual dog intervention there was a significant difference between pre-intervention and 6-month follow-up ($p= 0.003$) with better performance recorded at 6-month follow-up and a trend pre-intervention and 1-year follow-up ($p= 0.052$), again, with better performance at 1-year follow-up. Finally, for the children in the control group, there was a significant difference between pre- and post-intervention ($p= 0.022$) with better performance at post-test and pre-intervention and 6-week follow-up ($p= 0.023$) with better performance at 6-week follow-up

test. Figure 4 illustrated the mean scores for the task which showed the direction of results described.

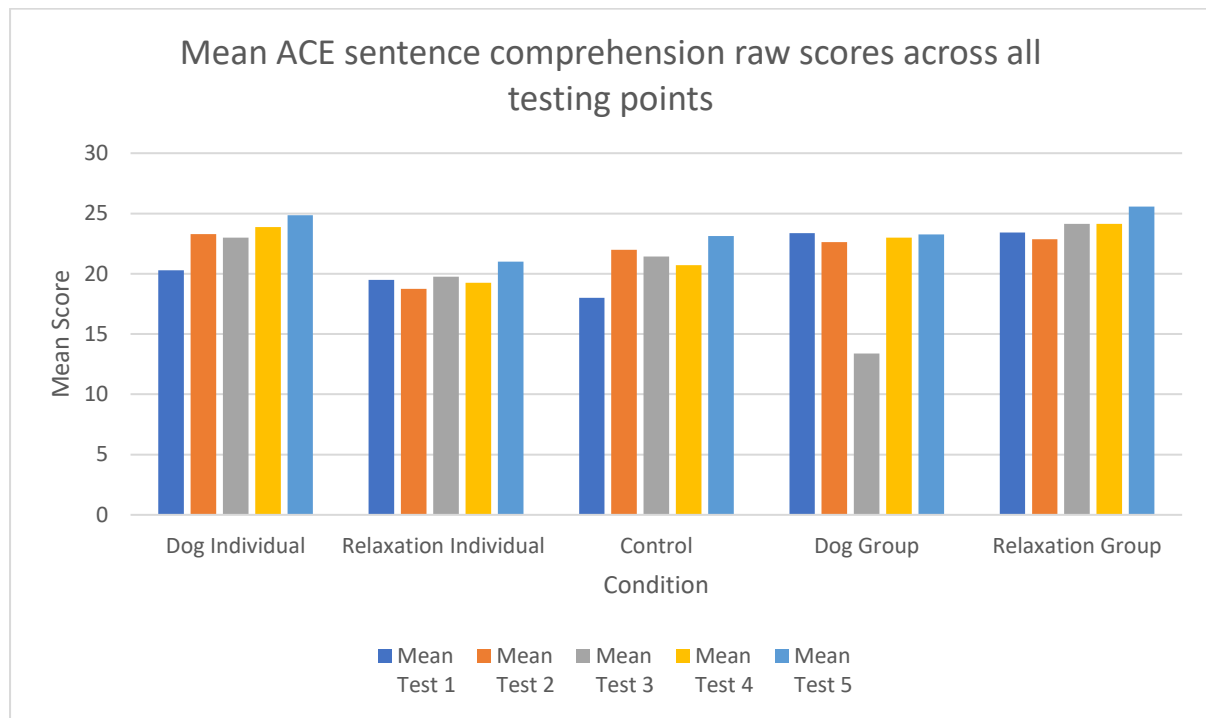


Figure 4: Mean ACE Sentence Comprehension scores for all assessment points

5.1.2.2 Immediate effects of dog and relaxation interventions

To investigate specifically the direct effect of the intervention immediately after intervention, 3x2 Repeated Measures ANOVAs of Condition x Test Time were calculated (Table 8). This calculation included all the children who completed this task regardless of whether they completed all follow-up assessments, therefore it included children who later dropped out.

Firstly, the calculations for the children in the individual interventions (dog individual, relaxation individual) compared to the control group showed a highly significant interaction effect between Condition x Test Time [$F(2,27)= 6.62$, $p=0.005$, $\eta p^2= 0.33$] as the children in the dog individual intervention, but also the children in the control group improved, while the children in the relaxation individual intervention did not (Figure 5).

For the children in the group interventions (dog group, relaxation group compared to the control group), there was a significant main effect for Test Time [$F(1,45)=5.54$, $p= 0.023$,

$\eta^2 = 0.11$] as most children improved over time and therefore showed learning effects.

There was a highly significant interaction between Condition x Test Time [$F(2,45)=5.91$, $p=0.005$, $\eta^2 = 0.33$]. The means demonstrated that the children in the dog group intervention did not improve at post-test while the children in the control and relaxation group did (Figure 5).

Bonferroni post-hoc calculations indicated no significant differences between the different conditions (i.e. dog and relaxation; dog and control; relaxation and control). Planned comparisons pre-post-intervention were presented above, as part of the longitudinal data.

Table 8

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) ANOVA for Sentence Comprehension Raw Score

Effect	df	F	P	η^2
Individual Intervention				
(A) Test Time	1, 27	0.07	0.790	0.003
(B) Condition	2, 27	0.14	0.869	0.10
A x B (interaction)	2, 27	6.62	0.005**	0.33
Group Intervention				
(A) Test Time	1, 45	5.54	0.023*	0.11
(B) Condition	2, 45	0.36	0.701	0.02
A x B (interaction)	2, 45	5.91	0.005**	0.21

Note: ** Indicates highly significant result; * Indicates a significant result

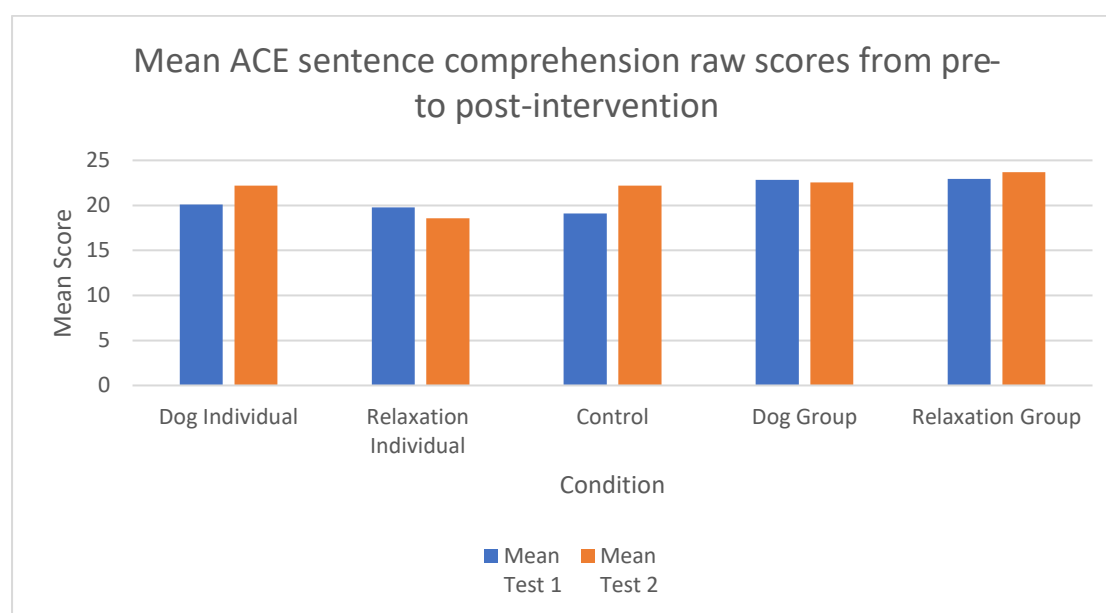


Figure 5: Mean ACE Sentence Comprehension scores for pre- post-intervention assessment

5.1.2.2.1 The influence of Pet and Dog Ownership on immediate effect of the interventions

ANCOVAs were calculated using Pet and Dog Ownership as covariates in separate analysis because the number of pet and dog owners were not equal across the different conditions (dog, relaxation, control). Very few parents whose children took part in the group intervention returned the questionnaires, so there was not enough data on these factors. Due to this ANCOVAs were only calculated for the children taking part in the individual intervention.

The only significant interaction effect of Condition x Test Time was maintained when Pet [$F(2,19)= 10.30$, $p= 0.001$, $\eta^2= 0.52$] and Dog [$F(1,19)= 9.02$, $p= 0.002$, $\eta^2= 0.49$] ownership were entered as covariates in separate analysis. The means indicated that the children in the dog intervention maintained their score, the children in the relaxation intervention improved their scores and those in the control condition showed a worse performance. Table 9 shows the full results.

Table 9
Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with Pet and Dog Ownership as Covariates ANCOVA for Sentence Comprehension (Raw Score)

Effect	df	F	p	η^2
Individual Intervention				
(C) Pet Ownership (covariate)	1, 19	0.004	0.954	0.000
(A) Test Time	1, 19	1.65	0.215	0.08
(B) Condition	2, 19	0.04	0.961	0.004
A x B (interaction)	2, 19	10.30	0.001**	0.52
A x C (interaction)	1, 19	2.76	0.113	0.13
(C) Dog Ownership (covariate)				
(A) Test Time	1, 19	0.03	0.573	0.02
(B) Condition	2, 19	0.11	0.897	0.01
A x B (interaction)	2, 19	9.02	0.002**	0.49
A x C (interaction)	1, 19	0.66	0.426	0.03

Note: ** Indicates highly significant result; * Indicates a significant result

5.1.3 ACE Sentence Comprehension standardised scores: Descriptive

statistics

The raw scores were converted to standardised scores and these were used for the calculations to establish whether the effects of the interventions were still evident when using a more robust score. The following Table 10 showed descriptive statistics for ACE: Sentence Comprehension standardised scores for baseline (test 1), immediate post-intervention follow-up (test 2), 6-week post-intervention follow-up (test 3), 6-month post-intervention follow-up (test 4) and 1-year post-intervention follow-up (test 5).

Table 10

Descriptive statistics (Mean and SD) of the ACE Sentence Comprehension (standardised scores) for all assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1- year	SD Test 5 1- year
DI	5.14	2.12	7.00	2.83	6.57	3.41	7.00	2.89	7.71	3.45
RI	5.63	2.97	5.13	3.8	5.88	2.9	4.75	3.06	4.88	3.23
C	4.86	1.68	8.29	4.86	6.71	3.09	6.57	3.55	7.14	3.63
DG	7.63	4.5	6.13	2.3	7.13	3.52	5.88	2.36	5.5	2.51
RG	7.11	3.02	6.44	2.07	7.56	3.01	7.11	2.62	6.89	2.03

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that the children in the individual dog group showed an improvement in mean scores from pre- to post-intervention and maintained a similar score for the rest of the assessment sessions. The children in the individual and group relaxation interventions maintained the same score throughout all the assessment points. Participants in the dog group intervention showed a slight decrease in scores from pre- to post-intervention followed by an increase at 6-week follow-up, a decrease at 6-month and a maintenance of the scores at the 1-year follow-up. The participants in the control condition showed an increase in mean

scores from pre- to post-intervention but then the scores dropped to the same level as pre-intervention at the subsequent assessments.

5.1.4 ACE Sentence Comprehension standardised scores: Inferential statistics

To investigate whether the differences in the mean scores were significant, analysis of variance (ANOVAs) and t-tests were conducted. Where enough data was available ANCOVAs using SES, pet and dog ownership as covariates were calculated. As above, the sphericity was always taken into account and the appropriate values were reported based on the Epsilon value. Independent samples t-tests were calculated to ensure the different conditions had children of similar ability before the intervention. The standardised data for the individual and group intervention participants was positively skewed at baseline, so it was log transformed (log10) in order that the data distribution tended towards normality.

5.1.4.1 Longitudinal effects of the dog and relaxation interventions

3x5 ANOVAs for Condition x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) (Table 11) were calculated separately for the children in the individual and group interventions. The calculation for the participants in the individual intervention indicated a significant main effect for Test Time [$F(4, 76) = 3.34, p = 0.013, \eta^2 = 0.15$] as all children improved over time and a highly significant Condition x Test Time interaction effect [$F(8, 76) = 3.79, p = 0.001, \eta^2 = 0.29$]. In brief, the dog individual intervention improved continuously, the relaxation individual intervention improved initially, but then worsened while children in the control group improved initially and then maintained that level of performance.

For the children in the group interventions there was also a significant Condition x Test Time interaction effect [$F(5.895, 61.898) = 2.58, p = 0.028, \eta^2 = 0.20$], with children in the control condition performing worse at baseline compared to the intervention groups, but showed an improvement at immediate follow-up and as a result had similar scores to the dog and relaxation group interventions. The dog group intervention performed similarly to the

relaxation group intervention. Bonferroni post-hoc calculations between the different conditions indicated no significant differences.

Table 11

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention and 6-week, 6-month, 1-year follow-ups) ANOVA for Sentence Comprehension Standard Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	4, 76	3.39	0.013*	0.15
(B) Condition	2, 19	0.78	0.474	0.08
A x B (interaction)	8, 76	3.79	0.001**	0.29
Group Intervention				
(A) Test Time	2.948, 61.898	1.05	0.377	0.05
(B) Condition	2, 21	0.19	0.830	0.02
A x B (interaction)	5.895, 61.898	2.58	0.028*	0.20

Note: ** Indicates highly significant result; * Indicates a significant result

To further investigate the differences for each condition between test points and to test the prediction made in this thesis, planned comparisons were calculated using paired t-tests. The only significant intervention difference was shown by the children in the individual dog intervention as there was a significant difference between pre- and post-intervention ($p=0.005$), pre-intervention and 6-week follow-up ($p=0.015$), pre-intervention and 6-month follow-up ($p=0.021$) and pre-intervention and 1-year follow-up ($p=0.021$). Figure 6 which shows the means indicated that this significant difference was due to the increase of mean scores which indicated that children performed better. There was also a significant difference for the children in the control condition between pre-intervention and 6-week follow-up ($p=0.030$), again shown on the graph as an increase in scores.

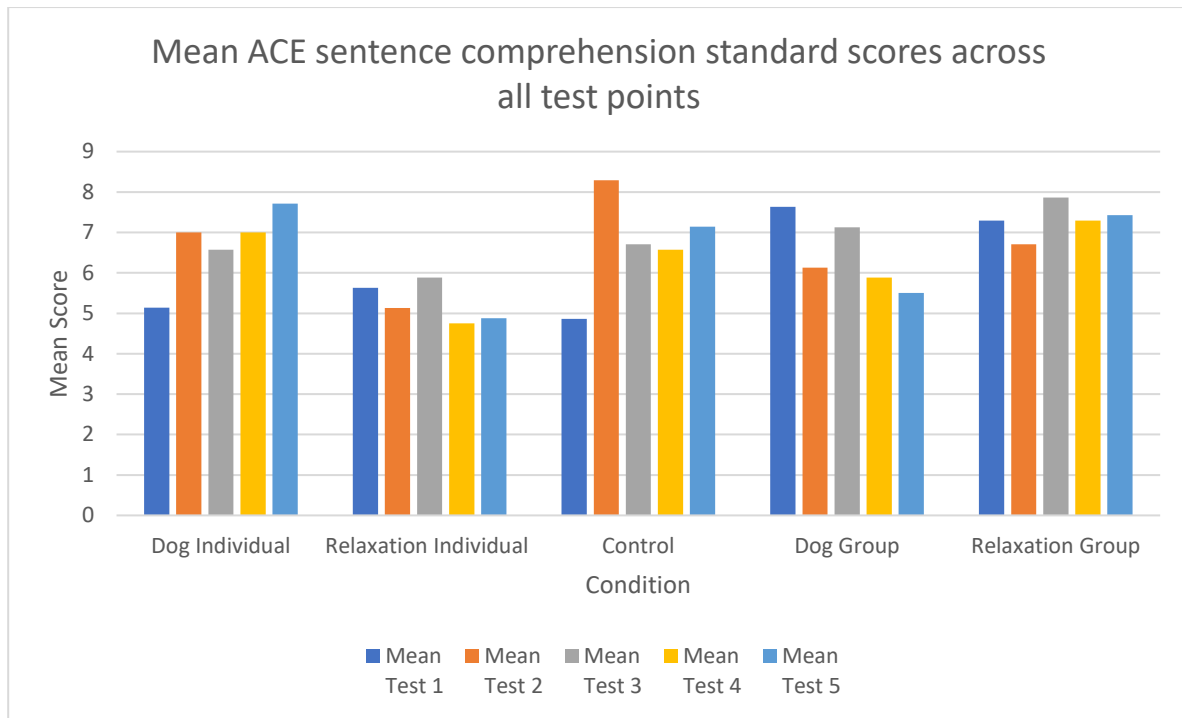


Figure 6: Mean ACE Sentence Comprehension for all assessment points

5.1.4.2 Immediate effects of dog and relaxation interventions

To investigate specifically the immediate effects comparing scores before and after interventions, 3x2 ANOVAs of Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) (Table 12) were calculated for the individual and group interventions. Children who did not complete all the follow-up sessions were still included in the pre-, post-intervention calculations.

For the group interventions, a significant main effect for Test Time was found [$F(1,45)= 4.09$, $p= 0.049$, $\eta^2= 0.08$] as most children improved on the measure from pre- to post-intervention, i.e. showed natural learning effects over time. In addition, a highly significant interaction effect for Condition x Test Time were found for children in the individual intervention [$F(2,27)= 6.15$, $p= 0.006$, $\eta^2= 0.31$] and a significant interaction effect was also present for the group intervention [$F(4,45)= 3.31$, $p= 0.046$, $\eta^2= 0.13$], with high to medium effect sizes. In the individual intervention the children in the dog and control conditions improved on the task while the children in the relaxation condition performed worse at post-intervention. The children in the control and relaxation group intervention

performed better while the children in the dog group intervention performed worse at post-intervention (Figure 7).

Bonferroni post-hoc calculations indicated no significant differences between children in the different conditions. Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 12

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Sentence Comprehension Standard Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 27	2.31	0.140	0.08
(B) Condition	2, 27	0.49	0.616	0.04
A x B (interaction)	2, 27	6.15	0.006**	0.31
Group Intervention				
(A) Test Time	1, 45	4.09	0.049*	0.08
(B) Condition	2, 45	0.82	0.447	0.04
A x B (interaction)	4, 45	3.31	0.046*	0.13

Note: ** Indicates highly significant result; * Indicates a significant result

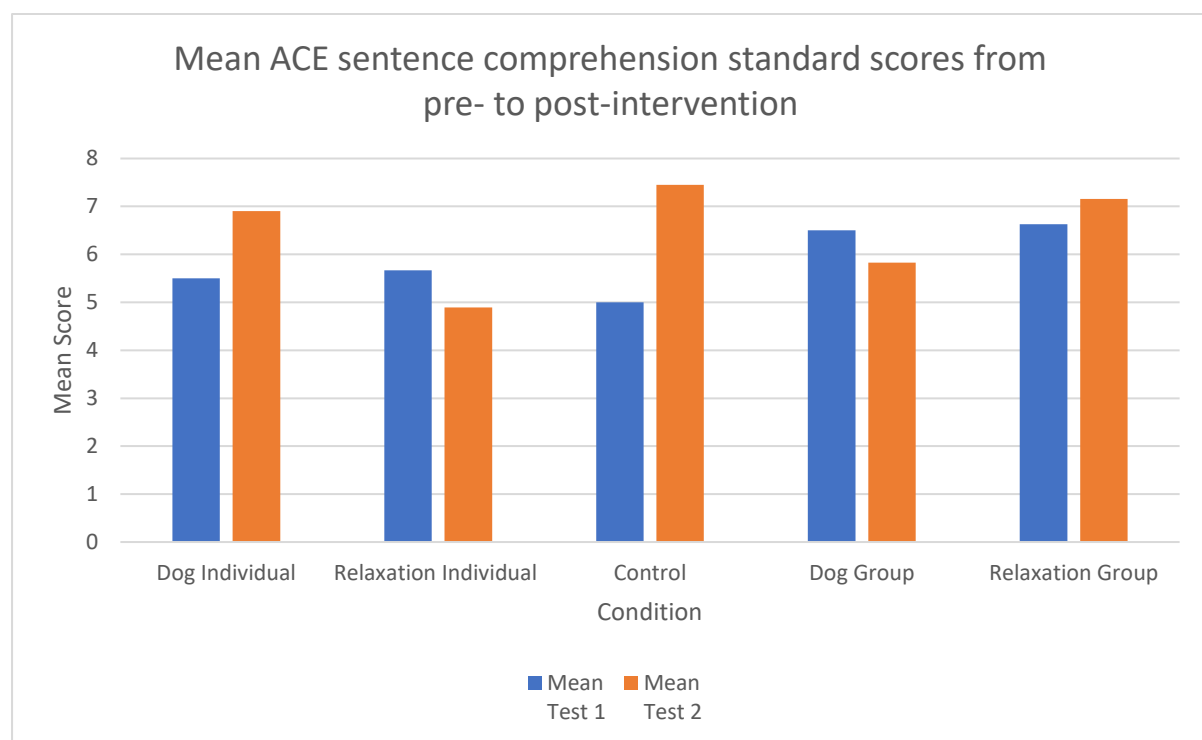


Figure 7: Mean ACE: Sentence Comprehension for pre- and post-intervention

5.1.4.2.1 The influence of Pet and Dog Ownership on immediate effect of the interventions

ANCOVAs were calculated using Pet and Dog Ownership as covariates in separate analysis because the number of pet and dog owners were not equal across the different conditions (dog, relaxation, control). Again, very few parents whose children took part in the group intervention returned the questionnaires, so there was not enough data on Pet and Dog Ownership to enter it into ANCOVA calculations. Due to this, ANCOVAs were only calculated for the children taking part in individual interventions.

Similar to the previous analysis, the highly significant interaction effect for Condition x Test Time remained for the participants in the individual intervention when Pet [$F(2,19)=7.47$, $p=0.004$, $\eta^2=0.44$] and Dog [$F(2,19)=8.56$, $p=0.002$, $\eta^2=0.47$] Ownership were entered as covariates (Table 13). The means indicated an increase of scores for the children in the dog intervention and control group but a worse performance for the children in the relaxation intervention.

Table 13

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with Pet and Dog Ownership as Covariates ANCOVA for Sentence Comprehension Standard Score

Effect	df	F	p	η^2
Individual Intervention				
(C) Pet Ownership (covariate)	1, 19	0.02	0.900	0.001
(A) Test Time	1, 19	0.22	0.643	0.01
(B) Condition	2, 19	0.37	0.699	0.04
A x B (interaction)	2, 19	7.46	0.004**	0.44
A x C (interaction)	1, 19	0.04	0.842	0.002
(C) Dog Ownership (covariate)				
(A) Test Time	1, 19	0.30	0.588	0.02
(B) Condition	1, 19	0.47	0.504	0.47
(B) Condition	2, 19	0.47	0.629	0.05
A x B (interaction)	2, 19	8.56	0.002**	0.47
A x C (interaction)	1, 19	1.58	0.225	0.08

Note: ** Indicates highly significant result; * Indicates a significant result

5.1.5 ACE Syntactic Formulation raw scores: Descriptive statistics

This task tested the production and grammar/ syntax skills of children working at a level close to their typically developing peers. Here the raw scores of the test were used for the calculations. The following table (Table 14) shows descriptive statistics for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-week post-intervention follow-up), test 4 (6-month post-intervention follow-up), test 5 (1-year post-intervention follow-up).

Table 14

Descriptive statistics (Mean and SD) of the ACE Syntactic Formulation (raw scores) for all assessment time points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	19.63	5.37	22	6.14	21.75	4.86	23	4.9	20.75	10.25
RI	14.17	7.78	18.33	7.45	18.33	5.16	19.33	9.33	19.33	4.68
C	17.4	4.16	22.2	1.79	22.8	2.68	22.6	2.97	22.8	3.42
DG	21.6	4.51	22.4	3.36	22.2	3.49	25.6	2.61	24.4	2.19
RG	20.8	3.9	23.4	5.5	26	1.41	24.4	1.67	25.2	2.28

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation

The means indicated that children in all conditions improved from pre- to post-intervention. Between immediate follow-up and 6-week follow-up, the children in the individual dog and relaxation interventions, control condition and dog group maintained a similar score while the children in the relaxation group interventions continued to show an increase in scores. At the 6-month follow-up point, children in the dog and relaxation individual interventions and the dog group intervention showed an improvement in scores, while the children in the control condition maintained their scores; the participants in the dog group intervention showed a decrease in scores indicating worse performance. The children in the control condition

continued to maintain the same score until the 1-year follow-up while the children in the relaxation individual and group interventions showed an increase in scores and the children in the dog group and individual interventions showed a decrease in scores.

5.1.6 ACE Syntactic Formulation raw scores: Inferential statistics

To investigate whether the means of the children taking part in each condition were significantly different between the conditions and over time, analysis of variance (ANOVAs) and t-tests were calculated. ANCOVAs were calculated to include SES, Pet and Dog Ownership as covariates where enough data was available.

Independent samples t-tests were calculated between the different conditions at test 1 (pre-intervention baseline) to establish any significant differences between children in the different conditions prior to the interventions starting. These calculations revealed that there were no significant differences between conditions at baseline (test 1) for the children in the individual interventions. There was a significant difference at baseline for the children taking part in the group interventions between the children in the dog and control group as well as between the children in the relaxation and control group. The results were normally distributed.

5.1.6.1 Longitudinal effects of dog and relaxation interventions

To investigate the effects of the interventions for the individual and group interventions 3x5 ANOVAs were calculated (Table 15). The only significant result was the highly significant main effect for Test Time for the children in the group intervention [$F(4,48) = 7.08$, $p < 0.001$, $\eta^2 = 0.37$] as all children improved over time.

There was no sufficient data on SES, Pet and Dog Ownership for children who took part at all assessment point so ANCOVAs were not calculated.

Table 15

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention and 6-week, 6-month and 1-year follow-up) ANOVA for Syntactic Formulation Raw Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	2, 126, 40.393	2.18	0.124	0.11
(B) Condition	2, 19	0.76	0.481	0.07
A x B (interaction)	4.252, 40.393	0.35	0.853	0.04
Group Intervention				
(A) Test Time	4, 48	7.08	<0.001**	0.37
(B) Condition	2, 12	1.46	0.272	0.20
A x B (interaction)	8, 48	1.07	0.399	0.15

*Note: ** Indicates highly significant result; * Indicates a significant result*

To investigate the predicted differences in scores for each intervention condition over time, paired samples t-tests were calculated. There were significant differences between pre- and post-intervention for children taking part in the dog individual intervention ($p= 0.023$) with significantly improved scores post-intervention. The same holds for children in the individual relaxation intervention with a significant improvement immediately post-intervention ($p= 0.047$) and at the 1-year follow-up point ($p= 0.014$). The children in the relaxation group intervention also showed a significant difference between pre-intervention and 6-week post-intervention follow-up ($p= 0.001$) as there was an improvement in scores. In the control group, there was only a significant difference between pre-intervention and 6-month post-intervention follow-up ($p= 0.026$) and pre-intervention and 1-year follow-up ($p= 0.016$) due to an improvement in scores. Figure 8 illustrates this.

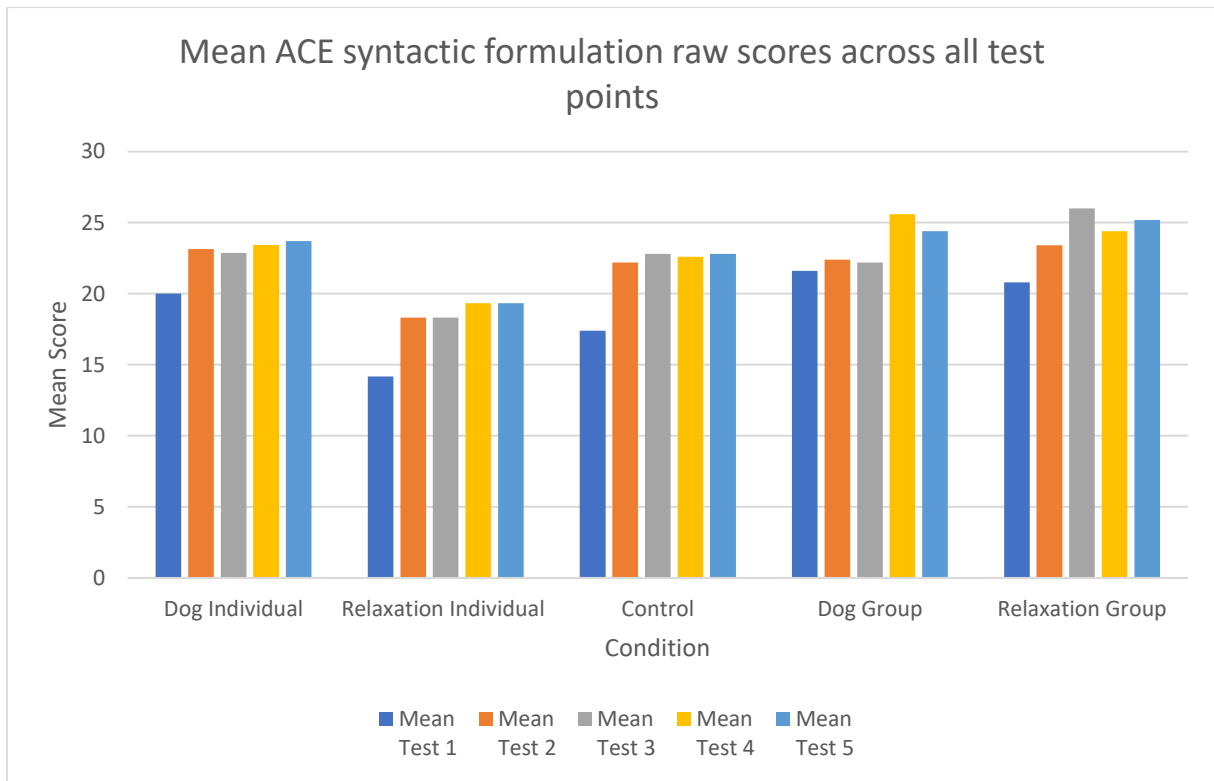


Figure 8: Mean ACE Syntactic Formulation across all assessment points

5.1.6.2 Immediate effects of dog and relaxation interventions

As direct effects of the intervention were predicted, 3x2 ANOVAs were calculated for the children in the individual and group interventions to assess if there was a difference in raw scores of children in different conditions (dog, relaxation, control) pre- to post-intervention (Table 16). Again, all children who completed this task were included, even if they did not complete all the follow-up assessments. There was not enough information provided by parents on SES, Pet and Dog Ownership so it was not possible to enter these as covariates.

There was a highly significant main effect for Test Time for the individual intervention [$F(1,21)= 14.00, p= 0.001, \eta^2= 0.40$] and the group intervention [$F(1,26)= 5.94, p= 0.022, \eta^2= 0.19$] as all children improved from pre- to post-intervention. Furthermore, for the group interventions, a significant main effect for Condition [$F(2,26)= 4.87, p= 0.016, \eta^2= 0.27$] was present. The means indicated the largest improvement for the children in the relaxation group and, interestingly, the smallest for children in the dog group (Figure 9).

A Bonferroni post-hoc test indicated a significant difference between the children in the dog group and control condition ($p=0.017$) with the children in the control condition showing a larger improvement (Figure 9). Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 16

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Syntactic Formulation Raw Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 21	14.00	0.001**	0.40
(B) Condition	2, 21	1.22	0.315	0.10
A x B (interaction)	2, 21	0.01	0.990	0.001
Group Intervention				
(A) Test Time	1, 26	5.94	0.022*	0.19
(B) Condition	2, 26	4.87	0.016*	0.27
A x B (interaction)	2, 26	0.42	0.663	0.03

Note: ** Indicates highly significant result; * Indicates a significant result

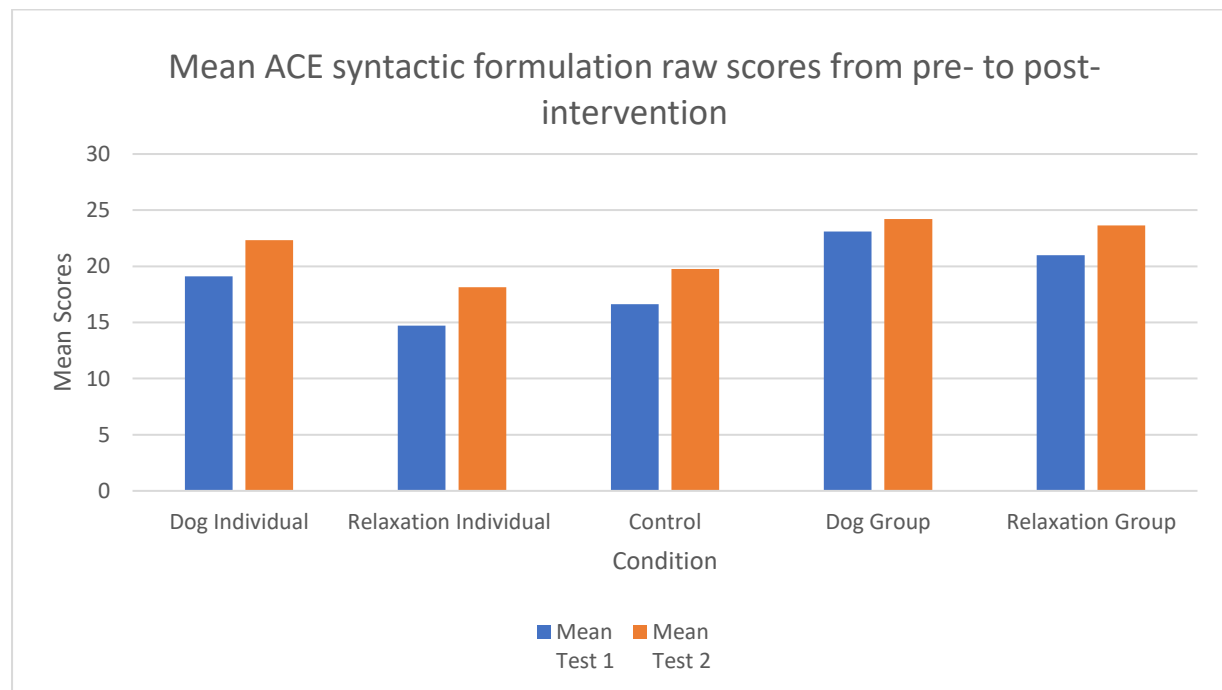


Figure 9: Mean ACE Syntactic Formulation pre- and post-intervention scores

5.1.7 ACE Syntactic Formulation standardised scores: Descriptive statistics

Here the raw scores were converted to standardised scores and these were used for the calculations. This was done to assess whether the benefits from the intervention are evident when using more robust, standardised scores. This is particularly important as other professionals use these scores and therefore any benefits will be more meaningful. The following table (Table 17) shows descriptive statistics for syntactic formulation standardised scores for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-week post-intervention follow-up), test 4 (6-month post-intervention follow-up), test 5 (1-year post-intervention follow-up).

Table 17

Descriptive statistics (Mean and SD) of the ACE syntactic formulation (standardised scores) for all assessment time points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	6.71	2.14	8.29	2.5	7.86	2.04	8.43	2.82	8.29	2.87
RI	5.17	2.32	6.67	3.56	6.5	2.07	7.17	3.25	6.17	1.94
C	5.4	1.95	7.2	0.84	7.8	1.3	7.6	1.14	7.8	1.48
DG	7.6	2.19	7.8	1.3	7.4	1.52	9	1.58	8	1.41
RG	7.6	1.34	8.4	2.88	9.8	1.64	8.6	1.52	8.8	1.48

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation

The means indicated that children in most conditions (dog individual, relaxation individual, control, relaxation group) increased their performance from pre- to post-intervention while the children in the dog group intervention did not. From post-intervention to 6-week follow-up children in the relaxation individual, dog group and control condition maintained the same scores, while the children in the dog individual intervention showed a decrease in scores and those in the relaxation group intervention showed an improvement in scores. During the next assessment phase (6-month) the children in the dog individual, relaxation individual and dog

group interventions showed an increase in mean scores while the children in the control condition maintained a similar score and those in the relaxation group showed a decrease in scores, indicating worse performance. At the last follow-up point (1-year) the children in the dog individual, control and relaxation group maintained a similar mean score while those in the relaxation individual and dog group intervention showed a worse performance.

5.1.8 ACE Syntactic Formulation standardised scores: Inferential statistics

To investigate whether the means were significant, analysis of variance (ANOVAs) and t-tests were calculated. Independent t-tests before the intervention (test 1) were calculated to ensure children were of the same ability across all conditions. The data from the children taking part in the individual interventions was normally distributed but the data from the children in the group interventions was positively skewed, so it was log transformed. ANOVAs were used to calculate any effects.

5.1.8.1 Longitudinal effects of dog and relaxation interventions

As before, 3x5 ANOVAs of Condition x Test Time were carried out to include all testing points for the children in the individual and group interventions (Table 18). A highly significant main effect for Test Time for the children in the individual intervention [$F(4,60)=5.21$, $p=0.001$, $\eta^2=0.26$] and a significant effect for the children in the group intervention [$F(2.503,30.037)=4.13$, $p=0.019$, $\eta^2=0.26$] were found as all children improved on this measure over the year of assessments (Figure 10).

Table 18

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for Syntactic Formulation Standardised Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	4, 60	5.21	0.001**	0.26
(B) Condition	2, 15	1.07	0.369	0.12
A x B (interaction)	8, 60	0.33	0.953	0.04
Group Intervention				
(A) Test Time	2.503, 30.037	4.13	0.019*	0.26
(B) Condition	2, 12	1.80	0.207	0.23
A x B (interaction)	5.006, 30.037	1.44	0.237	0.19

*Note: ** Indicates highly significant result; * Indicates a significant result*

In the individual dog intervention, planned comparisons using paired samples t-tests indicated a significant difference for the children between baseline and immediate follow-up ($p= 0.015$). There were no significant differences for the children in the dog group intervention. For the children in the individual relaxation intervention, significant differences were found between pre-intervention baseline and 6-month follow-up ($p= 0.007$). For the children in the relaxation group intervention, significant differences emerged between pre-intervention baseline and 6-weeks post-intervention ($p< 0.001$). The children in the control condition had a significant difference between pre-intervention and 6-months post-intervention ($p= 0.034$) as well as pre-intervention and 1-year post-intervention ($p= 0.014$). The direction of the scores is shown in Figure 10 and indicated that significant differences were all due to improvement of scores.

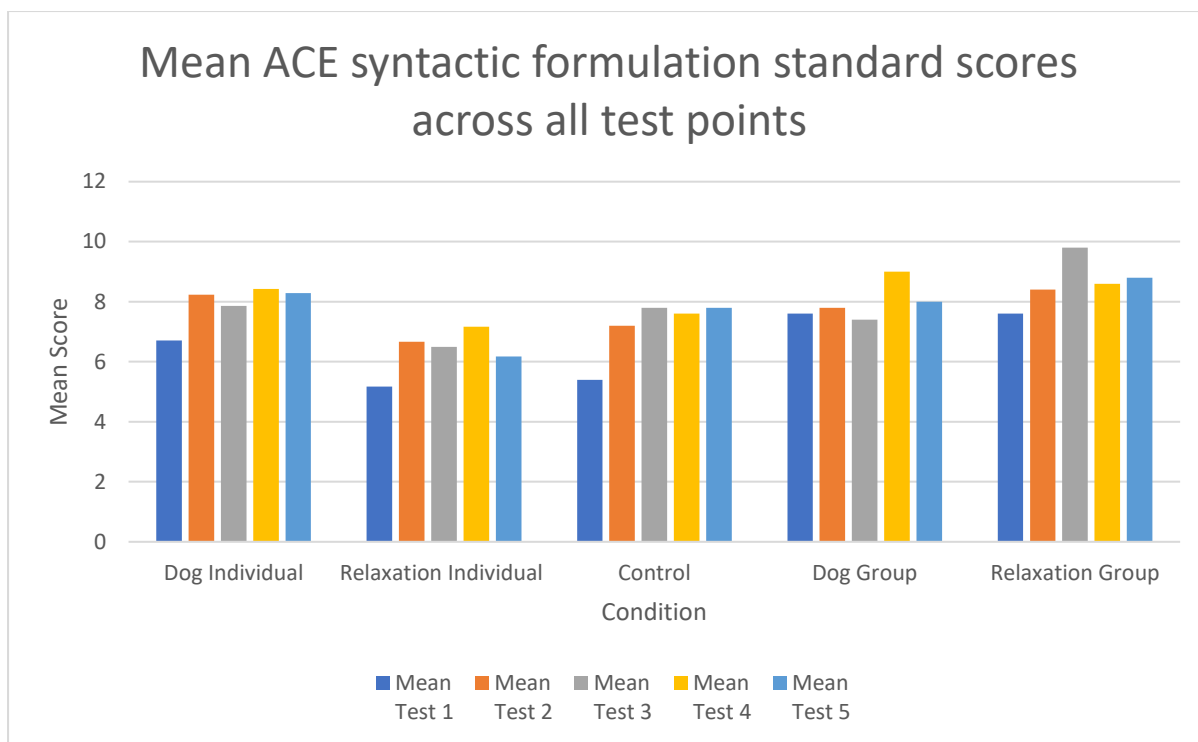


Figure 10: Mean ACE Syntactic Formulation across all assessment points

5.1.8.2 Immediate effects of dog and relaxation interventions

As previously a 3x2 ANOVA was conducted to assess specifically the direct intervention effects before and after intervention (Table 19). Again, this included all children who completed the interventions at these time points, not only the children who completed all follow-up sessions.

There was a highly significant main effect for Test Time between baseline and immediate follow-up for the children taking part in the individual interventions [$F(1,21)= 9.36$, $p= 0.006$, $\eta^2= 0.31$] as all children showed learning and improved their scores. There was also a significant between-subjects main effect for Condition for the children taking part in the group interventions [$F(2,26)= 5.08$, $p= 0.014$, $\eta^2= 0.28$] with largest improvements seen in children in the control condition, closely followed by the children in the relaxation group intervention. The scores of the children in the dog group intervention remained almost unchanged from pre- to post-intervention.

Bonferroni post hoc tests between conditions revealed a significant difference between the dog group intervention and the children in the control condition ($p=0.011$), with

the children in the control condition showing a greater improvement from pre- to post-intervention (Figure 11). Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 19

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Syntactic Formulation Standardised Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 21	9.36	0.006**	0.31
(B) Condition	2, 21	1.13	0.341	0.10
A x B (interaction)	2, 21	0.15	0.860	0.001
Group Intervention				
(A) Test Time	1, 26	1.55	0.224	0.06
(B) Condition	2, 26	5.08	0.014*	0.28
A x B (interaction)	2, 26	0.22	0.806	0.02

Note: ** Indicates highly significant result; * Indicates a significant result

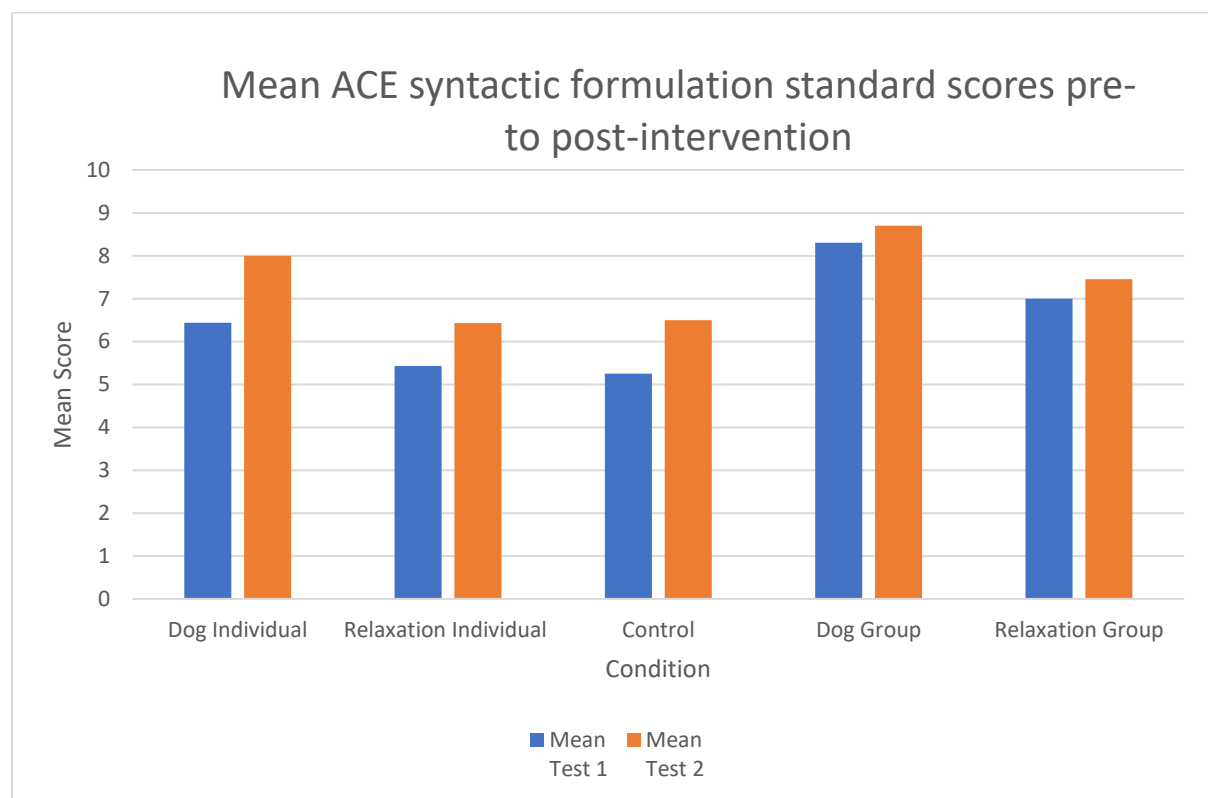


Figure 11: Mean ACE Syntactic Formulation pre- and post-intervention assessments

5.1.9 Categorisation: Descriptive statistics

An experimental task using categorisation was carried out measuring accuracy and reaction times of children placing items into one of two categories- ocean and farm and investigating if intervention effects could be observed. The following tables (Table 20- Table 23) showed the mean and SD reaction times for each category of images- atypical inanimate, atypical animate, typical inanimate and typical animate, across the five testing points. This task was adapted from Gee et al. (2012). This data was integrated in this chapter due to the tasks' importance to language.

Table 20

Descriptive statistics (Mean and SD of reaction times) of the categorisation task- atypical inanimate items for all testing points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	1641.5	441.85	1941.33	679.15	1641.17	479.57	1191.76	287.59	1163.75	296.52
RI	2575.17	1815.42	2477.17	974.97	1685.83	884.36	1991.65	801.12	1783.88	563.28
C	2833.25	1535.69	2009	1087.01	2263.42	1627.15	1896.53	1351.53	1776.27	815.79
DG	1507.75	483.76	1688.13	486.69	1665	571.84	1344.19	360.91	1267.64	324.44
RG	1773.08	490.17	1833.58	521.4	2374.42	1001.87	1853.1	535.41	1740.72	589.7

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation

Table 21

Descriptive statistics (Mean and SD of reaction times) of the categorisation task- atypical animate items for all testing points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6-week	SD Test 3 6- week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	1315.67	367.84	1412.5	288.31	114.67	140.14	1030.73	235.28	1061.4	200.49
RI	1940	1322.54	1746.17	513.22	1502.83	717.93	1118.09	279.83	1308.03	193.94
C	2046.08	831.04	1499.25	443.47	1330	397.78	1690.23	1512.66	1298.77	530.1
DG	1223.75	323.52	1111.75	220.13	1077.38	241.73	1046.5	289.46	957.91	149.7
RG	1287.17	287.39	1514.42	550.48	1471.83	557.19	1287.36	230.88	1307.92	296.03

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation

Table 22

Descriptive statistics (Mean and SD of reaction times) of the categorisation task- typical inanimate items for all testing points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	1567.33	508.25	1249	179.64	1173.5	179.99	1017.34	158	1097.53	341.76
RI	1366	337.22	1500.83	720.17	1461.33	900.72	1486.48	565.4	1424.21	436.35
C	1833.33	1002.37	1334.58	422.17	1507.83	498.72	1316.31	395.24	1116.58	298.2
DG	1047.38	96.94	1075.75	205.13	980.88	210.33	953	123.71	964.25	166.07
RG	1526.08	778.2	1393	371.23	1726.33	648.1	1454.32	524.03	1201.81	273.55

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation

Table 23

Descriptive statistics (Mean and SD of reaction times) of the categorisation task- typical animate items for all testing points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	1382.5	413.37	1138.83	312.93	1041	221.34	931.8	147.6	1036.61	326.65
RI	1415.5	852.36	1593.5	1036.85	1353.83	632.29	1077.23	208.83	1243.78	342.58
C	1494.17	624.19	1298.5	319.34	1149.83	290.64	1143.93	301.81	1061.44	298.86
DG	949.88	215.44	993.88	101.82	988.25	218.06	981.46	222.97	894.69	143.93
RG	1180.08	347.36	1192.75	425.34	1197.67	401.02	1290.46	242.7	1084.32	273.69

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation

The means indicated that the atypical inanimate items were categorised slower than the atypical animate objects and typical inanimate. The typical inanimate items were also categorised slower than the typical animate objects and the atypical animate were slower than the typical animate items. Overall, the typical animate objects were processed quickest and the most difficult and slowest to process were the atypical inanimate objects.

5.1.10 Categorisation: Inferential statistics

To investigate whether the reaction time means were significantly different, analysis of variance (ANOVAs) and t-tests were calculated. Although this sample was skewed at baseline, it was likely to be representative of the children with special educational needs, due to their varying ability. As a result, the data was not normalised, especially as there was still a bell-shaped curve.

5.1.10.1 Immediate effects of individual interventions on categorising typical vs atypical and animate vs inanimate objects

For the children in the individual intervention, an ANOVA was calculated to include Condition (dog individual, relaxation individual, control) x Animacy (animate, inanimate) x Typicality

(typical, atypical) x Test Time (pre- and post-intervention) with repeated measures on the last factor Test Time (Table 24). There was a highly significant main effect for Animacy [$F(1,27)= 19.04$, $p < 0.001$, $\eta p^2 = 0.41$] with animate items categorised quicker than inanimate. There was also a highly significant main effect for Typicality [$F(1,27)= 59.99$, $p < 0.001$, $\eta p^2 = 0.69$] with typical items categorised quicker than atypical ones. Furthermore, there was also a highly significant interaction effect for Animacy x Typicality [$F(1,27)= 11.92$, $p = 0.002$, $\eta p^2 = 0.31$] with the animate typical items categorised quickest. Another significant interaction was for Typicality x Condition [$F(2,27)= 3.95$, $p = 0.031$, $\eta p^2 = 0.23$]. Bonferroni post-hoc tests showed no significant differences between the children in the different conditions.

In addition, planned comparisons using paired samples t-tests from pre- to post-intervention within each condition also showed no significant differences. The means indicate that most children categorise typical animate items quicker than typical inanimate. The children in the dog group intervention seem to categorise all typical items quicker than the children in the other conditions.

Table 24

Condition (dog individual, relaxation individual, control) x Test Time (pre- and post-intervention) x Animacy x Typicality Condition ANOVA for Categorisation Reaction Times Score

Effect	df	F	p	ηp^2
(A) Test Time	1, 27	0.36	0.554	0.01
(B) Condition	2, 27	0.50	0.613	0.04
(C) Animacy	1, 27	19.04	< 0.001**	0.41
(D) Typicality	1, 27	59.99	< 0.001**	0.69
A x B (interaction)	2, 27	1.81	0.183	0.12
B x C (interaction)	2, 27	0.20	0.822	0.01
B x D (interaction)	2, 27	3.95	0.031*	0.23
A x C (interaction)	1, 27	0.03	0.868	0.001
A x B x C (interaction)	2, 27	1.04	0.367	0.07
A x D (interaction)	1, 27	0.001	0.981	< 0.001
A x B x D (interaction)	2, 27	1.09	0.351	0.075
C x D (interaction)	1, 27	11.92	0.002**	0.31
B x C x D (interaction)	2, 27	0.63	0.538	0.05
A x C x D (interaction)	1, 27	1.14	0.296	0.04
A x B x C x D (interaction)	2, 27	0.29	0.754	0.02

Note: ** Indicates highly significant result; * Indicates a significant result

5.1.10.2 Immediate effects of group intervention on categorising typical vs atypical and animate vs inanimate objects

For the children in the group intervention, an ANOVA was calculated to include Condition (dog group, relaxation group, control) x Animacy (animate, inanimate) x Typicality (typical, atypical) x Test Time (pre- and post-intervention) (Table 25). There was a highly significant main effect for Animacy [$F(1,51)= 19.99, p< 0.001, \eta p^2= 0.60$] with animate items categorised quicker than inanimate. There was also a highly significant main effect for Typicality [$F(2,51)= 64.11, p< 0.001, \eta p^2= 0.56$] with typical items categorised quicker than atypical ones. Furthermore, there was also a highly significant interaction effect between Animacy x Typicality [$F(1,51)= 15.58, p< 0.001, \eta p^2= 0.23$] as well as a just significant interaction effect between Test Time x Animacy x Condition [$F(2,51)= 3.180, p= 0.050, \eta p^2=0.11$].

Bonferroni post-hoc test showed no significant differences between the different conditions. Planned comparisons, paired samples t-tests assessed whether there were any significant differences pre- to post-intervention within each condition. These showed no significant differences.

Table 25

Condition (control, dog group, relaxation group) x Test Time (pre- and post-intervention) x Animacy x Typicality Condition ANOVA for Categorisation Reaction Times Score

Effect	df	F	p	ηp^2
(A) Test Time	1, 51	2.17	0.147	0.04
(B) Condition	2, 51	2.92	0.063	0.10
(C) Animacy	1, 51	74.99	< 0.001**	0.60
(D) Typicality	1, 51	64.11	< 0.001**	0.56
A x B (interaction)	2, 51	2.98	0.060	0.11
B x C (interaction)	2, 51	0.16	0.857	0.01
B x D (interaction)	2, 51	2.17	0.124	0.08
A x C (interaction)	1, 51	0.06	0.802	0.001
A x B x C (interaction)	2, 51	3.18	0.050*	0.11
A x D (interaction)	1, 51	0.08	0.776	0.002
A x B x D (interaction)	2, 51	0.67	0.518	0.03
C x D (interaction)	1, 51	15.58	< 0.001**	0.23
B x C x D (interaction)	2, 51	0.41	0.668	0.02
A x C x D (interaction)	1, 51	0.66	0.421	0.01
A x B x C x D (interaction)	2, 51	1.90	0.160	0.07

Note: ** Indicates highly significant result; * Indicates a significant result

5.2 Effects of AAI on Language- Children with Lower Ability

The children of this ability only completed one language task- BAS verbal comprehension. Results were presented using descriptive and inferential statistics. Only the raw scores were calculated here as children were significantly delayed compared to their peers of the same chronological age. As a result, the standardised tests did not provide an appropriate standardised score usable for this group. The number of children who took part at the different test points varied. Table 26 provides more detail.

Table 26

The number of children in the low ability group taking part at the different language assessment points for each condition

Task	Condition	Test 1 Baseline N	Test 2 After Intervention N	Test 3 6-week N	Test 4 6-month N	Test 5 1-year N
BAS Verbal Comprehension	Dog Individual	18	18	18	18	18
	Relax Individual	11	11	11	11	8
	Control	11	11	10	10	8

Attrition rates were minimal (N=6) and equally spread across conditions.

5.2.1 BAS Verbal Comprehension raw scores: Descriptive statistics

This task tested the comprehension skills of children who were delayed in their language development as their chronological age was 8-10 years but this task was for 3-6-year-old typically developing children. Table 27 showed the descriptive statistics (Mean and SD) of the BAS verbal comprehension (raw scores) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 27

Descriptive statistics (Mean and SD) of the BAS verbal comprehension (raw scores) for all assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	12.22	5.14	14.61	5.09	13.94	4.84	13.94	5.22	14.94	5.72
RI	12.91	2.64	14.18	5	16.36	4.46	17.45	3.21	18.27	2.72
C	12.5	4.47	12.13	4.52	12.12	5.17	11.75	5.97	11.88	5.74

DI= Dog Individual; RI= Relaxation Individual; C= Control

The mean scores indicated that children in the dog and relaxation intervention improved from baseline to post-intervention as the scores were higher. The children in the relaxation intervention continued to improve in all subsequent tests. The children in the dog intervention have shown a reduction in scores at the 6-week follow-up and a maintenance of scores between 6-weeks and 6-months. At the 1-year follow-up there was an increase in mean scores again for the children in the dog intervention. The children in the control condition did not have a difference in scores from baseline to any of the follow-up points.

5.2.2 BAS Verbal Comprehension raw scores: Inferential statistics

To investigate whether the differences in mean scores were significant, ANOVAs and t-tests were conducted next. ANCOVAs were calculated using information on SES, Pet and Dog Ownership as covariates where enough parents returned the questionnaires and the groups did not become too small to calculate. The sphericity was taken into account and findings were reported appropriately. Independent samples t-tests revealed no significant differences between children in the different conditions at baseline. The data was normally distributed at baseline.

5.2.2.1 Longitudinal effects of dog and relaxation interventions

A 3x5 ANOVA was calculated to indicate and differences between Conditions (dog individual, relaxation individual and control) for all follow-up tests, up to 1 year after the intervention (Table 28).

There was a highly significant main effect for Test Time as all children improved over time [$F(2.941, 99.997) = 3.99, p = 0.010, \eta^2 = 0.11$]. There was also a significant interaction effect for Test Time x Condition [$F(5.882, 99.997) = 2.57, p = 0.024, \eta^2 = 0.13$].

A Bonferroni post hoc test indicated no significant differences but the means indicate that the children in the control group maintained the same scores over the year, whereas the children in the dog intervention showed an improvement immediately after the intervention and then again at the 1-year test. The children in the relaxation group gradually improved on this task from one assessment to the next (Figure 12).

Table 28

Condition (dog, relaxation, control) x Test Time (pre- post-intervention, 6-week, 6-month, 1-year follow-up) ANOVA for Verbal Comprehension Raw Score

Effect	df	F	p	η^2
Individual Intervention				
(A) Test Time	2.941, 99.997	3.99	0.010**	0.11
(B) Condition	2, 34	1.81	0.179	0.10
A x B (interaction)	5.882, 99.997	2.57	0.024*	0.13

Note: ** Indicates highly significant result; * Indicates a significant result

Planned comparisons using paired samples t-tests were calculated to establish significant differences within each condition. Between pre-intervention and immediate follow-up there was a significant difference for the children in the dog individual intervention ($p = 0.004$).

There was also a significant difference between pre-intervention and 1-year follow-up for the same children ($p = 0.007$). For the children in the individual relaxation intervention there was a significant difference between pre-intervention and 6-week follow-up ($p = 0.018$) and pre-intervention and 6-month follow-up ($p = 0.017$) as well as pre-intervention and 1-year follow-up ($p = 0.013$). These significant differences were due to the children performing better after

the interventions as presented in Figure 12. No significant differences were found for the children in the control condition.

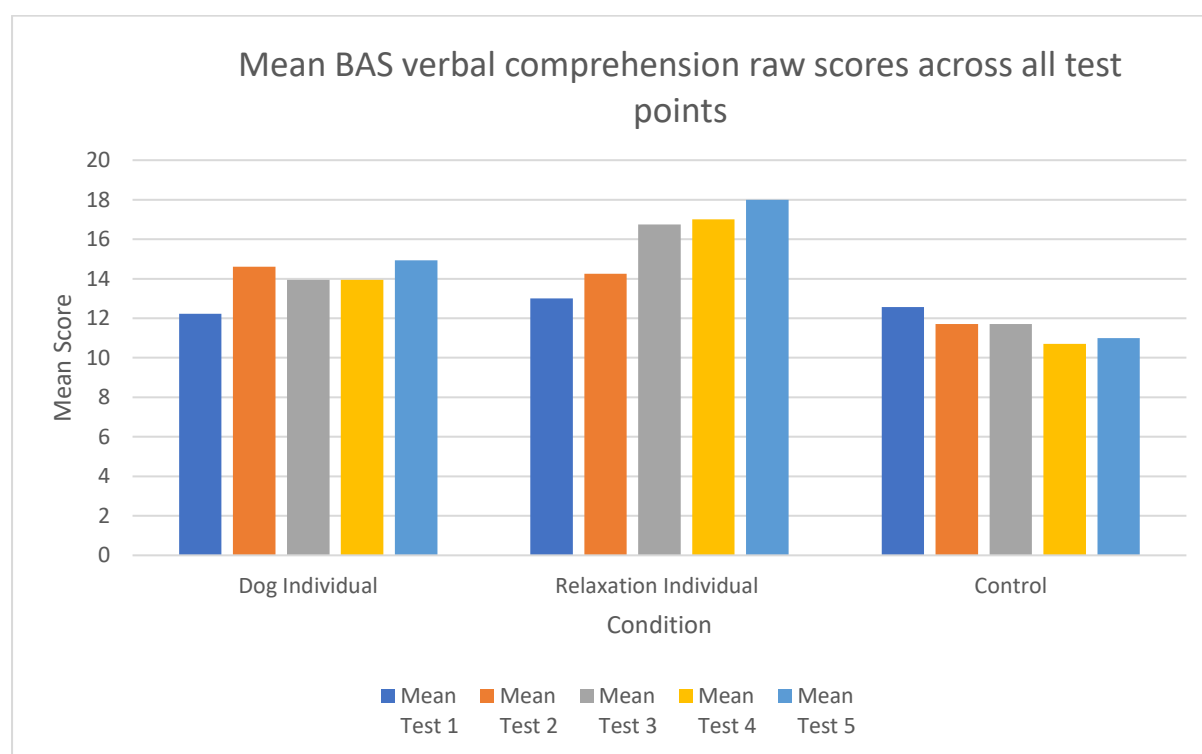


Figure 12: Mean BAS verbal comprehension across all assessment points

5.2.2.2 Immediate effects of dog and relaxation interventions

A 3x2 ANOVA was calculated (Table 29) for pre- and post-intervention effects. This enabled the use of data of more children who took part even if they have missed some of the follow-up testing sessions. There was a highly significant main effect for Test Time as children in all conditions showed an improvement from pre- to post-intervention [$F(1,40)= 7.69$, $p= 0.008$, $\eta p^2= 0.16$] (Figure 13).

Table 29

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Syntactic Formulation Standardised Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1,40	7.69	0.008**	0.16
(B) Condition	2	0.83	0.442	0.00
A x B (interaction)	2, 40	3.17	0.053	0.14

Note: ** Indicates highly significant result; * Indicates a significant result

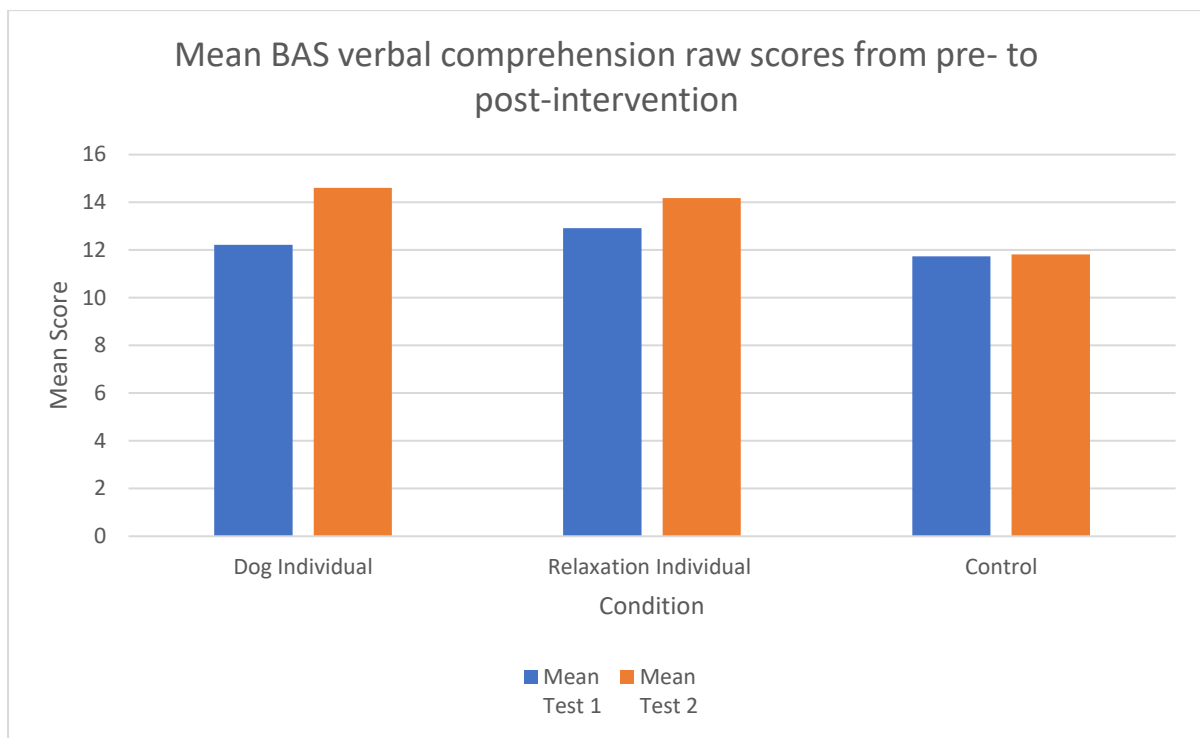


Figure 13: Mean BAS Verbal Comprehension for pre- and post-intervention assessments

5.2.2.2.1 The influence of SES, Pet and Dog Ownership on immediate effect of the interventions

ANCOVAs were calculated to assess whether SES, Pet or Dog Ownership influence the effect of the intervention (Table 30). The only significant effect was the maintenance of Test Time when SES was included as a covariate [$F(1,24) = 5.54$, $p = 0.027$, $\eta^2 = 0.19$] and the means indicated that children across all conditions improved on this score from pre- to post-intervention.

Table 30

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with SES, Pet and Dog Ownership as Covariates ANCOVA for Verbal Comprehension

Effect	df	F	p	ηp^2
Individual Intervention				
(C) SES (covariate)	1, 24	1.03	0.317	0.04
(A) Test Time	1, 24	5.54	0.027*	0.19
(B) Condition	2, 24	0.99	0.387	0.08
A x B (interaction)	2, 24	0.69	0.513	0.05
A x C (interaction)	1, 24	2.67	0.115	0.10
(C) Pet Ownership (covariate)	1, 28	3.31	0.080	0.11
(A) Test Time	1, 28	0.34	0.564	0.01
(B) Condition	2, 28	0.39	0.680	0.03
A x B (interaction)	2, 28	1.52	0.236	0.10
A x C (interaction)	1, 28	2.84	0.103	0.09
(C) Dog Ownership (covariate)	1, 27	0.001	0.980	0.00
(A) Test Time	1, 27	0.91	0.349	0.03
(B) Condition	2, 27	0.63	0.543	0.04
A x B (interaction)	2, 27	0.76	0.476	0.05
A x C (interaction)	1, 27	0.01	0.922	0.00

Note: ** Indicates highly significant result; * Indicates a significant result

5.3 Effects of AAI on Language- Summary

The results of this chapter are summarised in Table 31 below. The ticks indicate a significant difference. The ANOVAs are written based on the factors calculated. For instance, a 3x2 in the ANOVA/ ANCOVA column means that the results are for the 3x2 ANOVA for the factors of Condition (dog, relaxation, control) and Test Time (pre- and post-intervention). The 3x5 ANOVA included all follow-up testing points. The SES, Pet (pet ownership) and Dog (dog ownership) stand for the factors entered as covariates in the ANCOVAs. The Group/ Individual column is an indication of whether the statistical test was calculated using the data from the children taking part in the individual dog and relaxation interventions or the group dog and relaxation interventions. The column labelled Time (T) indicates a significant main effect for time and the column Condition (C) indicates a significant between-subjects main effect for condition, if a tick is in the box. In this instance the condition is the intervention/ control that children took part in (i.e. individual dog/ relaxation, control, group dog/ relaxation). The T x C column indicates a Time x Condition interaction effect. The T x Covariate column is for the ANCOVA calculations only as it indicates an interaction between

test time and the covariate included in the calculation (i.e. pet ownership, dog ownership or SES).

Table 31

Summary of Significant Results for All Language Tasks: ACE and BAS-3

Task	ANOVA/ ANCOVA	Group (G)/ Individual (I)	Time (T)	Condition (C)	T x C	T x Covariate
ACE: Sentence Comprehension (Raw Scores)	3x5	I				
		G			✓	
	3x 2	I			✓	
		G	✓		✓	
	3x2 Pet	I			✓	
ACE: Sentence Comprehension (Standard Scores)	3x5	I	✓		✓	
		G			✓	
	3x2	I			✓	
		G	✓		✓	
	3x2 Pet	I			✓	
ACE: Syntactic Formulation (Raw Scores)	3x5	I				
		G	✓			
	3x2	I	✓			
		G	✓	✓		
ACE: Syntactic Formulation (Standardised Scores)	3x5	I	✓			
		G	✓			
	3x2	I	✓			
		G		✓		
BAS-3: Verbal Comprehension (Raw Scores)	3x5	I	✓		✓	
	3x2	I	✓			
	3x2 SES	I	✓			
	3x2 Pet	I				
	3x2 Dog	I				
CATEGORISATION						
ANOVA		Time (T)	Condition (C)	T x C	Other Significant Effect (Specify)	
Individual Intervention: 3x2x2x2 Condition x Test Time x Animacy x Typicality					Animacy Main: ✓	
					Typicality Main: ✓	
					(C) x Typicality: ✓	
					Animacy x Typicality: ✓	
Group Intervention: 3x2x2x2 Condition x Test Time x Animacy x Typicality					Animacy Main: ✓	
					Typicality Main: ✓	
					Animacy x Typicality: ✓	
					(T) x (C) x Animacy ✓	

In summary, the table indicated that the interventions had an effect on children's language development, with raw and standardised scores indicating similar results in terms of levels of significance. The detailed results, including the direction of the findings were discussed next and are presented in Appendix 12.

5.4 Discussion

5.4.1 Overview of main findings and scoring differences

The results presented here indicated some positive learning effects over time as well as benefits of the interventions provided. The children completed different tasks based on their ability and showed different benefits from the interventions.

The children of higher ability showed more benefits of DAI on the production task (ACE syntactic formulation) immediately after the intervention period if they were in the dog individual intervention, followed by the children in the relaxation individual intervention. The children in the dog and relaxation group intervention and control condition did not show a significant improvement on the same task. When using the standard scores, the children in the individual dog condition also showed a large improvement on the comprehension task (ACE sentence comprehension), but when using the raw scores, the children in the individual relaxation showed the largest improvement on this task, followed by the children in the control condition. For the lower ability children there was a significant benefit of DAI on their comprehension task (BAS verbal comprehension) immediately after taking part in the dog individual intervention, while the children in the control and relaxation intervention did not show a beneficial effect.

The categorisation task, which considered how quickly and accurately children categorised objects did not show any condition effects between the children based on the intervention they took part in. However, in line with previous research (e.g. Gee et al., 2012) there was a significant difference between items with animate items being categorised quicker than inanimate and typical items being categorised quicker than atypical.

The following discussion addresses the differences between raw and standardised scores, as well as establishes the improvements children show over time. The group and individual intervention differences are discussed as well as the influence of the external factors: SES, pet and dog ownership. Following this, the results for the categorisation task are discussed. All the findings are then related to the importance of improving language for children with special educational needs.

5.4.2 Comparison of raw and standardised scores

Children of high and low ability across the different conditions were of a similar ability for most tasks at the beginning of the study. However, a difference in the calculations emerged for the children in the high ability group as the calculations completed with the raw scores differed to the standardised score calculations. When the t-tests were run with the raw scores, the significance level was closer to the statistically significant point (0.05) compared to the analysis conducted with the standardised scores. This indicated that the raw scores were perhaps more sensitive to change with the potential to indicate trends that may not be established with the standardised scores. Although this has not been investigated for the test used here, there is general consensus that the standardised scores can be more or also less sensitive to change depending on the number of items used to assess a particular skill (Wasserman & Bracken, 2003). In this case, standardised measures may be seen to lack sensitivity and perhaps not capture the true progress of the participant, especially for those with special needs. This point was further supported as linear distribution standardised scores (which was the type used in ACE) was only based on the mean and distribution of the sample who have taken part in the creation of the test (Wasserman & Bracken, 2003). As the large majority of participants were typically developing, their progression on language tasks was likely to be better than children with special needs. As a result, the standardised scores would be appropriate for typically developing children but not those with special needs. This was an especially important consideration as in the manuals these tests it is

advised to use the standardised scores for any calculations, providing enough tasks have been completed to yield a standard score.

An alternative would be to use the raw score. However, the limitation of utilising a raw score which may be more sensitive was that it may be easier to see a false positive effect due to skewed data. It was proposed that the most comprehensive way of using standardised tests such as the one used here was to calculate both raw and standardised scores in order to see the statistical differences from the robust standardised score as well as any trends from the raw scores, which could be explored further with a larger sample size. This is especially important when working with children with special educational needs, as the standardised tests are largely created for typically developing children with a very small sample size for children with special needs on some occasion, but these children are often of a high ability.

Further differences between calculating raw scores and standardised scores were evident when running ANOVAs for the group intervention. For the task ACE syntactic formulation, the result of the standardised score was less significant (but still statistically significant) than the raw score calculation. This further supported the idea of the standardised score being less significant for statistical calculations and the raw score likely to be more sensitive (showing larger significance) are both important for understanding the data. This is especially the case as the test has not included children with the same profile and ability when creating the standardised norms. This further advocates for the importance of analysing both raw and standardised scores, particularly for children with special educational needs. Some tests such as the language measure used here has had a smaller sample of children with special educational needs take part for the standardisation of the tasks. However, the children recruited have been high functioning and as a result similar to typically developing children in their academic ability; not representative of the general population of children attending special needs schools. As a result, standardised measures need to be developed to be appropriate for these children to assess their development and enable appropriate comparisons.

5.4.3 Improvements over time

As previously mentioned, the results indicated that children with special needs improved on some of the language measures over time. For the children of higher ability, all children in the individual and control condition improved over time on the ACE sentence comprehension and ACE syntactic formulation task. All children in the lower ability group also improved over time on the BAS verbal comprehension.

Looking more specifically to answer the questions of whether an AAI or relaxation intervention would aid the development of children within these areas, it appeared that the children of high ability benefitted from both the relaxation and dog intervention on different tasks, suggesting that different interventions were needed depending on the skill which was targeted for improvement. For the comprehension task (ACE sentence comprehension) there were differences in scores for children in the different conditions across the various time points. For children within each condition, it was found that immediate benefits were for those in the relaxation individual intervention and individual dog intervention. A similar finding is evident for the ACE syntactic formulation task where children in the dog individual intervention showed the most significant improvement post-intervention, followed by the children in the relaxation individual intervention. It was important to treat this finding with caution as these significant results were only based on comparing the same children pre- to post- intervention. When comparing the children in the interventions to the control group there were no significant differences. This would suggest that although within each condition there was a significant improvement, this was not significantly different from the children taking part in the other conditions.

The children of lower ability who completed the BAS verbal comprehension task also showed a significant improvement over time. The results, when analysed for each condition, indicated that the significant benefits post-intervention were only evident for the children in the dog condition. As the children in the control and relaxation condition did not show an improvement, it was suggested that interventions with dogs can help children develop their

language comprehension. However, as previously discussed this finding needed to be treated with caution as these comparisons were only pre- to post-intervention for children within each condition and were not significantly different when compared directly to the children in the control condition.

Overall it can be concluded that AAI appeared to improve children's performance on a language tasks for children with special educational needs who were significantly delayed as well as those who were working on a similar level as typically developing peers. However, further investigation is needed to clarify how exactly the dog intervention has helped children improve significantly on these language tasks along with a larger participant cohort in order to investigate these differences compared to the control group.

5.4.4. Effects of the covariates: SES, pet and dog ownership

Further to the main effect which this research investigated, information on SES, pet ownership and dog ownership was also collected through parent questionnaires. As the sample size for each test was fairly small these were only factored in as covariates in separate ANCOVAs for the children in the individual intervention who completed the ACE sentence comprehension task and the children with low ability who completed the BAS verbal comprehension task. They have provided an indication of their influence, but further investigation was needed to find out their effect. The results showed that for the ACE sentence comprehension task the only significant difference when including all of the covariates was for the interaction effect between time and condition. The findings indicated that the covariates did not impact on the findings for this task. This was not the case for the BAS verbal comprehension task, as there was a time and condition interaction when dog ownership was included in the calculation. Although it was not possible to investigate the effect having a pet dog has on the influence of the interventions as the groups were too small to calculate the analysis, this should be explored further in future research.

5.4.5 Categorisation findings

The categorisation task was a computer-based activity where each child had to decide whether each item belonged to the ocean or farm. Half of the them were farm items and half ocean items. Within each category (farm/ ocean) half were animate and half inanimate. From the animate/ inanimate objects half were typical exemplars and half atypical. The computer recorded children's correct/ incorrect response as well as the length of time it took the child to make the decision (reaction time). The aim was to investigate whether children categorised items quicker if they were in the dog intervention condition.

Although there did not appear to be an effect for condition, there was an effect for animacy, where the animate objects were categorised quicker than the inanimate objects and also an effect for typicality where the typical items were categorised quicker than the atypical items. This is in line with previous research with younger participants (Gee et al., 2012; Mandler, Bauer & McDonough, 1991) as children were thought to use thematic strategies and were affected by the type of stimulus (Blanchet, Dunham & Dunham, 2001). Such findings would advocate that children with special educational needs categorise similarly to typically developing peers, although future research would need to compare children with special educational needs to typically developing children on the same tasks. This would provide an insight into the ability to process and categorise items which in turn has an impact on children's language development (see Meints, Plunkett & Harris, 1999, Mients, Plunkett & Harris, 2008).

5.4.6 Benefits of the interventions for children with special educational needs

The beneficial findings presented so far are promising. It is important to discuss the benefits that such improvement could have on the children with learning difficulties. Firstly, the less able children who completed the BAS verbal comprehension task were working at the cognitive and linguistic level of 3-5-years, although their chronological age was 8-10-years. Their language comprehension delay may have co-occurred with other developmental

delays. This is proposed to be the case as previous research has found that language facilitates skills such as adaptive behaviour and communication for children with ASD (Szatmari et al., 2003). Furthermore, limited ability to communicate was described as likely to result in problem behaviours as they can become the child's means of communicating with the adult (Carr & Durand, 1985).

As a result of the research presented here, a link is suggested between language delay, communication and behaviour that the child was exhibiting -attempting to develop the language of a child may impact on the other areas of development and daily functioning (e.g. Zampini & D'Odorko, 2009). Further to this, teaching and caring for a child with behavioural problems was also associated with the increased levels of stress of caregivers and teachers (Lecavalier et al., 2006). In children where this was the case, it may be possible to address some of the behavioural problems by improving the child's language development, impacting on the wellbeing of the adults working and living with the child. In addition, improving a child's language ability is likely to result in improved social skills as research suggested that children who were more advanced in their early language development were likely to be exposed to more social situations and as a result learn how to deal with them (Bennett et al., 2013). This would further advocate for early intervention to help children learn language and therefore improve their communication and other skills which would in turn improve the quality of their daily life. With the current research indicating that child-led one-to-one dog sessions improved children's comprehension in just 4 weeks, it is reasonable to consider using AAls for children who are delayed in their language as well as other areas of development as this may impact on their ability to communicate appropriately for their age.

Further to the children who are significantly delayed in their development, benefits of AAI were also established in this work for children with special needs working at a similar ability to their typically developing peers. It is important to highlight the fact that these benefits were established for both the comprehension and production task which is not surprising as these are related skills. More research needs to be conducted to establish which skill is improved first for children with which disorder and how much that affects the

other skill as well as whether the same pattern of improvement occurs in children of lower ability. Nonetheless, this is promising as children with different diagnosis show different delays. For instance, children with Williams Syndrome differ in their language profile compared to children with Down's Syndrome (Singer Harris, Bellugi, Bates, Jones & Rossen, 1997). Furthermore, children with ASD have a larger production-comprehension lag where their comprehension is more delayed than usual (Maljaars, Noens, Scholte & van Berckelaer-Onnes, 2012). In contrast, children with Down's Syndrome have a larger deficit in expressive language, compared to receptive language (for more detail see Martin, Klusek, Estigarribia & Roberts, 2009) and have production differences such as less frequent production of multi-word utterances (Zampini & D'Odorico, 2011). In further support of this notion, children with ADHD with language delay have poorer receptive language compared to children with language delay who do not have ADHD (El Sady et al., 2013). These different trajectories indicate that diagnosis specific research concentrating on various subgroups of each diagnosis is needed. However, the AAI benefits shown in this research are promising and have the potential to benefit many children with various diagnosis.

5.5 Conclusion

The current research investigated the effect of dog-assisted intervention and a relaxation intervention on children's language development compared to a no treatment control group. Having established that children with special educational needs improved on a language task after spending time in AAI sessions has opened up the opportunity for application in practice as well as further research.

The research is particularly important as finding interventions which could be made available early on to facilitate language development for children with delayed language are likely to improve the child's communication. As a result, the child's quality of life would be enhanced as well as potentially improving their linguistic abilities.

In addition to this, teachers, caregivers and other family members are also likely to benefit and experience an enhanced quality of life. This will be due to better understanding

of the needs of the child they were caring for as well as more contentment due to improved communication. This was particularly important as caring for or teaching a child with special educational needs may be considerably easier if they were better able to communicate. It is also potentially possible that they will be taught new skills and knowledge more easily, at least in areas where language assists learning.

Chapter 6: Cognition Results

As previously presented in Chapter 3, children with special educational needs are delayed in their cognitive development. As a result, schools seek to provide interventions to improve this development. As previously discussed, there is very limited research on the potential cognitive benefits of AAI for children with special needs, with most of the research investigating one-off task completions in the presence of a dog as opposed to intervention benefits. This chapter presents the findings of the effect of a classroom-based AAI on the cognitive ability of children with special educational needs. The results are presented for children working close to the level of their chronological age (high ability) and then for children who were severely delayed in their cognition (low ability) and as a result were working at a level appropriate for a younger chronological age (i.e. from age 3-years).

6.1 Effects of AAI on Cognition- Children with High Ability

Children who were working at a cognitive level similar to their typically developing peers completed the BAS-3 School-Age tasks. Depending on their ability and understanding some completed all four subsections (Recognition of Designs, Pattern Construction, Matrices, Quantitative Reasoning) while other children only completed the tasks, they were able to do.

Results are described using descriptive and inferential statistics per measure. The calculations with raw scores are presented first, followed by calculations of the standardised cluster scores: SNC; Non-Verbal Reasoning (NVR) and Special Ability (SA). The findings from the Fruit Stroop task are also presented here as only the children of higher ability were able to complete this task.

The sphericity was taken into account and when it was not violated, the sphericity assumed was reported, however, when it was violated the Greenhouse-Geisser or Huynh-Feldt were reported as appropriate. The number of children who took part at the different test points varied. Table 32 provides more detail.

Table 32

The number of children in the high ability group taking part at the different cognitive assessment points for each condition

Task	Condition	Test 1 Baseline N	Test 2 After Intervention N	Test 3 6-weeks N	Test 4 6-months N	Test 5 1-year N
BAS Recognition of Designs	Dog Individual	10	10	10	10	8
	Relax Individual	8	8	7	8	7
	Control	11	11	10	8	9
	Dog Group	21	21	21	10	11
	Relax Group	21	21	20	15	12
BAS Pattern Construction	Dog Individual	11	11	11	10	9
	Relax Individual	8	8	6	8	7
	Control	11	11	10	8	9
	Dog Group	21	21	21	10	11
	Relax Group	21	21	20	15	12
BAS Matrices	Dog Individual	10	10	10	10	8
	Relax Individual	8	8	7	8	7
	Control	11	11	10	8	9
	Dog Group	21	21	21	10	11
	Relax Group	21	21	20	15	12
BAS Quantitative Reasoning	Dog Individual	9	9	8	9	9
	Relax Individual	8	8	7	8	7
	Control	10	10	10	8	9
	Dog Group	19	19	19	8	9
	Relax Group	19	19	18	13	10
BAS Standardised Cluster Score (SNC)	Dog Individual	10	10	7	10	8
	Relax Individual	8	8	6	8	7
	Control	11	11	10	8	9
	Dog Group	21	21	18	10	11
	Relax Group	21	21	18	15	12
BAS Non-verbal Reasoning (NVR)	Dog Individual	8	8	6	8	8
	Relax Individual	8	8	6	8	7
	Control	10	10	10	8	9
	Dog Group	19	19	17	9	10
	Relax Group	19	19	17	13	10
BAS Spatial Ability (SA)	Dog Individual	10	10	7	10	8
	Relax Individual	8	8	5	8	7
	Control	11	11	10	8	9
	Dog Group	21	21	18	10	11
	Relax Group	21	21	18	15	12

For a longitudinal sample with SEN children, participant attrition was small and retention was on average 73% over time (minimum retention was 47.4%; maximum retention was 100%).

Attrition was mostly due to children moving schools. Completion of assessment and lack

thereof at different time points for students was due to absence (illness or appointments) or the child showing an increased number of challenging behaviours.

6.1.1 BAS Recognition of Designs raw scores: Descriptive statistics

This task tested the recognition and short-term memory attention of children working at a level close to their typically developing peers. Table 33 showed the descriptive statistics (Mean and SD) of the BAS recognition of designs (raw scores) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 33

Descriptive statistics (Mean and SD) of the BAS Recognition of Designs (raw scores) for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	12.63	5.45	11.25	3.99	13.25	4.8	12.25	2.92	13.63	5.58
RI	11	3.41	11.5	3.27	13.33	3.39	13.5	4.68	13.67	4.55
C	12.57	3.55	13.57	4.69	15.43	5.65	15.29	5.16	18.71	4.75
DG	12.5	6.79	12.6	4.27	12.8	5.31	12.8	4.41	14.3	5.36
RG	12.64	6.77	11.55	4.46	14.55	5.96	12.18	4.12	15.27	5.35

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that children in the dog individual intervention and relaxation group intervention performed worse between pre- to post-intervention while the children in the individual relaxation and dog group interventions performed at the same level and the children in the control group performed slightly better. All children performed better at the 6-week follow-up point apart from those taking part in the dog group intervention who maintained the same scores as the previous test sessions. The children maintained similar scores at the 6-week follow-up apart from those in the relaxation group intervention who

performed worse. At the 1-year follow-up, the children in the dog individual intervention, control and relaxation group intervention showed a better performance on the task while the rest of the children maintained their scores from the previous testing sessions.

6.1.2 BAS Recognition of Designs raw scores: Inferential statistics

Analysis of Variance (ANOVAs) and t-tests were calculated to establish whether the differences in mean scores were significant. Where enough data was available ANCOVAs using SES, Pet and Dog Ownership as covariates were calculated. The sphericity was always taken into account and the appropriate values were reported based on the Epsilon value. Independent samples t-tests for test 1 confirmed that there were no significant differences between conditions for both individual and group intervention. The data was skewed at baseline, so it was log transformed (log10) for the distribution to tend towards normality before the ANOVAs were calculated.

6.1.2.1 Longitudinal effects of dog and relaxation interventions

3x5 ANOVAs to include all the follow-up testing points were calculated for Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) for the children taking part in the individual and group interventions (Table 34). There was a significant main effect for Test Time for all participants [individual interventions: $F(2.282, 41.0810) = 3.24$, $p = 0.043$, $\eta^2 = 0.15$; group interventions: $F(4, 100) = 5.29$, $p = 0.001$, $\eta^2 = 0.18$] as all children improved on the task over time (Figure 14).

Table 34

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for Recognition of Designs (Raw Score)

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	2.282, 41.081	3.24	0.043*	0.15
(B) Condition	2, 18	1.13	0.346	0.11
A x B (interaction)	4.565, 41.081	0.84	0.574	0.09
Group Intervention				
(A) Test Time	4, 100	5.29	0.001**	0.18
(B) Condition	2, 25	0.70	0.506	0.05
A x B (interaction)	8, 100	0.66	0.729	0.05

*Note: ** Indicates highly significant result; * Indicates a significant result*

To investigate the predicted differences between conditions before and after interventions and compared to the control group, planned comparisons were calculated using paired samples t-tests. These revealed a significant improvement in scores for the children in the individual relaxation intervention between pre-intervention baseline (test 1) and immediate post-intervention assessment (test 2) ($p= 0.031$). There was also a significant difference between pre-intervention (test 1) and 6-week post-intervention (test 3) for the children in the group relaxation intervention ($p= 0.019$) who improved at 6-week follow-up. The children in the control condition showed a significant improvement in scores between pre-intervention baseline (test 1) and 1-year post-intervention assessment (test 5) ($p= 0.007$).

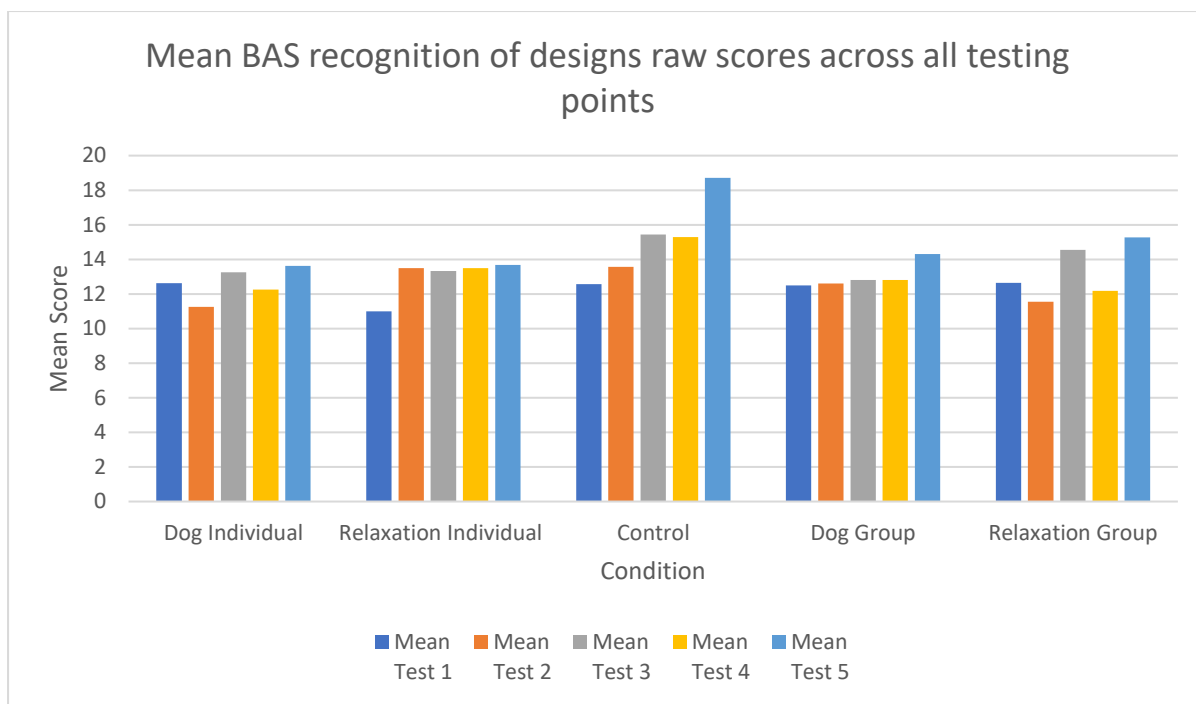


Figure 14: Mean BAS Recognition of Designs across all assessment points

6.1.2.1.1 The influence of SES, Pet and Dog Ownership on longitudinal effect of the interventions

There were no significant differences for the 3x5 ANCOVAs.

6.1.2.2 Immediate effects of dog and relaxation interventions

3x2 ANOVAs for Condition (dog, relaxation, control) and Test Time (pre-, post-intervention) were calculated for the children in the individual and group interventions. There were no significant differences. Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

6.1.2.2.1 The influence of SES, Pet and Dog Ownership on immediate effect of the interventions

The ANCOVAs (Table 35) established a significant interaction effect between Condition x Test Time for the individual intervention when Pet [$F(2,20)= 3.97, p= 0.035, \eta^2= 0.28$] and Dog [$F(2,20)= 6.29, p= 0.008, \eta^2= 0.40$] Ownership were entered as covariates. The means indicated that the children in the relaxation and control conditions showed an improvement at

immediate post-intervention assessment, while the children in the dog intervention perform worse at immediate follow-up than at pre-intervention.

Table 35

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with SES, Pet and Dog Ownership as Covariates ANCOVA for Recognition of Designs Raw Score

Effect	df	F	p	ηp^2
Individual Intervention				
(C) SES (covariate)	1, 16	0.94	0.346	0.06
(A) Test Time	1, 16	2.14	0.163	0.12
(B) Condition	2, 16	0.50	0.613	0.06
A x B (interaction)	2, 16	1.20	0.328	0.13
A x C (interaction)	1, 16	1.41	0.252	0.08
(C) Pet Ownership (covariate)	1, 20	1.20	0.286	0.06
(A) Test Time	1, 20	0.70	0.414	0.03
(B) Condition	2, 20	0.84	0.443	0.08
A x B (interaction)	2, 20	3.97	0.035*	0.28
A x C (interaction)	1, 20	0.48	0.499	0.02
(C) Dog Ownership (covariate)	1, 19	0.12	0.734	0.01
(A) Test Time	1, 19	4.05	0.059	0.18
(B) Condition	2, 19	0.79	0.467	0.08
A x B (interaction)	2, 19	6.29	0.008**	0.40
A x C (interaction)	1, 19	3.65	0.071	0.16
Group Intervention				
(C) Pet Ownership (covariate)	1, 16	0.36	0.559	0.02
(A) Test Time	1, 16	0.73	0.405	0.04
(B) Condition	2, 16	0.98	0.396	0.11
A x B (interaction)	2, 16	0.45	0.647	0.05
A x C (interaction)	1, 16	1.41	0.252	0.08
(C) Dog Ownership (covariate)	1, 16	1.08	0.313	0.06
(A) Test Time	1, 16	0.38	0.548	0.02
(B) Condition	2, 16	1.45	0.263	0.15
A x B (interaction)	2, 16	0.39	0.683	0.05
A x C (interaction)	1, 16	0.73	0.407	0.04

Note: ** Indicates highly significant result; * Indicates a significant result

6.1.3 BAS Pattern Construction standardised scores: Descriptive statistics

This task assessed the children's ability to replicate a pattern, tested problem solving and spatial awareness skills. In this case, standardised test scores were used. Descriptive statistics (Means and SDs) of the BAS Pattern Construction (standardised scores) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention) were presented in Table 36.

Table 36

Descriptive statistics (Mean and SD) of the BAS pattern construction (standardised scores) for all assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	19.89	9.13	30.78	11.78	33.44	9.91	32.89	13.77	34	13.53
RI	21	7.91	32.4	9.29	19	15.94	28.5	13.88	30	11.2
C	25.29	9.39	31.29	9.73	32.86	11.92	39.14	14.79	40.43	14.13
DG	35.8	16.94	38.6	19.92	42.5	21.31	38.8	25.94	44.8	21.46
RG	25.09	11.05	25.73	14.26	25.64	13.95	30.36	15.36	30.27	12.28

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that children in the control condition showed an increase in their scores between all test times. Children in the individual interventions (dog and relaxation) showed an increase in scores across all test points apart from between 6-week and 6-month follow-up. There was a slight decrease in mean scores for the children in the dog individual intervention and between immediate follow-up and 6-week follow-up for the children in the relaxation individual intervention. The children in the relaxation group intervention maintained similar scores across the year of testing apart from between 6-week and 6-month follow-up when they showed an increase. The children in the dog group intervention showed an increase in their mean scores between pre- to post-intervention and 6-week follow-up. Between the following two testing points (6-month and 1-year) the children showed a decrease in scores.

6.1.4 BAS Pattern Construction standardised scores: Inferential statistics

To investigate whether the differences between mean scores presented above are significant, Analysis of Variance (ANOVAs) and t-tests were calculated. ANCOVAs with the factors of SES, Pet and Dog Ownership were calculated where enough data was available. In reporting the analysis, the sphericity was taken into account and appropriate calculations

reported based on the Epsilon value. Independent samples t-tests were calculated at test 1. There were no significant differences between conditions for the children taking part in the individual intervention but there was a difference at baseline between the children taking part in the group interventions. The data was normally distributed at baseline, so ANOVAs and ANCOVAs were calculated.

6.1.4.1 Longitudinal effects of dog and relaxation interventions

A 3x5 ANOVA to include all follow-up testing points was not calculated for the individual interventions as there were only 5 participants in the relaxation condition who completed all testing points. Instead, a 3x5 (Condition x Test Time) ANOVA was calculated only for the children in the group interventions (Table 37). There was a highly significant main effect for Test Time [$F(3.905, 97.632) = 7.90, p < 0.001, \eta^2 = 0.24$] as children in all group interventions and control condition improved over time (Figure 15).

Table 37

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for BAS Pattern Construction Standardised Score

Effect	df	F	p	η^2
Group Intervention				
(A) Test Time	3.905, 97.632	7.90	<0.001**	0.24
(B) Condition	2, 25	1.76	0.192	0.12
A x B (interaction)	7.811, 97.632	1.36	0.227	0.10

Note: ** Indicates highly significant result; * Indicates a significant result

To further investigate the predicted differences between conditions, planned comparisons using paired samples t-tests within each condition were calculated. The children in the dog group intervention showed a significant difference in scores between baseline and immediate post-intervention follow-up ($p = 0.022$), pre-intervention and 6-week follow-up ($p = 0.009$) and pre-intervention and 1-year follow-up ($p = 0.005$) due to an improvement at each follow-up assessments. The children taking part in the relaxation group intervention only showed a significant difference in scores between baseline and 6-month follow-up ($p = 0.005$) as there was a significant improvement at test 4. Children in the control condition

indicated significant differences in scores between baseline and immediate follow-up ($p=0.008$), baseline and 6-week follow-up ($p=0.004$), baseline and 6-month follow-up ($p=0.001$) and baseline and 1-year follow-up ($p=0.017$) due to an improvement of performance at each assessment.

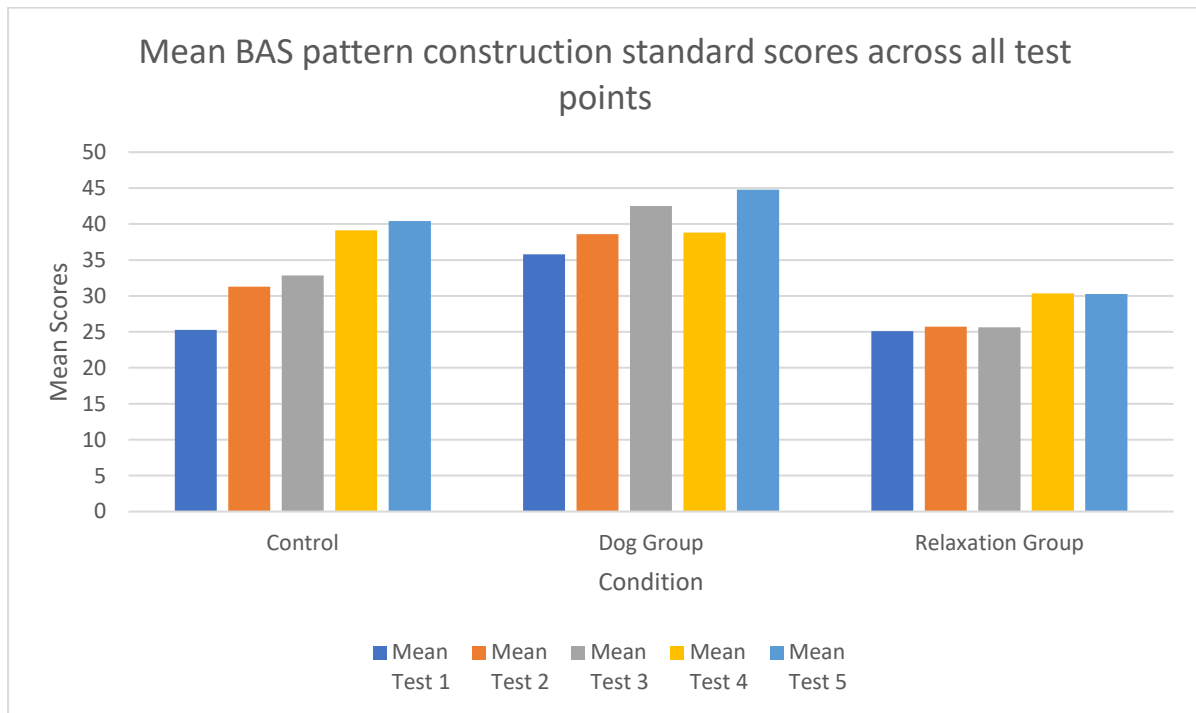


Figure 15: Mean BAS Pattern Construction scores for all assessment points

6.1.4.2 Immediate effects of dog and relaxation interventions

A repeated measures ANOVA was calculated to investigate if there were any significant differences pre- to post-intervention when including all children who took part at the pre-, post-intervention test. This allowed for the inclusion of calculations with children who took part in the individual interventions as well as group interventions. There was a highly significant main effect for Test Time from the 3x2 ANOVA (Table 38) for all children [individual intervention: $F(1,25)=53.04$, $p<0.001$, $\eta^2=0.68$; group intervention $F(1,50)=17.15$, $p<0.001$, $\eta^2=0.26$] with children in all conditions improving on their scores from pre- to post-intervention (Figure 16). Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 38

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Pattern Construction (Standardised Score)

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 25	53.03	< 0.001**	0.68
(B) Condition	2, 25	0.26	0.114	0.02
A x B (interaction)	2, 25	2.37	0.777	0.16
Group Intervention				
(A) Test Time	1, 50	17.15	<0.001**	0.26
(B) Condition	2, 50	2.81	0.069	0.10
A x B (interaction)	2, 50	1.64	0.204	0.06

Note: ** Indicates highly significant result; * Indicates a significant result

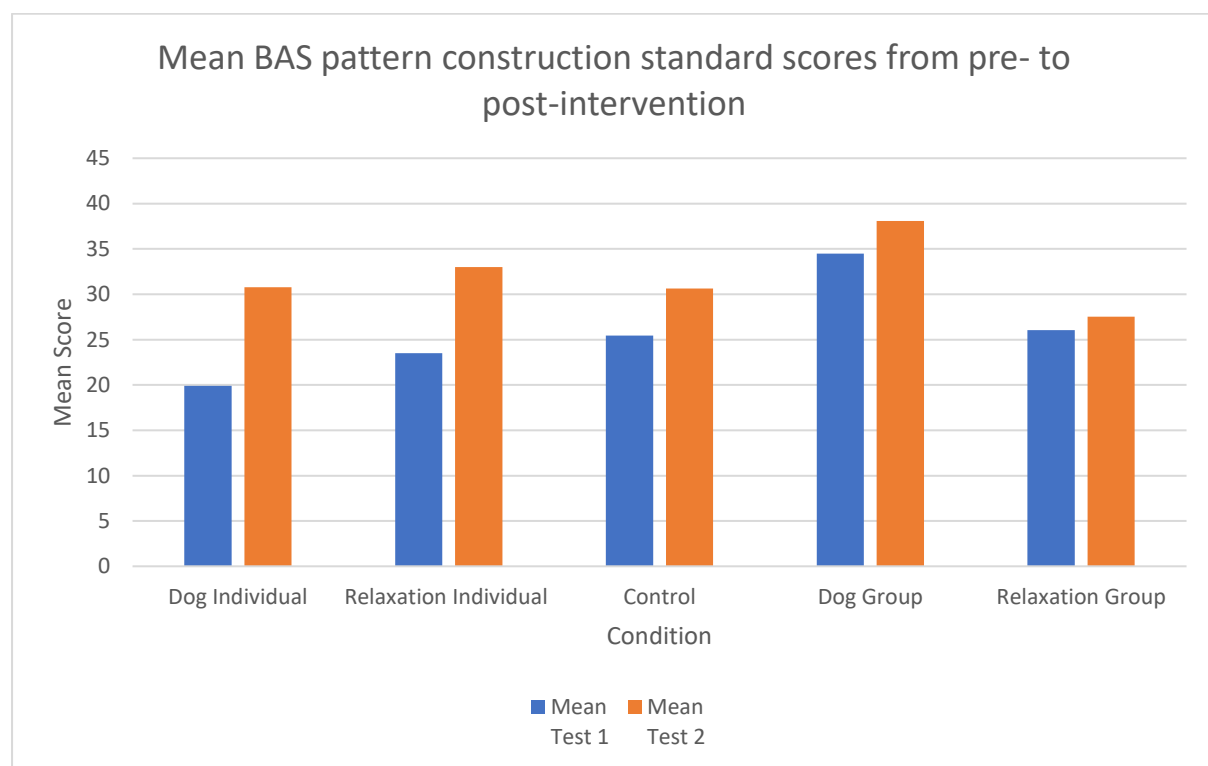


Figure 16: Mean BAS Pattern Construction from pre- to post-intervention

6.1.4.2.1 The influence of SES, Pet and Dog Ownership on immediate effect of the interventions

ANCOVAs using Pet and Dog Ownership information as covariates were calculated to establish whether those factors influence the effectiveness of the interventions. There was a between-subject just significant main effect for Condition for children in the group intervention when Pet Ownership was entered as a covariate [$F(2,16) = 3.64$, $p = 0.050$, $\eta p^2 =$

0.31] and a significant Test Time main effect for the children in the individual interventions [$F(1,19)= 4.64, p= 0.044, \eta p^2= 0.20$] (Table 39). The means indicated that the children in the dog and control group increased their scores at immediate follow-up whereas the children in the control group remained the same at immediate follow-up.

Table 39

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with Pet and Dog Ownership as Covariates ANCOVA for Pattern Construction (Standardised Score)

Effect	df	F	p	ηp^2
Individual Intervention				
(C) Pet Ownership (covariate)	1, 19	3.24	0.088	0.15
(A) Test Time	1, 19	4.64	0.044*	0.20
(B) Condition	2, 19	0.47	0.633	0.05
A x B (interaction)	2, 19	0.82	0.458	0.08
A x C (interaction)	1, 19	0.07	0.798	0.004
 (C) Dog Ownership (covariate)				
(A) Test Time	1, 18	0.01	0.914	0.001
(B) Condition	2, 18	0.69	0.513	0.07
A x B (interaction)	2, 18	1.47	0.257	0.14
A x C (interaction)	1, 18	1.57	0.227	0.08
 Group Intervention				
(C) Pet Ownership (covariate)	1, 16	1.75	0.204	0.10
(A) Test Time	1, 16	0.47	0.503	0.03
(B) Condition	2, 16	3.64	0.050*	0.31
A x B (interaction)	2, 16	0.41	0.669	0.05
A x C (interaction)	1, 16	0.03	0.877	0.002
 (C) Dog Ownership (covariate)				
(A) Test Time	1, 16	0.05	0.827	0.003
(B) Condition	2, 16	2.24	0.139	0.22
A x B (interaction)	2, 16	0.27	0.765	0.03
A x C (interaction)	1, 16	0.04	0.842	0.003

Note: ** Indicates highly significant result; * Indicates a significant result

6.1.5 BAS Pattern Construction alternative scores: Descriptive statistics

This task assessed the children's ability to replicate a pattern, testing problem solving and spatial awareness skills. In this case, alternative test scores were used. Descriptive statistics (Means and SDs) of the BAS pattern construction (standardised scores) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention) were presented in Table 40.

Table 40

Descriptive statistics (Mean and SD) of the BAS pattern construction (alternative scores) for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	8.11	3.1	10.89	2.71	11.33	2.96	20.67	26.94	10.89	4.43
RI	7.83	1.84	10.67	2.58	14.83	12.06	9	3.58	10.17	2.56
C	9.86	2.12	10.86	2.8	12	3.16	12.43	3.1	12	2.94
DG	13	4.35	12.2	5.35	13.2	5.9	23	27.88	12.4	4.4
RG	9.45	4.53	8.55	3.42	9.36	3.7	9.82	3.87	15.18	14.51

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that overall children improved across most assessment points regardless of the condition they were in. The difference was for the children in both group interventions (dog and relaxation) between baseline and immediate follow up as they performed worse post-intervention. Children in the dog group and individual interventions and those in the control group also showed a decrease in scores at the 1-year follow-up. The children in the individual relaxation intervention showed lower scores at 6-month follow-up.

6.1.6 BAS Pattern Construction alternative scores: Inferential statistics

To investigate if the mean differences are significant between the different test points ANOVAs have been calculated. When enough data was available SES, Pet and Dog Ownership were entered as covariates in ANCOVA calculations.

As the data for the children in the individual interventions was skewed, it was log transformed (log10) before the calculations. The raw scores were used in the group data as it was normally distributed. Sphericity was taken into account and the appropriate values were reported based on the Epsilon value.

Independent samples t-tests calculated at test 1 showed that there were no significant differences between conditions for the children taking part in the individual

intervention but there was a difference at baseline between the children taking part in the group interventions.

6.1.6.1 Longitudinal effects of dog and relaxation interventions

3x5 ANOVAs indicated no significant differences.

To investigate the predicted differences within each condition, planned comparisons using paired samples t-tests were calculated. These indicated a significant difference between pre- to post-intervention for the children in the individual dog ($p=0.002$) and individual relaxation ($p=0.002$) interventions with children improving post-intervention. There was also a significant difference between pre-intervention and 6-week follow-up for the children in the individual dog intervention ($p=0.006$) and control condition ($p=0.020$) due to better scores on the task. There were no significant differences for the children taking part in the group interventions. Figure 17 showed the means.

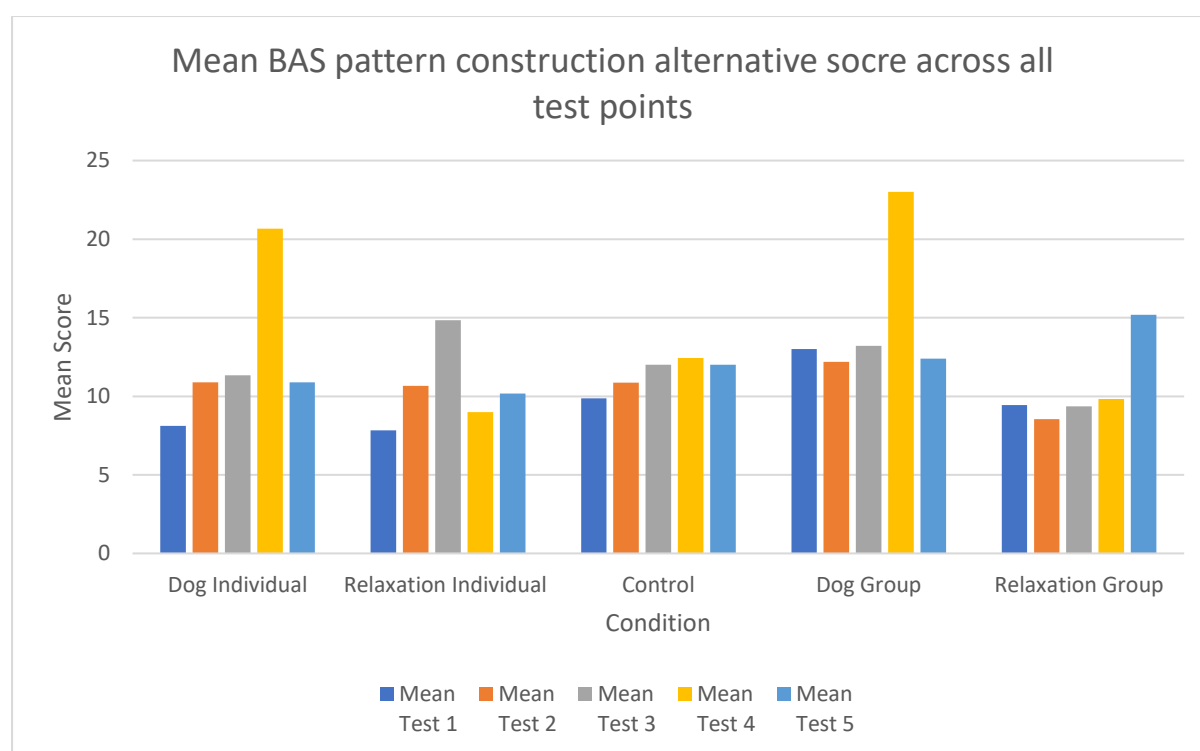


Figure 17: Mean BAS Pattern Construction scores across all assessment points

6.1.6.1.1 The influence of SES, Pet and Dog Ownership on longitudinal effect of the interventions

The 3x5 ANCOVAs revealed no significant differences.

6.1.6.2 Immediate effects of dog and relaxation interventions

A 3x2 Repeated measures ANOVA of Condition (dog, relaxation control) and Test Time (pre-, post-intervention) were calculated for the children taking part in the individual and group interventions separately to include all children who took part, even if children later missed some of the follow-up sessions (Table 41).

Results showed a highly significant main effect for Test Time for the participants in the individual interventions [$F(1,27) = 34.06$, $p < 0.001$, $\eta^2 = 0.56$] as all children improved their scores after the intervention period (Figure 18). The participants in the group intervention showed a significant between-subjects main effect for Condition [$F(2,50) = 3.82$, $p = 0.029$, $\eta^2 = 0.13$]. The children in the control condition showed improved scores from pre- to post-intervention period whereas the children taking part in group interventions have worse scores at immediate post-intervention assessment (Figure 18). Bonferroni post-hoc calculations showed no significant differences. Planned comparisons pre-post-intervention were presented above, as part of the longitudinal data.

Table 41

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Pattern Construction (Alternative Score)

Effect	df	F	p	η^2
Individual Intervention				
(A) Test Time	1, 27	34.06	<0.001**	0.56
(B) Condition	2, 27	1.04	0.367	0.07
A x B (interaction)	2, 27	2.20	0.130	0.13
Group Intervention				
(A) Test Time	1, 50	1.03	0.315	0.02
(B) Condition	2, 50	3.82	0.029*	0.13
A x B (interaction)	2, 50	1.86	0.167	0.07

Note: ** Indicates highly significant result; * Indicates a significant result

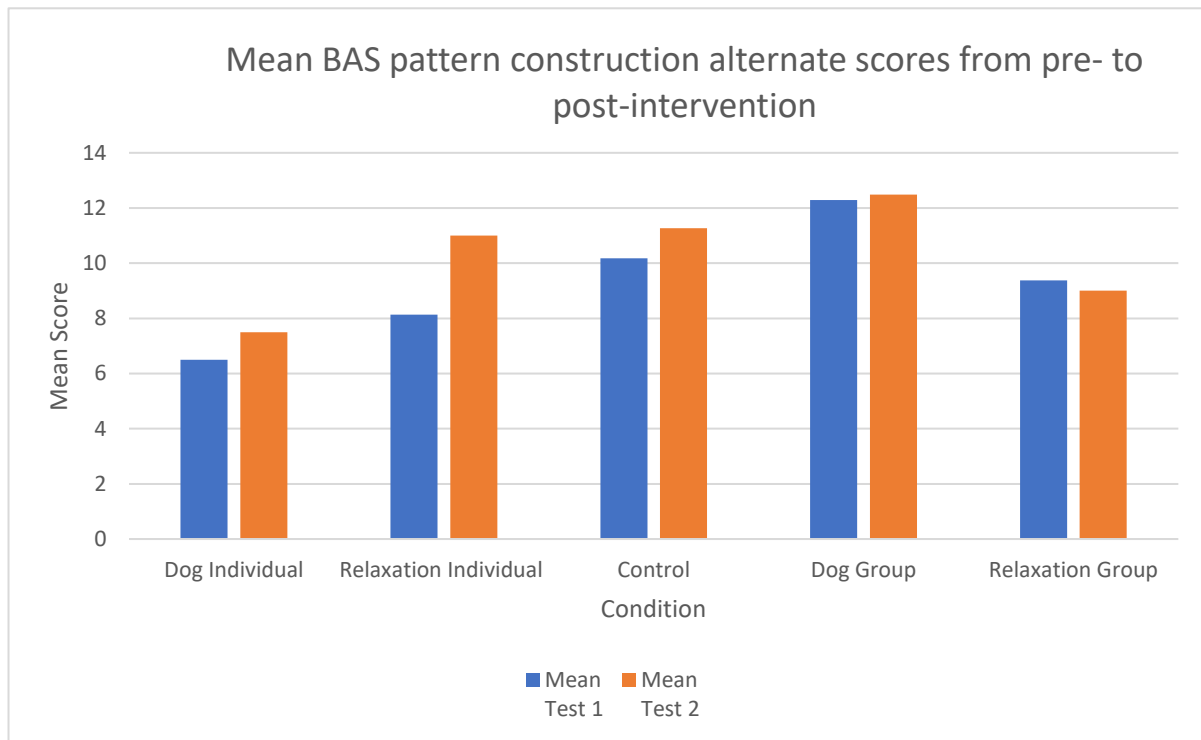


Figure 18: Mean BAS Pattern Construction for pre- and post-intervention assessment

6.1.6.2.1 The influence of SES, Pet and Dog Ownership on immediate effect of the interventions

SES, Pet and Dog Ownership were entered as covariates (Table 42). The only significant difference was a main effect for Condition with Pet Ownership as a covariate, for the children in the group interventions [$F(2,16)= 4.91$, $p= 0.002$, $\eta^2= 0.38$]. The means indicated that the children in the relaxation and dog interventions performed worse at immediate post-intervention while the children in the control group perform slightly better.

Table 42

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with SES, Pet and Dog Ownership as Covariates ANCOVA for Pattern Construction (Alternative Score)

Effect	df	F	p	ηp^2
Individual Intervention				
(C) SES (covariate)	1, 16	1.25	0.279	0.07
(A) Test Time	1, 16	0.13	0.723	0.01
(B) Condition	2, 16	0.83	0.453	0.09
A x B (interaction)	2, 16	1.20	0.324	0.13
A x C (interaction)	1, 16	1.07	0.315	0.06
(C) Pet Ownership (covariate)	1, 21	2.10	0.160	0.09
(A) Test Time	1, 21	5.68	0.069	0.15
(B) Condition	2, 21	0.59	0.562	0.05
A x B (interaction)	2, 21	1.40	0.268	0.12
A x C (interaction)	1, 21	0.09	0.770	0.004
(C) Dog Ownership (covariate)	1, 20	0.02	0.898	0.90
(A) Test Time	1, 20	1.04	0.321	0.05
(B) Condition	2, 20	0.69	0.515	0.06
A x B (interaction)	2, 20	0.73	0.494	0.07
A x C (interaction)	1, 20	0.003	0.957	0.00
Group Intervention				
(C) Pet Ownership (covariate)	1, 16	1.20	0.289	0.07
(A) Test Time	1, 16	0.05	0.831	0.003
(B) Condition	2, 16	4.91	0.022*	0.38
A x B (interaction)	2, 16	0.80	0.465	0.09
A x C (interaction)	1, 16	0.03	0.858	0.002
(C) Dog Ownership (covariate)	1, 16	0.002	0.965	< 0.001
(A) Test Time	1, 16	0.00	0.998	0.000
(B) Condition	2, 16	3.43	0.057	0.30
A x B (interaction)	2, 16	0.47	0.636	0.06
A x C (interaction)	1, 16	0.001	0.974	0.000

*Note: ** Indicates highly significant result; * Indicates a significant result*

6.1.7 BAS Matrices raw scores: Descriptive Statistics

This task tested the child's ability to work out and use the rules as well as reason and problem solve. Descriptive statistics (Means and SDs) of the BAS Matrices (raw scores) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention) were presented in Table 43.

Table 43

Descriptive statistics (Mean and SD) of the BAS Matrices (high ability) for all assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	11.5	6	11.88	6.06	12	4.99	13.13	5.84	13.5	8.21
RI	8.33	4.18	10.5	5.39	11.5	5.09	11.83	5.12	10.83	4.83
C	10.86	2.48	12.29	4.07	11.29	3.68	14.57	4.58	16.14	3.81
DG	11.4	5.62	12.8	6.91	13.9	6.21	13.7	6.18	14.3	6.78
RG	8.73	2.05	9.27	3.93	10.45	3.64	11.91	6.89	10.82	3.28

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that children overall improved their scores across assessment points.

The exceptions were the children in the relaxation individual and group intervention at 1-year follow up who showed a decrease in scores. The same was true for the children in the control condition at 6-week point and for the children in the dog group condition at the 6-month point.

6.1.8 BAS Matrices raw scores: Inferential statistics

To investigate whether these means were significantly different, ANOVAs and t-tests were calculated. If there was enough data, ANCOVAs using SES, Pet and Dog ownership as covariates were also calculated. Independent samples t-test at test 1 showed no significant differences between conditions. The scores for the individual interventions were normally distributed at baseline but the group interventions scores were skewed and therefore log transformed (log10).

6.1.8.1 Longitudinal effects of dog and relaxation interventions

3x5 ANOVAs (Table 44) investigated Condition (dog, relaxation, control) x Test Time for individual and group intervention sessions. The results revealed a highly significant main effect for Test Time for all participants [individual intervention: $F(4, 72) = 6.94, p < 0.001, \eta^2 = 0.28$; group intervention: $F(4, 100) = 6.03, p < 0.001, \eta^2 = 0.19$] as all children showed an improvement on the task over time (Figure 19). Planned comparisons using paired-samples t-tests to investigate any changes within each condition between different test points indicated no significant differences.

Table 44

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for Matrices

Effect	df	F	p	η^2
Individual Intervention				
(A) Test Time	4, 72	6.94	<0.001**	0.28
(B) Condition	2, 18	0.44	0.648	0.05
A x B (interaction)	8, 72	1.52	0.167	0.14
Group Intervention				
(A) Test Time	4, 100	6.03	<0.001**	0.19
(B) Condition	2, 25	1.41	0.263	0.10
A x B (interaction)	8, 100	0.49	0.859	0.04

Note: ** Indicates highly significant result; * Indicates a significant result

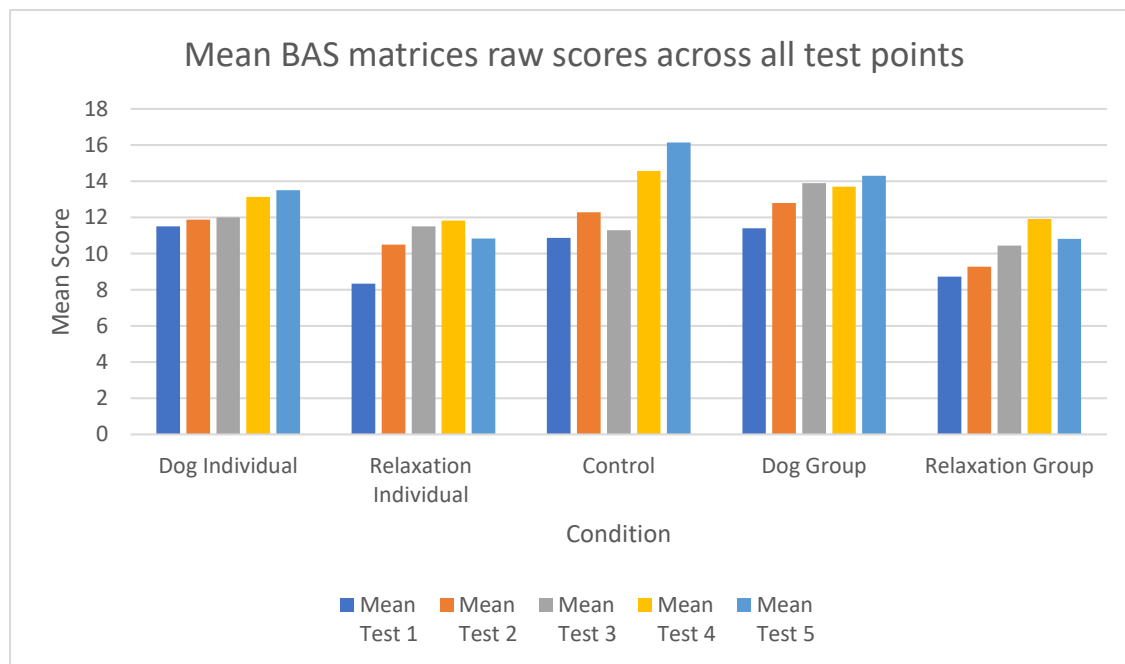


Figure 19: Mean BAS Matrices scores for all assessment points

6.1.8.2 Immediate effects of dog and relaxation interventions

3x2 ANOVAs (Table 45) were calculated to include all children, regardless of whether they have missed follow-up sessions. There was a highly significant main effect for Test Time for all participants [individual intervention: $F(1,26)= 9.27$, $p= 0.005$, $\eta p^2= 0.26$; group intervention $F(1,50)= 10.68$, $p= 0.002$, $\eta p^2= 0.18$] due to improving on this task (Figure 20). Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 45

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Matrices

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 26	9.27	0.005**	0.26
(B) Condition	2, 26	0.12	0.885	0.01
A x B (interaction)	2, 26	1.69	0.558	0.04
Group Intervention				
(A) Test Time	1, 50	10.68	0.002**	0.18
(B) Condition	2, 50	0.50	0.608	0.02
A x B (interaction)	2, 50	0.76	0.471	0.03

Note: ** Indicates highly significant result; * Indicates a significant result

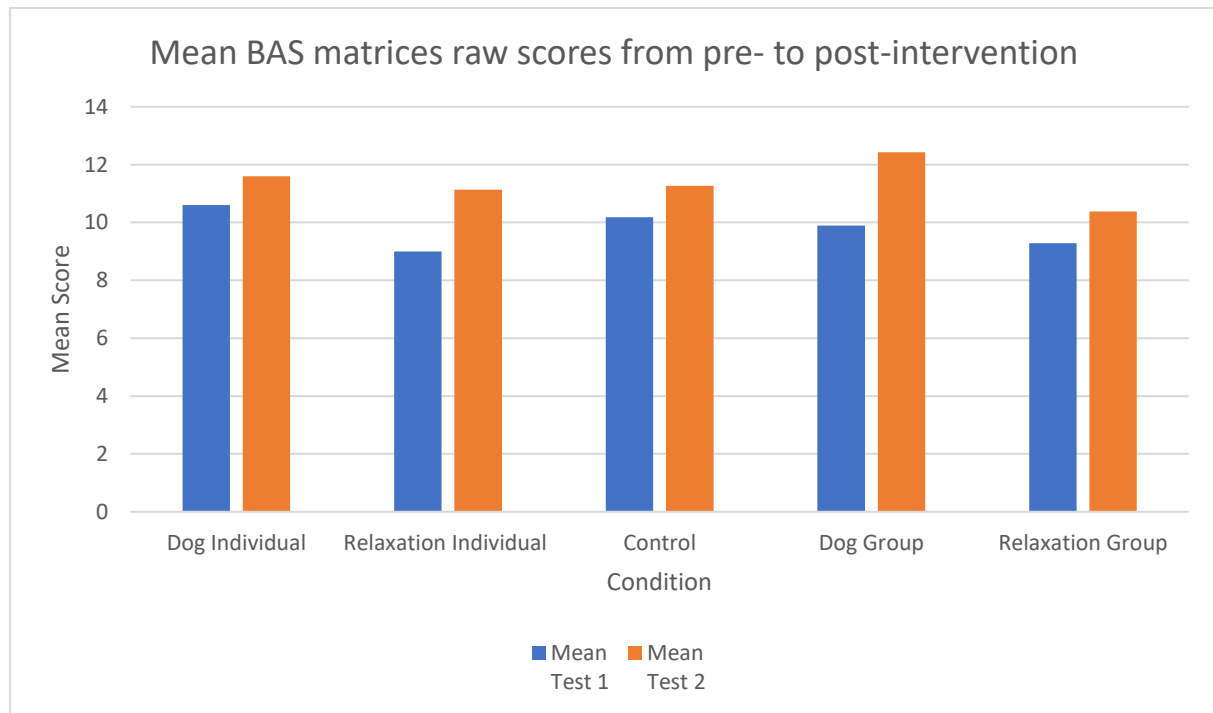


Figure 20: Mean BAS Matrices from pre- to post-intervention scores

6.1.8.2.1 *The influence of pet and dog ownership on immediate effect of the interventions*

The 3x2 ANCOVAs did not show any significant differences.

6.1.9 BAS Quantitative Reasoning raw scores: Descriptive statistics

This task assessed the numeric non-verbal reasoning of the child. Descriptive statistics (Mean and SD) were presented in Table 46 for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 46

Descriptive statistics (Mean and SD) of the BAS quantitative reasoning for all assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	7.13	2.95	8.88	4.16	9.88	4.73	11.38	7.44	11.38	6.46
RI	8.33	2.81	9.83	5.57	9.67	2.88	10.83	7.03	9.5	6.16
C	8.71	1.98	10	2.65	8.43	1.72	9	3.27	10.86	3.24
DG	10.5	6.46	12.88	10.49	12.63	9.24	16	10.88	15.63	10.78
RG	7.67	5.52	8.11	6.86	8.11	6.88	9.89	6.51	11.78	7.01

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that children in all conditions showed an improvement in scores from pre- to post-intervention. Children in the dog individual intervention continued improving until 6-month follow-up and then maintained their score at the 1-year follow-up. The participants in the relaxation individual, dog and relaxation group interventions maintained their scores at the 6-week follow-up and then had an improvement in scores at the 6-month follow-up. The control group showed a decrease in scores at 6-week follow-up and maintained that score for the 6-month follow-up. At the 1-year follow-up children in the relaxation individual

intervention showed a decrease in scores, children in the dog group intervention maintained their score while those in the control and relaxation group intervention showed an improvement in scores.

6.1.10 BAS Quantitative Reasoning raw scores: Inferential statistics

To establish whether the differences in means were significant, ANOVAs and t-tests were calculated. When enough data was available SES, Pet and Dog Ownership were entered as covariates in ANCOVAs. Independent samples t-test showed no significant differences between conditions at test 1. The data from the children in the individual intervention was skewed so it was log transformed towards normality before being calculated in an ANOVA. Sphericity was also taken into account when reporting the results.

6.1.10.1 Longitudinal effects of the dog and relaxation interventions

3x5 ANOVAs were calculated for the children in the individual and group interventions (Table 47). The results indicated a significant main effect for Test Time for all children [individual intervention $F(4,72) = 2.69$, $p = 0.038$, $\eta^2 = 0.13$; group intervention $F(2.350, 49.358) = 4.53$, $p = 0.012$, $\eta^2 = 0.18$] due to an improvement in scores over time.

Table 47

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for Quantitative Reasoning

Effect	df	F	p	η^2
Individual Intervention				
(A) Test Time	4, 72	2.69	0.038*	0.13
(B) Condition	2, 18	0.03	0.972	0.003
A x B (interaction)	8, 72	1.62	0.135	0.15
Group Intervention				
(A) Test Time	2.350, 49.358	4.53	0.012**	0.18
(B) Condition	2, 21	0.92	0.415	0.08
A x B (interaction)	4.701, 49.358	0.84	0.523	0.52

Note: ** Indicates highly significant result; * Indicates a significant result

To establish whether there were any significant differences within each condition as predicted, planned comparisons using paired samples t-tests were calculated. There was a

significant difference for the children in the dog individual intervention as there was a significant increase in scores between pre-intervention and 6-week follow-up ($p= 0.006$), pre-intervention and 6-month follow-up ($p= 0.014$) and pre-intervention and 1-year follow-up ($p< 0.001$). There was also a significant difference for the children in the relaxation group intervention between pre-intervention and 6-month follow-up ($p= 0.019$) and pre-intervention and 1-year follow-up ($p= 0.002$) as children performed better at the follow-up points (Figure 21). There were no significant differences for the no treatment control group.

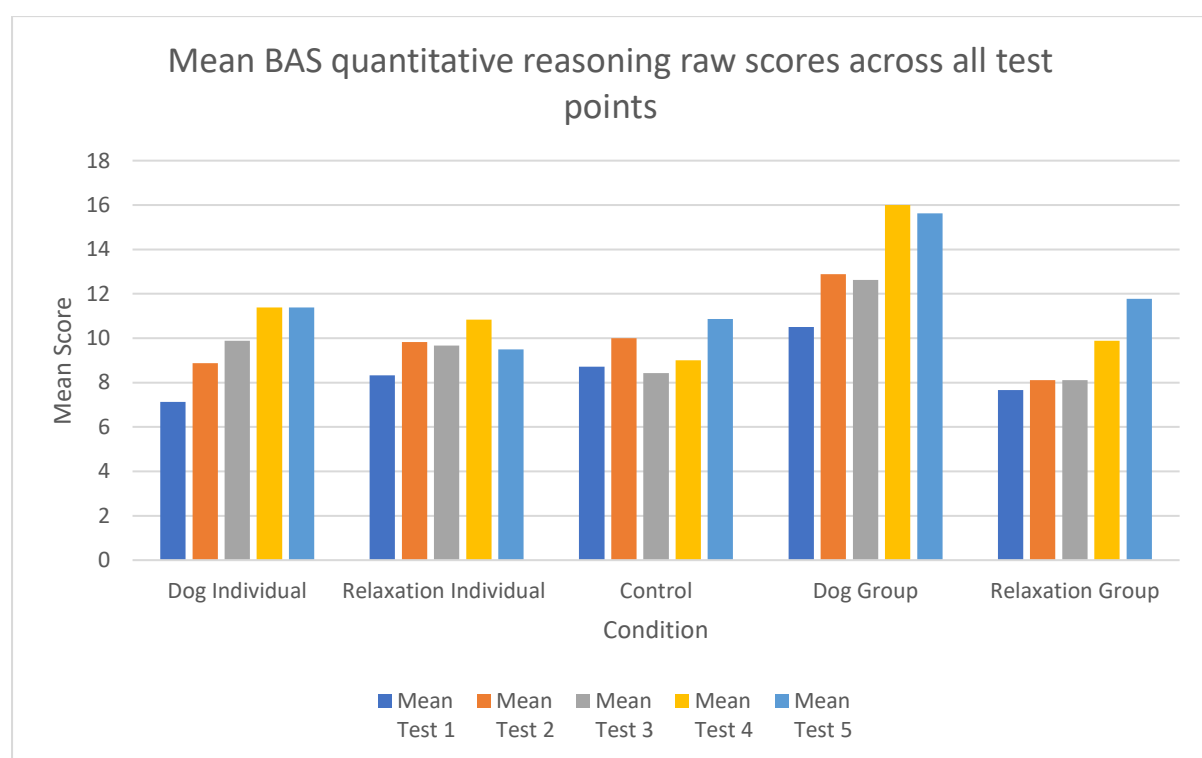


Figure 21: Mean BAS Quantitative Reasoning for all assessment points

6.1.10.1.1 The influence of Pet and Dog Ownership on longitudinal effect of the interventions

The 3x5 ANCOVA showed no significant differences.

6.1.10.2 Immediate effects of dog and relaxation interventions

3x2 ANOVAs were calculated for children taking part in the individual and group interventions to include all children who took part in the intervention, even if the participants

did not complete all follow-up testing sessions. The calculations indicated no significant differences. Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

6.1.10.2.1 The influence of Pet and Dog Ownership on longitudinal effect of the interventions

The 3x2 ANCOVAs (Table 48) indicated that there was a main effect for Test Time when Dog Ownership was entered as a covariate [$F(1,18)= 5.32$, $p= 0.033$, $\eta p^2= 0.23$]. The means indicated that all children improved over time. Due to the small numbers it was not possible to separate the results on the basis of dog ownership, so it was not possible to establish which subgroup the interventions benefit the most.

Table 48

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) with Pet and Dog Ownership as Covariates ANCOVA for Quantitative Reasoning

Effect	df	F	p	ηp^2
Individual Intervention				
(C) Pet Ownership (covariate)	1, 19	0.56	0.465	0.03
(A) Test Time	1, 19	3.90	0.063	0.17
(B) Condition	2, 19	0.19	0.832	0.02
A x B (interaction)	2, 19	0.52	0.602	0.05
A x C (interaction)	1, 19	2.49	0.131	0.12
(C) Dog Ownership (covariate)				
(A) Test Time	1, 18	5.32	0.033*	0.23
(B) Condition	2, 18	0.08	0.921	0.01
A x B (interaction)	2, 18	0.80	0.467	0.08
A x C (interaction)	1, 18	4.26	0.054	0.19
Group Intervention				
(C) Pet Ownership (covariate)	1, 14	0.01	0.928	0.001
(A) Test Time	1, 14	4.50	0.052	0.24
(B) Condition	2, 14	0.26	0.777	0.04
A x B (interaction)	2, 14	0.59	0.567	0.08
A x C (interaction)	1, 14	3.76	0.073	0.21
(C) Dog Ownership (covariate)				
(A) Test Time	1, 14	0.51	0.489	0.04
(B) Condition	2, 14	0.01	0.987	0.002
A x B (interaction)	2, 14	0.24	0.788	0.03
A x C (interaction)	1, 14	0.36	0.556	0.03

Note: ** Indicates highly significant result; * Indicates a significant result

6.1.11 BAS SNC cluster raw score: Descriptive statistics

This score was calculated for the children who completed all four tasks (recognition of designs, pattern construction, matrices and quantitative reasoning), including their raw scores and converting them into standardised scores. This enabled the comparison to the normed data. Descriptive statistics (Mean and SD) of SNC cluster scores were presented in Table 49 for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 49

Descriptive statistics (Mean and SD) of the BAS SNC Cluster Score (raw score) for all test times.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	163.6	44.71	169	44.27	166.2	29.59	168.2	48.56	166.2	47.93
RI	147	7.38	166.4	23.05	163.6	22.82	166	23.73	163.4	12.26
C	157	6.33	164.86	17.17	166.71	25.43	168.43	20.15	172.14	18.85
DG	174.43	38.29	191.14	53.88	190.71	52.31	186.57	53.29	186	50.37
RG	149.44	20.84	149.56	23.4	154.22	27.16	156.67	27.72	158.33	26.24

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that the children in the dog and relaxation individual interventions improved from pre- to post-intervention, showed lower scores at 6-week follow-up, improved again at 6-month follow-up and performed worse at 1-year follow-up. In the dog group intervention, children showed an increase immediately after the intervention then a decrease in scores at 6-week and 6-month follow-up, followed by a maintenance of scores at 1-year assessment. The children in the relaxation group intervention maintained similar scores from pre- to post-intervention, followed by an increase of scores at all subsequent test points. The children in the control condition improved at each assessment point.

6.1.12 BAS SNC cluster raw score: Inferential statistics

To investigate whether the differences in mean scores were significant ANOVAs and t-tests were calculated. When there was enough data on SES, Pet and Dog Ownership, ANCOVAs were calculated using those factors.

Independent t-tests showed no significant differences between condition at test 1 for all participants. The individual intervention data was skewed so the log transformed data (log10) was used in the ANOVAs calculated. The group intervention data was normally distributed. Sphericity was taken into account results were appropriately reported.

6.1.12.1 Longitudinal effects of the dog and relaxation interventions

Not enough children completed all 5 test points so it was not possible to calculate a 3x5 ANOVA, with all follow-up testing points for the children in the individual intervention. However, this ANOVA was calculated for the children in the group intervention (Table 50). There was a highly significant main effect for Test Time [$F(4, 76) = 3.88, p = 0.006, \eta^2 = 0.17$] as children showed a steady progress over time on this measure as shown by Figure 22.

Table 50

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for SNC Raw Cluster Score

Effect	df	F	p	η^2
Group Intervention				
(A) Test Time	4, 76	3.88	0.006**	0.17
(B) Condition	2, 19	2.00	0.163	0.17
A x B (interaction)	8, 76	0.74	0.655	0.07

Note: ** Indicates highly significant result; * Indicates a significant result

To further investigate whether these differences were significant between the different test points as predicted, planned comparisons were calculated using paired samples t-tests for each condition. For the children in the dog group intervention there was a significant difference between pre-intervention and post-intervention ($p = 0.003$) and pre-intervention and 6-week follow-up ($p = 0.009$). The children in the relaxation group intervention only showed a significant difference between pre-intervention and 6-week follow-up ($p = 0.018$).

Figure 22 shows that these significant differences were as a result of children improving their scores. There were significant differences for the children in the control condition between pre- and post-intervention ($p= 0.047$) and pre-intervention and 1-year follow-up ($p= 0.036$).

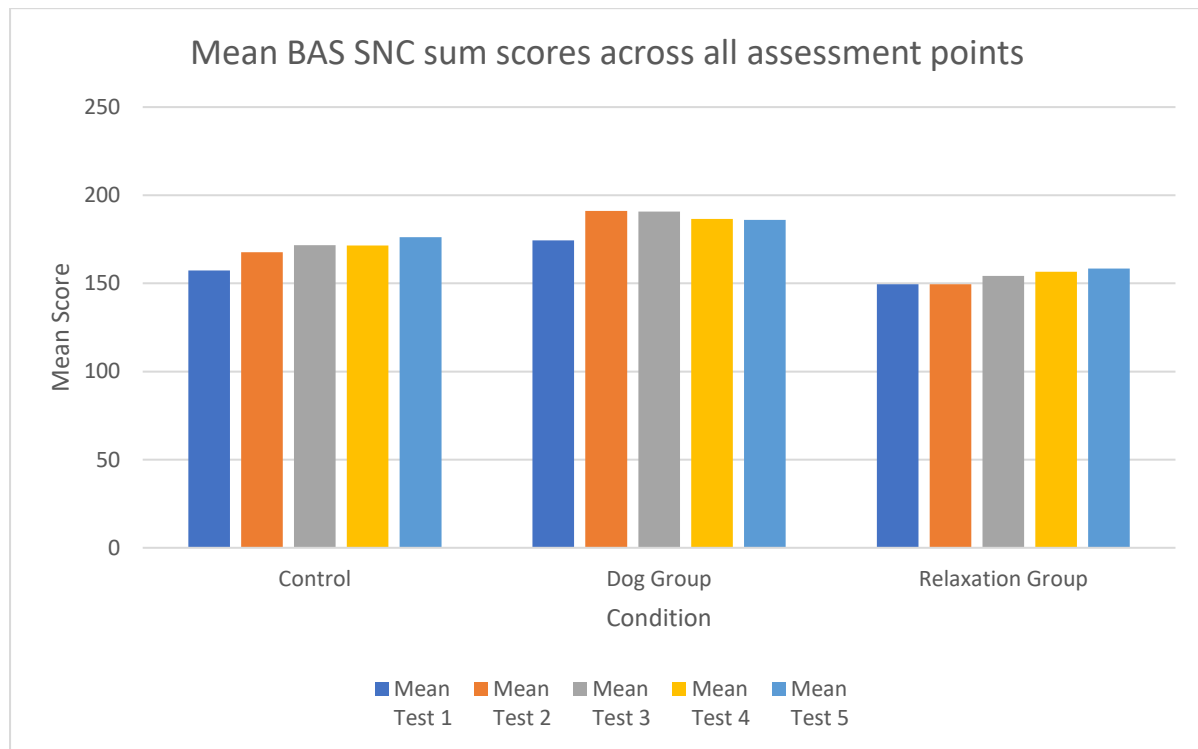


Figure 22: Mean BAS SNC scores across all assessment points

6.1.12.2 Immediate effects of dog and relaxation interventions

3x2 Repeated Measures ANOVAs (Table 51) were calculated to establish any pre- and post-intervention differences to include all children who took part, regardless of whether they completed all the follow-up tests. The results indicated a highly significant main effect for Test Time for all children [individual intervention: $F(1,26)= 25.61$, $p< 0.001$, $\eta p^2= 0.50$; group intervention: $F(1,49)= 17.73$, $p< 0.001$, $\eta p^2= 0.27$] as they all improved their scores from pre- to post-intervention (Figure 23). Planned comparisons pre-post-intervention were presented above, as part of the longitudinal data.

Table 51

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for SNC Raw Cluster Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 26	25.61	<0.001**	0.50
(B) Condition	2, 26	0.21	0.810	0.02
A x B (interaction)	2, 26	2.49	0.103	0.16
Group Intervention				
(A) Test Time	1, 49	17.73	< 0.001**	0.27
(B) Condition	2, 49	0.67	0.515	0.03
A x B (interaction)	2, 49	2.20	0.122	0.08

Note: ** Indicates highly significant result; * Indicates a significant result

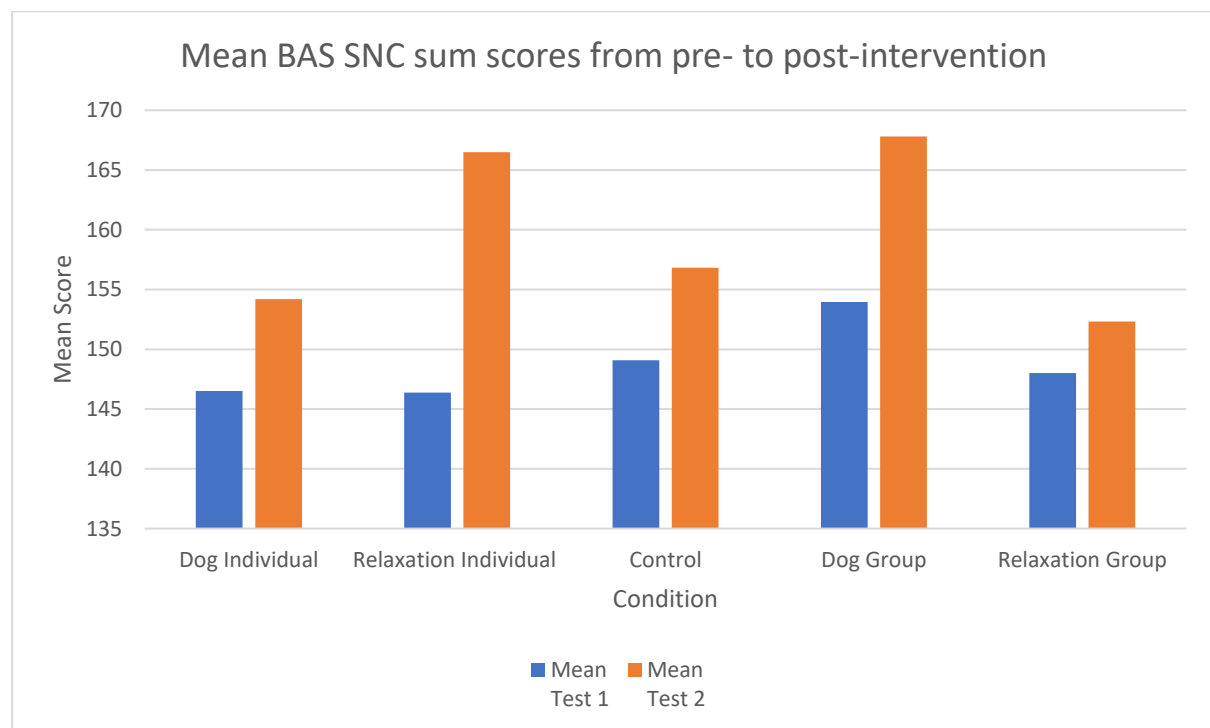


Figure 23: Mean BAS SNC score for pre- and post-intervention assessments

6.1.12.2.1 The influence of pet and dog ownership on immediate effect of the interventions

The 3x2 ANCOVAs showed no significant differences.

6.1.13 BAS SNC cluster standardised score: Descriptive statistics

This score was calculated for the children who completed all four tasks (recognition of designs, pattern construction, matrices and quantitative reasoning). Here the cluster raw score was converted to a standardised score, allowing for comparison to the normed data. Descriptive statistics (Mean and SD) of SNC cluster standardised scores were presented in Table 52 for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 52

Descriptive statistics (Mean and SD) of the BAS SNC cluster score (standard scores) for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	81.2	22.3	83.8	22.32	82.6	15.01	83.6	24.41	82.4	24.4
RI	72.8	3.77	82.6	11.89	81.4	11.57	82.4	11.87	81	6.33
C	77.71	3.09	81.71	8.79	82.86	3.09	81.71	8.79	82.86	12.86
DG	86.71	19.53	95.14	25.18	94.86	26.69	92.86	26.97	92.43	25.41
RG	74	10.34	74.11	11.74	76.44	13.64	77.67	13.81	78.44	13.14

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that between pre- and post-intervention most children showed an improvement in their scores, with the exception of the relaxation group intervention where children maintained the same score. Between immediate follow-up and 6-week follow-up children on the dog individual, relaxation individual and dog group intervention showed a reduction in scores while the children in the control and relaxation group intervention showed an improvement in mean scores. Between test 3 and test 4 the children in the dog and relaxation individual interventions as well as relaxation group intervention increased their mean scores while the children in the other conditions showed worse performance

(decreased scores). For the final assessment point, the children in the dog and relaxation individual interventions showed a decrease in scores while the children in the dog group intervention maintained the same scores and the rest of the children showed an improvement.

6.1.14 BAS SNC cluster standardised score: Inferential statistics

To assess whether the changes in means were significant ANOVAs were conducted.

ANCOVAs using SES, Pet and Dog Ownership as covariates were calculated if enough data was available. Sphericity was taken into account when reporting the calculations.

Independent t-tests showed no significant differences between condition at test 1 for the individual and group intervention. The individual intervention data was skewed at test 1, it was log transformed before running the ANOVA. The group intervention data was normally distributed.

6.1.14.1 Longitudinal effects of the dog and relaxation interventions

Not enough children in the individual interventions completed all 5 test points so it was not possible to calculate a 3x5 ANOVA. The 3x5 ANOVA (Table 53) for children in the group intervention indicated a highly significant main effect for Test Time [$F(4,76) = 3.90$, $p = 0.006$, $\eta^2 = 0.17$] as children showed a similar improvement over time regardless of the condition they were in (Figure 24).

Table 53

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) ANOVA for SNC Standard Cluster Score

Effect	df	F	p	η^2
Group Intervention				
(A) Test Time	4, 76	3.90	0.006**	0.17
(B) Condition	2	2.01	0.162	0.17
A x B (interaction)	8, 76	0.75	0.652	0.07

*Note: ** Indicates highly significant result; * Indicates a significant result*

To further investigate differences in conditions over time, planned comparisons were calculated. The children in the dog group intervention showed a highly significant difference between pre- and post-intervention ($p= 0.003$) and pre-intervention and 6-week follow-up ($p= 0.009$) due to an improvement in scores. The children in the relaxation group intervention showed a significant difference only between pre-intervention and 6-week follow-up ($p= 0.017$) due improved scores (Figure 24). The findings indicated a just significant difference for the children in the control condition between pre- and post-intervention ($p= 0.049$) as well as pre-intervention and 1-year follow-up ($p= 0.034$).

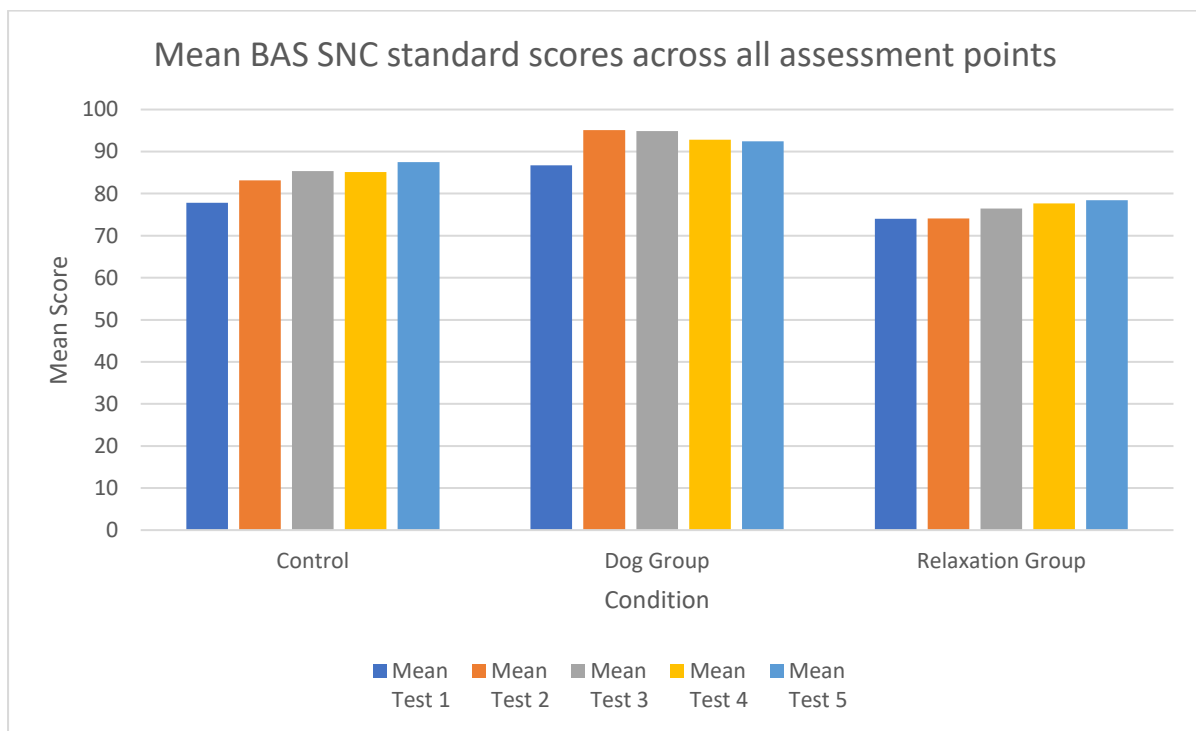


Figure 24: Mean BAS SNC scores across all assessment points

6.1.14.2 Immediate effects of dog and relaxation interventions

The 3x2 ANOVA (Table 54) was calculated to establish any immediate intervention effects including all children, regardless of whether they completed all follow-up assessments. There was a highly significant main effect for Test Time for all participants [individual intervention: $F(1,26)= 23.90$, $p< 0.001$, $\eta^2= 0.48$; group intervention: $F(1,49)= 17.67$, $p<0.001$, $\eta^2= 0.27$] as regardless of the condition, all children showed an improvement on

this score (Figure 25). Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 54

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) ANOVA for SNC Standard Cluster Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 26	23.90	< 0.001**	0.48
(B) Condition	2, 26	0.21	0.811	0.02
A x B (interaction)	2, 26	2.40	0.111	0.16
Group Intervention				
(A) Test Time	1, 49	17.67	<0.001**	0.27
(B) Condition	2, 49	0.69	0.508	0.03
A x B (interaction)	2, 49	2.20	0.121	0.08

Note: ** Indicates highly significant result; * Indicates a significant result

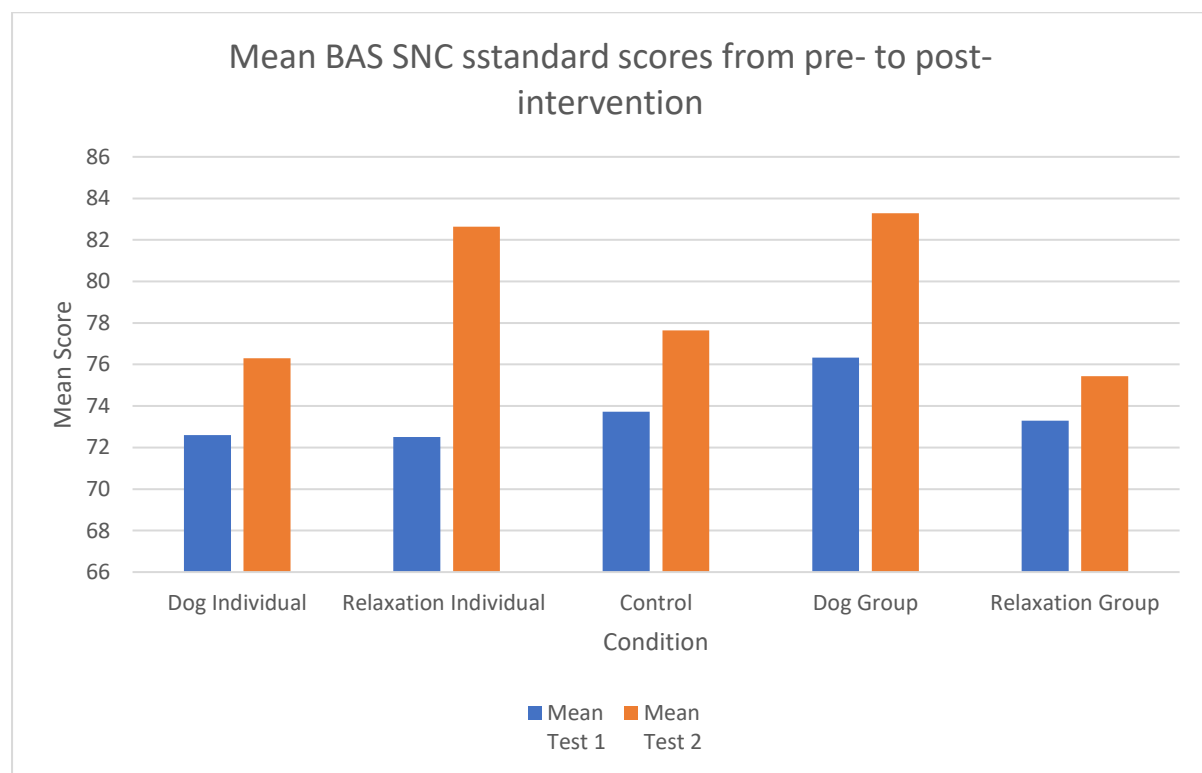


Figure 25: Mean BAS SNC scores for pre- and post-intervention assessments.

6.1.14.2.1 The influence of Pet and Dog Ownership on immediate effect of the interventions

The 3x2 ANCOVAs which included SES, Pet and Dog Ownership as covariates showed no significant differences.

6.1.15 BAS Non-Verbal Reasoning (NVR) score: Descriptive statistics

This score was calculated to assess the child's non-verbal reasoning by combining the scores from the matrices and quantitative reasoning tasks. Descriptive statistics (Mean and SD) of the BAS NVR score for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention) were presented in Table 55.

Table 55

Descriptive statistics (Mean and SD) of the BAS NVR score for all assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	83.4	30.9	86.2	30.89	79.2	12.64	86.2	29.12	84.6	29.57
RI	73.2	5.54	77.6	11.95	78	9.27	78	10.79	74.4	5.73
C	75	4.83	78	6.19	74.43	4.35	77.57	7.93	78.71	8.66
DG	80.86	13.79	90.71	29.03	91	25.37	88.43	24.39	85	22.1
RG	72.75	7.27	73.63	9.88	74.38	11.94	77.38	16.36	74.38	9.1

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that all children improved from pre- to post-intervention. The children in the relaxation individual and relaxation and dog group intervention also showed an improvement at 6-week follow-up while the other children had worse performance. At the 6-month follow-up children in the dog individual intervention, control and relaxation group improved on their scores while the children in the individual relaxation intervention maintained their scores and those in the dog group intervention performed worse. At the 1-year follow-up point only children in the control group showed an improvement while the other participants showed a worse performance.

6.1.16 BAS Non-Verbal Reasoning (NVR) score: Inferential statistics

To investigate whether the differences in mean scores were significant, analysis of variance and t-tests were calculated. Where enough data was available SES, Pet and Dog Ownership were entered as covariates in separate ANCOVAs. Sphericity was taken into account and the results appropriately reported. Independent t-tests showed no significant differences between condition at test 1 for the individual and group interventions. The scores for the individual intervention were skewed so they were log transformed (log10) to tend towards normality. The scores for the group intervention were normally distributed.

6.1.16.1 Longitudinal effects of the dog and relaxation interventions

3x5 ANOVAs of Condition x Test Time established no significant differences. Planned comparisons using paired samples t-tests were calculated to investigate any time effects within each condition. The only significant difference was for the children in the individual relaxation intervention and dog group intervention as their scores improved significantly ($p=0.046$ and $p=0.032$ respectively) between pre- and post-intervention. There were no other significant differences (Figure 26).

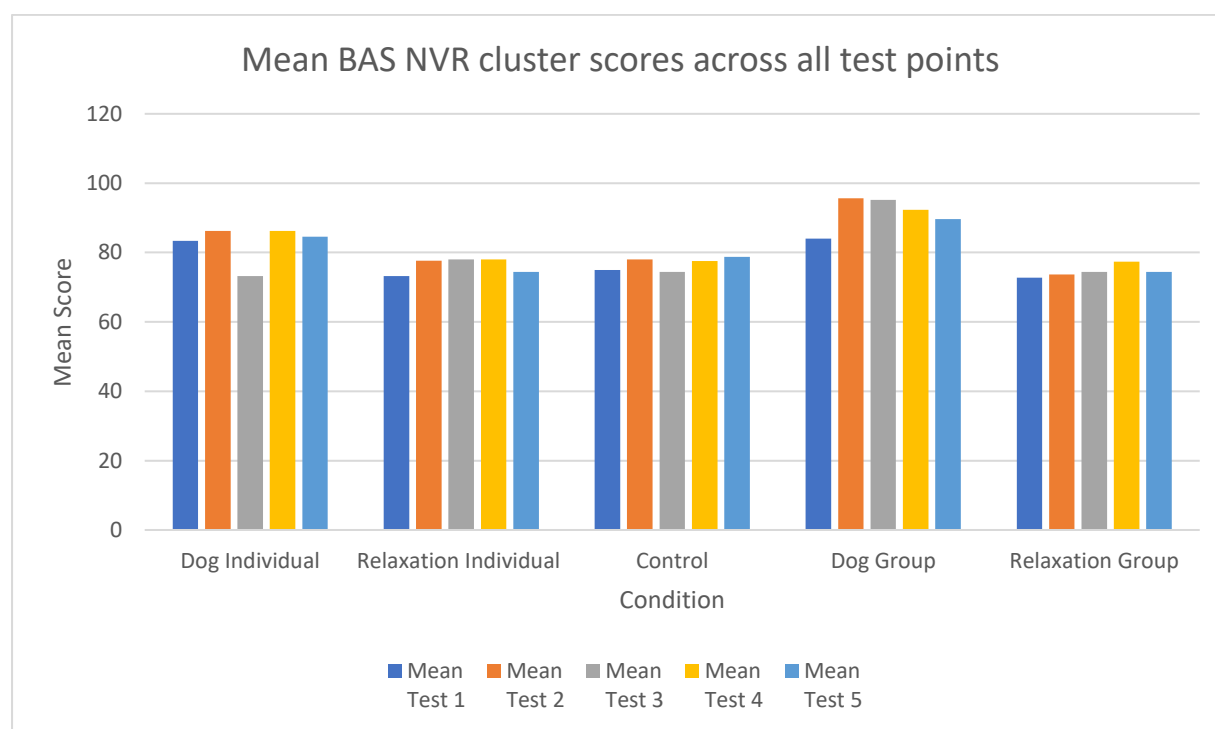


Figure 26: Mean BAS NVR scores across all assessment points

6.1.16.2 Immediate effects of dog and relaxation interventions

3x2 ANOVAs were calculated (Table 56) to establish any differences pre- and post-intervention including all children regardless of how many follow-up assessments they were able to complete. There was a significant main effect for Test Time for all participants [individual intervention: $F(1,23)= 6.95$, $p= 0.015$, $\eta^2= 0.23$; group intervention: $F(1,44)= 5.62$, $p= 0.022$, $\eta^2= 0.11$] as children overall improved on this measure between pre- and post-intervention regardless of the condition, they were in (Figure 27). Planned comparisons pre-, post-intervention were presented, as part of the longitudinal data.

Table 56

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for NVR Score

Effect	df	F	p	η^2
Individual Intervention				
(A) Test Time	1, 23	6.95	0.015*	0.23
(B) Condition	2, 23	0.26	0.773	0.02
A x B (interaction)	2, 23	1.31	0.289	0.10
Group Intervention				
(A) Test Time	1, 44	5.62	0.022*	0.11
(B) Condition	2, 44	1.49	0.237	0.06
A x B (interaction)	2, 44	2.46	0.097	0.10

Note: ** Indicates highly significant result; * Indicates a significant result

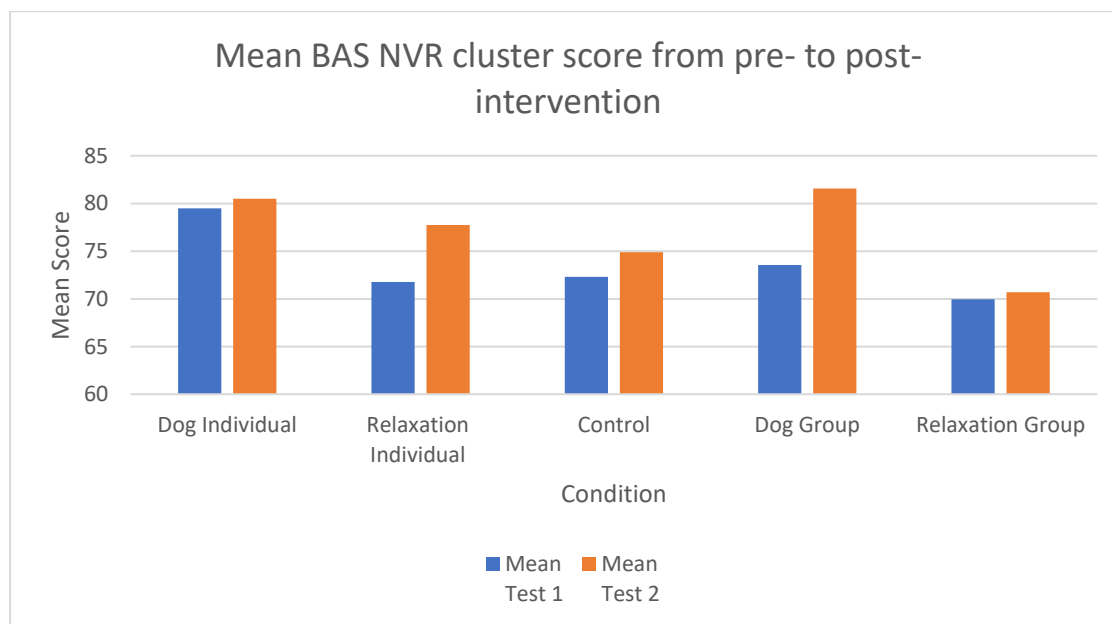


Figure 27: Mean BAS NVR scores from pre- to post-intervention assessment

6.1.16.2.1 *The influence of pet and dog ownership on immediate effect of the interventions*

The 3x2 ANCOVAs which included Pet and Dog ownership as covariates indicated no significant differences.

6.1.17 BAS Spatial Ability (SA) score: Descriptive statistics

The Spatial Ability score comprised of the scores from the recognition of designs and pattern construction tasks, assessing the children's spatial ability and awareness. Table 57 showed the descriptive statistics (Mean and SD) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 57

Descriptive statistics (Mean and SD) of the BAS SA for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	83	12.19	84.8	9.45	90.2	15.52	84.4	15.44	84	13.98
RI	79.25	4.99	92	11.49	87.25	12.74	90.75	16.88	90.5	8.66
C	86.29	4.59	90.29	14.29	96	21.15	94.29	18.36	96.29	15.4
DG	96	23.38	100.86	21.02	100.29	22.41	99.14	25.21	102.29	23.6
RG	83.11	13.93	82.78	15.36	85.78	17.04	85.11	13.68	90.33	14.41

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that most children improved from pre- to post-intervention with only the children in the relaxation group intervention showing a worse performance at test 2. Children in the relaxation individual intervention performed worse at test 3 while the children in the dog group intervention maintained their scores and the remaining children improved again at this point. At the 6-month follow-up assessment improvement was shown by the children in the individual relaxation intervention only. The children in the group relaxation intervention

maintained the same scores while the rest of the children performed worse. At the final assessment, children in both individual interventions maintained their scores while the remaining children showed better performance (increase in scores).

6.1.18 BAS Spatial Ability (SA) score: Inferential statistics

To assess whether the difference in means was significant, analysis of variance and t-tests were calculated. ANCOVAs using SES, Pet and Dog Ownership as covariates were calculated when enough data was available. Sphericity was taken into account and appropriately reported. Independent samples t-test revealed no significant differences between conditions at baseline. The data was normally distributed.

6.1.18.1 Longitudinal effects of the dog and relaxation interventions

3x5 ANOVA was only calculated for the group intervention (Table 58), as not enough children from the individual intervention completed all five testing sessions.

There was a highly significant main effect for Test Time [$F(4,76) = 4.20$, $p = 0.004$, $\eta^2 = 0.18$] as children improved overall, regardless of the condition they were in (Figure 28).

Table 58

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for Spatial Ability Score

Effect	df	F	p	η^2
Group Intervention				
(A) Test Time	4, 76	4.20	0.004**	0.18
(B) Condition	2, 19	1.66	0.216	0.15
A x B (interaction)	8, 76	0.74	0.654	0.07

*Note: ** Indicates highly significant result; * Indicates a significant result*

Planned comparisons using paired samples t-tests revealed a significant increase in scores pre- to post-intervention ($p = 0.048$) and pre-intervention to 1-year follow-up ($p = 0.048$) for the children in the dog group intervention. The children in the relaxation group intervention showed a significant improvement between pre-intervention and 6-week follow-up ($p = 0.035$). The children in the control group showed a significant difference between pre-intervention to 1-year follow-up ($p = 0.043$) due to an improvement in scores (Figure 28).

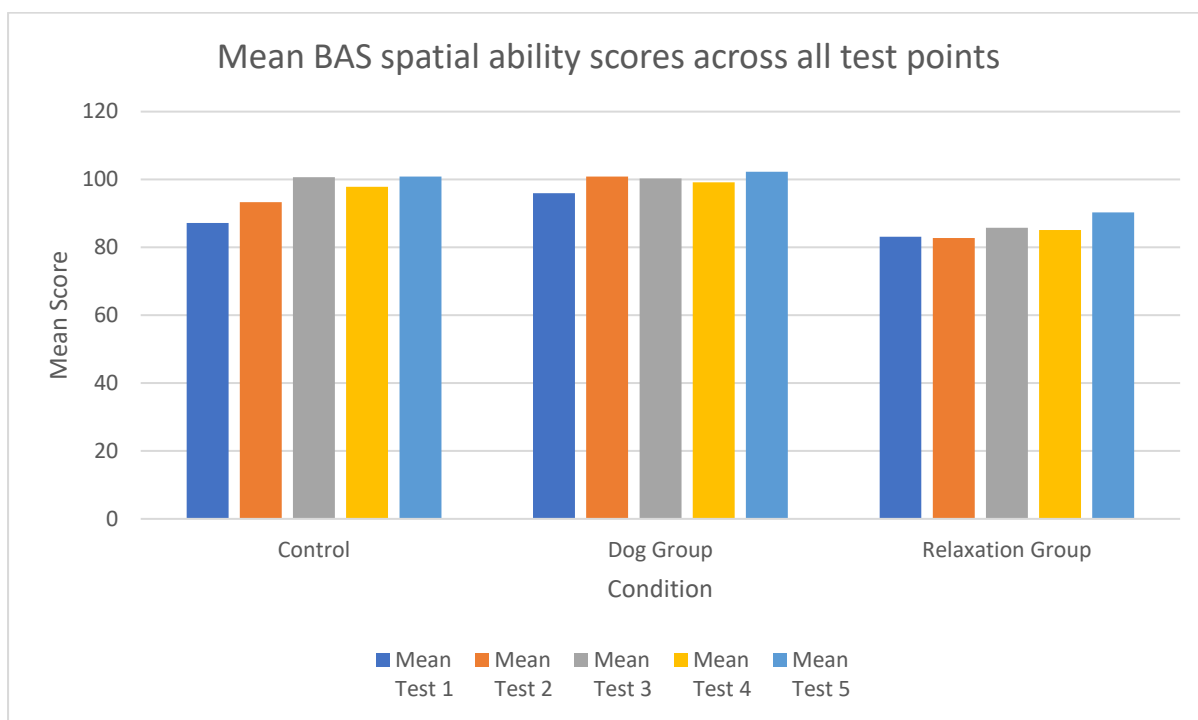


Figure 28: Mean BAS Spatial Ability score across all assessment points

6.1.18.2 Immediate effects of dog and relaxation interventions

A 3x2 ANOVA (Table 59) investigated particularly whether there were immediate effects after the intervention, including all children who took part. There was a highly significant main effect for Test Time for the children in the individual [$F(1,26)= 20.72, p< 0.001, \eta^2= 0.44$] and group interventions [$F(1,49)= 10.34, p= 0.002, \eta^2= 0.17$] as most children indicated an improvement on scores. There was also an interaction effect for Condition x Test Time for the children taking part in the individual [$F(2,26)= 3.56, p= 0.043, \eta^2= 0.22$] intervention with the children in the individual relaxation intervention showing the largest improvement post-intervention, followed by the children in the control condition and then the children in the individual dog intervention (Figure 29). Planned comparisons pre-post-intervention were presented, as part of the longitudinal data.

Table 59

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Spatial Ability Score

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 26	20.72	<0.001**	0.44
(B) Condition	2, 26	0.99	0.384	0.07
A x B (interaction)	2, 26	3.56	0.043*	0.22
Group Intervention				
(A) Test Time	1, 49	10.34	0.002**	0.17
(B) Condition	2, 49	1.49	0.237	0.06
A x B (interaction)	2, 49	0.162	0.851	0.01

Note: ** Indicates highly significant result; * Indicates a significant result

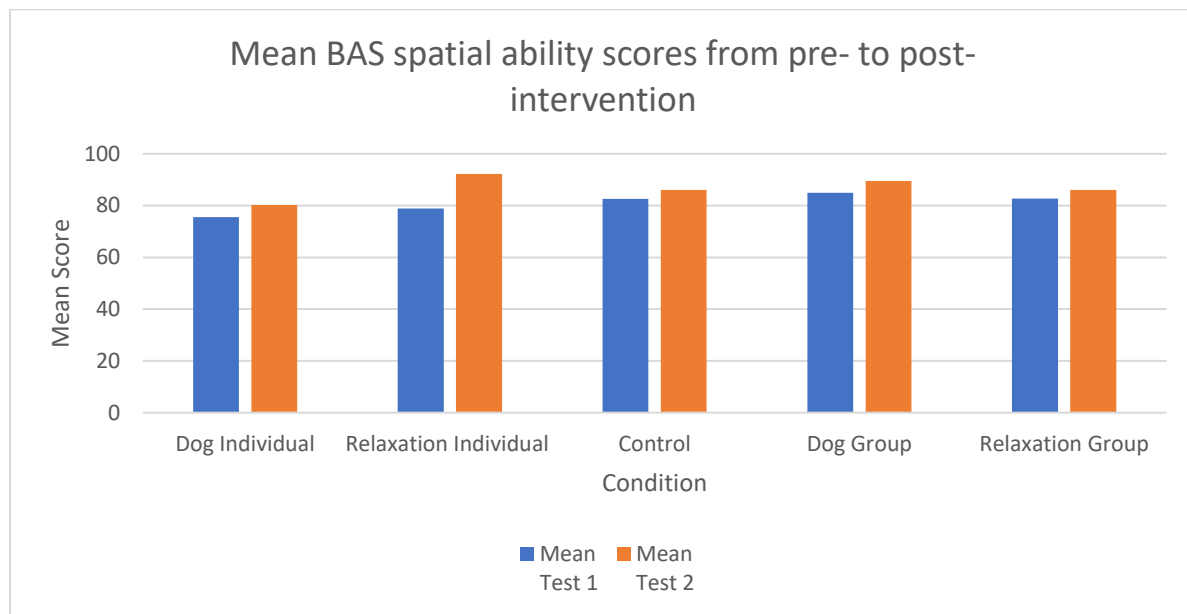


Figure 29: Mean BAS Spatial Ability score for pre- and post-intervention assessments

6.1.18.2.1 The influence of pet and dog ownership on immediate effect of the interventions

ANCOVAs were calculated using the factors of SES, Pet and Dog ownership (Table 60). The significant interaction effect between Test Time and Condition for the children in the individual intervention remained significant when Pet [$F(2,20)= 3.94$, $p= 0.036$, $\eta p^2= 0.28$] and Dog [$F(2,19)= 4.47$, $p= 0.026$, $\eta p^2= 0.32$] Ownership were entered as covariates. The means indicated that the children who improved most were those in the relaxation intervention and control group.

Table 60

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with SES, Pet and Dog Ownership as Covariates ANCOVA for Spatial Ability Score

Effect	df	F	p	ηp^2
Individual Intervention				
(C) SES (covariate)	1, 16	0.24	0.631	0.02
(A) Test Time	1, 16	3.65	0.074	0.19
(B) Condition	2, 16	1.05	0.371	0.12
A x B (interaction)	2, 16	1.87	0.186	0.19
A x C (interaction)	1, 16	0.60	0.451	0.04
(C) Pet Ownership (covariate)				
(A) Test Time	1, 20	1.17	0.292	0.06
(B) Condition	1, 20	2.87	0.106	0.13
(B) Condition	2, 20	1.48	0.252	0.13
A x B (interaction)	2, 20	3.94	0.036*	0.28
A x C (interaction)	1, 20	0.14	0.710	0.01
(C) Dog Ownership (covariate)				
(A) Test Time	1, 19	1.88	0.186	0.09
(B) Condition	1, 19	3.44	0.079	0.15
(B) Condition	2, 19	2.23	0.135	0.19
A x B (interaction)	2, 19	4.47	0.026*	0.32
A x C (interaction)	1, 19	1.13	0.302	0.06
Group Intervention				
(C) Pet Ownership (covariate)	1, 16	0.06	0.805	0.004
(A) Test Time	1, 16	0.24	0.628	0.02
(B) Condition	2, 16	1.35	0.288	0.14
A x B (interaction)	2, 16	0.41	0.672	0.05
A x C (interaction)	1, 16	0.98	0.337	0.06
(C) Dog Ownership (covariate)				
(A) Test Time	1, 16	1.13	0.349	0.12
(B) Condition	1, 16	0.08	0.777	0.01
(B) Condition	1, 16	1.13	0.349	0.12
A x B (interaction)	2, 16	0.21	0.817	0.03
A x C (interaction)	1, 16	0.43	0.524	0.03

Note: ** Indicates highly significant result; * Indicates a significant result

6.1.19 Fruit Stroop Analysis 1: Interference- congruent vs incongruent fruit:

Descriptive Statistics

This task was selected to include children who were not fluent at reading as well as those who were. It tested inhibition and executive functioning. This score took into account the congruent and incongruent condition. Descriptive statistics (Mean and SD) of the Fruit Stroop (Analysis 1) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention) were presented in Table 61.

Table 61

Descriptive statistics (Mean and SD) of the Fruit Stroop (Analysis 1) for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	0.28	0.13	0.2	0.1	0.24	0.22	0.23	0.18	0.12	0.19
RI	0.21	0.18	0.16	0.12	0.14	0.24	0.06	0.36	0.25	0.04
C	0.16	0.12	0.25	0.21	0.25	0.19	0.28	0.13	0.25	0.12
DG	0.17	0.08	0.21	0.08	0.05	0.18	0.12	0.13	0.15	0.07
RG	0.22	0.18	0.23	0.18	0.2	0.15	0.24	0.16	0.31	0.16

The means indicated that the children in the dog and relaxation individual interventions showed a reduction in mean scores from pre- to post-intervention, while the children in the other condition showed an increase in mean scores for the same period. At the 6-week follow-up most children showed a reduction in mean scores with the exception of children in the dog individual intervention who showed an increase and the children in the control group who maintained the same score. At the 6-month follow-up test children in the dog and relaxation individual intervention showed lower mean scores while the other children showed an increase. At the final, 1-year follow-up, the dog intervention and control conditions had a reduction in mean scores while the remaining children showed an increase. In this calculation a higher mean score meant more interference, therefore worse performance.

6.1.20 Fruit Stroop Analysis 1: Interference- congruent vs incongruent fruit:

Inferential Statistics

Although the data was skewed at baseline, the scores have not been log transformed as Fruit Stroop is not a standardised test and therefore the results would not necessarily be normally distributed. As a result, log transformation may result in the loss of any potential effects.

6.1.20.1 Longitudinal effects of the dog and relaxation interventions

3x5 ANOVAs indicated no significant differences. Planned comparisons using paired samples t-tests also showed no significant differences between any of the test points within each condition.

6.1.20.2 Immediate effects of dog and relaxation interventions

To investigate pre- to post-intervention differences, 3x2 ANOVAs to including all children, regardless of whether they completed the follow-up sessions were calculated. They showed no significant differences. Planned comparisons pre-, post-intervention were presented, as part of the longitudinal data.

6.1.20.2.1 The influence of pet and dog ownership on immediate effect of the interventions

The 3x2 ANCOVAs did not show any significant differences.

6.1.21 Fruit Stroop Analysis 2: Interference for colour processing- shape vs incongruent fruit: Descriptive statistics

The Fruit Stroop task assessed executive functioning and inhibition. Analysis 2 established participants' colour processing ability and interference. Table 62 has the descriptive statistics (Mean and SD) of the Fruit Stroop (Analysis 2) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 62

Descriptive statistics (Mean and SD) of the Fruit Stroop (Analysis 2) for all test assessment points.

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention	Mean Test 3 6-week	SD Test 3 6-week	Mean Test 4 6-month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
DI	0.27	0.19	0.23	0.08	0.28	0.18	0.29	0.18	0.28	0.1
RI	0.25	0.15	0.19	0.13	0.29	7.85	0.25	0.22	0.21	0.13
C	0.24	0.1	0.17	0.16	0.3	0.23	0.33	0.11	0.3	0.08
DG	0.23	0.2	0.26	0.11	0.19	0.1	0.11	0.43	0.13	0.12
RG	0.27	0.09	0.31	0.25	0.25	0.14	0.35	0.15	0.35	0.15

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that children in the group interventions (dog and relaxation) showed an increase at test 2 and a decrease in test 3 whereas the children in the other conditions (individual dog and relaxation, control) showed a decrease at test 2 and an increase at test 3. At the 6-month follow-up (test 4) children in the individual dog intervention maintained their scores, those in the relaxation group intervention showed an increase and the remaining children showed a decrease. At the 1-year follow-up, children in the dog individual and relaxation group intervention maintained their scores, while the children in the dog group intervention showed an increase and the children in the other groups showed a decrease. In this instance a decrease meant less interference therefore better performance.

6.1.22 Fruit Stroop Analysis 2: Interference for colour processing- shape vs incongruent fruit: Inferential statistics

To investigate whether the differences in mean scores were significantly different ANOVAs and t-tests were calculated. Sphericity was taken into account and the results were appropriately reported. There were no significant differences between conditions at baseline. Although the data was skewed at baseline, the scores were not log transformed as explained previously.

6.1.22.1 Longitudinal effects of the dog and relaxation interventions

The 3x5 ANOVAs showed no significant differences. Planned comparisons were calculated using paired samples t-tests to assess differences within each condition. They showed no significant differences.

6.1.22.2 Immediate effects of dog and relaxation interventions

To assess immediate effects of the interventions and include children who have not completed all the follow-up assessments, 3 (dog, relaxation, control) x 2 (pre-, post-intervention) ANOVAs were calculated (Table 63). There was a significant main effect in the group intervention for Condition [$F(2,46) = 3.75$, $p = 0.031$, $\eta^2 = 0.14$]. The means indicated that the children in the group dog and relaxation interventions show more interference at Test 2, immediately post-intervention.

The Bonferroni post hoc revealed a significant difference between the control and dog group conditions ($p = 0.027$) with control children performing better at post-test as they showed less interference compared to the children in the dog group intervention. Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 63

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Fruit Stroop Analysis 2

Effect	df	F	p	η^2
Individual Intervention				
(A) Test Time	1, 24	1.55	0.226	0.06
(B) Condition	2, 24	1.42	0.260	0.11
A x B (interaction)	1, 24	0.24	0.790	0.02
Group Intervention				
(A) Test Time	1, 46	0.53	0.469	0.01
(B) Condition	2, 46	3.75	0.031*	0.14
A x B (interaction)	2, 46	0.44	0.650	0.02

Note: ** Indicates highly significant result; * Indicates a significant result

6.1.22.2.1 *The influence of Pet and Dog Ownership on immediate effect of the interventions*

The 3x2 ANCOVAs showed no significant differences.

6.1.23 Fruit Stroop speed of processing (SOP): Descriptive statistics

The Fruit Stroop Task assessed children's executive functioning and ability to inhibit information. The speed of processing measure established how quickly the children were able to respond using the reaction time measure. Table 64 showed the descriptive statistics (Mean and SD) of the Fruit Stroop (SOP) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 64: *Descriptive statistics (Mean and SD) of the Fruit Stroop (SOP) for all assessment points.*

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	0.65	0.27	-0.53	-0.19	0.63	0.19	0.61	0.14	0.64	0.19
RI	0.77	0.21	-0.62	0.1	0.66	0.11	0.73	0.12	0.66	0.18
C	0.56	0.12	-0.6	0.17	0.67	0.2	0.72	0.17	0.72	0.19
DG	0.69	0.18	-0.69	0.17	0.72	0.13	0.75	0.16	0.78	0.14
RG	0.58	0.19	-0.6	0.2	0.56	0.24	0.65	0.16	0.69	0.17

DI= Dog Individual; RI= Relaxation Individual; C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that all children showed faster processing (lower score) at test 2 (immediately after intervention) and higher scores at test 3 (6-week follow-up). The children in the individual dog intervention showed a reduction in scores at test 3 (6-month follow-up) while the rest of the children showed increased mean scores. At the 1-year follow-up children in the relaxation intervention showed lower scores, those in the control group maintained the same scores and the rest of the children showed an increase. As this is a

SOP score, the higher score meant a longer time to process the information (slower processing), so the lower scores indicated improvement on the task.

6.1.24 Fruit Stroop Analysis 3: speed of processing (SOP): Inferential statistics

To investigate whether the differences in mean scores were significant, analysis of variance were calculated. Sphericity was taken into account and results were appropriately reported. At baseline there were significant differences for Speed of Processing (SOP) for the children in the individual intervention. The significant difference was between the children taking part in the individual relaxation intervention and control group. Although the data was skewed at baseline, the scores were not log transformed as Fruit Stroop was not a standardised test and therefore the results would not necessarily be normally distributed. As a result, log transformation may result in the loss of any potential effects.

6.1.24.1 Longitudinal effects of the dog and relaxation interventions

The 3x5 ANOVAs (Table 65) showed a highly significant main effect for Test Time for all participants [individual intervention: $F(2.175, 43.505) = 230.27$, $p < 0.001$, $\eta^2 = 0.92$; group intervention: $F(1.658, 38.142) = 305.26$, $p < 0.001$, $\eta^2 = 0.93$]. Children became faster at this task.

Table 65

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) ANOVA for Fruit Stroop SOP

Effect	df	F	η^2	p
Individual Intervention				
(A) Test Time	2.175, 43.505	230.27	< 0.001**	0.92
(B) Condition	2, 20	0.39	0.685	0.04
A x B (interaction)	4.350, 43.505	1.09	0.377	0.10
Group Intervention				
(A) Test Time	1.658, 38.142	305.26	< 0.001**	0.93
(B) Condition	2, 23	1.55	0.233	0.12
A x B (interaction)	3.317, 38.142	0.92	0.505	0.07

Note: ** Indicates highly significant result; * Indicates a significant result

Planned comparisons using paired samples t-tests revealed that there was a significant difference between pre- and post-intervention for all children ($p < 0.001$ for all conditions) due to children processing the information quicker. Children in the control condition showed an opposite significant difference - from pre-intervention to 6-month follow-up ($p = 0.002$) and pre-intervention to 1-year post-intervention ($p = 0.002$) as they performed significantly slower at these points.

6.1.24.2 Immediate effects of dog and relaxation interventions

3x2 ANOVAs (Table 66) included children who did not complete all follow-up assessments and revealed a highly significant main effect for Test Time as all children completed the task quicker at immediate follow-up [individual intervention: $F(1,24) = 415.06$, $p < 0.001$, $\eta^2 = 0.35$; group intervention: $F(1,46) = 607$, $p < 0.001$, $\eta^2 = 0.93$]. There was also a main effect for Condition for the individual intervention [$F(2,24) = 3.40$, $p = 0.050$, $\eta^2 = 0.24$] which just reached significance, where children in the relaxation intervention performed the quickest. Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 66

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) ANOVA for Fruit Stroop SOP

Effect	df	F	p	η^2
Individual Intervention				
(A) Test Time	1, 24	415.06	< 0.001**	0.35
(B) Condition	2, 24	3.40	0.050*	0.24
A x B (interaction)	2, 24	1.42	0.261	0.11
Group Intervention				
(A) Test Time	1, 46	607.31	< 0.001**	0.93
(B) Condition	2, 46	0.07	0.932	0.003
A x B (interaction)	2, 46	1.65	0.204	0.07

Note: ** Indicates highly significant result; * Indicates a significant result

6.1.24.2.1 *The influence of pet and dog ownership on immediate effect of the interventions*

ANCOVAs were calculate to include Pet and Dog Ownership as covariates (Table 67). The main effect for Test Time for the children in the individual intervention remained highly significant when Pet [$F(1,16)= 23.75, p< 0.001, \eta^2= 0.60$] and Dog Ownership [$F(1, 16)= 13.54, p= 0.002, \eta^2= 0.46$] were entered as covariates. The means indicated that all children's SOP improved as they completed the tasks quicker.

Table 67

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with Pet and Dog Ownership as Covariates ANCOVA for Fruit Stroop SOP

Effect	df	F	p	η^2
Individual Intervention				
(C) Pet Ownership (covariate)				
(A) Test Time	1, 16	23.75	< 0.001**	0.60
(B) Condition	2	1.79	0.198	0.18
A x B (interaction)	2, 16	2.93	0.082	0.27
A x C (interaction)	1, 16	0.90	0.357	0.05
(C) Dog Ownership (covariate)				
(A) Test Time	1, 16	13.54	0.002**	0.46
(B) Condition	2	2.20	0.143	0.22
A x B (interaction)	2, 16	2.47	0.116	0.24
A x C (interaction)	1, 16	0.002	0.969	< 0.001

Note: ** Indicates highly significant result; * Indicates a significant result

6.2 Effects of AAI on Cognition- Children with Lower Ability

The results for the children working at a lower ability than their typically developing peers are presented next using descriptive and inferential statistics for each measure. Children completed up to three subsections of the BAS-3 Pre-School Age Scale. The results for the picture similarity, pattern construction and matrices tasks are presented below. As previously discussed in Chapter 5, only raw scores will be calculated here as the children were very delayed in their ability and there were no appropriate standardised norms. The number of participants differed between the test points. Table 68 below provides more detail.

Table 68

Descriptive statistics (Mean and SD) of BAS tasks for all assessment points.

Task	Condition	Test 1 Baseline N	Test 2 After Intervention N	Test 3 6-weeks N	Test 4 6-months N	Test 5 1-year N
BAS Picture Similarity	Dog Individual	20	20	20	19	20
	Relax Individual	13	13	13	13	13
	Control	16	16	15	15	14
BAS Pattern Construction	Dog Individual	14	14	13	13	11
	Relax Individual	11	11	11	11	11
	Control	11	11	10	9	8
BAS Matrices	Dog Individual	10	10	9	8	8
	Relax Individual	10	10	10	10	10
	Control	8	8	6	6	5

Attrition was due to children moving schools. Retention was between 62.5% and 100%. The non-completion of assessments at some time points for students, but completion of subsequent assessments was due to absence (illness or appointments) or the child showing an increased number of challenging behaviours.

6.2.1 BAS Picture Similarity raw scores: Descriptive statistics

This task tested children's reasoning and problem solving when matching pictures. Table 69 showed the Descriptive statistics (Mean and SD) of the BAS Picture Similarity for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 69

Descriptive statistics (Mean and SD) of the BAS Picture Similarity raw scores for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	17.58	5.07	21.05	6.53	20.05	6.05	19.26	6.2	21.47	5.33
RI	20.38	5.58	20.38	5.38	21.46	4.84	21.54	4.75	23.31	4.84
C	15.14	3.33	15.36	4.8	15	6.95	17.07	5.44	17.93	5.23

DI= Dog Individual; RI= Relaxation Individual; C= Control

The means indicated that only the children in the individual dog intervention improved from pre- to post-intervention; during this time the other children maintained the same scores. At the 6-week follow-up children in the control condition continued to maintain their score while the children in the individual relaxation intervention showed an improvement but those in the dog intervention showed a reduction in scores. The pattern at the 6-month follow-up point assessment showed that the children in the control group improved, those in the dog intervention group showed a decrease in scores while the relaxation intervention participants maintained the same score. At the final assessment point, the children in the dog and relaxation intervention showed an improvement in scores while the control group had the same scores as previously.

6.2.2 BAS Picture Similarity raw scores: Inferential statistics

To investigate whether any of the mean differences were statistically significant, ANOVAs were calculated. Where enough data was available, SES, Pet and Dog Ownership were entered as covariates. Sphericity was taken into account when the findings were reported. Independent samples t-test revealed a statically significant difference between dog and control condition. The data was normally distributed.

6.2.2.1 Longitudinal effects of the dog and relaxation interventions

A 3x5 ANOVA investigated Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) for the children in the individual intervention (Table 70). There was a highly significant difference for Test Time [$F(4,172) = 5.47$, $p < 0.001$, $\eta^2 = 0.11$] as children improved on the task over the year. There was also a between-subjects effect for Condition [$F(2,43) = 4.87$, $p = 0.012$, $\eta^2 = 0.19$]. The means (Figure 30) indicated that the children in the dog intervention maintained their improvement from the intervention over time, while the children in the relaxation and control conditions only showed an improvement at the 1-year follow-up point.

Table 70

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month and 1-year follow-up) ANOVA for Picture Similarity

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	4, 172	5.47	< 0.001**	0.11
(B) Condition	2, 43	4.87	0.012*	0.19
A x B (interaction)	8, 172	1.18	0.317	0.05

Note: ** Indicates highly significant result; * Indicates a significant result

Planned comparisons within each condition using paired samples t-tests indicated that there was a highly significant difference for the children in the dog condition between pre- and post-intervention ($p= 0.005$) and between pre-intervention and 6-week follow-up ($p= 0.029$) due to an improvement in scores. Children in the dog intervention and control condition showed a significant difference in scores between pre-intervention and 1-year follow-up (dog intervention $p= 0.001$; control condition $p=0.040$) as they improved on this measure.

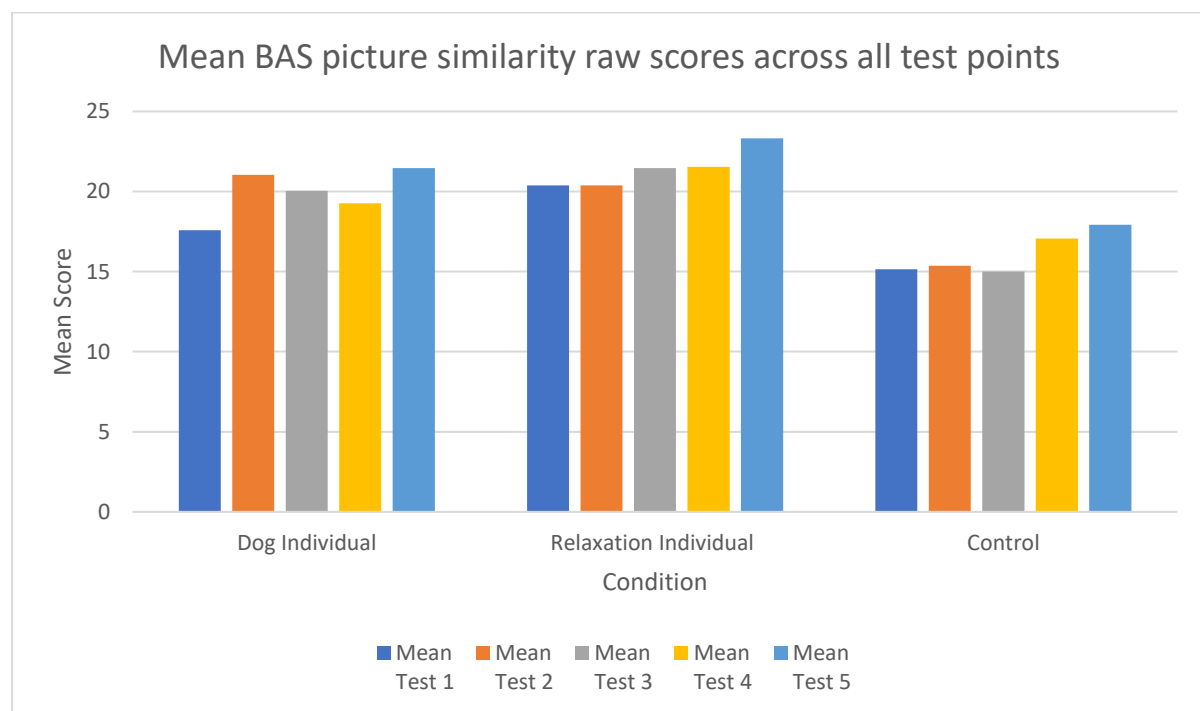


Figure 30: Mean BAS Picture Similarity score across all assessment points

6.2.2.1.1 The influence of pet and dog ownership on longitudinal effect of the interventions

ANCOVAs using SES, Pet and Dog Ownership as covariates were calculated next (Table 71). The main effect for Test Time was still evident when Pet Ownership was entered as a covariate [$F(4,124)=3.19$, $p=0.016$, $\eta p^2=0.09$] as overall all children improved on the task over time. In addition, there was also an interaction effect between Test Time and Pet Ownership [$F(4,124)=2.52$, $p=0.045$, $\eta p^2=0.08$]. It was not possible to calculate this further as not all parents provided the information of whether they have a pet.

Table 71

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) with Pet and Dog Ownership as Covariates ANCOVA for Picture Similarity

Effect	df	F	p	ηp^2
Individual Intervention				
(C) SES (covariate)	1, 27	0.01	0.934	0.00
(A) Test Time	4, 108	0.94	0.446	0.03
(B) Condition	2, 27	1.79	0.186	0.12
A x B (interaction)	8, 108	1.28	0.260	0.09
A x C (interaction)	4, 108	0.79	0.535	0.03
(C) Pet Ownership (covariate)	1, 31	0.13	0.725	0.004
(A) Test Time	4, 124	3.19	0.016*	0.09
(B) Condition	2, 31	1.72	0.196	0.10
A x B (interaction)	8, 124	1.19	0.314	0.07
A x C (interaction)	4, 124	2.52	0.045*	0.08
(C) Dog Ownership (covariate)	1, 30	0.96	0.334	0.03
(A) Test Time	4, 120	1.14	0.343	0.04
(B) Condition	2, 30	2.09	0.142	0.12
A x B (interaction)	8, 120	1.08	0.383	0.07
A x C (interaction)	4, 120	0.43	0.787	0.01

Note: ** Indicates highly significant result; * Indicates a significant result

6.2.2.2 Immediate effects of dog and relaxation interventions

A 3x2 ANOVA (Table 72) was calculated to establish any pre-, post-intervention differences for all children who completed the interventions, regardless of whether they completed all follow-up assessments. The analysis established a significant main effect for Test Time [$F(1,46)=4.67$, $p=0.036$, $\eta p^2=0.09$] as children have improved their scores between pre- and post-intervention. There was an interaction effect Condition x Test Time [$F(2,46)=4.72$,

$p= 0.014$, $\eta p^2= 0.17$] as well as a highly significant between subject main effect for Condition [$F(2,46)= 5.57$, $p= 0.007$, $\eta p^2= 0.20$]. The children in the dog intervention showed the biggest improvement while the children in the relaxation and control groups had similar scores at pre- and post-intervention.

The Bonferroni post hoc test showed a significant difference between the dog individual intervention and control conditions ($p= 0.022$) and the relaxation individual intervention and control conditions ($p= 0.014$). Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

Table 72

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Picture Similarity

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 46	4.67	0.036*	0.09
(B) Condition	2, 46	5.57	0.007**	0.20
A x B (interaction)	2, 46	4.72	0.014**	0.17

Note: ** Indicates highly significant result; * Indicates a significant result

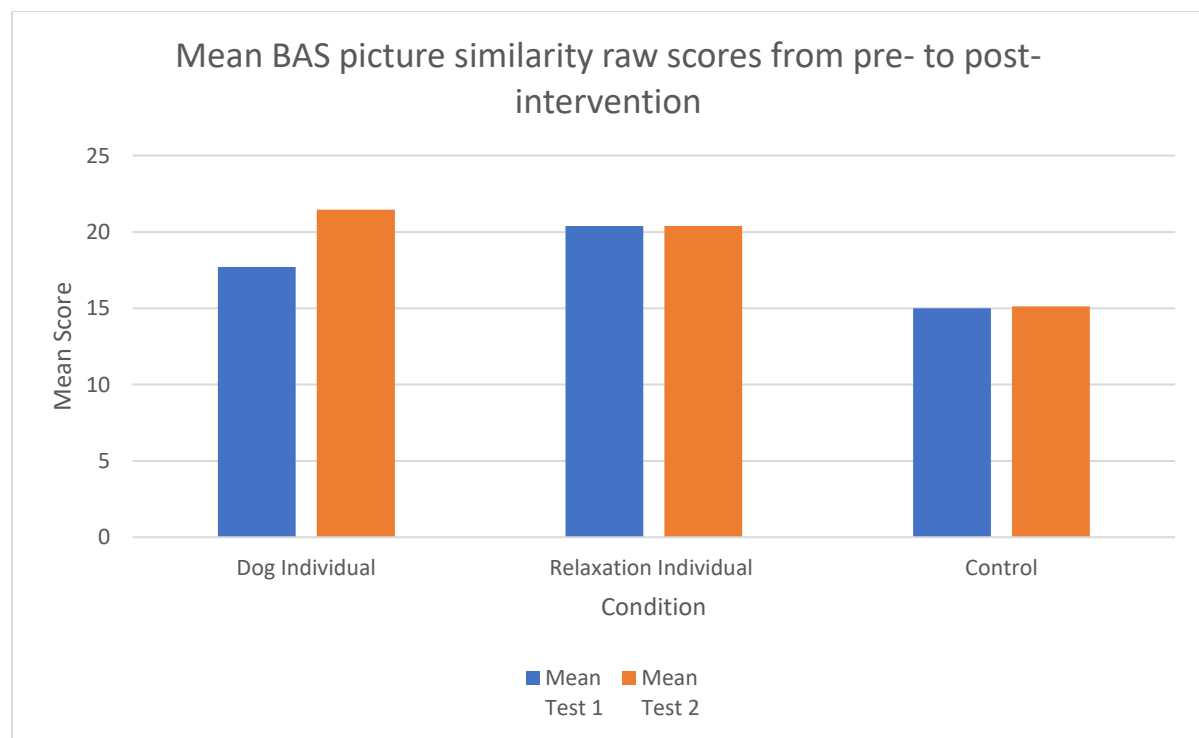


Figure 31: Mean BAS Picture Similarity score for pre- and post-intervention assessment

6.2.2.2.1 *The influence of pet and dog ownership on immediate effect of the interventions*

SES, Pet and Dog Ownership were entered as covariates (Table 73). When Pet Ownership was entered as a covariate, the significant main effect for Test Time remained [$F(1,33)=4.80$, $p=0.036$, $\eta^2=0.23$] The means indicated that overall children improved on this task between pre- and post-intervention.

Table 73

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with Pet and Dog Ownership as Covariates ANCOVA for Picture Similarity

Effect	df	F	p	η^2
Individual Intervention				
(C) SES (covariate)	1, 29	0.03	0.564	0.001
(A) Test Time	1, 29	0.41	0.528	0.01
(B) Condition	2, 29	2.33	0.115	0.14
A x B (interaction)	2, 29	1.74	0.193	0.11
A x C (interaction)	1, 29	1.43	0.242	0.05
(C) Pet Ownership (covariate)	1, 33	0.002	0.967	0.00
(A) Test Time	1, 33	4.80	0.036*	0.13
(B) Condition	2, 33	2.25	0.121	0.12
A x B (interaction)	2, 33	3.21	0.053*	0.16
A x C (interaction)	1, 33	2.72	0.109	0.08
(C) Dog Ownership (covariate)	1, 32	1.34	0.255	0.04
(A) Test Time	1, 32	0.02	0.890	0.001
(B) Condition	2, 32	2.67	0.084	0.14
A x B (interaction)	2, 32	2.90	0.069	0.15
A x C (interaction)	1, 32	0.20	0.661	0.01

Note: ** Indicates highly significant result; * Indicates a significant result

6.2.3 BAS Pattern Construction raw scores: Descriptive statistics

This task assessed the children's ability to replicate a pattern, testing problem solving and spatial awareness skills. As the children were significantly delayed in their ability, the raw scores were used for these calculations. Table 74 below presented the descriptive statistics (Mean and SD) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 74

Descriptive statistics (Mean and SD) of the BAS Pattern Construction (low ability) for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	10.82	14.39	15.64	20.41	16.45	22.52	8	5.55	13.36	15.49
RI	11.55	8.19	13	9.07	12.27	7.24	13.55	8.35	14.27	9.26
C	17.75	23.41	13.38	13.51	9.75	6.99	10.5	8.12	9.63	8.19

DI= Dog Individual; RI- Relaxation Individual; C= Control

The means indicated an improvement in scores for the children in the intervention conditions (dog and relaxation) and worse performance for the children in the control condition from pre- to post-intervention. At the 6-week follow-up point children in the dog intervention improved on their scores again while all other children showed worse performance. At the 6-month follow-up, the children in the dog condition showed a worse performance while the other children improved their scores. At the 1-year follow-up children in the control condition performed worse on the task while the children in the dog and relaxation intervention improved their performance.

6.2.4 BAS Pattern Construction raw scores: Inferential statistics

To investigate whether the mean differences were significant, analysis of variance were conducted. Sphericity was taken into account when reporting the results. Independent samples t-tests showed no significant differences between condition differences at test 1. As the data was skewed at baseline, the scores were log transformed (log10) to tend towards normality.

6.2.4.1 Longitudinal effects of the dog and relaxation interventions

3x5 ANOVA was calculated to investigate Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) for the children in the individual interventions. The analysis indicated no significant differences. Planned comparisons using

paired samples t-tests to show differences within each condition were calculated and showed no significant differences.

6.2.4.2 Immediate effects of dog and relaxation interventions

A 3 (Condition) x 2 (Test Time) ANOVA was calculated to assess immediate effects of the interventions on the BAS Pattern Construction task. There were no significant differences. Planned comparisons pre-, post-intervention were presented above, as part of the longitudinal data.

6.2.4.2.1 The influence of pet and dog ownership on immediate effect of the interventions

The 3 (Condition) x 2 (Test Time) ANCOVAs which incorporated the factors of Pet and Dog Ownership showed no significant differences.

6.2.5 BAS Matrices raw scores: Descriptive statistics

This task assessed children's reasoning and problem-solving skills. As children were severely delayed, raw scores were used for the calculations. Table 75 below indicates the Descriptive statistics (Mean and SD) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 75

Descriptive statistics (Mean and SD) of the BAS matrices (low ability) for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
DI	8.13	2.36	9.25	3.11	9.38	3.11	9.75	2.61	9.63	2.56
RI	8	2	8.8	1.69	8.3	2.26	8.7	2.41	10	2.58
C	7	1.58	10.4	1.34	7.8	2.86	8.6	1.52	8.4	2.7

DI= Dog Individual; RI= Relaxation Individual; C= Control

The means indicated that the children in the dog intervention showed an improvement on their scores from pre- to post-intervention and then maintained this score for the other follow-up assessments. The children in the relaxation intervention only showed an improvement at the 1-year follow-up point. The participants in the control condition showed an increase in scores post-intervention, but worse performance at 6-week follow-up; the scores were then maintained for the remaining assessment points.

6.2.6 BAS Matrices raw scores: Inferential statistics

To investigate whether the mean differences were significant ANOVAs and t-tests were calculated. Sphericity was taken into account when reporting the findings. Independent samples t-tests at test 1 revealed no significant differences between conditions. The data was normally distributed.

6.2.6.1 Longitudinal effects of the dog and relaxation interventions

It was not possible to calculate a 3x5 ANOVA as not enough children who completed the Matrices task took part in all five testing sessions.

6.2.6.2 Immediate effects of dog and relaxation interventions

To investigate pre-, post-intervention differences for all children taking part in the intervention regardless of whether they took part in the follow-up assessment a 3x2 ANOVA was calculated for Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) (Table 76). There was a highly significant main effect for Test Time [$F(1,25) = 12.38$, $p = 0.002$, $\eta^2 = 0.33$] as children improved regardless of the condition they were in. Planned comparisons revealed no significant differences.

Table 76

Condition (dog, relaxation, control) x Test Time (pre- and post-intervention) ANOVA for Matrices

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 25	12.38	0.002**	0.33
(B) Condition	2, 25	0.04	0.961	0.003
A x B (interaction)	2, 25	0.89	0.422	0.07

Note: ** Indicates highly significant result; * Indicates a significant result

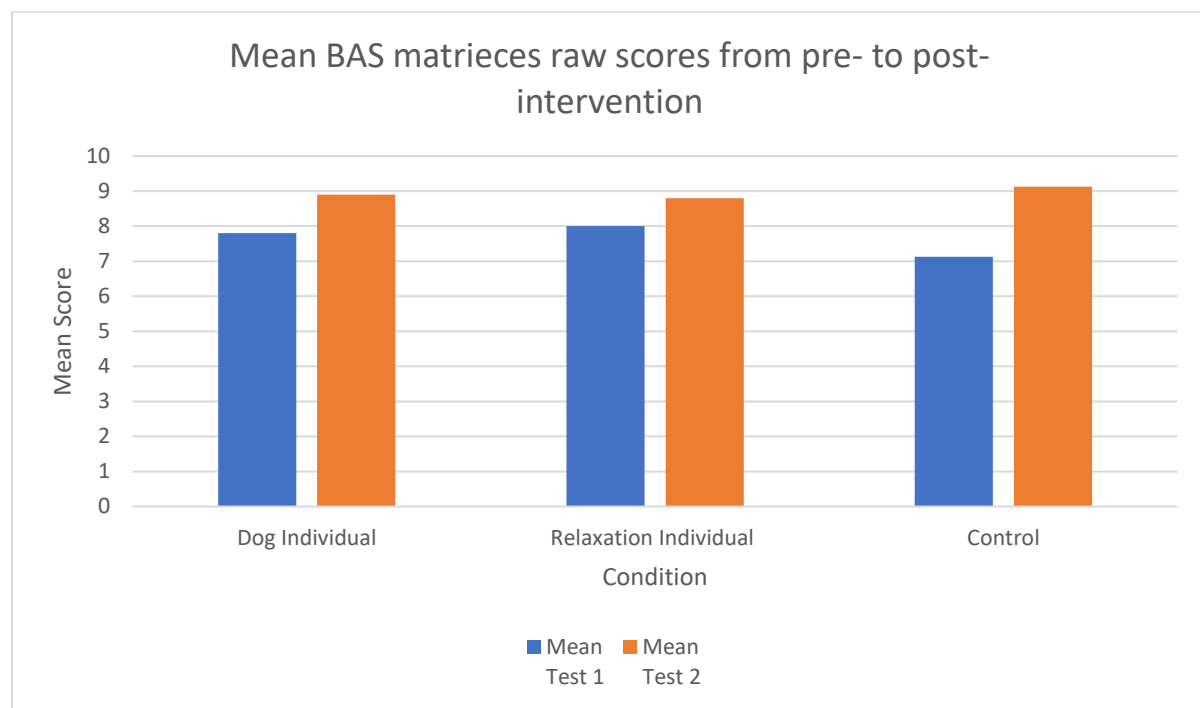


Figure 32: Mean BAS Matrices scores for pre- to post-intervention assessment

6.2.6.2.1 The influence of pet and dog ownership on immediate effect of the interventions

Pet and Dog Ownership were entered as covariates into the ANCOVAs (Table 77). The main effect for Test Time was maintained with Pet Ownership as a covariate [$F(1, 16) = 8.65$, $p = 0.010$, $\eta p^2 = 0.35$] due to an improvement in scores.

Table 77

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with Pet and Dog Ownership as Covariates ANCOVA for Matrices

Effect	df	F	p	ηp^2
Individual Intervention				
(C) Pet Ownership (covariate)	1, 16	1.13	0.305	0.07
(A) Test Time	1, 16	8.65	0.010**	0.35
(B) Condition	2, 16	0.38	0.691	0.05
A x B (interaction)	2, 16	2.92	0.083	0.27
A x C (interaction)	1, 16	3.89	0.066	0.20
(C) Dog Ownership (covariate)	1, 16	0.52	0.480	0.03
(A) Test Time	1, 16	0.25	0.621	0.02
(B) Condition	2, 16	0.42	0.662	0.05
A x B (interaction)	2, 16	1.44	0.266	0.15
A x C (interaction)	1, 16	0.02	0.879	0.001

*Note: ** Indicates highly significant result; * Indicates a significant result*

6.3 Effects of AAI on Cognition- Summary

The results of this chapter are summarised in Table 78 below. The ticks indicate a significant difference. The ANOVAs were labelled in the table based on the factors calculated. For instance, a 3x2 in the ANOVA/ ANCOVA column means that the results were for the 3x2 ANOVA for the factors of condition (dog, relaxation, control) and time (pre- and post-intervention). The SES, Pet (pet ownership) and Dog (dog ownership) stand for the factors entered as covariates in the ANCOVAs.

The Group/ Individual column was an indication of whether the statistical test was calculated using the data from the children taking part in the individual dog and relaxation intervention or the group dog and relaxation intervention.

The column labelled Time (T) indicated a significant main effect for time and the column Condition (C) indicated a significant between-subjects main effect for condition. In this instance the condition was the intervention/ control that children took part in (i.e. individual dog/ relaxation, control, group dog/ relaxation). The T x C column indicated a Time x Condition interaction effect. The T x Covariate column was for the ANCOVA calculations only as it indicated an interaction between time and the covariate included in the calculation (i.e. pet ownership, dog ownership or SES).

Table 78

Summary of Significant Results for All Tasks and Cluster Scores

Task	ANOVA/ ANCOVA	Group (G)/ Individual (I)	Time (T)	Condition (C)	T x C	T x Covariate
Recognition of Designs	3x5	I	✓			
		G	✓			
	3x5 Pet	I				
	3x2	I				
		G				
	3x2 SES	I				
		G				
	3x2 Pet	I			✓	
		G				
	3x2 Dog	I			✓	
		G				
Pattern Construction Standard Scoring	3x5	I				
		G	✓			
	3x2	I	✓			
		G	✓			
	3x2 Pet	I	✓			
		G		✓		
Pattern Construction Alternative Scoring	3x5	I				
		G				
	3x5 Pet	I				
	3x2	I	✓			
		G		✓		
	3x2 SES	I				
	3x2 Pet	I				
		G		✓		
Matrices (School- Age)	3x5	I	✓			
		G	✓			
	3x5 Pet	I				
	3x2	I	✓			
		G	✓			
	3x2 SES	I				
	3x2 Pet	I				
		G				
Quantitative Reasoning	3x5	I	✓			
		G	✓			
	3x5 Pet	I				
	3x2	I				
		G				
	3x2 Pet	I				
		G				
	3x2 Dog	I	✓			
		G				
SNC Raw Score	3x5	I				
		G	✓			
	3x2	I	✓			
		G	✓			
	3x2 SES	I				
	3x2 Pet	I				
		G				
	3x2 Dog	I				
		G				
3x3 Dog		I				

SNC Standard Score	3x5	G	✓			
	3x2	I	✓			
		G	✓			
	3x2 SES	I				
	3x2 Pet	I				
		G				
	3x2 Dog	I				
		G				
NVR Score	3x5	G				
	3x2	I	✓			
		G	✓			
	3x2 Pet	I				
		G				
	3x2 Dog	I				
		G				
	Spatial Ability	3x5	G	✓		
3x2		I	✓		✓	
		G	✓			
3x2 SES		I				
3x2 Pet		I			✓	
		G				
3x2 Dog		I			✓	
		G				
Stroop Analysis 1	3x5	I				
		G				
	3x2	I				
		G				
	3x2 Pet	I				
	3x2 Dog	I				
Stroop Analysis 2	3x5	I				
		G				
	3x2	I			✓	
		G				
	3x2 Pet	I				
	3x2 Dog	I				
Stroop Speed of Processing	3x5	I	✓			
		G	✓			
	3x2	I	✓	✓		
		G	✓			
	3x2 Pet	I	✓			
		G				
	3x2 Dog	I				
		G	✓			
Picture Similarity	3x5	I	✓	✓		
	3x5 SES	I				
	3x5 Pet	I	✓			✓
	3x5 Dog	I				
	3x2	I	✓	✓	✓	
	3x2 SES	I				
	3x2 Pet	I	✓			
	3x2 Dog	I				
Pattern Construction (Pre-School)	3x5	I				
	3x2	I				
	3x2 SES	I				
	3x2 Pet	I				
	3x2 Dog	I				
	3x3	I				
	3x3 SES	I				
	3x3 Pet	I				
	3x3 Dog	I				
Matrices (Pre-School)	3x5					
	3x2	I	✓			
	3x2 Pet	I	✓			
	3x2 Dog	I				

In summary, the majority of significant effects were for Time which meant that all children improved on the measures due to development and maturation. There were some differences between the children in the different conditions which will be discussed in detail next. It is, however, important to note that planned comparisons within each condition show promising results. Full results in Appendix 12.

6.4 Discussion

The results indicate differences in learning depending on the areas of development as well as the ability of the child. These will be discussed below and related to previous research presented in earlier chapters.

6.4.1 Summary of Results- Children with Higher Ability

The findings indicate that children in the high ability group improve on some of the standardised tasks over time, including BAS recognition of designs, BAS pattern construction, BAS matrices and BAS quantitative reasoning. This improvement over time is also evident in the combined scores, including BAS SNC cluster score, BAS non-verbal reasoning score and BAS spatial ability score. For the Fruit Stroop, children also showed quicker processing over time.

Although the benefits above are evident for all children across time, the dog-assisted and relaxation interventions had a different effect depending on the task. The SNC cluster score, non-verbal reasoning and spatial ability indicated that the biggest improvement immediately after the intervention was for the children in the dog group intervention. In contrast, on some occasions the children in the relaxation interventions performed better. For instance, the children in the relaxation individual intervention performed best (significant improvement) on the BAS recognition of designs task after the intervention compared to baseline. The children also showed a significant improvement at post-intervention on the BAS non-verbal reasoning score although this improvement was not as large as the

improvement for children in the dog group intervention. Additionally, for some tasks such as BAS pattern construction, children in the dog individual and control conditions performed similarly, both with a significant increase in test scores at immediate follow-up compared to baseline, with the children in the control group showing larger improvement. Similarly, the children in all intervention conditions (relaxation and dog, individual and group) performed significantly quicker at the immediate follow-up on the speed of processing of the Fruit Stroop.

This data would indicate that more benefits were due to the dog-intervention compared to the relaxation intervention, but further exploration is needed to establish the exact benefits with larger sample size. This will allow the exploration of these findings and assess whether the benefits seen would be significantly different from other interventions which will provide evidence for using AAI in sessions to improve cognitive ability. Although to date the research for AAI improving cognitive ability is limited (e.g. Gee et al., 2010), and the current findings are promising, there is a lack of comparison between different interventions.

6.4.2 Summary of Results- Children with Lower Ability

For the children in the lower ability group, there were no improvements over time when including the test points across the whole year on BAS pattern construction and BAS matrices. There were, however, improvements in scores over time on the BAS picture similarity during the year of follow-up testing as well as for the BAS matrices tasks pre- to post-intervention. The limited improvement of all children across time is also seen within conditions, with the interventions appearing to have overall less benefit for these children compared to the children of higher ability. However, on the BAS picture similarity task children in the dog intervention were the only ones when compared pre-, post-intervention differences in the different conditions (dog, relaxation, control) to improve significantly post-intervention and maintained this improvement at the 6-week follow-up point.

There were no other significant differences within each condition. This could indicate that these children develop less over time and potentially longer interventions may be

needed to support their development. In addition, it is suggested that as these children are more delayed, they are also most in need of having interventions as they are unlikely to be able to take part in other provisions or access the curriculum. Nevertheless, the fact that the dog-intervention is the only one to yield any significant improvement is encouraging and it suggests that this area needs to be explored and developed further.

6.4.3 Interventions: group vs individual

Here, the effect of the interventions will be discussed, starting with the differences between the individual and group interventions, followed by the different areas of development affected by the two interventions. The impact of the interventions relating to the ability of the children will also be presented followed by the limitation of the research and advice for future projects.

The dog and relaxation intervention were provided either as an individual or group intervention. The results indicated that this different structure had a varied impact on the effectiveness of the intervention. For the children completing the school-aged recognition of designs task, it was evident that those in the individual relaxation intervention showed the biggest benefit from pre- to post-intervention. No significant benefits were evident from the group relaxation intervention on this task. These results advocated for the difference in the effect of an intervention based on how it is delivered. A similar pattern was evident for the BAS non-verbal reasoning score where there was a significant improvement pre- to post-intervention for the children in the dog group intervention, but not in the dog individual intervention as well as an improvement for the relaxation individual intervention but not for the relaxation group intervention. This would indicate that although both interventions had a significant impact on the children's non-verbal reasoning scores with the control children not showing this improvement, it was the children in the dog group intervention who benefited the most when comparing the two different interventions. This finding was not evident for the children in the control condition which is in line with previous research into ASD which found that the two interventions provided (joint attention or symbolic play) were effective in

expressive language gains while the children in the control condition did not show these improvements (Kasari, Paparella, Freeman & Jahromi, 2008).

Leaving the structure of each intervention aside, the findings discussed above indicate that the dog and relaxation interventions appear to have benefited children differently, despite being similar in their length and structure. This is also in line with previous research investigating different interventions and their impact on children with Autism which revealed that an executive functioning intervention benefitted children more than a social skills intervention when measuring children's problem solving, flexibility and planning/organising (Kenworthy et al., 2013). The remit of the current study enhances our knowledge of which interventions are effective. Future research needs to explore the benefits reported here and create interventions specific for the children taking part to improve the areas which children are delayed in.

Adding to the knowledge gap, where enough data was available, the factors of SES, pet ownership and dog ownership were included to assess if they have an effect on the interventions. Findings indicated an influence of these factors on the recognition of designs and pattern construction for the children completing the school age battery. When analysing the cluster scores, some of the covariates also influenced the standardised SNC cluster scores, NVR scores and spatial ability calculations. For the children of lower ability, the covariates influenced the findings for the picture similarity and matrices task. Such findings would indicate that SES as well as pet and dog ownership may play a role in the success of the interventions provided. It was not possible to further investigate these findings to find out how the covariates influence the effect of the interventions as the sample size was too small. Previous research found similar results, where the effect of a human education program towards animals was found to be especially beneficial when the quality of children's relations with their pets was considered as a covariate (Ascione & Weber, 1996). In this project, the quality of children's relations with their pet was not measured. Partially due to the complexity of this cohort and the difficulty for the children to answer questions, it remains an open question if children taking part have relationships with their own pets and if greater benefit

from the intervention on the different subtests would occur. However, this cannot be concluded from the current data. Future research needs to explore this area in further detail, together with more information on type of pet, if any training has been provided and the child's attachment.

While the main question in this research was the influence of the AAI and relaxation intervention on children's performance on the tasks, other novel findings have emerged as a result of working with children with special educational needs. These findings are discussed next.

6.4.4 BAS-3

This section will explore the different tasks assessed in the BAS-3 in relation to the children with special educational needs who took part in the project. Firstly, the overall findings, including the learning effects for the BAS-3 are discussed, for all participants regardless of their ability and the tasks they completed. This will be followed by limitations including the difference when calculating raw and standardised scores and the significant differences between groups at baseline on the different BAS-3 tasks. Suggestions for future research will be concluded the BAS-3 discussion.

The subsections of the BAS-3 assessed different cognitive areas of development and established that children with special educational needs did not have a steady progress on all areas during the year. On many of the tasks and some of the standardised scores there was a significant increase in learning from before to after intervention as well as when including the mid- to long-term follow-up sessions. For instance, for the BAS pattern construction scores children in the control condition showed an improvement at every assessment point. This was expected as children attended school to learn and develop. However, the children in either of the intervention groups did not show continuous and consistent improvement at every assessment point. Furthermore, on the BAS recognition of designs task, children in the control condition showed significant improvements at the 1-year follow-up and children in the relaxation group intervention showed an improvement at the 6-week follow-up, showing some learning effects but these were not consistent at all follow-up

test points and not for all children. Similarly, on the BAS quantitative reasoning task there was an improvement for the children in the dog individual condition at 6-week follow-up and every test session after that, while the children in the relaxation group intervention showed an improvement at the 6-month and 1-year follow-up point, but no benefits were evident for the children in the other conditions. This difference in improvement over time suggests that children with special needs may take longer to improve on the task. This enhances our knowledge on the areas of difficulty children in special needs schools often have and the comparison to their typically developing peers.

Similar findings were evident for the children in the lower ability group. For instance, BAS pattern construction scores showed no significant effects between pre- and post-intervention as well as when the follow-up points were considered. In contrast, in the matrices task children showed an overall improvement pre- to post-intervention, but no improvements on the follow-up visits. This was perhaps due to some children having symptoms or diagnosis which prevented them from learning and improving on certain cognitive tasks. This proposition is supported by previous research which concluded that children with some diagnosis show a larger deficit in some cognitive tasks compared to children with different diagnosis (Rowe et al., 2006), indicating a potential issue with learning particular skills.

With such findings the current research can highlight areas of development which need to be targeted and advocate for extra intervention due to the children not showing the desired improvement over time. Previous research demonstrated specialised intervention for young children with Autism based on developmental and applied behavioural principles lead to significantly better outcomes compared to children referred to community providers for commonly used interventions (Dawson, Rogers, Munson, Smith, Winter, Greenson et al., 2010). Although children of different levels of delay showed lack of improvement on different tasks. This may be an indication that children need to be targeted with specific interventions. Furthermore, these differences emphasised the fact that the “one-size-fits-all” model is not

sufficient for children with special educational needs. In order to target individual deficits, children need to be taught and have interventions set up based on the individual's needs.

Further to the individual subsections, when investigating the cluster scores, the non-verbal reasoning showed a similar pattern. Children who took part in the group and the individual interventions appeared to be improving immediately after intervention, but no improvement was evident for any of the follow-up sessions. Interventions may be affecting children differently depending on whether they were set up on individual or group basis. It is also possible that the children in the individual intervention had symptoms or diagnosis which prevented them from learning and developing to achieve better scores on these tasks after the interventions. This was a factor the current research could not take into account as very little is known about specific diagnosis and the areas of development they affect most severely. In addition to that any conditions affect sufferers in varying degrees so further research needs to investigate the effect of the diagnosis on various tasks. Previous research supported this idea as it has for instance been established that children with ADHD perform faster but less accurately on some cognitive tasks such as fluid reasoning (Tamm & Juranek, 2012), however providing specific non-verbal reasoning interventions have an impact on children with ADHD (Bergman-Nutley et al., 2011).

Furthermore, other work showed that medication and behaviour management programs were associated with reduction of the core symptoms of ADHD but there did not appear to be an improvement on standardised scores or overall attainment in school (Loe & Feldman, 2007). Further support that specific areas of developmental delay affect children's specific abilities comes from research by Everatt et al. (2011). They found that behavioural problems such as poor attention or hyperactive and/or impulsive behaviours correlate positively with lower academic scores. However, contrary to Loe and Feldman (2007), Everatt and colleagues found that when these behaviours were targeted through educational and behavioural interventions, gains in academic attainment were seen (Everatt et al., 2011). Such research indicates that some children exhibit behaviours which prevent them

from developing on certain tasks in the long term. This advocates for specific interventions to allow children to learn more effectively.

It is also important to discuss some potential issues of using a standardised measure such as BAS-3 with children with various special educational needs and of various ability. As previously established, children completed the tasks they were able to. For those who took part in the School Age tasks (high ability), a raw score for the sub-sections and standardised (cluster) scores for each area of ability was calculated, whereas the children completing the Pre-School Age tasks (low ability) only had raw scores for each sub-section. This was due to the fact the children were more delayed and as a result there were no age appropriate standardised scores to match their ability. Calculating these raw scores enabled the results to show whether any of the interventions were beneficial for a particular area of cognitive development. However, these scores may not have been as robust as they have not been transferred to standardised scores, which was why the standardised scores were used where possible. Further to this, for the pattern construction task, the children working at a similar level to their typically developing peers were timed on each pattern they completed as there was an option to use standard or alternative scoring. For the significantly delayed children, it was only possible to use the alternative scoring method. Although this difference between children of different abilities may be seen as a disadvantage for the less able children, from the data for the more able children, it was evident that the results were similar regardless of whether the raw or standardised scores were used. As a result of this similarity, the findings for the lower ability children who only use the alternate scoring were seen as representative and reliable. Furthermore, the SNC raw and standard scores yielded similar results. Indicating similarity between scores advocates for the use of standardised scores where possible even for children with special educational needs as it may be more robust.

6.4.5 Fruit Stroop

Here the results of the Fruit Stroop are discussed with reference to the interventions and their influence on executive functioning as well as discussing the different methods of calculating this task.

Interference was shown to be less at post intervention for the children in the control condition which was significantly different from the children in the dog group intervention, indicating that the dog intervention did not have an effect on the level of interference. Furthermore, speed of processing yielded different significant results. All children's performance improved between baseline testing and immediate post-intervention testing as well as during later follow-up tests. It is unlikely that this represents a practice effect given that children only performed each task once prior to intervention. Whilst it was feasible for one task to influence processing of the dimensions within other tasks on the Stroop leading to possible practice effects (MacLeod & Dunbar, 1988; MacLeod, 1991), the conditions within this study were counterbalanced across participants with the intention of limiting potential learning, practice and order effects. It is, however, possible that all children become faster at completing the task, but there was no improvement on the interference. That can explain the improvement on the SOP measure for all children which was not seen in the interference calculations. Overall, the interventions provided did not seem to improve interference or speed of processing when completing this executive functioning task.

It is important to remember that the various methods used here to calculate interference/inhibition scores from Stroop task performance could mask or exaggerate the extent of inhibition/interference in cognitive processing of clinical populations (Jensen, 1965; Demick & Marks, 2016; Scarpina & Tagini, 2015). In line with previous research and to ensure that different methods of calculation were considered, children should continue to complete three different conditions of the Fruit Stroop, including the separate control condition of colour processing as advised by Scarpina and Tagini (2015). When analysing the results, interference scores should be calculated using three different analyses as the current research has done.

The lack of intervention benefits would suggest that an animal intervention may not be beneficial in improving performance on this type of executive functioning task. Further exploration with the presence of a dog and longer intervention as well as targeted sessions on improving executive functioning are still unexplored and may yield beneficial effects.

6.5 Conclusion

The discussion so far established that children who were more severely impaired and as a result completed the pre-school subscales benefitted from the dog condition on various cognitive tasks. However, the relaxation intervention did not appear to have been beneficial. On the other hand, the children working more closely to the level of a typically developing child and who completed the school age scale, have benefitted from the dog and relaxation interventions but on different tasks. This indicates that the two interventions provided had a different impact on children taking part. Previous research for children with ASD investigated the effect of two different interventions and found that the children with lowest language levels at the start of the intervention benefitted more from one of the interventions provided (Kasari et al., 2008).

Furthermore, the dog intervention may have been more effective for children who were of lower ability as it was more interactive and the dog was requiring the child to attend, whereas the child could have found it difficult to concentrate in the relaxation intervention and follow through for the duration of the intervention. For example, for one child in the individual dog intervention it was observed that when he would move away from the dog to engage in self-stimulatory behaviours, one dog in particular followed the child and stood next to him. If the child did not attend to the dog after a few seconds, the dog would gently nudge the child with his snout so the child would attend to the dog again. In contrast, no such interaction was possible with the relaxation intervention. Instead, the equivalent was the researcher verbally prompting the child to lie/ sit down if the child was visibly not attending. However, children may have been lying/ sitting but not following through with the relaxation recording. Another reason for the dogs benefitting the children more may be due to children

showing an affinity to animals (LoBue et al., 2012) as discussed in the introduction.

Alternatively, if children found school difficult and stressful because of assessment pressures or because they struggle with social situations, the dogs may have acted as comfort and social support (Bonas et al., 2000) or as a buffer in mediating the situation (McNicholas & Collis, 1995; Serpell, 1996; Siegel, 1990).

Future research needs to further investigate factors such as SES, pet and dog ownership and their influence on the effectiveness of the interventions provided. The results here showed some differences when entering these factors as covariates. It has not been possible to investigate these factors further due to the limited sample size. Furthermore, having a larger, more selective sample (e.g. high functioning ASD, Asperger's Syndrome, Down's Syndrome etc) would enable optimizing interventions for populations with specific special educational needs.

In conclusion, the research presented in Chapter 4 and Chapter 5 indicated that the interventions are having a beneficial effect on different language and cognitive areas of development. However, these findings have not established why the children may benefit from these interventions. In order to attempt to answer this question, the next chapter investigated physiological differences using cortisol. Furthermore, links to the outcomes of the behavioural measures were also established.

Chapter 7: Physiology and Behaviour Results

As presented in Chapter 3, children with various special educational needs are likely to have different levels of physiological markers as well as score atypically on various measures of behaviour. In order to affect physiological factors (e.g. reduce levels of cortisol which is an indication of stress) or improve behaviour (e.g. challenging behaviour, empathy), interventions are often needed. As discussed previously, there has been limited research in the area of Animal-Assisted Interventions for children with special educational needs in these areas. This chapter presented findings on the measures of cortisol, anxiety, self-esteem, behaviour at home and school, as well as empathising and systemizing behaviours. Only children who were working at a level close to their typically developing peers were able to complete these measures. This was due to the types of measures, for example, self-report measures require deeper understanding. The exceptions are for the empathy and systemizing quotient, behaviour at home and school questionnaires as these were parent- and teacher-report measures. In the calculations for these measures, children with low and high abilities were presented together to ensure a reasonable sample size as some parents and teachers did not return the questionnaires.

7.1 Results

Results for the different measures are reported below, with descriptive statistics, followed by inferential statistics for each measure. For most measures there were five testing points (pre- and post-intervention, 6-week, 6-month, 1-year follow-up). The exceptions are the measure of cortisol, Child Behaviour Rating Scale (teacher report questionnaire) and Empathy/ Systemizing Quotient (parent-report questionnaire) and behaviour at home which were only collected pre- and post-intervention. The number of participants varied between the different assessment points. More detail is provided in Table 79.

Table 79: *The number of children taking part in the assessments overall assessment points*

Task	Condition	Test 1 Baseline N	Test 2 After Intervention N	Test 3 6-weeks N	Test 4 6-months N	Test 5 1-year N
Culture-Free Self-Esteem Inventories	Control	10	10	9	9	8
	Dog Group	17	17	17	7	7
	Relax Group	17	16	11	11	8
Revised Children's Manifest Anxiety Scale	Control	10	10	9	9	8
	Dog Group	17	17	17	7	7
	Relax Group	17	16	11	11	8
Child Behaviour Rating Scale	Dog Individual	20	15	N/A	N/A	N/A
	Relax Individual	18	14	N/A	N/A	N/A
	Control	17	9	N/A	N/A	N/A
Empathy/Systemizing Quotient	Dog Individual	18	14	N/A	N/A	N/A
	Relax Individual	17	13	N/A	N/A	N/A
	Control	15	10	N/A	N/A	N/A
Cortisol	Dog Individual	9	9	N/A	N/A	N/A
	Relax Individual	6	6	N/A	N/A	N/A
	Control	17	17	N/A	N/A	N/A
	Dog Group	9	9	N/A	N/A	N/A
	Relax Group	6	6	N/A	N/A	N/A

N/A: not applicable, measures which were not collected at these test points.

Attrition was due to children moving schools. Retention was between 41.1% and 100%.

Some participants did not complete a particular test point but completed subsequent assessments. This was due to absence (illness or appointments) or the child showing an increased number of challenging behaviours. The children completing these assessments were from the high ability group as children in the low ability group did not understand the questions. The teacher (Child Behaviour Rating Scale) and parent (Empathy/Systemizing Quotient, behaviour at home) measures included children in the high and low ability groups. Not enough data was available for the children in the individual intervention for the Culture-Free Self-Esteem Inventories and Revised Children's Manifest Anxiety Scale.

7.1.1 Culture-Free Self-Esteem Inventories- third edition (CFSEI-3): Descriptive statistics

This self-report measure assessed children's self-esteem. Table 80 presented the descriptive statistics (Mean and SD) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention).

Table 80

Descriptive statistics (Mean and SD) of the CFSEI-3 for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6- month	Mean Test 5 1-year	SD Test 5 1-year
C	11.13	2.53	11.5	2.83	13	3.21	10.88	2.59	10.38	4.5
DG	10	5.23	10.14	5.93	10.43	5.8	10.43	5.5	10.43	5.5
RG	12.83	2.32	13.17	2.64	13.17	1.84	13.5	2.59	13.5	2.59

C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that the children in the control condition showed an increase in self-esteem at the 6-week follow-up point but overall (across the test sessions for the year duration of the project) the children had the same level of self-esteem. The children in the relaxation group intervention showed an initial rise in self-esteem from pre- to post-intervention and then maintained their score while the children in the dog group intervention did not show a change in self-esteem score at any point.

7.1.2 Culture-free self-esteem inventories- third edition (CFSEI-3): Inferential statistics

To investigate whether the differences in mean scores were significant analysis of variance were calculated. Sphericity was taken into account when the results were reported. Independent samples t-tests showed no significant differences between conditions at test 1 (baseline). The data was positively skewed so it was log transformed (log10) before the ANOVA calculations.

7.1.2.1 Longitudinal effects of the dog and relaxation interventions

A 3x5 ANOVA investigated Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) for the children taking part in the group interventions. The calculation indicated no significant differences. Planned comparisons indicated no significant differences for any of the conditions. The only trend towards significance ($p= 0.051$) was for the children in the control condition between test 1 (pre-

intervention baseline) and test 3 (6-week follow-up) due to a higher score of self-esteem (Figure 33).

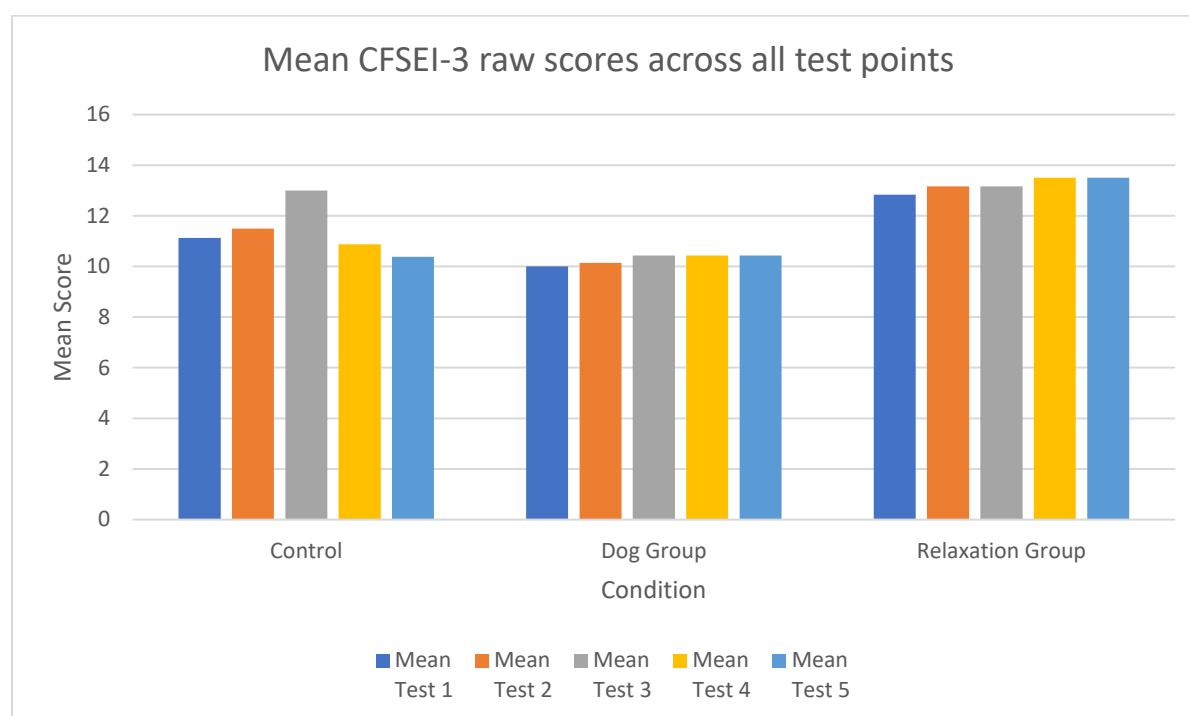


Figure 33: Mean CFSEI-3 score for all assessment points

7.1.2.2 Immediate effects of dog and relaxation interventions

The 3x2 ANOVA included all children who took part regardless of whether they had completed all follow-up assessments. This calculation revealed no significant differences.

7.1.3 Revised children's manifest anxiety scale- second edition (RCMAS-2):

Descriptive statistics

This self-report measure assessed children's anxiety. Table 81 presented the descriptive statistics (Mean and SD) for test 1 (baseline, pre-intervention), test 2 (immediate, post-intervention), test 3 (6-weeks post-intervention), test 4 (6-months post-intervention) and test 5 (1-year post-intervention). The descriptive statistics were only presented for the group interventions and control condition as few children in the individual interventions completed the anxiety self-report measure.

Table 81

Descriptive statistics (Mean and SD) of the RCMAS-2 for all assessment points

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention	Mean Test 3 6- week	SD Test 3 6- week	Mean Test 4 6- month	SD Test 4 6-month	Mean Test 5 1-year	SD Test 5 1-year
C	4	2.14	4.38	2.62	2.75	2.92	3.13	1.96	3.38	2.93
DG	4.71	2.87	4.71	3.09	4.57	3.1	4.86	3.29	4.71	3.09
RG	3.29	1.8	3.57	2.94	2.57	2.44	2.86	1.95	2.86	1.95

C= Control; DG= Dog Group; RG= Relaxation Group

The means indicated that the children in the control and relaxation group intervention showed lower anxiety scores as the project went on (i.e. from pre-intervention to the end of the longitudinal testing: 1-year follow-up). The children in the dog group intervention on the other hand maintained the same score of anxiety, indicating that their self-report level of anxiety did not change.

7.1.4 Revised Children's Manifest Anxiety Scale- second edition (RCMAS-2):

Inferential statistics

To investigate whether the differences in mean scores were significantly different, analysis of variance were calculated. Sphericity was taken into account when the results were reported. Independent samples t-tests showed no significant differences between conditions at test 1 (baseline). The data was normally distributed.

7.1.4.1 Longitudinal effects of the dog and relaxation interventions

A 3x5 ANOVA investigated Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) for the children in the group interventions (Table 82). There was a significant main effect for Test Time [$F(2.098, 39.870) = 3.68, p = 0.032, \eta^2 = 0.16$]. Most children (control and relaxation condition) had lower anxiety scores at the follow-up assessment points compared to the pre- and immediate post-intervention test sessions, indicating lower levels of anxiety. This trend was shown in Figure 34. There

were no significant differences from the Bonferroni post-hoc tests when comparing the different conditions.

Table 82

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) x Condition ANOVA for RCMAS-2

Effect	df	F	p	ηp^2
Group Intervention				
(A) Test Time	2.098, 39.870	3.68	0.032*	0.16
(B) Condition	2, 19	0.64	0.537	0.06
A x B (interaction)	4.197, 39.870	0.82	0.522	0.08

Note: ** Indicates highly significant result; * Indicates a significant result

Planned comparisons using paired samples t-tests for children within each condition indicated that the only significant difference was for the children in the relaxation group intervention between pre-intervention and 6-week follow-up ($p= 0.046$), where children have shown significantly lower level of anxiety at the 6-week follow-up point. There were no significant differences for the children in the dog or control conditions (Figure 34).

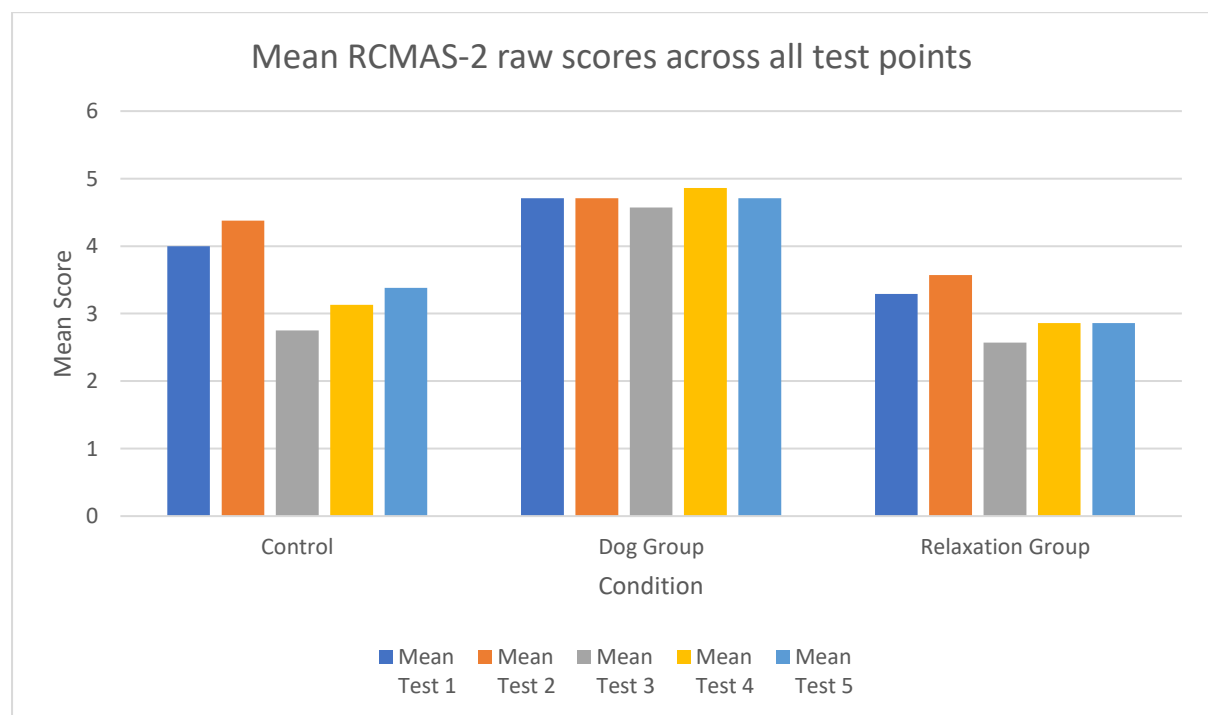


Figure 34: Mean RCMAS-2 score for all assessment points

7.1.4.2 Immediate effects of dog and relaxation interventions

To include all children taking part in the intervention regardless of whether they took part in all follow-up sessions, a 3x2 ANOVA was calculated to assess pre- and post-intervention effects. There were no significant differences. Planned comparisons for immediate effects were presented above, together with the longitudinal data.

7.1.5 Child Behaviour Rating Scale (CBRS): Descriptive statistics

This task assessed the behaviour of children within the classroom as rated by their teacher. Few teachers for the children in the group intervention completed the questionnaire at pre- and post-intervention. As a result, calculations were only completed with the children in the individual interventions. The descriptive statistics (mean and SD) were presented in Table 83 for pre- and post-intervention as this measure was only collected at these points.

Table 83

Descriptive statistics (Mean and SD) of the CBRS for test 1 (baseline, pre-intervention) and test 2 (immediate, post-intervention)

Condition	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After Intervention
Dog Individual	52.08	10.13	52.00	6.92
Relaxation Individual	50.33	13.98	57.44	13.68
Control	52.75	5.39	54.38	7.27
Dog Group	56.41	7.94	61.59	9.50
Relaxation Group	60.92	4.58	64.25	8.81

The means indicated that the children in the dog individual intervention maintained the same behaviour pre- to post-intervention whereas the rest of the children showed higher scores which indicated better behaviour after the intervention.

7.1.6 Child Behaviour Rating Scale (CBRS): Inferential statistics

To investigate whether the mean differences were significant, ANOVAs and t-tests were calculated. Sphericity was taken into account when reporting the results. Independent samples t-tests showed no differences at baseline between the children in the different conditions. The data was negatively skewed at baseline so it was log transformed (log10) before the ANOVA calculations.

7.1.6.1 Immediate effects of dog and relaxation interventions

The 3x2 ANOVA (Table 84) for the individual interventions indicated a significant main effect for Test Time [$F(1,59)= 5.26$, $p= 0.025$, $\eta p^2= 0.08$] and a between-subjects highly significant main effect for Condition [$F(4,59)= 3.86$, $p= 0.007$, $\eta p^2= 0.21$].

The Bonferroni post-hoc tests showed no significant differences between the children in the individual dog and relaxation interventions and the control group. However, there was a significant difference between the children in the control and relaxation group intervention ($p= 0.031$) as children in the relaxation group showed higher scores indicating better behaviour. Planned comparisons using paired samples t-tests to compare before and after intervention testing indicated that there were no significant differences for the individual intervention. There was a significant difference from pre- to post-intervention for the children in the dog group intervention ($p= 0.009$), with children having higher scores indicating better behaviour.

Table 84

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) ANOVA for CBRS

Effect	df	F	p	ηp^2
Individual Intervention				
(A) Test Time	1, 27	11.70	0.002**	0.30
(B) Condition	1, 27	0.47	0.630	0.03
A x B (interaction)	2, 27	1.88	0.172	0.12
Group Intervention				
(A) Test Time	1, 39	2.00	0.165	0.05
(B) Condition	2, 39	3.65	0.035*	0.16
A x B (interaction)	2, 39	0.10	0.904	0.01

*Note: ** Indicates highly significant result; * Indicates a significant result. The means indicated an increase in scores which indicates better classroom behaviour (Figure 35).*

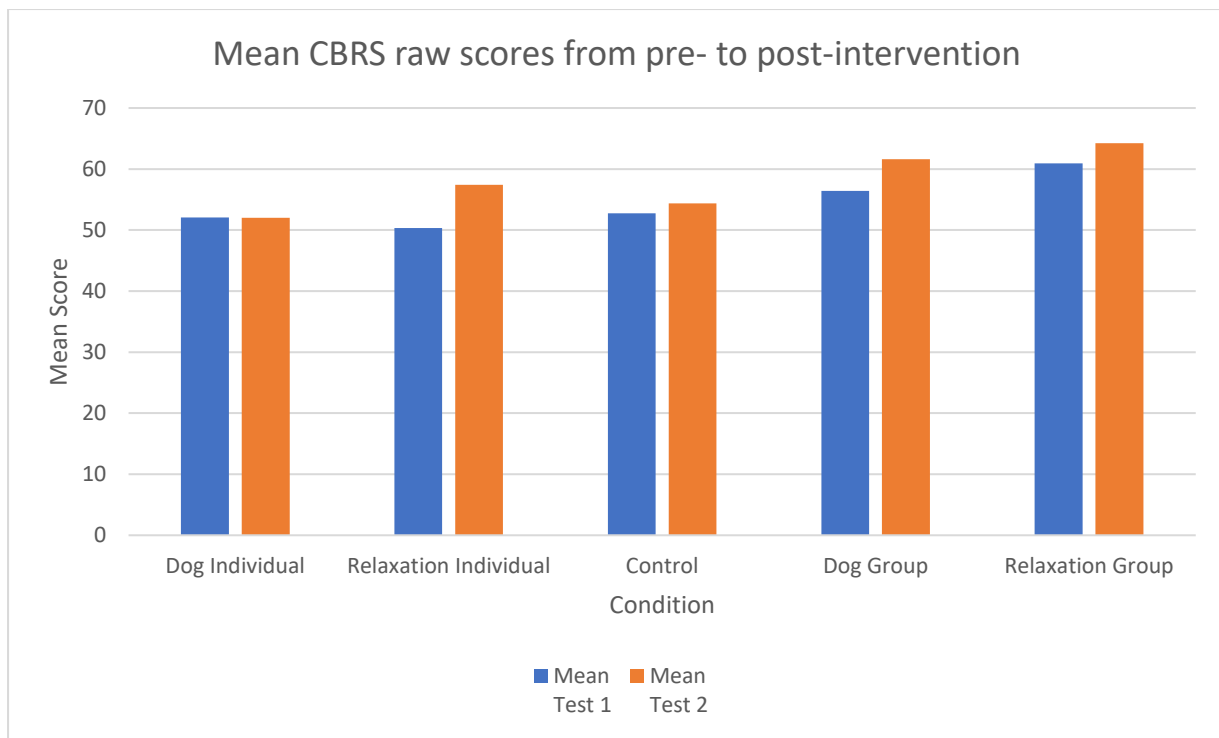


Figure 35: Mean CBRS score for pre- and post-intervention assessment

7.1.6.1.1 The influence of Pet and Dog Ownership on immediate effect of the interventions

The 3x2 ANCOVAs (Table 85) indicated no significant differences for the children in the individual interventions. For the group interventions, there was a significant difference for Dog Ownership [$F(1,14)= 5.78$, $p= 0.031$, $\eta^2= 0.29$] and Condition [$F=(2,14)= 5.97$, $p= 0.013$, $\eta^2= 0.46$]. All children showed an improvement in behaviour but the largest improvement in the means was for the children in the dog group intervention.

Table 85

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with SES, Pet and Dog Ownership as Covariates ANCOVA for CBRS

Effect	df	F	p	ηp^2
Individual Intervention				
(C) SES (covariate)	1, 15	1.08	0.316	0.07
(A) Test Time	1, 15	0.25	0.624	0.02
(B) Condition	2, 15	1.17	0.338	0.14
A x B (interaction)	2, 15	0.25	0.785	0.03
A x C (interaction)	1, 15	2.10	0.168	0.12
(C) Pet Ownership (covariate)	1, 19	0.16	0.694	0.01
(A) Test Time	1, 19	3.13	0.093	0.14
(B) Condition	1, 19	1.60	0.228	0.14
A x B (interaction)	2, 19	0.71	0.502	0.07
A x C (interaction)	1, 19	0.64	0.434	0.03
(C) Dog Ownership (covariate)	1, 19	1.40	0.252	0.07
(A) Test Time	1, 19	0.01	0.909	0.001
(B) Condition	2, 19	2.25	0.133	0.19
A x B (interaction)	2, 19	1.02	0.381	0.10
A x C (interaction)	1, 19	0.50	0.486	0.03
Group Intervention				
(C) Pet Ownership (covariate)	1, 14	0.44	0.520	0.03
(A) Test Time	1, 14	0.20	0.661	0.01
(B) Condition	2, 14	2.56	0.113	0.27
A x B (interaction)	2, 14	0.33	0.725	0.05
A x C (interaction)	1, 14	0.69	0.420	0.05
(C) Dog Ownership (covariate)	1, 14	5.78	0.031*	0.29
(A) Test Time	1, 14	1.37	0.262	0.09
(B) Condition	2, 14	5.97	0.013*	0.46
A x B (interaction)	2, 14	0.81	0.464	0.10
A x C (interaction)	1, 14	2.33	0.149	0.14

Note: ** Indicates highly significant result; * Indicates a significant result

7.1.7 Empathy quotient (EQ): Descriptive statistics

These scores presented children's ability to empathise. Only the children who took part in the individual intervention were reported here because parents for the children in the group intervention did not return enough EQSQs (pre-intervention N= 13, post-intervention N=3). Children were not separated in terms of ability here due to the measure being parent report and the number of returned questionnaires did not allow for the data to be separated based on ability. The descriptive statistics (mean and SD) were presented in Table 86.

Table 86

Descriptive statistics (Mean and SD) of the EQ for test 1 (baseline, pre-intervention) and test 2 (immediate, post-intervention)

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention
Dog Individual	23.43	9.57	22.21	9.22
Relaxation Individual	18.62	4.81	18.46	5.8
Control	16.45	8.44	19.71	6.8

The means indicated that the children in the dog individual intervention showed a slight reduction in empathy at post-test, while the children in the relaxation intervention maintained the same score and those taking part in the control group showed an increase in empathy score.

7.1.8 Empathy quotient (EQ): Inferential statistics

To assess whether the mean differences were significant, analysis of variance were calculated. Sphericity was taken into account when reporting the data. Independent samples t-tests revealed no significant differences at baseline. The data was normally distributed.

7.1.8.1 Immediate effects of dog and relaxation interventions

The 3x2 ANOVA showed no significant differences. Planned comparisons using paired samples t-tests to assess any changes within each condition revealed no significant differences between pre- and post-intervention.

7.1.8.1.1 The influence of pet and dog ownership on immediate effect of the interventions

The 3x2 ANCOVA showed no significant differences.

7.1.9 Systemizing quotient (SQ): Descriptive statistics

These scores present the children's ability to systemize. The descriptive statistics (Mean and SD) were presented in Table 87.

Table 87

Descriptive statistics (Mean and SD) of the SQ for test 1 (baseline, pre-intervention) and test 2 (immediate, post-intervention)

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After intervention	SD Test 2 After intervention
Dog Individual	21.43	7.34	20.07	9.90
Relaxation Individual	23.00	6.70	20.69	6.93
Control	19.29	7.25	19.29	7.89

The means indicated that children in the dog and relaxation intervention had lower systemizing score after the intervention while the children in the control group maintained the same score.

7.1.10 Systemizing Quotient (SQ): Inferential statistics

To assess whether the mean differences were significant, analysis of variance were calculated. Sphericity was taken into account when reporting the data. Independent samples t-tests revealed no significant differences at baseline. The data was normally distributed.

7.1.10.1 Immediate effects of dog and relaxation interventions

A 3x2 ANOVA indicated no significant differences. Planned comparisons using paired samples t-tests to assess any changes within each condition before and after intervention revealed no significant differences.

7.1.10.1.1 The influence of Pet and Dog Ownership on longitudinal effect of the interventions

The 3x2 ANCOVA (Table 88) which included dog ownership has indicated a main effect for Test Time [$F(1,30) = 4.63$, $p = 0.040$, $\eta^2 = 0.13$] and significant interaction effect between

Test Time and Dog Ownership [$F(1,30)= 6.86, p= 0.014, \eta p^2= 0.19$]. The means indicated that overall, children had lower SQ scores post-intervention. Specifically, this was true for the children in the dog and relaxation groups, while those in the control group showed the same scores at baseline and post-test. This suggests that children show less systemizing behaviours. Due to the small number of parents who responded to the pet ownership questionnaire it was not possible to conduct any further analysis to investigate the effect a pet dog has on the effectiveness of the interventions. There were no significant Bonferroni-adjusted post-hoc tests or paired samples t-tests results.

Table 88

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention, 6-week, 6-month, 1-year follow-up) with SES, Pet and Dog Ownership as Covariates ANCOVA for Systemizing Quotient

Effect	df	F	p	ηp^2
Individual Intervention				
(C) SES (covariate)	1, 26	0.001	0.912	< 0.001
(A) Test Time	1, 26	0.00	0.962	< 0.001
(B) Condition	2, 26	0.61	0.550	0.05
A x B (interaction)	1, 26	0.18	0.679	0.01
A x C (interaction)	2, 26	0.44	0.646	0.03
(C) Pet Ownership (covariate)	1, 30	1.34	0.256	0.04
(A) Test Time	1, 30	0.09	0.766	0.003
(B) Condition	2, 30	0.27	0.763	0.02
A x B (interaction)	2, 30	0.51	0.609	0.03
A x C (interaction)	1, 30	0.55	0.463	0.02
(C) Dog Ownership (covariate)	1, 30	0.01	0.914	< 0.001
(A) Test Time	1, 30	4.63	0.040*	0.13
(B) Condition	2, 30	0.28	0.762	0.02
A x B (interaction)	2, 30	0.42	0.659	0.03
A x C (interaction)	1, 30	6.86	0.014*	0.19

Note: ** Indicates highly significant result; * Indicates a significant result

7.1.11 Parent/ Carer Child Behaviour Questionnaire: Descriptive statistics

This was a parent/ carer report questionnaire devised for this research. Adults rated the child's behaviour at home before and after the intervention. Few parents of children in the group interventions completed the behaviour questionnaires at both points: pre- and post-intervention (pre-intervention N=13, post-intervention N=3). As a result, the calculations were completed with the children in the individual interventions and control condition. Children in

the high and low ability group were included in this calculation together as this was a parent-report measure. There was not enough data to enable the calculations to be done depending on the ability of the children. Descriptive statistics were presented in Table 89.

Table 89

Descriptive statistics (Mean and SD) of the parent/carer child behaviour questionnaire for test 1 (baseline, pre-intervention) and test 2 (immediate, post-intervention)

	Mean Test 1 Baseline	SD Test 1 Baseline	Mean Test 2 After Intervention	SD Test 2 After Intervention
Dog Individual	58.47	8.89	56.27	9.47
Relaxation Individual	61.92	4.17	59.92	5.17
Control	52	7.89	54.63	10.21

The means indicated that children in the intervention conditions had lower scores at post-test indicating that their behaviour at home was worse according to their parents/ carers. The children in the control condition showed the opposite pattern.

7.1.12 Parent/ Carer Child Behaviour Questionnaire: Inferential statistics

To investigate whether mean differences were significant, analysis of variance was calculated. Sphericity was taken into account and results were appropriately reported. The values were negatively skewed at baseline so they were log transformed (log10) before analysis.

7.1.12.1 Immediate effects of dog and relaxation interventions

A 3x2 ANOVA calculating pre- and post-intervention scores indicated no significant differences. Planned comparisons using paired samples t-tests to assess any changes within each condition revealed no significant differences.

7.1.12.1.1 The influence of SES, pet and dog ownership on immediate effect of the interventions

The 3x2 ANCOVA (Table 90) which included SES indicated a significant main effect for Test Time [$F(1, 28) = 6.08$, $p = 0.020$, $\eta^2 = 0.18$] and an interaction effect for Test Time and SES [$F(1, 28) = 5.77$, $p = 0.023$, $\eta^2 = 0.17$]. The children overall reduced their scores on this measure meaning that they behaved worse at home. This was particularly true for the children in the dog and relaxation intervention as the children in the control condition showed no difference. There was also a highly significant main effect for Pet Ownership when it was entered as a covariate [$F(1, 32) = 9.30$, $p = 0.005$, $\eta^2 = 0.23$].

Table 90

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) with SES, Pet and Dog Ownership as Covariates ANCOVA for Parent/ Carer Child Behaviour Questionnaire

Effect	df	F	p	η^2
Individual Intervention				
(C) SES (covariate)	1, 28	0.34	0.566	0.01
(A) Test Time	1, 28	6.08	0.020*	0.18
(B) Condition	1, 28	0.88	0.425	0.06
A x B (interaction)	1, 28	0.44	0.646	0.31
A x C (interaction)	1, 28	5.77	0.023*	0.17
(C) Pet Ownership (covariate)	1, 32	9.30	0.005**	0.23
(A) Test Time	1, 32	0.34	0.567	0.01
(B) Condition	2, 32	1.86	0.172	0.10
A x B (interaction)	2, 32	1.99	0.153	0.11
A x C (interaction)	1, 32	0.16	0.694	0.01
(C) Dog Ownership (covariate)	1, 32	3.77	0.061	0.11
(A) Test Time	1, 32	0.53	0.472	0.02
(B) Condition	2, 32	1.65	0.209	0.09
A x B (interaction)	2, 32	2.16	0.132	0.12
A x C (interaction)	1, 32	0.89	0.352	0.03

Note: ** Indicates highly significant result; * Indicates a significant result

7.1.13 Cortisol: Descriptive statistics

The children provided saliva samples before and after the intervention to measure their baseline cortisol levels. The mean from the samples at pre- and post-intervention was taken as described above in Chapter 4: Method. The descriptive statistics were presented in Table 91 (Mean and SD).

Table 91

Descriptive statistics (Mean and SD) of the baseline cortisol level before and after the interventions

	Mean Baseline Pre-intervention	SD Baseline Pre-intervention	Mean Baseline Post-intervention	SD Baseline Post-intervention
Dog Individual	0.16	0.07	0.17	0.06
Relaxation Individual	0.14	0.06	0.27	0.19
Control	0.14	0.07	0.13	0.04
Dog Group	0.15	0.05	0.09	0.02
Relaxation Group	0.15	0.06	0.13	0.05

The means indicate that the children in the relaxation individual intervention showed the largest increase in cortisol levels post-intervention, followed by those in the dog individual intervention. The children in the control group showed a slight decrease in cortisol, followed by the children in the relaxation group intervention. The largest decrease in cortisol levels was shown by the children in the dog group intervention. The majority of children were in the high ability group as those in the low ability group were unable to provide saliva. As very few children in the low ability group provided saliva this calculation included all children, without separate calculations based on ability.

7.1.14 Cortisol: Inferential statistics

To investigate whether these differences in cortisol levels were significant, analysis of variance were calculated. Sphericity was taken into account when reporting the results. The mean baseline cortisol was skewed before intervention, so the data was log transformed (log10) to tend towards normality. At baseline, there were no significant differences between conditions.

7.1.14.1 Immediate effects of dog and relaxation intervention

A 5 (dog individual, relaxation individual, control, dog group, relaxation group) x 2 (pre-, post-intervention) ANOVA was calculated. There was a highly significant interaction effect for

Test Time and Condition [$F(4,39)= 5.10$, $p= 0.002$, $\eta p^2= 0.34$]. See Table 92 below for results and effect sizes in overview.

Planned comparisons using paired samples t-test were calculated to investigate differences before and after intervention within each condition. They indicated a significant difference from pre- to post-intervention for the children in the dog group intervention ($p= 0.004$) who showed a significant decrease in cortisol over time (Figure 36).

Bonferroni post-hoc tests revealed a significant difference between dog individual and dog group ($p= 0.001$), relaxation individual and control ($p= 0.008$), relaxation individual and dog group ($p= 0.007$), control and dog group ($p= 0.009$) and dog group and relaxation group ($p= 0.013$). The children in the dog group intervention had significantly lower cortisol at post-test compared to the children in all other interventions.

Table 92

Condition (dog, relaxation, control) x Test Time (pre-, post-intervention) ANOVA for baseline Cortisol

Effect	df	F	p	ηp^2
(A) Test Time	1, 39	0.32	0.577	0.01
(B) Condition	4, 39	2.29	0.077	0.19
A x B (interaction)	4, 39	5.10	0.002**	0.34

Note: ** Indicates highly significant result; * Indicates a significant result

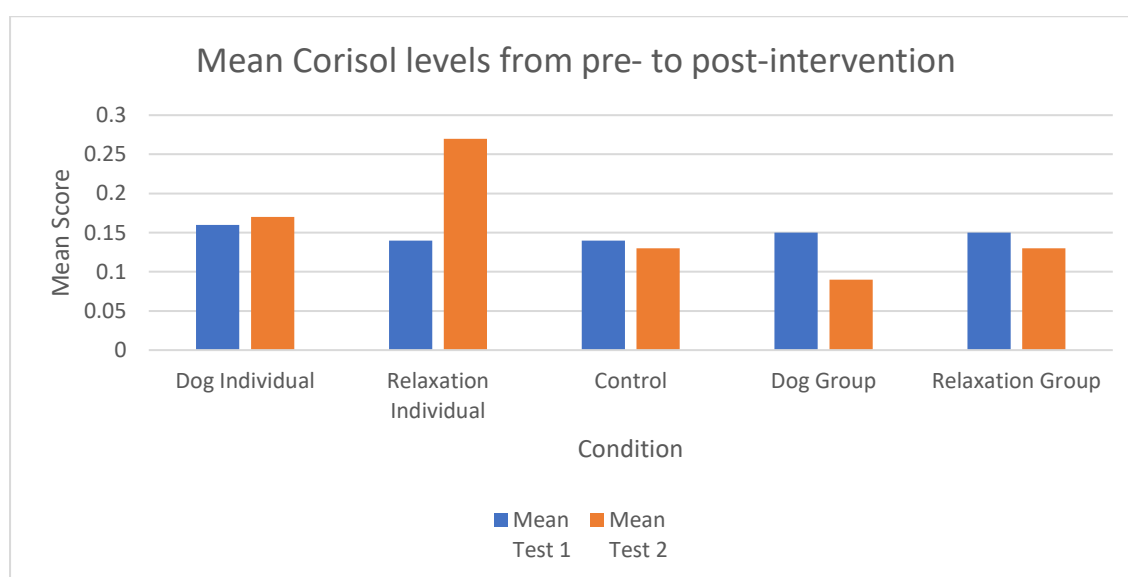


Figure 36: Mean baseline cortisol levels at pre- and post-intervention assessment

7.2 Effects of AAI on Physiology and Behaviour- Summary

The results of this chapter were summarised in Table 93 below. The ticks indicated a significant difference. The ANOVAs were based on the factors calculated. For instance, a 3x2 in the ANOVA/ ANCOVA column meant that the results were for the 3x2 ANOVA for the factors of Condition (dog, relaxation, control) and Test Time (pre- and post-intervention). The 3x5 ANOVA included all follow-up testing points. The SES, Pet (pet ownership) and Dog (dog ownership) stood for the factors entered as covariates in the ANCOVAs.

The Group/ Individual column was an indication of whether the statistical test was calculated using the data from the children taking part in the individual dog and relaxation intervention or the group dog and relaxation intervention.

The column labelled Time (T) indicated a significant main effect for time and the column Condition (C) indicated a significant between-subjects main effect for condition. In this instance the condition is the intervention/ control that children took part in (i.e. individual dog/ relaxation, control, group dog/ relaxation). The T x C column indicated a Time x Condition interaction effect. The T x covariate column was for the ANCOVA calculations only as it indicated an interaction between time and the covariate included in the calculation (i.e. pet ownership, dog ownership or SES).

Table 93

Summary of Significant Results for All Tasks Presented in Chapter 7

Task	ANOVA/ ANCOVA	Group (G)/ Individual (I)	Time (T)	Condition (C)	T x C	T x Covariate
CFSEI-3	3x5	G				
	3x2	G				
RCMAS-2	3x5	G	✓			
	3x2	G				
CBRS	3x2	I	✓			
		G		✓		
	3x2 SES	I				
	3x2 Pet	I				
		G				
	3x2 Dog	I				
		G		✓		
Emotion Quotient (EQ)	3x2	I				
	3x2 SES	I				
	3x2 Pet	I				
	3x2 Dog	I			✓	
Systemizing Quotient (SQ)	3x2	I				
	3x2 SES	I				
	3x2 Pet	I				

	3x2 Dog	I	✓			✓
Parent/ Carer Child Behaviour Questionnaire	3x2	I				
	3x2 SES	I	✓			✓
	3x2 Pet	I				
	3x2 Dog	I				
Cortisol	5x2	I & G			✓	

In summary, there were some differences on the behavioural and physiological measures assessed here which differed depending on the intervention. For instance, cortisol only significantly reduced for the children in the dog group intervention.

7.3 Discussion

7.3.1 Overview of findings

The findings from the measures presented here varied. The measure of baseline cortisol showed a significant reduction after the intervention for the children in the dog group intervention only. Similarly, teachers reported that the behaviour of children in the dog group intervention improved after the intervention. There was also a difference between the children in the relaxation group intervention and the control group where children in the relaxation intervention showed better behaviour in the classroom. The interventions appeared to have no effect on children's anxiety, self-esteem and empathising ability immediately after the interventions. When assessing the change over a year, however, there was a main effect for anxiety, with an indication that most children showing reduced anxiety over time, regardless of the experimental condition they were in. More specifically, the children in the relaxation individual condition showed significantly reduced anxiety from pre- to 6-weeks post-intervention.

In addition, the external factors of SES, pet and dog ownership also appeared to influence the effectiveness of the intervention on EQSQ and the parent report behaviour at home. It was not possible to investigate how these factors on the effectiveness of the intervention due to the small sample size. The findings were discussed in detail next. The effects of the interventions were discussed first, followed by the effects of the external factors and final conclusions.

7.3.2 Effects of the interventions

The effects of the interventions varied depending on the measure in question. When investigating the objective physiological measure of cortisol, the children in the dog group intervention showed a significant reduction in their cortisol levels compared to the other groups. In contrast, the other children showed an increase in their cortisol from pre- to post-intervention. The children in the individual relaxation intervention showed a significant increase in cortisol between baseline and post-intervention measures when compared to the children in the control group. These results showed that the dog group intervention was most successful in reducing cortisol, an indication of the reduction of stress. This could be explained with “Social Buffering” which suggests that social factors regulate the response to stress (Flannery, Beauchamp & Fisher, 2017; O’Haire et al., 2015). Therefore, the participants taking part in the dog intervention as a group may feel more supported by their peers and therefore the effect of the dog is more prominent. This appears to have been the case in the current study as the group intervention was more effective for cortisol reduction than the one-to-one intervention. It is therefore suggested that the effect of the group facilitated the effect of the dog intervention for children with special educational needs and as a result their cortisol levels were reduced. In addition, the effect of the dog was not necessarily related to petting the dog, as previously thought (Kertes et al., 2017), as children in the individual condition children were able to pet the dog more compared to the children in the group intervention, yet their cortisol has not been reduced more. These findings answer questions raised by literature reviews within AAI (e.g. Mapes & Rosen, 2016; Brelsford et al., 2017) with regards to the type of animal intervention that is most effective. It is suggested that a group intervention is more beneficial in reducing stress, than an individual intervention which at the same time reduces working time for the animals. This structure would also make it more feasible and easier to organise AAI sessions. The beneficial effects for the dog group intervention have also been established on the teacher-report behaviour at school measure with the children in the dog group intervention showing better behaviour. This indicates that the physiological changes are also observable by the adults taking care of the

child. This finding supports research with other interventions where teachers reported improved classroom behaviour (Black & Fernando, 2014; Kotrschal & Ortbauer, 2003) as well as gains in pro-social behaviour and emotion regulation (Harpin, Rossi, Kin & Swanson, 2016) for primary school pupils after a mindfulness-based intervention. Although the beneficial findings in the current research were from the dog group intervention rather than the relaxation intervention, this can be explained with the structure of the sessions. Mindfulness was used in the previous research as an intervention to explicitly teach a relaxation technique. This may therefore be more effective than the relaxation intervention used in this project which only required children to listen to the story and relax as opposed to being taught the technique to be used in future situations. Further research using relaxation interventions and varying type, length and intensity of intervention could ensure the effect was clearly understood.

The self-report measures for self-esteem and anxiety have not shown an immediate change between pre- and post-intervention scores. The current findings support previous research conducted with hospitalised children which found that AAls did not reduce the anxiety in participants (Barker, Knisely, Schubert, Green & Ameringer, 2015). Further to this, previous work indicated that petting a real animal reduced state anxiety (Shiloh, Sorket & Terkel, 2003) which could be the case in the current research as the children were allowed to pet the dogs. However, further research into contact with the dog, duration and type of interaction needs to be conducted as well as measuring different types of anxiety.

The short form of the anxiety self-report questionnaire was used on this occasion and as a result, it was not possible to investigate the effect of the interventions on different types of anxiety. There was however reduced anxiety for the children in the relaxation intervention at the 6-week follow-up point. This is in line with previous findings as a relaxation intervention, which included relaxation-breathing and self-management and found the intervention reduced children's anxiety (Chiang, Ma, Huang, Tseng & Hsueh, 2009). Furthermore, mindfulness-based cognitive therapy has also shown significant reduction in children's anxiety, especially when they reported elevated levels of anxiety (Semple, Lee,

Rosa & Miller, 2010). The current research replicated these findings only for the group intervention and not for the individual intervention. This could be due to the difference in interventions used, or due to a difference in populations, as the children taking part in the group interventions were of higher ability only.

Findings for the self-esteem measure suggest no differences for the children in any intervention condition. The dog-assisted intervention did not have an effect on children's self-reported self-esteem. This fits with previous research which established that the self-esteem of adolescents with emotional, behavioural or learning difficulties did not change as a result of an equine assisted activities program (Holmes et al., 2011). However, for adolescents experiencing depression and/or anxiety equine-assisted psychotherapy was found to improve their self-esteem (Wilson, Buultjens, Monfries & Karimi, 2017). These differences were likely due to the difference in interventions provided as well as the difference in the profile of participants. For instance, animal-assisted activities were likely to be less structured where as a therapy session was likely to have a clear aim and be set up in a way to achieve success and the presence of the animal was likely to facilitate this. The lack of benefit from the relaxation intervention is not in line with previous research. In fact, mindfulness-based intervention has been shown to improve self-esteem for adolescents in a mental health clinic (Tan & Martin, 2012). However, a review investigating yoga interventions concluded that reliable research was lacking in the field for school-based interventions. Only one of the research articles which passed the inclusion criteria for the review investigated self-esteem changes as a result of a mindfulness-based yoga intervention and showed an increased level of self-esteem for girls as a result of the intervention (Ferreira-Vorkapic et al., 2015). It was suggested that such differences may be based on the interventions provided and the difference in structure and aims to be achieved as well as due to including participants with a different profile or indeed different gender, which was not assessed here.

7.3.3 Effect of external factors

When investigating these behavioural, socio-emotional and physiological measures, it was not simple to see changes, as they were likely to be affected by other factors. For instance, SES and dog ownership appeared to play a part in the effectiveness of the interventions as there was an effect for time for the group intervention on the teacher behaviour questionnaire as well as for the individual interventions on the parent-report behaviour questionnaire. It is difficult to know how these factors influence the effectiveness of AAI. Nonetheless, these findings were similar to previous research which found that AAI reduced the frequency and severity of aggressive behaviour in participants admitted to acute psychiatric units (Marques, Mendes, Gamito & De Sousa, 2015). Alternative interventions also showed an effect on behaviour too. For instance, a yoga intervention for children with ASD found that there was an improvement in the children's behavioural problems (Narasingharao, Pradhan & Navaneetham, 2017). A meta-analysis investigating the effect of Mindfulness-Based Interventions (MBIs), found that MBIs reduce disruptive behaviours in youths, including those with developmental or behavioural disabilities (Klingbeil et al., 2017).

Although we had limited information on SES due to parents not wishing to answer these questions, research has previously established that low SES acted as a predictor of behavioural problems (Hosokawa & Katsura, 2018) and was related to higher levels of child internalising behaviour problems (Pisani Altafim, McCoy & Martins Linhares, 2018). Further to this, a meta-analysis has also established that low SES was associated with high levels of anti-social behaviour among children and adolescents (Piotrowska, Stride, Croft & Rowe, 2015). The authors concluded that if the intervention did have a different effect on children from different SES background, it was likely that the children from low SES families would benefit most. This could be due to behavioural issues being more prominent to begin with and therefore being easier to see a change if and when it occurs. However, it is not possible to state this with confidence from the current data.

For the EQSQ questionnaire, for both the empathy and systemizing scores, dog ownership as a covariate had a moderating effect. For the systemizing score, the means

indicated that the children in the dog and relaxation condition showed less systemizing after the interventions whereas the children in the control condition had roughly the same score at post-intervention as they did at pre intervention. Research so far has not investigated the effect of AAI on empathizing and systemizing but it has been established that systemizing was higher in males in the general public (Wright & Skagerberg, 2012). Clearly, the interventions in the current study only influenced the systemizing rather than the empathising score. If true, interventions such as AAI and relaxation may improve non-social deficits which children are experiencing as the systemizing score is related to non-social deficits whereas the empathising score was related to social difficulties (Svedholm- Häkkinen et al., 2018). Research would need to explore the link between non-social deficits and systemizing and establish whether change in one will influence the other. If such a link is found, research could then assess whether this is true for children with other disorders, not just Autism. Although these trends in mean scores were interesting to discuss, it was important to highlight that they were not significant. However, when dog ownership was entered as a covariate, there were significant differences. For the empathising score there was a difference for the children in the different conditions across the time points whereas for the systemizing score there was a difference across time, suggesting overall change of scores for everyone. This difference in where the significance lies further adds to the argument that perhaps the dog and relaxation intervention affected children differently, depending on external factors such as dog ownership. It is important to research this further, with more participants who provide all the background family and pet information.

In conclusion, establishing differences on the socioemotional, behavioural and physiological measures due to the interventions provided has been challenging. It was likely that these factors were very difficult to change with the intervention provided. This may have been due to the interventions not being administered for long enough (duration) or often enough (intensity). As a result, future research should concentrate on dosage.

The next chapter discussed the findings from this chapter and the language and cognition chapters and related them to the theory presented in Chapter 2. Possible benefits

of future animal interventions as discussed as well as any areas where other alternative interventions, such as relaxation may be more appropriate. Furthermore, recommendations for future research were made and practical implications emphasised.

Chapter 8: Discussion

8.1 Overview

This chapter aims to summarise and discuss the findings from the studies conducted. To begin, the aims of this research were revisited, followed by the contribution and originality of the work and the benefit to the research field of Animal-Assisted Interventions. The findings were used to answer the hypotheses set out in Chapter 2. To conclude, limitations of the project were stated as well as guidance for future research.

8.2 Aims of the Project

The present research investigated if there were any effects from a 4-week school-based Dog-Assisted Intervention (DAI) for children with special educational needs. The effects were assessed in terms of children's language and cognitive development as well as self-esteem and anxiety. The physiological measure of cortisol was also collected as was data on behaviour from parents and teachers. The DAI was compared to an active control (relaxation intervention) and a no treatment control group, both interventions were carried out either individually or in small groups. The children completed the assessments before and after the intervention as well as 6 weeks, 6 months and 1 year later to assess any longitudinal effects.

8.3 Contribution and Originality

The current research recruited a sample larger than most previous research in the field of AAI. Crucially, it also recruited a sample of children who attended the special educational needs schools, representative of the children who attend these schools. All children, regardless of their ability and diagnosis were eligible to take part. While previous research has often recruited children with a single diagnosis such as ASD (e.g. O'Haire et al., 2014; Gabriels et al., 2012; Gabriels et al., 2015) or ADHD (e.g. Schuck et al., 2015), the majority of children taking part in this project had comorbid disorders, making their needs at times

more challenging and individual. This approach ensured maximum inclusivity of children with comorbid conditions such as severe intellectual disabilities who have historically been under-represented in research (Autistica, 2019), including in the field of AAI. By being inclusive, the findings established benefits from the interventions that were generalisable to the real-life environment of special needs schools. It also enabled the provision of advice for children with severe needs who may not otherwise have had appropriate interventions to enhance their development.

In addition to this, the interventions ran in two formats (one-to-one or group) to establish which was most effective. Much of the current research has been conducted on a one-to-one basis (e.g. Martin & Farnum, 2002) with some findings reported in case-study designs (e.g. Silva et al., 2011). Limited research has been conducted with children in small groups (e.g. O'Haire et al., 2014) but to-date, no comparison between group and individual intervention has been investigated within the same research and with similar intervention structure. The current research bridged this knowledge gap. This will now allow a better understanding of beneficial effects in group settings and also has real life implications on future work. More specifically, it will result in less working time for the animals involved as well as make interventions more feasible due to optimising the schedule for children to take part simultaneously, where appropriate.

Lack of scientific rigour has often been highlighted in AAI research so the current work used a Randomised Control Trial (RCT) design, comparing the dog-assisted intervention to an active control (relaxation intervention) which was similar in length and structure to the dog intervention and to an additional no treatment control group. By comparing the findings to a no treatment control, the natural development and progression of the children was accounted for. The inclusion of an active control ensured effects were not due to additional attention and other factors relating to any intervention. In addition, different dogs and handlers were used to avoid specific effects from one dog and handler only. Also, all involved were familiarised with all dog and handler teams they would meet throughout the sessions to avoid novelty effects.

Furthermore, the longitudinal design of this study is another area missing from most current AAI research. Although previous research established beneficial effects (e.g. Anderson & Meints, 2016; Beetz et al., 2011; Borgi et al., 2016; Gabriels et al., 2012; Gabriels et al., 2015; O'Haire et al., 2014, 2015; Schuck et al., 2015; Wedl et al., 2015), it is often not clear how long these effects last after the intervention has finished. Here, effects were monitored for up to 1-year post-intervention. This knowledge has fundamental practical implications for future AAls as it established how long the effects lasted for and allowed to suggest when to reintroduce the intervention as a potential refresher session.

Another novel aspect of the current research was the wide range of assessments and measures used for the same cohort of children with special educational needs. Data was gathered from the children in the form of standardised tests (cognition, language) and questionnaires (self-esteem, anxiety) as well as physiological measures (cortisol) and experimental tasks (Fruit Stroop, categorisation). In addition, parents completed behavioural measures (behaviour at home questionnaire, EQ-SQ) and family background questionnaire (SES, pet ownership). Teachers also completed a questionnaire investigating behaviour at school. Having collected this comprehensive set of data, the results indicated which area of development was enhanced the most as a result of the interventions. This results in better understanding of what works for children with complex needs and adds to the current literature, providing evidence for future interventions.

Finally, this study employed strict safety protocols. All dog handlers were trained on dog body language and fully responsible for their dogs at all times. If the dog showed any sign of discomfort, they would have been removed from the session. The children were also taught about dog body language and "Do's and Don'ts" to know how to behave around the dogs and what not to do (Appendix 11). The researcher on this project was also trained and present in the room for all sessions.

8.4 Answering the research questions

8.4.1 Hypothesis 1: Intervention effects are expected to be strongest in the dog-intervention and intermediate in the relaxation intervention, with no effects or only maturation effects occurring in the no-treatment control group

In keeping with previous research (e.g. Gee et al., 2009; Gabriels et al., 2012; Gee et al., 2010), this hypothesis was supported by language assessment i.e. ACE syntactic formulation as children in the dog individual intervention improved immediately after the sessions, the children in the relaxation individual intervention showed a smaller but still just significant improvement and the children in the control condition showed no significant improvement in the same time period. This was indicated by the calculations and the increase in mean scores. Improving children's language development was particularly important as this supports children in their social development (Bennett et al., 2013) as well as being the foundation for other skills in the future such as academic ability and reading (Davidson & Ellis Weismer, 2014). Similarly, for the cognitive tasks (namely those providing the BAS non-verbal reasoning score), children in the dog group intervention improved the most, closely followed by the relaxation individual intervention, with no significant improvement for the children in the control group or other intervention groups. This was indicated by the calculations and the increase in mean scores. There was also an improvement for the pattern construction task (high ability) for the children taking part in the dog and relaxation individual interventions, immediately post intervention. On this occasion both interventions appear to benefit the children similarly (i.e. improved by the same amount as indicated by means and calculations). Both benefits established here showed that the improvements were evident in the language and cognitive tasks, suggesting that areas of development were not strictly separate, which was in line with previous research (Bergman-Nutley et al., 2011).

The hypothesis was also partially supported by the cognitive cluster score (SNC), with the children in the dog group intervention showing the most significant improvement,

followed by the children in the control condition, indicating an advantageous effect of the dog intervention, but also learning effects; without an effect for the relaxation intervention. Further partial support was evident from the findings of the other language tasks (high ability children: sentence comprehension, standardised score; low ability children: verbal comprehension) and some of the cognitive tasks (high ability children: spatial ability; low ability children: picture similarity) where although the main analysis indicated improvement over time, when investigating further it was apparent that the children in either of the dog conditions (individual or group) showed the only significant improvement immediately after the intervention while the children in the relaxation and control conditions did not show a significant improvement at that point. Similarly, teachers reported that only the children in the dog group intervention improved in their classroom behaviour after the intervention. This was an interesting finding, as it was also the same children (those in the dog group intervention) who showed the only significant reduction of baseline cortisol, indicating a reduction of stress after the interventions. These two findings would suggest that physiological changes in cortisol (an indicator of levels of stress) were related to the children's behaviour in class as assessed by the teachers.

A detailed model to account for these findings of DAI showing beneficial effects for children in different areas of development is the Biopsychosocial Model (Engel, 1981) (see Chapter 2). This model can be used to better explain the improvement of language comprehension and expression as well as cognitive improvements and physiological changes for the children in the dog intervention group. In fact, this model makes connections between all the changes, together with the intervention as it takes into account biological, psychological and social factors and suggests that they influence and interact with each other to predict outcomes. Such an explanation takes into account the child's cognitive ability which was affected by the condition they were diagnosed with and in some cases their physical disability. For instance, due to the current study's more supportive results for beneficial effects of dog versus relaxation interventions overall, a child with low cognitive ability who was still exploring through touch and other senses was perhaps more likely to be

influenced by the touch of the dog, rather than by the relaxation intervention in which they listened to a recording. In addition to this, it was well documented that children with certain learning difficulties have repetitive motor and vocal behaviours which were seen to interfere with skills acquisition (Morrison & Rosales-Ruiz, 1997). These behaviours were found to be more frequent and intense in children with Autism (Bodfish et al., 2000). As many of the children taking part had autistic traits or a diagnosis of Autism, they may have easily drifted into other thoughts and engaged in self-stimulatory behaviours while listening to the relaxation recording and therefore not followed through with it for the duration of the session. As a result of this, they may not have experienced the full effect of the relaxation provided. However, in the dog group, a similar child may have been kept engaged by the dog. For example, on one occasion when a child moved away to engage in self-stimulatory behaviours, the dog walked over and gave the child a small nudge on his hand which made the child attend to the dog. Such additional anecdotal observations suggest that some children who engaged in self-stimulatory behaviours may be more attentive in the dog condition, perhaps reducing these self-stimulatory behaviours. This explanation was also supported by previous research which found that children in a dog intervention group exhibited fewer repetitive behaviours following the intervention compared to children in a control group (Becker et al., 2017).

Another social aspect which may have contributed towards the improvement of, for example, cognition of children in the dog group may be a sense of inclusion and understanding of social situations. For instance, children who were not feeling included and struggle with social situations with peers may find it easier to interact with the dog. Research found that children with Autism who took part in a social skills program with dogs showed significantly fewer deficits in social skills and better communication skills after the intervention compared to the children who undertook the same training but without the dog (Becker et al., 2017), indicating that dogs can help facilitate social interaction. In the current project many of the children chose to interact with the dog only, not engaging with the handler or researcher. Furthermore, children often knew what the dog's name was but did

not remember the name of the handler or researcher. This observation indicates that the dogs were encouraging more interaction with the child than the adults present.

In terms of the psychological factors, anxiety and stress may be likely to impact the effect of any intervention for children with special needs. It has been suggested that a dog reduces anxiety and stress which allowed the benefits on other areas to be seen as a result of the AAI and previous research has shown that children's cortisol awakening response (used as a measure of stress) reduced by 48% when a dog was introduced in the family and increased again to the same initial level when the dog was removed (Viau et al., 2010). Lower levels of cortisol in the presence of a dog were also found for children with insecure attachment who took part in a stress test. This reduction in cortisol was not evident when the stress test was conducted with a friendly human as support (Beetz et al., 2011). In the current research the dog intervention also reduced cortisol levels, which indicated a reduction of overall stress. Cortisol was not measured to assess the levels for each task (as in Beetz et al., 2011), but the baseline measure encompassed how stressed children were feeling in general. Some children were visibly anxious the first time they took part in the language and cognitive tasks, but they became visibly calmer when with the dogs and after interventions ended, when completing the task(s) the second time. At this point children were also less fidgety, which can be explained with the reduction of levels of cortisol (i.e. reduction of stress). While no dog intervention effects were found for the self-report anxiety measure used, this cortisol result was another indicator that the dogs were influencing the physical signs of stress. This, in turn, was likely to have an effect on the child's performance. Future research will need to incorporate further stress and anxiety measure suitable for children of all abilities during task performance in order to ensure any influence on such factors can be measured accurately.

Although the theories can explain the findings of beneficial effects from the DAI, such effects were not evident on all tasks completed by the children. Some results indicated that while the dog-assisted intervention was effective, there were also significant effects for the children in the relaxation intervention, and at times, for the children in the control group. For

instance, on the cognitive pattern construction task all children (high ability) showed an improvement, with those in the control condition showing the largest improvement, followed by the children in the dog group intervention. This indicated that these benefits were likely to be due to overall learning and maturation. Furthermore, this hypothesis was also not supported by the cognitive task of recognition of designs as the children in the individual and group relaxation intervention were the only ones to show an improvement immediately after the intervention. The experimental task of Fruit Stroop also did not fully support the hypothesis as all children improved equally on the speed of processing at immediate follow up, while the colour congruency calculation indicated least interference for the control condition. In addition, there were no immediate improvements on the categorisation task, self-esteem and anxiety questionnaires, the cognitive tasks of pattern construction and matrices for the children in the low ability group, as well as the cognitive task of quantitative reasoning for the children in the high ability group. In addition, no immediate effects were also shown for the congruency of the Fruit Stroop, EQSQ and Parent/Carer child behaviour questionnaire.

However, when assessing the effect of the relaxation intervention, the findings indicated that significant improvement on some tasks appeared at the 6-week follow up point while the effects were not present at the immediate follow up. This was the case for the low ability children in the individual intervention for the language task of verbal comprehension. For the high ability children this was the case for those in the group intervention for the cognitive tasks of recognition of design, SNC cluster score and spatial ability. For these, more able children (relaxation group intervention), there was also an indication of lower self-report anxiety at the 6-week follow-up point. This clearly indicated that a DAI or relaxation intervention need to be tailored as they would not be effective in improving performance on all areas and influencing all measures. Furthermore, the relaxation interventions may show their effect at different times but this needs further investigation.

8.4.2 Hypothesis 2: Immediate improvements after interventions will be stronger than longitudinal effects

As discussed above, there was not an immediate improvement on all tasks for the children taking part in the interventions. However, the tasks in which the children showed an improvement were assessed here in terms of whether the effects were stronger immediately post-intervention compared to the mid- to long-term follow-up sessions.

Overall, this hypothesis can be supported where effects were found, for example, by the children in the dog individual intervention who completed the language task- sentence comprehension (standard score) and showed the largest improvement immediately after the dog intervention. The follow-up assessments still showed a significant difference, but the improvement was smaller. However, it was important to point out that the benefits appear to be present a year after intervention and these same improvements were not evidenced in the other children. This would indicate that the dog individual intervention may have had lasting improvements on children's language skills. So far, research has not established many language benefits due to a dog intervention. One piece of research relevant to language development has assessed children's categorisation skills and concluded that young children were faster and more accurate at categorising items when in the presence of a dog (Gee et al., 2012). As categorisation links to language development, this would suggest that spending time with a dog was likely to improve children's language. However, to date, no research has investigated whether AAI would have an effect on language after the intervention as well as up to 1 year later.

The results of the current research were the first in the field and have explored language with different tasks to establish exactly which areas of language were improved through AAI interventions. It was important to note that a DAI benefit was not evident for all language tasks assessments and also not seen in the findings for the categorisation task adopted from Gee et al. (2012). One explanation for this difference in findings on the categorisation task may lie in the structure of the research. In the current research children

received between 4 and 8 sessions of DAI which were minimally structured interactions and the categorisation task was completed with the other measures before and after the intervention, without the dog being present. On the contrary, the research by Gee et al. (2012) was structured so the children completed the categorisation task with the dog in the room.

Other findings of the current project supported this hypothesis of immediate effects after intervention but they were not seen at follow up sessions, indicating that the effects did not last post-intervention. Children (low ability) in the dog individual intervention who completed the cognitive task picture similarity and the children (high ability) in the dog group intervention who took part in the cognitive task pattern construction (standard score) showed an improvement immediately after the intervention, 6-weeks and 1-year after the intervention had finished, but not at the 6-month assessment point. This finding indicated that the intervention effects for some tasks were likely to last 6-weeks after the AAI finished. As these effects were no longer seen at the 6-month follow-up it was likely that they were no longer present and the 1-year follow up effects were simply due to learning and maturation. This needs to be explored further with tasks and assessments conducted more frequently after the end of the intervention to establish exactly when the effect diminishes. This will enable future planning of AAI sessions, taking into account the most effective set up as well as the least number of working hours for the animals.

Such research is especially important as the benefits 6-weeks post-intervention were not evident for all tasks. For instance, for the language task verbal comprehension (low ability), children in the individual dog intervention showed the biggest improvement immediately after the intervention and at the 1-year post-intervention follow-up point. In this instance the improvement was likely to be due to maturation and development rather than the dog intervention. On the contrary, the improvement in the relaxation intervention was evident at the 6-week and 6-month and 1-year follow-up points. Here it is proposed that all the effects were due to the intervention as the children in the control condition did not show these improvements, but it was unclear why they were not seen at immediate follow up. The

conclusion of effects mainly lasting immediately post-intervention was further supported by the other tasks for high ability children, language: sentence comprehension (raw score) and cognition: recognition of designs, as effects were only evident immediately post-intervention.

In summary, effects were visible immediately after the 4-week intervention, and for some measures after 6-weeks, but in most cases not longer, so refresher sessions may be useful for some areas of interest. As research to date has not established how long the benefits of the AAI last these findings are promising and need further exploration to assess when the interventions need to be reintroduced for optimum benefits.

8.4.3 Hypothesis 3: Both individual and group dog-assisted interventions (DAIs) will have a positive effect on the tested measures for children with special educational needs

This hypothesis was not supported as the DAI often had a different effect depending on whether they were structured as one-to-one or group sessions. For instance, the findings from the language task verbal comprehension (low ability), sentence comprehension (high ability) and syntactic formulation (high ability) as well as the cognitive task: picture similarity (low ability), indicated that children in the dog individual intervention showed a significant improvement immediately after intervention, but children in the group intervention did not. This shows that the intervention structure (group or one-to-one) for these measures has an influence on the effectiveness. As previously discussed, one reason for the lack of effectiveness in the group intervention may be that the children had less exposure to the dog as more children were spending time in the session for the time slot. As a result, the physical interaction for the children was less. However, this may not be the only explanation. The findings indicated that the individual intervention effects were consistent for the language tasks. A further explanation could be that children had the whole intervention session to speak and communicate with the dogs, handlers and/ or researcher, which resulted in

children practicing their language skills and receiving more reinforcement from the intervention. This may have enhanced their language ability.

No research to date has investigated the type and minimum length of interaction required for effects to be seen on language development. However, research with pets has indicated an increase of oxytocin and decrease of cortisol when owners stroke their animals (Odendaal & Meintjes, 2003). Such research would advocate for the physical interaction playing an important part of the effectiveness of AAls hence, this may explain the current results. In contrast, when assessing the levels of cortisol in children and the effect of the interventions, only the children in the dog group intervention showed a reduction in their baseline cortisol levels post-intervention. These findings were in line with previous research which has also found beneficial effects when the intervention was provided to a group, for instance in the classroom (e.g. Anderson & Olson, 2006). It was suggested that a group intervention may be more effective in some instances as the children act as social support for each other especially as social support has been defined as actual and perceived support (Cohen & Willis, 1985). This would therefore suggest that the presence of other children in the session can be beneficial for some measures, but not others. These findings have practical implications when planning future AAl sessions as consideration needs to be given to the targeted area of development and whether a one-to-one or group intervention was most likely to be effective.

Overall the findings discussed so far indicated that a dog intervention was effective for improving performance on language and cognitive tasks as well as having an effect on physiological markers. One theory which would underpin these findings was that the dogs acted as social support for the children, as it has been established that animals can also act as social support (Bonas et al., 2000). Although the dogs were not present during the assessment it could be argued that through spending time in the intervention sessions the children felt more supported and therefore performed better in the assessments after the 4-week interventions.

However, not all measures showed an intervention effect over time for the children taking part. This was the case for the cognitive tasks for the low ability children: pattern construction and matrices, the congruency calculation for the Fruit Stroop, the categorisation task and the following questionnaires: self-esteem, EQSQ and parent/carer-report child behaviour. Such results emphasised the fact that AAls and relaxation interventions were only effective in certain areas of development and there is not a “one-size-fits-all” model where the animal is the “magic pill” in improving children’s development. This was in line with previous research which has only found an effect of the intervention on some of the measures they assessed (e.g. Gabriels et al., 2012).

8.4.4 Hypothesis 4: Pet ownership will not have an effect on the benefits of AAI and relaxation intervention

The data collected on pet and dog ownership was limited as not all parents of this SEN cohort returned the questionnaires. However, overall there did not seem to be a clear effect of pet ownership on benefits of the interventions, supporting the hypothesis. Some differences were evident on tasks such as language sentence comprehension (raw scores) when pet and dog ownership were included. On this occasion the difference between conditions were due to the children in the dog intervention not showing a difference in scores but the children in the relaxation intervention improved their score and the control children showed worse performance at immediate follow up. On the cognitive measure of recognition of designs when the same factors were entered, the children in the dog condition were showing worse performance, while those in the relaxation and control conditions showed an improvement immediately after the intervention. For the cognitive tasks of pattern construction (standard scoring, for details see Chapter 4), quantitative reasoning, picture similarity, matrices (low ability) as well as Fruit Stroop Speed of Processing, all children improved on the scores from pre- to post-intervention when these factors were entered into the analysis. Due to parents not returning all questionnaires, it was not possible to establish

the effect of pet and dog ownership in detail. Future research could consider alternative ways of gathering this information from parents such as data collection in person (e.g. at parent evenings) or via a telephone conversation. These alternative methods would reduce the burden of completing the questionnaire and remove any extra demand such as the parents having to complete a written form. It is important to factor in pet and dog ownership when assessing the effectiveness of AAls as it will allow better understanding of the external factors which may influence the success of an intervention. This is further supported by the fact that pet ownership as well as details about the relationship between the pet and participant could be included in the biopsychosocial model (Engel, 1981) which best explains benefits of AAls. To date, not many research studies have included pet ownership within the factors which are likely to have an impact on the effectiveness of AAls. This is surprising considering benefits of pet ownership have been established including the reduction in stress in children with special needs who have a pet dog (Kertes et al., 2008). If children with special needs who have a pet are more advanced on a task already because of it, or have lower baseline stress, then the AAls may not be as effective. This was difficult to assess currently due to the lack of knowledge about the influence of pet ownership on AAI effectiveness.

8.5 Limitations

The participants taking part in this research consisted of children attending SEN schools with significantly fewer females. Although this was fully representative of the population, this meant that gender differences could not be investigated. The sample size of this project was larger than most AAI research to date and children had different levels of ability, again representative of the SEN population. As a result, they did not complete the same tasks and some children with lower ability completed only one task which they understood. This resulted in the number of children taking part for each task to be less than the overall total number of children participating in the research. While the sample size was sufficient for the main analysis, with results showing at times high effect sizes, the sample was not large

enough to consistently include factors such as pet ownership into a detailed analysis. However, the large sample size allowed for children to be subdivided in terms of their ability based on which tasks children could complete. This allowed for the conclusion to be more relevant to the profile of child the interventions help as well as be clear on which areas of development benefit most from which intervention.

To make the interventions more child specific there was a need for more information to be provided by the parents. In the current study some parents did not return the questionnaires. This may have been due to time constraints as parents who have children with special needs have a lot more appointments to attend as well as less free time when the child is at home as often, they need to be supervised at all times. In addition to this, the parents themselves may have had special needs and as a result, struggled to complete the questionnaires. It is therefore suggested that future research, especially for children with special needs, employed additional methods of data collection rather than questionnaires (e.g. speaking to parents face-to-face, telephone conversations).

The relaxation intervention chosen was a recording of a relaxation story specifically made for children of this age. This was easy to administer and ensured that all children received exactly the same intervention. However, as it was a recording which mostly required the children to listen and imagine, it was impossible to monitor how much the children were attending to the intervention. Furthermore, for some children it was difficult to lie down and close their eyes, so they were allowed to lie down with their eyes open or sit on a chair with their eyes open or closed. As a result, it was concluded that future relaxation interventions need to be carefully selected and more child and ability specific, to suit their needs and be effective. The effect of a recorded intervention compared to a “real-life” intervention could in future be investigated, too.

The dogs had different personalities and behaviour when coming to visit the children with some being very active, doing tricks and training where as others mostly resting and being calm so the children could talk to them and stroke them. Children saw different dogs throughout the 8 sessions to avoid potential individual dog-specific effects. However, as the

sessions were child-led, sessions sometimes needed the handler or researcher to give ideas to the child to enable the session to continue. It is therefore suggested that future research has some child-led and some structured activities to ensure optimum effect of the AAI.

8.6 Future Direction for Research and Recommendations

This research provided detailed evidence of the beneficial effects of DAI for children with special educational needs. Future research needs to confirm differences between children based on their primary diagnosis and areas of delay in order to establish what and for whom AAls are most beneficial for. Recently, a review by Payne, Bennett and McGreevy (2015) has concluded that human factors such as personality influence the human-dog relationship. As a result, it is likely that human factors also affect the success of the AAI sessions.

In order to expand the field of AAI, future research should also aim to investigate dosage by varying the amount and length of AAls systematically and with different populations. Although conducting research on a larger scale than previous studies is expensive and time consuming, the findings of RCTs will be beneficial and improve the standing of the field. In such research it will be important to maintain the inclusiveness of the current study and explore the benefits for children with various disorders, as research recently has largely concentrated on ASD, often with children who are high-functioning. Although useful in providing an insight into children with Autism, this will not be accurate for all children with developmental disorders and therefore is not generalisable to most pupils attending special educational needs schools.

In line with this, the longevity of AAI needs to be investigated, too. The current research shows minimal benefits at the 6-month and 1-year post-intervention follow-up, but maintain some benefits at the 6-week follow-up. This suggests that AAls may need to be re-introduced in cycles in order to show continuous effects, but when this should be needs to be investigated in future research.

Future investigations need to pay particular attention when planning AAI research, considering the use of more structured AAI sessions, with clear outcomes as some children may find unstructured activities more difficult. Alternatively, more flexible sessions could be split into a child-led time and a target specific time which aims to improve different areas of development of the child, particularly for children with special educational needs. Again, studies need to investigate these effects systematically.

The measures used in AAI research should also be selected carefully for their usefulness and objectivity. The current research has a comprehensive set of mostly standardised measures which enabled the depth of understanding to assess which areas of development show the greatest impact from the AAI. Furthermore, future research should also take more factors into account such as attachment to parents as well as attachment to pets and attitudes towards animals. In the current research, the majority of children who were signed up to take part in the project were British Nationals of Caucasian origin, who perhaps see dogs as part of the family, whereas families from other cultural backgrounds may not view animals in the same way. Research has shown that dog owners in the USA were more likely to report keeping their German Shepherd dogs at home during the day and at night as well as label them as pets compared to owners of German Shepherds in Hungary (Wan et al., 2009). This different view of dogs as pets could suggest cultural difference in attitudes towards animals, perhaps not relating as closely to the animals and therefore not wishing their children to interact with them. Such views can also have an impact on the way the child views animals and therefore their interaction and potentially whether the animal has an effect on the child. These measures (such as attitudes towards animals) together with developmental outcome tasks and physiological markers will allow for a detailed outline of the type of child the interventions work for best as well as the areas that improve most as a result of the AAI. This will also allow for the refining of the interventions to be most effective. RCT design, as used in this research is clearly advantageous to test intervention effects systematically with the use of control groups.

Finally, when conducting dog interventions researchers should ensure the safety of all involved by having welfare protocols and training of stress signalling for the dog handlers and all the participants included in the research, should be provided. This should also be done in clinical, therapeutic and educational settings. Where possible, a handler should be solely responsible for the dog. This is not thought to influence the effect of interventions as previous AAI research has found that a friendly human researcher did not show the same effect as a dog (e.g. Gee et al., 2007). This structure will ensure the safety and welfare of the dog and human participants.

The final chapter will conclude the findings of this thesis.

Chapter 9: Conclusions

The current research has established immediate benefits from the dog-assisted interventions for the standardised language measures for all children regardless of their ability. Benefits for this intervention were also seen immediately after the intervention for the cognitive measure of pattern construction as well as the cognitive cluster scores of SNC, non-verbal reasoning and spatial ability for the children in the high ability group. The cognitive task picture similarity, for the children in the low ability group also showed a significant improvement for the children in the dog intervention. There were limited benefits for the behavioural measures but teacher questionnaires showed an improvement in classroom behaviour after children took part in the dog group intervention. The same children also showed a significant reduction in baseline cortisol, indicating a reduction of stress. This will indicate that behaviour as assessed by the teachers may be influenced or affected by the cortisol levels which would indicate how stressed a child is.

These benefits were promising but it was important to note that they vary across tasks and across children depending on their ability as well as whether they took part in an individual or group intervention. As a result, it can be concluded that AAls need to be specific in their structure to assess which areas of development show most beneficial effects. In addition to that, in this thesis the AAI sessions varied due to being child led and dog and handler dependant. In future more research is needed to assess what type of structure of intervention is more effective in helping children develop on particular tasks. As for the relaxation task, it consisted of two pre-recorded stories, one involving a butterfly and one a jellyfish. Again, future research will need to explore other stories as well as other methods of relaxation to assess which would be the most effective in helping children with special needs on specific tasks.

As the results were encouraging, interventions targeting language and cognitive development used in educational settings should consider incorporating AAls as part of the provision, given the beneficial effects found here. Behavioural benefits at home were not

found due to the AAI provided in the current research indicating that the benefits may not be transferrable from the educational setting to the home environment.

Finally, it is recommended that professionals consider including dogs as part of interventions with children with special needs, but also to measure the outcome of these interventions and assess their effectiveness regularly. The measures should be objective and the benefit of including an animal should be clear and more effective than an intervention without animals. Safety of all involved has to be paramount and strict protocols must be in place. The animal's welfare should not be compromised and if at any point the animal is no longer happy to be involved (judged through body language and behaviour), the intervention should be stopped immediately.

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Appendix 1:

Protocol for the Collection of Salivary Cortisol

1. General guidelines

- Researchers to wear disposable gloves when collecting and handling any saliva samples.
- Baby wipes to be available for use by children and researchers.
- Each child will provide saliva at the same time each day over the course of the study to ensure consistency across samples.
- All collected samples will be recorded in an inventory, including participant code, date, time and sample/test stage. A comments section will also be completed to record notes on any specific issues or problems.

1. Baseline cortisol collection

(Saliva samples to be collected on 3 consecutive days, 1 per day, per child)

- All baseline samples to be collected between 9.00 and 10.00am.
- Vials to be labelled with participant code details prior to children entering the room.
- Groups of 3-4 children to give saliva samples at the same time and are collected from the classroom.
- Salimetrics collection protocol to be followed to ensure consistency at all times.
- Explain to the children that our saliva can tell us a lot about how our body is working and we would like them to help us by providing saliva.
- All collected samples to be double checked that they are labelled with a participant code, date and time and then are immediately placed into a cool bag for the morning.
- All samples are then transferred to a -20°C storage freezer at the University of Lincoln, Psychology Lab B for short term storage, for a maximum of 7 days.
- Samples to be transported for external analysis and then destroyed.

Appendix 2: Parent family background questionnaire

Please complete all questions with a ball point pen.

Please shade in the circle to give your answer as shown.

1. Do you have any pets?	Yes	<input type="radio"/>	No	<input checked="" type="radio"/>
1a. If yes, please tell us what type of animal they are:				

SES and Family Questionnaire

In order to compare our data to national averages we would ask that you complete the 12 questions below in relation to your child's early development and family background.

Please do not write your name or address on any part of this questionnaire so that the information is anonymous and confidential.

YOUR CHILD'S HEALTH AND DEVELOPMENT

1. At what week of pregnancy was your child born? ☐ Week 33 or before ☐ Week 34 to 36 ☐ Week 37 or later ☐

2. How much did your child weigh at birth? ☐ Up to 5lb 8oz ☐ 5lb 9oz to 9lb 14oz ☐ 9lb 15oz or over ☐

3. How many siblings does your child have? (include full and half siblings) ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more ☐

3a. What position is this child? ☐ 1st born ☐ 2nd born ☐ 3rd born ☐ Other

3b. Is your child a twin/multiple birth? ☐ Yes ☐ No ☐

4. Is your child:

White British/Irish	<input type="radio"/>	Mixed Ethnicity: White and other	<input type="radio"/>	Asian/Asian British	<input type="radio"/>
Black/African/Caribbean /Black British	<input type="radio"/>	Other ethnic group (please give details):			

5. Which other people over 18 years old live in this home with you and your child?

Mum	<input type="radio"/>	Dad	<input type="radio"/>	Grandparent/ s	<input type="radio"/>
Other related adults (please say how many)	<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> more
Other non-related adults (please say how many)	<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> more

6. How many other children live in your home with you? (please say how many in each age range)

Children										
0-18 months	0	<input type="radio"/>	1	<input type="radio"/>	2	<input type="radio"/>	3	<input type="radio"/>	more	<input type="radio"/>

Children										
19 months-3 years 11 months	0	<input type="radio"/>	1	<input type="radio"/>	2	<input type="radio"/>	3	<input type="radio"/>	more	<input type="radio"/>

Children										
4- 11 years	0	<input type="radio"/>	1	<input type="radio"/>	2	<input type="radio"/>	3	<input type="radio"/>	more	<input type="radio"/>

Children										
12 - 17 years	0	<input type="radio"/>	1	<input type="radio"/>	2	<input type="radio"/>	3	<input type="radio"/>	more	<input type="radio"/>

7. How many bedrooms are in your home?	1	<input type="radio"/>	2	<input type="radio"/>	3	<input type="radio"/>	4	<input type="radio"/>	5+	<input type="radio"/>
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Child’s Mum

8. Child’s mum’s age is....	Up to 20 years old	<input type="radio"/>	21-25 years old	<input type="radio"/>
	26-30 years old	<input type="radio"/>	31-35 years old	<input type="radio"/>
			36+ years old	<input type="radio"/>

8a. Mum is...	Married/Civil Partnered	<input type="radio"/>	Living with partner	<input type="radio"/>
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Single ☐ Separated/Divorced ☐ Widowed ☐

8b. Mum's highest education is...	No formal qualifications	<input type="radio"/>	GCSE/O Level/NVQ Level 1 or 2/ similar	<input type="radio"/>
A Level/NVQ Level 3/ similar	<input type="radio"/>	University degree/HND/HNC/NVQ Level 4 or 5/similar	<input type="radio"/>	Postgraduate/similar e.g. (PGCE, PhD, MA etc.)
				<input type="radio"/>

8c. Mum's work status is...	Not currently in work	Never worked, have only been in training or education	<input type="radio"/>
An employee	<input type="radio"/>	Self-employed (with employees)	<input type="radio"/>
		Self-employed (without employees)	<input type="radio"/>

8d. Mum's current/last job title: (please be specific)

8e. How many people work for mum's employer or for mum if she is/was an employer? (only answer this question if mum is/was an employee or self-employed with employees)

0 ☐ 1-24 ☐ 25+ ☐

Child's Dad

9. Child's dad's age is...	Up to 20 years old	<input type="radio"/>	21-25 years old	<input type="radio"/>
26-30 years old	<input type="radio"/>	31-35 years old	<input type="radio"/>	36+ years old
				<input type="radio"/>

9a. Dad is... Married/Civil Partnered ☐ Living with partner ☐

Single ☐ Separated/Divorced ☐ Widowed ☐

9b. Dad's highest education is... ☐ No formal qualifications ☐ GCSE/O Level/NVQ Level 1 or 2/ similar ☐
☐ A Level/NVQ Level 3/ similar ☐ University degree/HND/HNC/NVQ Level 4 or 5/similar ☐ Postgraduate/similar e.g. (PGCE, PhD, MA etc.) ☐

9c. Dad's work status is... ☐ Not currently in work ☐ Never worked, have only been in training or education ☐
☐ An employee ☐ Self-employed (with employees) ☐ Self-employed (without employees) ☐

9d. Dad's current/last job title: (please be specific)

9e. How many people work for dad's employer or for dad if he is/was an employer? (only answer this question if dad is/was an employee or self-employed with employees)

0 ☐ 1-24 ☐ 25+ ☐

10. What is the overall household income (before tax) per year in your child's main home?

£0-£14000 ☐ £14,001-£24,000 ☐ £24,001-£42,000 ☐ £42,001 or more ☐

11. Does your child attend full time education? Yes ☐ No ☐

11a. If no, how many hours do they attend in a typical week?

12. Does your child regularly hear a language that is not English? Yes ☐ No ☐

12a. If yes, for how many hours does your child hear this other language in a typical week:

12b. If yes, what is this other language?

Appendix 3: Parent pet-ownership questionnaire

Please complete all questions with a ball point pen.

Please shade in the circle to give your answer as shown.

1. Do you have any pets?	Yes	<input type="radio"/>	No	<input checked="" type="radio"/>
1a. If yes, please tell us what type of animal they are:				

Pet Ownership Questionnaire

Animals play a major part in the lives of many people across the globe, with family pets often considered part of the family.

In order to help us further understand pet ownership in general, and interactions with dogs in particular, we would ask that

you please complete the 12 questions below.

Please do not write your name or address on any part of this questionnaire so that the information is anonymous and confidential.

1. Do you have any pets?	Yes	<input type="radio"/>	No	<input type="radio"/>
--------------------------	-----	-----------------------	----	-----------------------

1a. If yes, please tell us what type of animal they are:

1b. How many of each type do you have?

2. If you have a dog/s, what breed/s do you have?

If no, please go directly to Question 3.

2a. How old was your dog/s when you got it?

2b. Please tell us about any puppy training or similar courses you attended?

3. If you don't currently have a dog, how much contact has your child had with dogs in the last 2 years?

None ☐ Very Little ☐ Moderate ☐
s than once per week) (once per week)

Frequently (daily) ☐ Please give further information if you wish:

4. In general, does your child like animals? Yes ☐ No ☐ Only familiar ones ☐

5. In general, does your child like dogs? Yes ☐ No ☐ Only familiar ones ☐

6. Is your child frightened of dogs? Yes ☐ No ☐ Sometimes ☐

7. If you own a dog, is your child frightened of it? Yes ☐ No ☐ Sometimes ☐

8. Have you ever been bitten by a dog (not including play)? Yes ☐ No ☐

If No, please go directly to question 9

8a. If Yes, how many times and at what age/s where you bitten?

8b. Please rate the importance of the bite on a scale from 1 (small nip) to 5 (serious bite).

1	2	3	4	5
Small nip, mark on skin, no blood)				Serious bite, skin perforation, blood)
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8c. When you were bitten was it?

A familiar dog ☐ Your own dog ☐ An unfamiliar dog ☐

9. Has your child ever been bitten by a dog (not including play)? Yes ☐ No ☐

If No, please go directly to question 10

9a. If Yes, how many times and at what age was your child bitten?

9b. Please rate the importance of the bite on a scale from 1 (small nip) to 5 (serious bite).

1	2	3	4	5
(small nip, mark on skin, no blood)				(serious bite, skin perforation, blood)
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

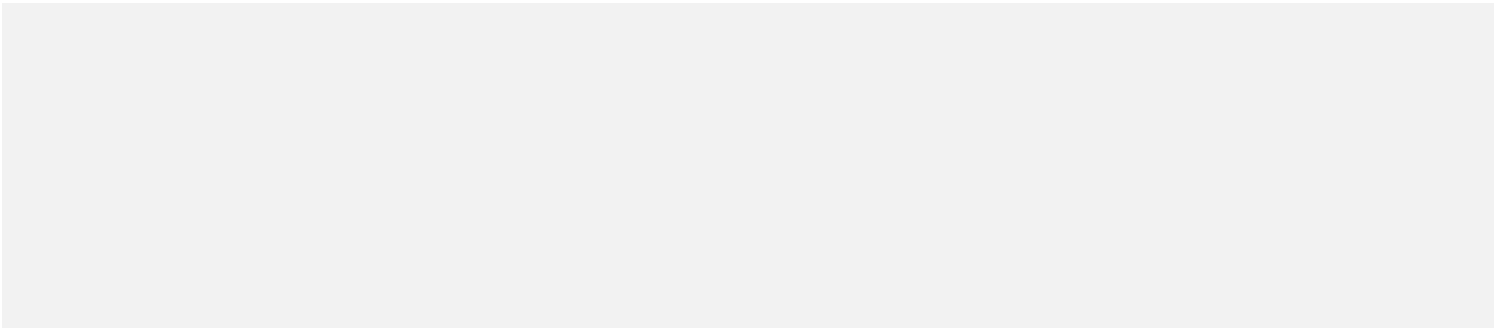
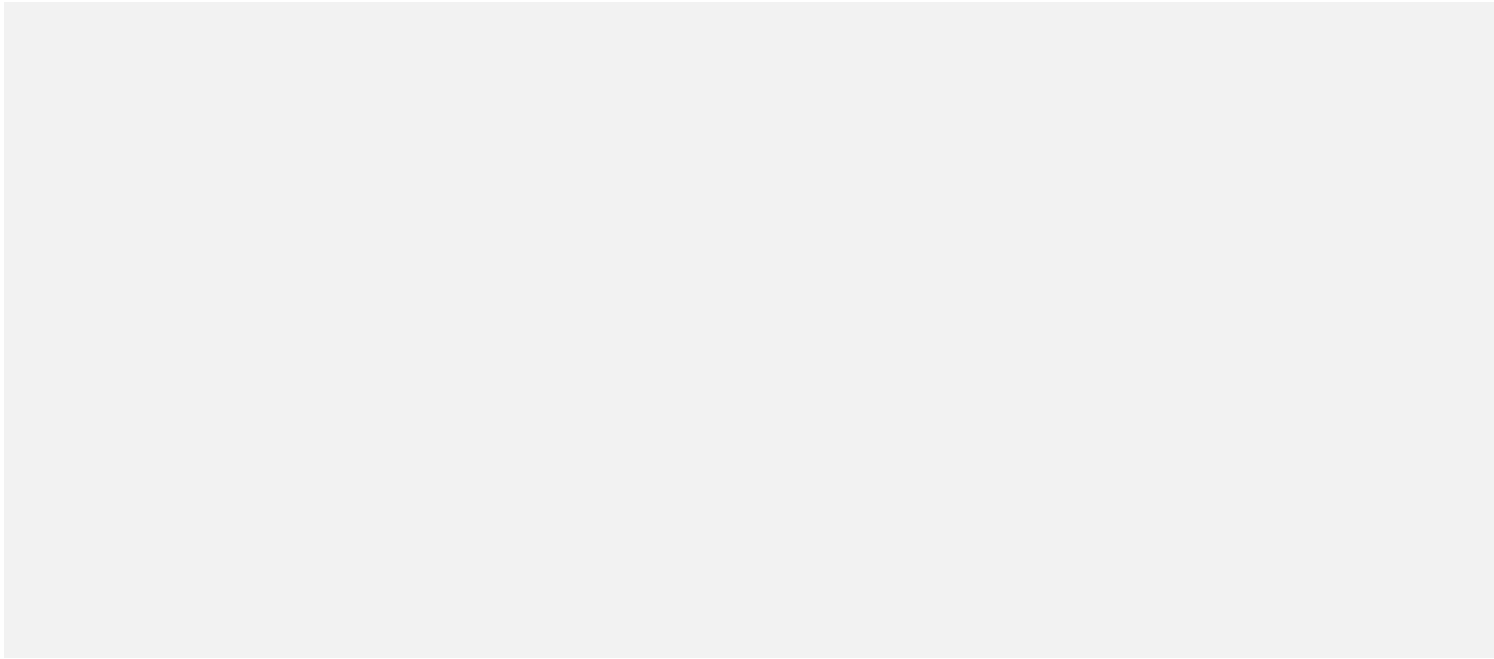
9c. When your child was bitten was it?

☐ A familiar dog ☐ Your own dog ☐ An unfamiliar dog ☐

10. Have you ever owned a dog (past or present) that bit any person, including yourself (not including play)? Yes ☐ ☐ No

11. Have you ever owned a dog (past or present) that bit a child under 18 years , (not including play)? Yes ☐ ☐ No

12. Please use this space to tell us any other information you think may be relevant to the above questions in relation to your family, dog bites and safety around dogs.



Appendix 4: Behaviour at home questionnaire

†*

	Description of behaviour	Never	Rarely	Sometimes	Often	Always
Q1.	My child is happy at school.	0	0	0	0	0
Q2.	My child likes to spend time on school related tasks at home.	0	0	0	0	0
Q3.	My child communicates to me about school at home.	0	0	0	0	0
Q4.	My child is late for school in the mornings.	0	0	0	0	0
Q5.	My child has good attendance at school.	0	0	0	0	0
Q6.	My child communicates to me about worries of school.	0	0	0	0	0
Q7.	My child likes to help around the home.	0	0	0	0	0
Q8.	My child does tasks at home without being continually asked.	0	0	0	0	0
Q9.	My child follows our household rules.	0	0	0	0	0
Q10.	My child tidies up after him/herself.	0	0	0	0	0
Q11.	My child treats others with respect at home.	0	0	0	0	0
Q12.	My child argues/is oppositional towards others at home.	0	0	0	0	0
Q13.	My child is withdrawn and anxious.	0	0	0	0	0
Q14.	My child displays calm behaviour.	0	0	0	0	0
Q15.	My child likes to be on their own.	0	0	0	0	0
Q16.	My child has temper tantrums.	0	0	0	0	0
Q17.	My child is angered easily.	0	0	0	0	0
Q18.	My child looks/acts sad and lonely.	0	0	0	0	0

Please use this space to provide any further information you think may be useful for us to know:

Thank you for taking the time to complete our questionnaire. Your £5 shopping voucher will be with you soon.

Appendix 5: Protocol for collection of data

General guidelines

- Each child was given their participant code at the beginning of the study. These were allocated by the order in which the children took part in the study and started at 101 (i.e. child 1 in the first school was 101).
- The children who were completing both BAS-3 and the ACE tasks, completed these in an alternative order between children but within children the order was kept the same.

ORDER OF ADMINISTRATION FOR THE SCREENING TOOLS

The order below is correct for children who could complete all tasks, however not all children had the ability to do so. The order was always the same but the tasks which were too difficult were omitted.

1. Self-report questionnaires:

- a. RCMAS-2 (Revised children's manifest anxiety scale)**
- b. CFSEI-3 (Culture free self-esteem inventories)**

The researcher explained that first she will ask children questions relating to how the child feels and they just need to give a yes or no response. The children were assured that there is no right or wrong answer and that they didn't have to answer a question if they did not want to.

2. or 3. BAS-3 (British Ability Scales)

Next the researcher introduced the BAS tasks as games. The child was made aware that they can stop the tasks if they are too difficult or they did not want to take part.

2. or 3. ACE (Assessment of Comprehension & Expression)

The next tasks were described as games with words and pictures. Again, the child was made aware that they can stop the tasks if they are too difficult or they did not want to take part.

4. Fruit Stroop

This was described as the fruit game. The researcher explained that the children will get three different sheets (the order of the conditions was counterbalanced between participants, the following description is the example of the order some children would have had the tasks in) and 30 seconds per sheet to complete as much as they can.

The first one (incongruent condition) was explained as the fruit being coloured in the wrong colour and the task was to ignore the colour they were coloured in and select with a tick in the box the colour they should be.

The second condition (congruent condition) was explained as having an outline of the fruit and again the child had to tick the colour the fruit usually is.

The last condition (neutral condition) had coloured shapes on the sheet and children were asked to tick the colour that the shape is.

Appendix 5 (continued):

If anyone ticked the wrong colour, children were asked to put a line through it and tick the correct colour. The children were asked to complete as many as they can and try to do so accurately. They were reassured that they will not be able to finish the task in 30 seconds but were asked to do their best and complete as many as they can.

5. Categorisation task


The categorisation task was described as a computer game, and the button box was presented. The instructions on the screen were read which stated:

“You will see a series of pictures on the screen. Some of the objects belong at the Ocean and others belong on the Farm. If you think the picture you see belongs in the Ocean you need to press the blue button, if you think it belongs on the farm press the green button. Shall we have a practice?” There were 4 practise pictures which the child categorised using the button box. Once completed, the child was asked if they had any questions. They were told that for the next pictures they need to try and do it as quickly and correctly as they can and if they are not sure where the item belongs to have a guess

Debrief

- Researcher to thanked the child for taking part in the tasks and asked for any feedback. If feedback was relevant to the study, a note was made on the test record sheets.
- The child was able to choose 2 stickers for taking part and received a small toy as a thank you. The researcher walked the child to the classroom, ensuring the toy was put safely away until play/ home time.

Appendix 6: Ethics

EA2 Ethical Approval Form: Human Research Projects	Please word-process this form, handwritten applications will not be accepted		 UNIVERSITY OF LINCOLN
<p>This form must be completed for each piece of research activity whether conducted by academic staff, research staff, graduate students or undergraduates. The completed form must be approved by the designated authority within the College.</p> <p>Please complete all sections. If a section is not applicable, write N/A.</p>			
1 Name of Applicant	Prof. Kerstin Meints		
	School: Psychology	College: Social Science	
2 Position in the University	Professor		
3 Role in relation to this research	PI		
4 Brief statement of main Research Question	<p>Investigating the effects of Animal Assisted Intervention (AAI) on children – what works?</p> <p>Investigating the effect of dog assisted intervention on typically developing children and children with ASD/ADHD and coexisting learning difficulties in the classroom setting.</p>		

<p>5 Brief Description of Project</p>	<p>This is an externally-funded longitudinal project with a duration of 3 years.</p> <p>MARS / Waltham are the funders and the project has undergone scrutiny by peer-reviewers and by the Mars/Waltham international research committee and received Ethical approval via the MARS / Waltham's research Ethics committee.</p> <p>The study:</p> <p>This is a longitudinal study looking at the effect of dog intervention and relaxation intervention in a classroom setting for children aged 8-9- years. There will be randomised controlled trials with the different populations (typical / special needs) and in 2 different intervention settings (individual intervention versus classroom-based group intervention).</p> <p>Children will be assigned at random to one of 3 intervention groups (with dog / with relaxation activity / no intervention control). Experimental, socio-emotional, physiological and cognitive and language measures will be taken before and after the intervention. This will demonstrate if the interventions have an effect on the measured abilities and physiological and socio-emotional states of the participants. Children will go through a dog familiarisation and dog safety training before the intervention. This will ensure that the results are not due to novelty effects of being with a dog in school for the first time.</p> <p>Measures:</p> <p>SES and EQSQ:</p> <p>Some of the baseline measures will be completed by the parents prior to starting the testing (SES- measuring socioeconomic status and EQSQ, measuring empathy).</p> <p>Socio-emotional measures:</p> <p>Children will be asked to complete the following baseline standardised measures at each point of testing:</p> <ul style="list-style-type: none"> - Battle's Culture Free Self Esteem Inventory (CFSEI) (measuring self-esteem) - Revised Children's Manifest Anxiety Scale, <p>Cognitive and Language measures:</p> <ul style="list-style-type: none"> - Second edition (RCMAS-2) (2008) (measuring stress and anxiety)
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	<ul style="list-style-type: none"> - ACE (measuring language) - British Ability Scales, Third edition (measuring cognition). - Experimental tasks on categorisation, language & maths: 10 minutes on laptop/eye-tracker measuring: Looking preferences / Eye-tracking, error rate, reaction times. <p>Physiological measures:</p> <ul style="list-style-type: none"> - Skin conductance: Each child will be asked to wear an E4 Empatica wristband https://www.empatica.com/e4-wristband which will measure galvanic skin responses while they are completing the standardised measures and during the individual intervention. - Cortisol / Oxytocin: Salivary cortisol/oxytocin samples will be collected from each participant using a “smell-and-spit” game with the children. This will require the child to smell a pleasant smell to stimulate saliva production and then spit into a purpose-made container. We will comply with common procedure to seal, label and place samples in a cooled container to then freeze them. <p>Timeline:</p> <p>Children will be tested on the standardised measures and language/cognitive task in schools initially (Test 1) and then straight after the last intervention to investigate immediate intervention effects (Test 2). They will again be tested 6 weeks after the last intervention for short-term effects (Test 3), after 6 months (Test 4) and 1 year (Test 5) for intermediate and long-term effects respectively.</p>	
	Approximate Start Date: 1.1.2016	Approximate End Date: 31.12.20018
6 Name of Principal Investigator or Supervisor	Prof. Kerstin Meints	
	Email address: kmeints@lincoln.ac.uk	Telephone: 01522 886474

7 Names of other researchers or student investigators involved	1. Victoria Brelsford 2. Mirena Dimolareva 3. Research administrator / lab and project manager (TBA) 4. Voluntary research assistants	
8 Location(s) at which project is to be carried out	Primarily schools in Lincolnshire will be asked to take part. However, as the SEN schools usually have smaller class sizes it is possible that some schools are recruited from other counties.	

9 Statement of the ethical issues involved and how they are to be addressed – including a risk assessment of the project based on the vulnerability of participants, the extent to which it is likely to be harmful and whether there will be significant discomfort.	<p>Consent</p> <ul style="list-style-type: none"> Fully informed consent will be gained from the schools taking part. Fully informed consent will be gained from each parent before the child is able to take part Assent will be gained from all children prior to testing. <p>Brief</p> <p>Each participant will be briefed:</p> <ul style="list-style-type: none"> Before completing the standardised tests and other measures Before the collection of salivary cortisol Before wearing the watch to measure galvanic skin responses Before completing the language/cognitive task Before taking part in the dog or relaxation intervention <p>Debrief</p> <p>Each participant will be given a debrief</p> <ul style="list-style-type: none"> After completing the standardised tests / measures After the collection of salivary cortisol, After wearing the watch to measure galvanic skin responses, After completing the language/cognitive task
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(This will normally cover such issues as whether the risks/adverse effects associated with the project have been dealt with and whether the benefits of research outweigh the risks)

- After taking part in the dog or relaxation intervention.

Withdrawal

- The parents have the right to withdraw their child's data at any point and up to 3 months after testing.
- Each child is able to stop taking part in the testing at any point without having to give reasons. They will still get a sticker for participation.

Confidentiality

- All data is kept anonymous and confidential. Each child will have participant number on the record forms. Personal data will be stored in a locked cabinet in the Infant and Child Development Lab, Minerva Building, University of Lincoln. Whenever the school of Psychology moves, the data will again be stored in the new Infant and Child Development Lab in a locked cabinet – unless there will be a secure server be made available in future (like Liverpool's secure system) – in which case we would transfer the data securely onto this system.
- Children will not be named in any reports.

Allergies and Phobias

- In order to protect children and their wellbeing, we will ask parents to declare phobias and allergies to dogs. The children affected will be able to take part in this study but will be placed in a group which requires no direct contact with a dog. If there are children with allergies against dogs / dog hair, we will agree a procedure with schools so to ensure that the testing room will be appropriately cleaned after usage.

Child safety:

- Only certified dog handlers with trained and certified therapy dogs will be present around the children.
- Children will not interact with a dog before or after the sessions.
- Children will never have to be alone with any of the researchers.
- Children will never be alone with the dog handler, or the dog.
- If at any moment, the child shows any discomfort, the session will immediately be stopped.
- Dog behaviour specialists, e.g. Prof. Tiny de Keuster (University of Ghent) / Dr. Hannah Wright (University of Lincoln) will assess the dog handlers and dogs before study begins.
- The dog will be on a leash while in the room with the child and while in school premise

	<ul style="list-style-type: none"> Children, researchers, teachers and dog handlers will receive an additional dog safety training on safe behaviour with dogs (using Blue Dog) and dogs' body language and further advice from Prof. De Keuster and Dr. Wright before the study as part of the familiarisation to the dog. <p>Dog safety:</p> <ul style="list-style-type: none"> To minimise dogs' distress we will recruit multiple dogs and dog handlers, each dog will only be allowed to work for about 2 hours with the children. There will be regular breaks where the dog handler can give food treats and drink to the dog as appropriate. If a dog should get restless or need a break, then we will interrupt testing. If there are any signs of distress, we will stop testing or interrupt testing until the dog is happy to take part again. If there are signs that the dog does not want to continue testing, then testing will be stopped.
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Ethical Approval From Other Bodies

10 Does this research require the approval of an external body ?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
	<p>If "Yes", please state which body:-</p> <p>Mars / Waltham research committee and Mars / Waltham Ethics committee.</p>

11 Has ethical approval already been

obtained from that body ?

Yes ☒ -Please append documentary evidence to this form.

No ☐

If "No", please state why not:-

Please note that any such approvals must be obtained and documented before the project begins.

I can forward the email to the committee that the project has been approved. There is no other formal documentation about it as this is run via the Waltham/Mar research lead.

APPLICANT SIGNATURE

I hereby request ethical approval for the research as described above.

I certify that I have read the University's ETHICAL PRINCIPLES FOR CONDUCTING RESEARCH WITH HUMANS AND OTHER ANIMALS.



15.10.2015_____

Applicant Signature

Date

Prof Kerstin Meints

PRINT NAME

FOR STUDENT APPLICATIONS ONLY –

Academic Support for Ethics

Academic support should be sought prior to submitting this form to the designated Ethics Committee within the Faculty

- ***Undergraduate / Postgraduate Taught application***

A Academic Member of staff nominated by the School (consult your project tutor)

- ***Postgraduate Research***
- ***Application***

Director of Studies

I support the application for ethical approval

Academic / Director of Studies Signature

Date

PRINT NAME

FOR COMPLETION BY THE DESIGNATED ETHICS COMMITTEE WITHIN THE COLLEGE

Please select ONE of A, B, C or D below:

☐ A. Ethical approval is given to this research.

☐ B. Conditional ethical approval is given to this research.

10 Please state the condition (inc. date by which condition must be satisfied if applicable)

☐ C. Ethical approval cannot be given to this research but the application is referred on to the University Research Ethics Committee for higher level consideration.

11 Please state the reason

☐ D. Ethical approval cannot be given to this research and it is recommended that the research should not proceed.

12 Please state the reason, bearing in mind the University's ethical framework, including the

primary concern for Academic Freedom.	
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Signature of the Chair of the designated Ethics Committee within the College

Signature	Date
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Chair of _____

Please attach here:

Appendix 7: Parent recruitment letter and consent form

Infant and Child Development Lab

Department of Psychology

Brayford Pool,

Lincoln

LN6 7TS

Tel Infant Lab: 01522 886481

www.lincoln.ac.uk/psychology/babylab.htm

January 2015



Dear Parent/Carer,

The Infant Lab at the University of Lincoln has secured substantial research funding to carry out a unique and exciting research project with children and dogs. In this new project, we will investigate how the presence of a therapy dog improves children's mood, behaviour and learning in school.

We would like to ask if you would be interested to help us with our research.

What are we investigating?

Previous research highlights strikingly positive health and learning benefits of human-dog interactions. However, there is a lack of systematic research in this area. We have obtained funding to investigate how the presence of a dog affects children. Carrying out this research with 8-10-year-olds will help us understand how therapy dogs improve children's achievement and behaviour.

Why is this useful?

This project will help schools improve child wellbeing and educational outcomes to benefit children and families.

What exactly would we do?

We would bring a certified dog handler with their dog into the school to familiarise the children with the dog.

As part of the project, the research team will teach all children about interacting safely with dogs (about 30-45 minutes group session).

- All children will complete a set of standardised measures with a trained researcher (measures of empathy, self-esteem, stress & anxiety, language and learning; as well as physiological measures to assess changes in children, for example hormone levels from

saliva, to compare these with the other measures). Please note: To get saliva, children will be asked to spit into a little pot. We will then immediately freeze the samples and store them securely in a freezer at the University. Only research staff from the project will access the samples. Samples will not be labelled with the child's name. We will only use the samples to analyse children's bodily reaction to the dog/relaxation/control.

- Children will then be split randomly into one of the 3 groups (dog intervention, relaxation and control group).
- Children will then take part in 20-minute dog or 20-minute relaxation sessions for four weeks. The control group will do nothing.
- We would follow the children up after 6 weeks, 6 months and 1 year, just to repeat the measures (not the intervention) – this is so we know how long the effects of the dog or relaxation last.

How do we know if having a dog around changes anything?

We will compare the results of three groups: the dog intervention group, the relaxation group and the non-intervention control group to see if the dog and relaxation interventions had an effect.

What is your involvement?

We will ask you for written consent so your child can take part in the research. You would also be asked to complete a pet ownership and family questionnaire for which you will receive a £5 shopping voucher.

Welfare and Ethical considerations

The research is approved by the Mars/Waltham research ethics committee and by the University of Lincoln Psychology research Ethics Committee (soprec@lincoln.ac.uk).

All researchers are police checked and are highly experienced in carrying out research with children in schools. All data, including video-recordings of intervention sessions, will be anonymous, kept strictly confidential according to current data protection laws, only used for research purposes and stored in a secure location.

Children: Children are free to withdraw from the study at any point, parents are free to withdraw their children and their own data at any point up to two weeks after participation.

- Children in the dog sessions will be allowed to stroke or pat the dog if the handler decides it is appropriate.
- At no point will children be forced to touch the dog if they do not wish to.
- Parents will be asked whether their child has phobias related to dogs or allergies. Should this be the case, children could still take part in the study but be assigned to the yoga or control group.

Dogs: All dogs used in the project will be certified therapy dogs working with certified dog handlers (recruited, for example, through the **Pets As Therapy** programme, PAT). In addition, they will be specially selected for the classroom environment. Our external consultants are dog behaviour specialists and will assess the dogs and their handlers and select them for the project. At no point will a dog be touched if the dog signals it does not want to be approached.

We would be very glad if you gave your consent for your child to take part in this exciting new study that will hopefully have a lasting impact on future teaching practice.

Please do not hesitate to contact the research team at the Infant Lab on tel: 01522 886481 or email us: babylab@lincoln.ac.uk

We are happy to discuss the project in more detail.

Yours sincerely,

Lincoln Infant and Child Development Team

Principle Investigator: Prof Kerstin Meints - email: kmeints@lincoln.ac.uk 01522 886474

Researcher: Mirena Dimolavera – email: mdimolareva@lincoln.ac.uk

Researcher: Victoria Brelsford - email: ybrelsford@lincoln.ac.uk,

Consent Form

Investigating the effects of Animal-Assisted Intervention on Children



Consent form

I declare that I am the parent or legal guardian of _____

I have read the information letter and I am giving permission for my child to take part in the research.

Please delete as appropriate:

- Is your child currently taking any prescribed medication? **Yes/No**
- I can confirm that my child **does/does not** have an allergic reaction when exposed to contact with animals.
- I can confirm that my child **does/does not** have a phobia of dogs.

Please give any further details you think we should be aware of in relation to the allergy/phobia questions above:


Signed: _____

Parent Name (in block letters): _____ Date: _____

Email: _____

Daytime contact number: _____

Appendix 8: Risk tool and dog-welfare plan

<p style="text-align: center;">Lincoln Education Assistance with Dogs (LEAD)</p> <p style="text-align: center;">School Risk Assessment Tool</p> <p style="text-align: center;">-for research, educational or therapeutic interventions with <u>dogs</u> in educational settings</p>	 <p>UNIVERSITY OF LINCOLN</p>
<ul style="list-style-type: none">• This risk assessment is designed in accordance with the Society for Companion Dog Studies (SCAS) Dog-Assisted Interventions Code of Practice for the UK (June 2013)(www.scas.org.uk) and amended for the purposes of this research.• The SCAS voluntary code of practice offers both guidance on good practice for the delivery of dog-assisted interventions, in addition to ensuring that the welfare needs of both humans and dogs are met.• This risk assessment is designed to reduce risk and ensure that interventions take place safely within the school setting.• The research is approved by the Mars/Waltham research ethics committee and by the university of Lincoln Psychology research Ethics Committee (soprec@lincoln.ac.uk). <p>Please take the time to read the document carefully, assess in relation to your setting, sign and return to the research team/project manager.</p> <p>If there are additional risks that apply to your setting, please complete sections B and C below as required and return to the research team/project manager for further action.</p>	
PART A. ASSESSMENT DETAILS:	

Area/task/activity: Dog-assisted intervention in schools

***Name and address of lead researcher/ project manager:**

Location of activity: Room in School

School name: Address & Contact details:		Name of Person(s) undertaking Assessment:	
		Signature(s):	
Head Teacher (Name):		Date of Assessment:	
Signature:		Planned Review Date: (Minimum 12 months)	
How communicated to staff:		Date communicated to staff:	

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PART B. HAZARD IDENTIFICATION AND CONTROL MEASURES				
Step 1: Identify significant hazards	Step 2: Identify who might be harmed and how		Step 3: Identify precautionary measures already in place	Step 4: Identify person/s responsible
List of significant hazards (anything with potential to cause harm)	Who might be harmed?	Type of harm	Existing controls (Actions already taken to control the risk)	Name:
All below:	Pupils, teachers, adult helpers, animal handlers	All below:	♦ Staff should also refer to any internal school policy, if existing, in relation to animals on school premises when organising an animal visit to school	♦
Hygiene	Pupils, teachers, adult helpers, animal handlers	Infection, illness	♦ School infection control procedures to be followed at all times; ♦ School health & safety procedures to be followed at all times; ♦ Any significant cuts or abrasions on exposed skin of hands and arms should be covered before contact with the dog; ♦ Hand sanitizer gel and antibacterial wipes are provided for immediate use before and after contact with the dog;	♦

			<ul style="list-style-type: none"> ◆ Pupils and adults always wash their hands soon after contact with the dog (or coming into contact with the dog's bedding, water, toys, etc.) and especially before snack/meal times; ◆ <u>Further information, including facts about zoonotic diseases can be accessed from http://www.publichealth.hscni.net/directorate-public-health/health-protection/zoonoses-infections-acquired-animals</u> 	
Allergies, diseases, parasites	Pupils, teachers, adult helpers, animal handlers	Illness, allergic reaction	<ul style="list-style-type: none"> ◆ Parents are asked to identify any pupils known to have allergic reactions to dogs. These pupils may have restricted access to dogs depending on their allergy trigger. ◆ In the rare case that an allergic reaction should occur and does not subside, medical assistance will be sought; ◆ The dogs will have been regularly taken to a vet and have been recently dewormed and treated for fleas; ◆ All waste produced, whether accidental or routine, is handled and disposed of hygienically and contaminated items and surfaces properly washed and disinfected in accordance with schools H&S procedures; 	◆
Phobias	Pupils, teachers, adult helpers, animal handlers	Stress, adverse phobic reaction	<ul style="list-style-type: none"> ◆ Parents asked to identify pupils known to have a phobia or fear reaction of dogs; ◆ All children will have familiarisation sessions before the interventions begin to ensure confidence and comfort levels of the children involved; ◆ Where there are pupils with phobias, dogs are not banned from coming into school, but every effort is made to segregate dogs from those with phobias; 	◆
Safeguarding and protection of pupils: Human behaviour	Pupils, teachers	Dog handlers and researchers	<ul style="list-style-type: none"> ◆ All researchers, educators and practitioners and dog handlers will check if they need a safety check carried out through the Disclosure and Barring Service (DBS check) (or equivalent outside UK) and will obtain one if deemed necessary; ◆ Children will never be left alone with dog handlers and will be supervised at all times when in the presence of a dog; 	◆

Safeguarding children and adults: Dog behaviour	Pupils, teachers	Potential risk of Bites, scratches	<ul style="list-style-type: none"> ◆ Checks are carried out by the research team prior to the visit to ensure that the dogs are suitable to work with children present; ◆ Dogs are closely supervised by their handler at all times; ◆ Dogs will not be allowed to wander unrestricted around the school; ◆ Pupils are closely supervised by an adult during intervention; ◆ Pupils are given safety training with regards to behaviour around dogs prior to interaction with the dog; ◆ Pupils will be taught to recognise stress signalling in dog behaviour prior to interaction with a dog (dog safety training); ◆ Access to a First Aider and First Aid kits are located in school; ◆ In the unlikely event that any dog scratches or bites may occur, these are carefully washed and a first aider contacted immediately; ◆ Any incidents to be recorded in accordance with school procedures and logged in incident/accident books as appropriate; 	◆
Protection of dog	Dogs	Stress	<ul style="list-style-type: none"> ◆ The dog handler is responsible for ensuring that their dog's physical and psychological wellbeing is protected and not comprised; ◆ Dog first aid kits will be provided and dog handlers are responsible for any first aid administered to dogs; ◆ The Dog Welfare Act (2006) and the Dog Health and Welfare Act (Scotland) should be adhered to at all times. These laws apply to all dog owners/keepers, but it is every adults' responsibility to be mindful of this guidance in their interactions with the dog. (see fawc.org.uk/freedoms); ◆ Dogs will be monitored for signs of stress by their handler and the researcher and removed from the situation should they judge the animal to be stressed or in discomfort; ◆ All dogs will be given access to water and an appropriate area for rest, toileting and exercise. Children will not be permitted to interact with the dog at these times; 	◆

			<ul style="list-style-type: none"> ◆ Dogs will work no longer than 2 hours per day in direct contact with children; ◆ If at any time during the intervention sessions a dog's welfare is in danger of being compromised, the session will be stopped immediately; ◆ All dogs will have a care plan (see below) in place during their participation in the project ◆ a specialist consultant is assigned to the project and can be contacted for advice and guidance on dog welfare, behaviour and training throughout the study/intervention if required; 	
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I certify that the risk assessment above fully applies to the area/task/activity under assessment in (Name of school)

Signed:

Name:

Risk Assessor:

Do not sign off above if further actions are required (see below Part C for further action).

Part C:

If further action is required or there are further local significant hazards you think should be added, please record these actions here *in Part C* and sign off below.

Please return this document and the Action Plan at part C to the research/project team so that any additional issues can be acknowledged and acted upon asap.

PART C. ACTION PLAN – ADDITIONAL HAZARD IDENTIFICATION AND CONTROL MEASURES									
Further Significant hazards	Who might be harmed?	Type of harm	Existing controls (Actions already taken to control the risk)	Further action / controls required	Person(s) responsible to undertake action	Priority	Projected time scale	Notes / comments	Date completed

I certify that the assessment for the task/activity above covers all the significant hazards applicable (Name of school)

Signed:

Name:

Risk Assessor.

Appendix 9: Dog Care Plan

Name of dog: _____ Age: _____ Gender: _____ Breed: _____

Name of handler: _____

This Care Plan pertains to the welfare of dogs being used during intervention sessions with children in schools/ or participants in other settings. The Care Plan is part of, and should be read in conjunction with, the setting's / school's Risk Assessment document. Areas relating to safety training with children/other participants and teaching correct behaviour with dogs is detailed in the main risk assessment

Care & treatment	Behaviour management	Feeding & watering	Toileting	Enrichment	Exercise
<p>Visual health-checks will be carried out by handler before dog begins work in school/other setting.</p> <p>Dogs will be monitored throughout the interactive sessions to ensure their care and treatment is maintained to a high standard, including child/participant behaviour to ensure the dog is treated with respect.</p>	<p>During the intervention sessions, dog handlers and researchers trained in dog distress signalling will carry out constant observations of the child/dog interactions in order to detect signs of stress in the dogs.</p> <p>In the event that a dog becomes stressed the dog will be removed</p>	<p>Dogs will be fed before arrival at the school.</p> <p>Dogs will have constant access to water.</p> <p>Preferably no treats to be given, however, handler to decide on treats/rewards</p>	<p>Designated areas for toileting will have been previously agreed between the school/other setting, the researchers and dog handlers in advance.</p> <p>Dogs will be taken outside at regular intervals as the handler sees fit, or</p>	<p>Dogs may have a toy in the sessions in order to enable them to display their natural behaviours.</p> <p>Dogs will have a bed/blanket in a designated space in the room as a rest area away from human interaction and they should be</p>	<p>Designated areas for exercise will have been previously agreed between the school, the researchers and dog handlers in advance.</p> <p>When toileting the dog will be given time to exercise outside in order to enable them to display their natural behaviours and also as</p>

Dog handlers will have an animal first aid kit in order to administer emergency first aid in circumstances where this may be required.	from the situation in order to protect the welfare of all concerned and allow the dog to feel comfortable in its surroundings.	throughout sessions as they see fit. No treats to be given from hands of participants.	as required by the dog during intervention sessions with the child/other participant.	<p>given the opportunity to use it as they wish.</p> <p>Children/participants will not be permitted to approach the dog when the dog is in its resting space.</p>	a break from direct contact with children.
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Appendix 10:

Children's guidelines for child-dog interactions: Do's and Don'ts



Do

- ✓ Ask the adult if you can stroke the dog
- ✓ Ask the dog if he/she would like to be stroked
- ✓ Look at the dog when you want his/her attention
- ✓ Be gentle with the dog
- ✓ Give the dog treats on a plate
- ✓ Wash your hands after stroking the dog
- ✓ Leave the dog alone if he/she is resting in his/her bed



Don't

- × Don't kiss the dog
- × Don't hug the dog
- × Don't give the dog food from your hand
- × Don't take toys or food away from the dog
- × Don't lie in the dog's bed
- × Don't lean into, or reach over the dog
- × Don't put your face near the dog

Appendix 11: Familiarisation Protocol

The familiarisation sessions take place in a large room with a dog blanket/bed (provided by handler) and water bowl. Prior to the visits of the dog researchers have an individual care plan for each dog, approved by the handler to ensure welfare is safeguarded.

1. Familiarisation session:

The familiarisation process follows the dog body language training and the session where children were taught do's and don'ts when interacting with the dog. Only one dog will be familiarised with children at any one time within the school setting.

Firstly, the dog visits the room with their handler to get used to the surroundings before children are introduced. The dog then exits the room to allow children to come in and take their seats, at which point, the handler enters the room with the dog.

Each familiarisation session will begin with a reminder of the children's "Do's and Don'ts" to set the rules and expectations for appropriate behaviour around the dogs. Children who did not have this level of understanding had one-to-one support for this session to ensure safety of all involved. Next children will be able to say hello and stroke the dog should they wish to, no child was forced to do so. This was done in an orderly manner, ensuring there was no crowding of the animal.

For the rest of the session the children learnt more about the likes and dislikes of the dog and observed their behaviour. As every dog is different children were familiarised with every dog who was scheduled to visit the school. At the end children were able to say goodbye and stroke the dog should they wish to. Each session lasted about 15-20 minutes.

Appendix 12: Summary Table of Results

Table 1 Language Chapter

Task	Individual/ Group	ANOVA/ ANCOVA	Effect	P value	Partial Eta Squared	Bonferroni Post hoc	Planned Comparisons	Direction & P Value
ACE SC RAW	Individual	3x5	Time n/s	.229	.07		Pre- post	Dog n/s Relax [-] 0.002 Control [+] .022
			Condition n/s	.647	.65	N/S	Pre- 6 weeks	Dog n/s Relax n/s Control [+] .023
			Time x Condition n/s	.086	.17		Pre- 6 months	Dog [+] .003 Relax n/s Control n/s
							Pre- 1 year	Dog [+] .052 Relax n/s Control n/s
	Group		Time n/s	.775	.02		Pre- post	Dog n/s Relax n/s
			Condition n/s	.949	.01	N/S	Pre- 6 weeks	Dog n/s Relax n/s
			Time x Condition	.028*	.20		Pre- 6 months	Dog n/s Relax n/s
							Pre- 1 year	Dog n/s Relax n/s
	Individual	3x2	Time n/s	.790	.003			
			Condition n/s	.869	.10	N/S		
			Time x Condition	.005	.33			
	Group	3x2	Time	.023	.11			
			Condition n/s	.701	.02			
			Time x Condition	.005	.21			

	Individual	& Pet	Pet n/s	.954	.000			
			Time n/s	.215	.08			
			Condition n/s	.961	.004			
			Time x Condition	.001	.52			
			Time x Pet n/s	.113	.13			
		& Dog	Dog n/s	.490	.03			
			Time n/s	.573	.02			
			Condition n/s	.897	.01			
			Time x Condition	.002	.49			
			Time x Pet n/s	.426	.03			
ACE SC STD	Individual	3x5	Time	.013	.15		Pre- Post	Dog [+] .005 Relax n/s Control n/s
			Condition n/s	.474	.08	N/S	Pre- 6-weeks	Dog [+] .015 Relax n/s Control [+] .030
			Time x Condition	.001	.29		Pre- 6-months	Dog [+] .021 Relax n/s Control n/s
							Pre- 1-year	Dog [+] .021 Relax n/s Control n/s
	Group	3x5	Time n/s	.377	.05		Pre- Post	Dog n/s Relax n/s
			Condition n/s	.830	.02	N/S	Pre- 6-weeks	Dog n/s Relax n/s
			Time x Condition	.028	.20		Pre- 6 months	Dog n/s Relax n/s
							Pre- 1 year	Dog n/s Relax n/s
	Individual	3x2	Time n/s	.140	.08			

	Group	3x2	Condition n/s	.616	.04	n/s		
			Time x Condition	.006	.31			
			Time	.049	.08			
			Condition n/s	.447	.04	n/s		
	Individual	& Pet	Time x Condition	.046	.13			
			Pet n/s	.900	.001			
			Time n/s	.643	.01			
			Condition n/s	.699	.04			
			Time x Condition	.004	.44			
			Time x Pet n/s	.842	.002			
		& Dog	Dog n/s	.588	.02			
			Time n/s	.504	.47			
			Condition n/s	.329	.05			
			Time x Condition	.002	.47			
			Time x Dog n/s	.225	.08			
ACE SF RAW	Individual	3x5	Time n/s	.124	.11		Pre- Post	Dog [+] .023 Relax [+] .047 Control n/s
			Condition n/s	.481	.07	n/s	Pre- 6-weeks	Dog n/s Relax n/s Control n/s
			Time x Condition n/s	.853	.04		Pre- 6 months	Dog n/s Relax n/s Control [+] .026
							Pre- 1 year	Dog n/s Relax [+] .001 Control [+] .016
	Group	3x5	Time	<.001	.37		Pre- Post	Dog n/s Relax n/s
			Condition n/s	.272	.20		Pre- 6-weeks	Dog n/s Relax n/s

			Time x Condition	.399	.15		Pre- 6 months	Dog n/s Relax n/s
							Pre- 1 year	Dog n/s Relax n/s
	Individual	3x2	Time	.001	.40			
			Condition n/s	.315	.10	n/s		
			Time x Condition n/s	.990	.001			
	Group	3x2	Time	.022	.19			
			Condition	.016	.27	DG & C .017 (C+)		
			Time x Condition n/s	.663	.03			
ACE SF STD	Individual	3x5	Time	.001	.26		Pre- Post	Dog [+] .015 Relax n/s Control n/s
			Condition n/s	.369	.12	n/s	Pre- 6-weeks	Dog n/s Relax n/s Control n/s
			Time x Condition n/s	.953	.04		Pre- 6-months	Dog n/s Relax [+] .007 Control [+] .034
							Pre- 1-year	Dog n/s Relax n/s Control [+] .014
	Group	3x5	Time	.019	.26		Pre- Post	Dog n/s Relax n/s
			Condition n/s	.207	.23	n/s	Pre- 6-weeks	Dog n/s Relax [+] <.001
			Time x Condition n/s	.237	.19		Pre- 6-months	Dog n/s Relax n/s

							Pre- 1-year	Dog n/s Relax n/s
	Individual	3x2	Time	.006	.31			
			Condition n/s	.341	.10			
			Time x Condition n/s	.860	.001			
	Group	3x2	Time n/s	.224	.06			
			Condition	.014	.28	DG & C .011 (C+)		
			Time x Condition	.806	.02			
CAT	Individual	3x2x2x2 Cond x An x Typ x Time	Time n/s	.554	.01		Pre-Post	Dog n/s Relax n/s Control n/s
			Condition n/s	.613	.04	n/s		
			Animacy	< .001	.41			
			Typicality	< .001	.69			
			Test x Condition n/s	.183	.12			
			Condition x Animacy n/s	.822	.01			
			Condition x Typicality	.031	.23			
			Time x Animacy n/s	.868	.001			
			Time x Condition x Animacy n/s	.367	.07			
			Time x Typicality n/s	.981	< .001			
			Time x Condition x Typicality n/s	.351	.075			

			Animacy x Typicality	.002	.31			
			Condition x Animacy x Typicality n/s	.538	.05			
			Time x Animacy x Typicality	.296	.04			
			Time x Condition x Animacy x Typicality	.754	.02			
	Group	3x2x2x2 Cond x An x Typ x Time	Time n/s	.147	.04			
			Condition n/s	.063	.10	n/s	Pre- Post	Dog n/s Relax n/s
			Animacy	<.001	.60			
			Typicality	<.001	.26			
			Test x Condition n/s	.060	.11			
			Condition x Animacy n/s	.857	.01			
			Condition x Typicality	.124	.08			
			Time x Animacy n/s	.802	.001			
			Time x Condition x Animacy n/s	.050	.11			
			Time x Typicality n/s	.776	.002			
			Time x Condition x Typicality n/s	.518	.03			
			Animacy x Typicality	<.001	.23			

			Condition x Animacy x Typicality n/s	.668	.02			
			Time x Animacy x Typicality	.421	.01			
			Time x Condition x Animacy x Typicality	.160	.07			
BAS VComp	Individual	3x5	Time	.010	.11		Pre- Post	Dog [+] .004 Relax n/s Control n/s
			Condition n/s	.179	.10	n/s	Pre- 6-weeks	Dog n/s Relax [+] .018 Control n/s
			Time x Condition	.024	.13		Pre-6-months	Dog n/s Relax [+] .017 Control n/s
							Pre- 1-year	Dog [+] .007 Relax [+] .013 Control n/s
	Individual	3x2	Time	.008	.16			
			Condition n/s	.442	.00	n/s		
			Time x Condition n/s	.053	.14			
		& SES	SES n/s	.317	.04			
			Time	.027	.19			
			Condition n/s	.387	.08			
			Time x Condition n/s	.513	.05			
			Time x SES n/s	.115	.10			
		& Pet	Pet n/s	.080	.11			

			Time n/s	.564	.01			
			Condition n/s	.680	.03			
			Time x Condition n/s	.236	.10			
			Time x Pet n/s	.103	.09			
		& Dog	Dog n/s	.980	.00			
			Time n/s	.349	.03			
			Condition n/s	.543	.04			
			Time x Condition n/s	.476	.05			
			Time x Dog n/s	.922	.00			

Table 2 Cognitive Chapter

Task	Individual/ Group	ANOVA/ ANCOVA	Effect	P value	Partial Eta Squared	Bonferroni Post hoc	Planned Comparisons	Direction & P Value
BAS R of D	Individual	3x5	Time	.043	.15		Pre- Post	Dog n/s Relax [+] .031 Control n/s
			Condition	.346	.11	n/s	Pre- 6-weeks	Dog n/s Relax n/s Control n/s
			Time x Condition	.574	.09		Pre- 6- months	Dog n/s Relax n/s Control n/s
							Pre- 1-year	Dog n/s Relax n/s Control [+] .007
	Group	3x5	Time	.001	.18		Pre- Post	Dog n/s Relax n/s
			Condition n/s	.506	.05	n/s	Pre- 6-weeks	Dog n/s Relax [+] .019

			Time x Condition n/s	.729	.05		Pre- 6- months	Dog n/s Relax n/s
							Pre- 1-year	Dog Relax
Individual	3x2	Time	.299	.041				
		Condition	.418	.065				
		Time x Condition	.082	.175				
Group	3x2	Time	.180	.036				
		Condition	.879	.005				
		Time x Condition	.839	.007				
Individual	& SES	SES n/s	.346	.06				
		Time n/s	.163	.12				
		Condition n/s	.613	.06				
		Time x Condition n/s	.328	.13				
		Time x SES n/s	.252	.08				
	& Pet	Pet n/s	.286	.06				
		Time n/s	.414	.03				
		Condition n/s	.443	.08				
		Time x Condition	.035	.28				
		Time x Pet n/s	.499	.02				
	& Dog	Dog n/s	.734	.01				
		Time n/s	.059	.18				
		Condition n/s	.467	.08				
		Time x Condition	.008	.40				
		Time x Dog n/s	.071	.16				
Group	& Pet	Pet n/s	.559	.02				
		Time n/s	.405	.04				
		Condition n/s	.396	.11				
		Time x Condition n/s	.647	.05				
		Time x Pet n/s	.252	.08				

		& Dog	Dog n/s	.313	.06			
			Time n/s	.548	.02			
			Condition n/s	.263	.05			
			Time x Condition n/s	.683	.05			
			Time x Dog n/s	.407	.04			
BAS PCons STD	Group	3x5	Time	<.001	24		Pre- Post	Control [+] .008 Dog [+] .022 Relax n/s
			Condition n/s	.192	.12	n/s	Pre- 6-weeks	Control [+] .004 Dog [+] .009 Relax n/s
			Time x Condition n/s	.227	.10		Pre- 6months	Control [+] .001 Dog n/s Relax [+] .005
							Pre- 1 year	Control [+] .017 Dog [+] .005 Relax n/s
BAS PCons STD	Individual	3x2	Time	< .001	.68			
			Condition n/s	.114	.02	n/s		
			Time x Condition n/s	.777	.16			
	Group	3x2	Time	< .001	.26			
			Condition n/s	.069	.10	n/s		
			Time x Condition n/s	.204	.06			
	Individual	& Pet	Pet n/s	.088	.15			
			Time	.044	.20			
			Condition n/s	.633	.05			
			Time x Condition n/s	.458	.08			

		& Dog	Time x Pet n/s	.798	.004			
			Dog n/s	.736	.01			
			Time n/s	.914	.001			
			Condition n/s	.513	.07			
			Time x Condition n/s	.257	.14			
			Time x Dog n/s	.227	.08			
	Group	& Pet	Pet n/s	.204	.10			
			Time n/s	.503	.03			
			Condition	.050	.31			
			Time x Condition n/s	.669	.05			
			Time x Pet n/s	.877	.002			
		& Dog	Dog n/s	.942	<.001			
			Time n/s	.827	.003			
			Condition n/s	.139	.22			
			Time x Condition n/s	.765	.03			
			Time x Dog n/s	.842	.003			
BAS PCons ALT	Individual	3X2	Time	< .001	.56			
			Condition n/s	.367	.07			
			Time x Condition n/s	.130	.13			
	Group	3x2	Time n/s	.315	.02			
			Condition	.029	.13			
			Time x Condition n/s	.167	.07			
	Individual	&SES	SES n/s	.279	.07			
			Time n/s	.723	.01			
			Condition n/s	.453	.09			
			Time x Condition	.324	.13			

			Time x SES	.315	.06				
		& Pet	Pet n/s	.160	.09				
			Time n/s	.069	.15				
			Condition n/s	.562	.05				
			Time x Condition	.268	.12				
			Time x Pet	.770	.004				
			& Dog	Dog n/s	.898	.90			
		Time n/s		.321	.05				
		Condition n/s		.515	.06				
		Time x Condition		.494	.07				
		Time x Dog		.957	.00				
		Group	& Pet	Pet n/s	.289	.07			
				Time n/s	.831	.003			
				Condition	.022	.38			
				Time x Condition	.465	.09			
	Time x Pet			.858	.002				
	& Dog		Dog n/s	.965	<.001				
			Time n/s	.998	.00				
			Condition n/s	.057	.30				
			Time x Condition	.636	.06				
	Time x Dog	.974	.00						
BAS Mat	Individual	3x5	Time	< .001	.28		Pre- Post	Dog n/s Relax n/s Control n/s	
		Condition	.648	.05	n/s	Pre- 6-weeks	Dog n/s Relax n/s Control n/s		
		Time x Condition	.167	.14		Pre- 6-month	Dog n/s Relax n/s Control n/s		
						Pre- 1-year	Dog n/s		

								Relax n/s Control n/s
	Group	3x5	Time	<.001	.19		Pre- Post	Dog n/s Relax n/s
			Condition n/s	.263	.10		Pre- 6-weeks	Dog n/s Relax n/s
			Time x Condition n/s	.859	.04		Pre- 6-month	Dog n/s Relax n/s
							Pre- 1-year	Dog n/s Relax n/s
	Individual	3x2	Time	.005	.26			
			Condition	.885	.01			
			Time x Condition	.558	.04			
	Group	3x2	Time	.002	.18			
			Condition	.608	.02			
			Time x Condition	.471	.03			
BAS QR	Individual (p.	5x3	Time	.038	.13		Pre- Post	Dog n/s Relax n/s Control n/s
			Condition	.972	.003	n/s	Pre- 6-weeks	Dog [+] .006 Relax n/s Control n/s
			Time x Condition	.135	.15		Pre- 6-month	Dog [+] .014 Relax n/s Control n/s
							Pre- 1-year	Dog [+] <.001 Relax n/s Control n/s
	Group (p.	5x3	Time	.012	.18		Pre- Post	Dog n/s Relax n/s
			Condition	.415	.08	n/s	Pre- 6-weeks	Dog n/s Relax n/s

			Time x Condition	.523	.52		Pre- 6-month	Dog n/s Relax [+] .019
							Pre- 1-year	Dog n/s Relax [+] .002
	Individual	3x2	Time	.062	.137			
			Condition	.991	.001			
			Time x Condition	.470	.061			
	Group		Time	.494	.010			
			Condition	.078	.107			
			Time x Condition	.907	.039			
	Individual	(5x2) & Pet	Pet	.465	.03			
			Time	.063	.17			
			Condition	.832	.02			
			Time x Condition	.602	.05			
			Time x Pet	.131	.12			
			Dog	.613	.02			
			Time	.033	.23			
			Condition	.921	.01			
			Time x Condition	.467	.08			
			Time x Dog	.054	.19			
	Group		Pet	.928	.001			
			Time	.052	.24			
			Condition	.777	.04			
			Time x Condition	.567	.08			
			Time x Pet	.073	.21			
			Dog	.489	.04			
			Time	.460	.04			
			Condition	.987	.002			
			Time x Condition	.788	.03			
			Time x Dog	.556	.03			

BAS SNC Cluster	Group	3x5	Time	.006	.17		Pre- Post	Control [+] .047 Dog [+] .003 Relax n/s
			Condition	.163	.17	n/s	Pre- 6 weeks	Control n/s Dog [+] .009 Relax [+] .018
			Time x Condition	.655	.07		Pre- 6- months	Control n/s Dog n/s Relax n/s
							Pre- 1 year	Control [+] .036 Dog n/s Relax n/s
	Individual	3x2	Time	<.001	.50			
			Condition	.810	.02			
			Time x Condition	.103	.16			
	Group	3x2	Time	<.001	.27			
			Condition	.515	.03			
			Time x Condition	.122	.08			
BAS SNC Cluster STD	Group	3x5	Time	.006	.17		Pre- Post	Control [+] .049 Dog [+] .003 Relax n/s
			Condition	.162	.17		Pre- 6 weeks	Control n/s Dog [+] .009 Relax [+] .017
			Time x Condition	.652	.07		Pre- 6- months	Control n/s Dog n/s Relax n/s
							Pre- 1 year	Control [+] .034 Dog n/s Relax n/s
	Individual	3x2	Time	<.001	.48			

BAS NVR	Group	3x2	Condition	.811	.02			
			Time x Condition	.111	.16			
			Time	< .001	.27			
			Condition	.508	.03			
			Time x Condition	.121	.08			
	Individual	3x5	Time	.458	.062		Pre- Post	Dog n/s Relax .046 Control n/s
			Condition	.802	.031		Pre- 6 weeks	Dog n/s Relax n/s Control n/s
			Time x Condition	.939	.048		Pre- 6- months	Dog n/s Relax .086 Control n/s
							Pre- 1 year	Dog n/s Relax n/s Control n/s
	Group	3x5	Time	.270	.068		Pre- Post	Dog .036 Relax n/s
			Condition	.212	.158		Pre- 6 weeks	Dog n/s Relax n/s
			Time x Condition	.683	.073		Pre- 6- months	Dog n/s Relax. n/s
							Pre- 1 year	Dog n/s Relax n/s
	Individual	3x2	Time	.015	.23			
			Condition	.773	.02			
			Time x Condition	.289	.10			
	Group	3x2	Time	.022	.11			
			Condition	.237	.06			
			Time x Condition	.097	.10			

BAS SA	Group (p.	3x5	Time	.004	.18		Pre- Post	Control n/s Dog [+] .048 Relax n/s
			Condition	.216	.15	n/s	Pre- 6 weeks	Control n/s Dog n/s Relax [+] .035
			Time x Condition	.654	.07		Pre- 6- months	Control n/s Dog n/s Relax n/s
							Pre- 1 year	Control [+] .043 Dog [+] .048 Relax n/s
	Individual	3x2	Time	<.001	.44			
			Condition	.384	.07			
			Time x Condition	.043	.22			
	Group	3x2	Time	.002	.17			
			Condition	.237	.06			
			Time x Condition	.851	.01			
	Individual	& SES	SES	.631	.02			
			Time	.074	.19			
			Condition	.371	.12			
			Time x Condition	.186	.19			
			Time x SES	.451	.04			
		& Pet	Pet	.292	.06			
			Time	.106	.13			
			Condition	.252	.13			
			Time x Condition	.036	.28			
			Time x Pet	.710	.01			
		& Dog	Dog	.186	.09			
			Time	.079	.15			
			Condition	.135	.19			
			Time x Condition	.026	.32			

	Group	& Pet	Time x Dog	.302	.06			
			Pet	.805	.004			
			Time	.628	.02			
			Condition	.288	.14			
			Time x Condition	.672	.05			
			Time x Pet	.337	.06			
		& Dog	Dog	.349	.12			
			Time	.777	.01			
			Condition	.349	.12			
			Time x Condition	.817	.03			
			Time x Dog	.524	.03			
Stroop An 1	Individual	3x5	Time	.628	.012			
			Condition	.240	.133			
			Time x Condition	.057	.250			
	Group	3x5	Time	.445	.027			
			Condition	.325	.013			
			Time x Condition	.369	.087			
	Individual	3x2	Time	.268	.051			
			Condition	.468	.058			
			Time x Condition	.227	.116			
	Group	3x2	Time	.718	.003			
			Condition	.924	.003			
			Time x Condition	.505	.029			
Stroop AN 2	Individual	3x5	Time	.181	.074			
			Condition	.212	.144			
			Time x Condition	.169	.131			
	Group	3x5	Time	.967	.000			
			Condition	.090	.189			
			Time x Condition	.864	.013			
	Individual	3x2	Time	.226	.06			

	Group		Condition	.260	.11			
			Time x Condition	.790	.02			
		3.2	Time	.469	.01			
			Condition	.031	.14			
			Time x Condition	.650	.02			
Stroop SOP	Individual	3x5	Time	<.001	.92		Pre- Post	Dog [+] .001 Relax [+] .001 Control n/s
			Condition	.685	.04		Pre- 6week	Dog n/s Relax n/s Control n/s
			Time x Condition	.377	.10		Pre- 6month	Dog n/s Relax n/s Control [-] .002
							Pre- 1year	Dog n/s Relax n/s Control [-] .002
	Group	3x5	Time	<.001	.93		Pre- Post	Dog [+] .001 Relax [+] .001
			Condition	.233	.12		Pre- 6week	Dog n/s Relax n/s
			Time x Condition	.505	.07		Pre- 6month	Dog n/s Relax n/s
							Pre- 1year	Dog n/s Relax n/s
	Individual	3x2	Time	<.001	.35			
			Condition	.050	.24			
			Time x Condition	.261	.11			
	Group	3x2	Time	<.001	.93			
			Condition	.932	.003			
			Time x Condition	.204	.07			

	Individual	& Pet	Time	<.001	.60			
			Condition	.198	.18			
			Time x Condition	.082	.27			
			Time x Pet	.357	.05			
		& Dog	Time	.002	.46			
			Condition	.143	.22			
			Time x Condition	.116	.24			
			Time x Dog	.969	<.001			
BAS PicSim	Individual	3x5	Time	<.001	.11		Pre- Post	Dog [+] .005 Relax n/s Control n/s
			Condition	.012	.19		Pre- 6 weeks	Dog [+] .029 Relax n/s Control n/s
			Time x Condition	.317	.05		Pre- 6months	Dog n/s Relax n/s Control n/s
							Pre- 1 year	Dog [+] .001 Relax n/s Control [+] .040
		& SES	SES	.934	.00			
			Time	.446	.03			
			Condition	.186	.12			
			Time x Condition	.260	.09			
			Time x SES	.535	.03			
		& Pet	Pet	.725	.004			
			Time	.016	.09			
			Condition	.196	.10			
			Time x Condition	.314	.07			
			Time x Pet	.045	.08			
		& Dog	Dog	.334	.03			

			Time	.343	.04			
			Condition	.142	.12			
			Time x Condition	.383	.07			
			Time x Dog	.787	.01			
		3x2	Time	.036	.09			
			Condition	.007	.20	[D&C .022 D+] [R&C .014 C+]		
			Time x Condition	.014	.17			
		& SES	SES	.564	.001			
			Time	.528	.01			
			Condition	.115	.14			
			Time x Condition	.193	.11			
			Time x SES	.242	.05			
		& Pet	Pet	.967	.00			
			Time	.036	.13			
			Condition	.121	.12			
			Time x Condition	.053	.16			
			Time x Pet	.109	.08			
		& Dog	Dog	.255	.04			
			Time	.890	.001			
			Condition	.084	.14			
			Time x Condition	.069	.15			
			Time x Dog	.661	.01			
BAS PCons	Individual	3x5	Time	.684	.006			
			Condition	.732	.023			
			Time x Condition	.237	.101			
	Individual	3x2	Time	.135	.066			
			Condition	.852	.010			
			Time x Condition	.500	.041			

BAS Matrices	Individual .	3x5	Time	.030	.214			
			Condition	.763	.027			
			Time x Condition	.621	.047			
		3x2	Time	.002	.33			
			Condition	.961	.003			
			Time x Condition	.422	.07			
		& Pet	Pet	.305	.07			
			Time	.010	.35			
			Condition	.691	.05			
			Time x Condition	.083	.27			
			Time x Pet	.066	.20			
		& Dog	Dog	.480	.03			
			Time	.621	.02			
			Condition	.662	.05			
			Time x Condition	.266	.15			
			Time x Dog	.879	.001			

Table 3 Physiology and Behaviour Chapter

Task	Individual/ Group	ANOVA/ ANCOVA	Effect	P value	Partial Eta Squared	Bonferroni Post hoc	Planned Comparisons	Direction & P Value
SFCEI-3 Self Est	Group	3x5	Time	.858	.002			
			Condition	.394	.098	N/S		
			Time x Condition	.405	.096			
		3x2	Time	.906	.000			
			Condition	.206	.076			
			Time x Condition	.731				
RCMAS	Group	3x5	Time	.032	.16		Pre-Post	Control n/s

Anx								Dog n/s Relax n/s
			Condition	.537	.06		Pre- 6-wk	Control n/s Dog n/s Relax .046 (lower anx)
			Time x Condition	.522	.08		Pre-6m	Control n/s Dog n/s Relax n/s
							Pre-1y	Control n/s Dog n/s Relax n/s
	Group	3x2	Time	.773	.002			
			Condition	.567	.027			
			Time x Condition	.392	.045			
CBRS Teacher	Individual	3x2	Time	.002	.30		Pre-Post	Control n/s Dog n/s Relax n/s
			Condition	.630	.03		Pre- 6-wk	Control n/s Dog n/s Relax n/s
			Time x Condition	.172	.12		Pre-6m	Control n/s Dog n/s Relax n/s
							Pre-1y	Control n/s Dog n/s Relax n/s
	Group	3x2	Time	.165	.05		Pre-Post	Dog n/s Relax [+] .009
			Condition	.035	.16		Pre- 6-wk	Dog n/s Relax n/s
			Time x Condition	.904	.01		Pre-6m	Dog n/s Relax n/s

							Pre-1y	Dog n/s Relax n/s
	Individual	& SES	SES	.316	.07			
			Time	.624	.02			
			Condition	.338	.14			
			Time x Condition	.785	.03			
			Time x SES	.168	.12			
		& Pet	Pet	.694	.01			
			Time	.093	.14			
			Condition	.228	.14			
			Time x Condition	.502	.07			
			Time x Pet	.434	.03			
		& Dog	Dog	.252	.07			
			Time	.909	.001			
			Condition	.133	.19			
			Time x Condition	.381	.10			
			Time x Pet	.486	.03			
	Group	& Pet	Pet	.520	.03			
			Time	.661	.01			
			Condition	.113	.27			
			Time x Condition	.725	.05			
			Time x Pet	.420	.05			
		& Dog	Dog	.031	.29			
			Time	.262	.09			
			Condition	.013	.46			
			Time x Condition	.464	.10			
			Time x Pet	.149	.14			
EQ	Individual	3x2	Time	.369	.026			
			Condition	.244	.087			
			Time x Condition	.056	.169			

SQ	Individual	3x2	Time	.211	.050			
			Condition	.758	.018			
			Time x Condition	.654	.027			
		& SES	SES	.912	<.001			
			Time	.962	<.001			
			Condition	.550	.05			
			Time x Condition	.679	.01			
			Time x SES	.646	.03			
		& Pet	Pet	.256	.04			
			Time	.766	.003			
			Condition	.763	.02			
			Time x Condition	.609	.03			
			Time x Pet	.463	.02			
		& Dog	Dog	.914	<.001			
			Time	.040	.13			
			Condition	.762	.02			
			Time x Condition	.659	.03			
			Time x Pet	.014	.19			
Parent Beh	Individual	3x2 & SES	SES	.566	.01			
			Time	.020	.18			
			Condition	.425	.06			
			Time x Condition	.646	.31			
			Time x SES	.023	.17			
		& Pet	Pet	.005	.23			
			Time	.567	.01			
			Condition	.172	.10			
			Time x Condition	.153	.11			
			Time x Pet	.694	.01			
		& Dog	Dog	.061	.11			
			Time	.472	.02			

			Condition	.209	.09			
			Time x Condition	.132	.12			
			Time x Pet	.352	.03			
		X						
Cortisol	Individual & Group	5x3	Time	.577	.01	DI& DG .001 [DG -]	Pre- post-	DI n/s RI n/s C n/s DG .004 reduction RG n/s
			Condition	.077	.19	RI & C .008 RI [+]		
			Time x Condition	.002	.34	RI & DG .007 [DG -]		
						C & DG .009 [DG-]		
						DG & RG .013 [DG-]		