USING DOGS IN A HOME-BASED INTERVENTION WITH CHILDREN WITH AUTISM SPECTRUM DISORDERS

A Dissertation

by

COURTNEY E. ALISON

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2010

Major Subject: School Psychology

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Approved by:

Co-Chairs of Committee,	Jennifer Ganz
	Cynthia Riccio
Committee Members,	Bonnie Beaver
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ABSTRACT

Using Dogs in a Home-Based Intervention with Children with Autism Spectrum Disorders. (August 2010)

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Co-Chairs of Advisory Committee: Dr. Jennifer Ganz
Dr. Cynthia Riccio

Humans and dogs have lived among each other in mutually beneficial relationships for thousands of years. In recent years, this human-animal bond has emerged as a catalyst for animal-assisted activities and therapies that may benefit those with disabilities, including children with autism spectrum disorders (ASD). ASD are characterized by qualitative impairments in social interaction and communication and restricted repetitive and stereotyped patterns of behavior, interests, and activities. The nonverbal and nonjudgmental nature of dogs may be non-threatening and easier for children with ASD to decode, which may decrease anxiety and facilitate social bonding. Further, with their roles as social lubricants/transitional objects and natural foci of interest, dogs may facilitate social interaction between children with ASD and other people. Using a single case, multiple baseline design across participants, this study investigated whether multiple semi-structured interactions with dogs would increase social and communicative behaviors and decrease restricted repetitive and stereotyped patterns of behavior in children. Although only two had statistically significant results, all three participants showed responses to intervention in the hypothesized directions. This study

supports the position that children with ASD may benefit from participating in animal-assisted activities with dogs.

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CHAPTER I

INTRODUCTION

In recent history, prevalence rates of autism spectrum disorders (ASD) appear to have been rising; international rates rose from 2.4 – 4.9 per 10,000 in the late 1960s and early 1970s to 1.4 – 66.6 per 10,000 in the mid 1990s and early 2000s (Blaxill, 2009; Centers for Disease Control and Prevention, 2007; Chakrabarti & Fombonne, 2001; Gillberg & Wing, 1999; Wing & Potter, 2002). There is speculation about the reasons for this increase, such as evolving diagnostic criteria, increased awareness, diagnostic substitution, or differences in epidemiological data collection (Croen, Grether, Hoogstrate, & Selvin, 2002; Fombonne, 2001; Frith, 2003; Mandell & Palmer, 2005; Shattuck, 2006; Wing & Potter, 2002). Regardless of the reasons, there is an increased burden on public education systems to provide appropriate services to children who qualify as having ASDs (United States Department of Education/Office of Special Education and Rehabilitative Services/Office of Special Education Programs, 2009; United States Government Accountability Office, 2005). Autistic disorder (autism) and pervasive developmental disorder-not otherwise specified (PDD-NOS) fall within the autism spectrum (American Psychiatric Association, 2000). Autistic disorder is defined by three criteria that must be present before age 3; the criteria detailed in Appendix A delineate the combination and number of symptoms in each area that need to be present. The first criterion is qualitative impairments in reciprocal social

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This dissertation follows the style of *School Psychology Quarterly*.

interaction relative to developmental level. Behavioral signs of social interaction deficits include impairment in nonverbal behaviors such as eye contact, failure to develop peer relationships, and lack of social or emotional reciprocity. The second criterion is qualitative impairments in communication, as indicated by delay in language acquisition, deficits in starting or maintaining conversations with others, and lack of spontaneous, make-believe play. Finally, there must be restricted repetitive stereotyped patterns of behavior, interests, and activities. For example, people with autism may engage in hand-flapping, spinning, or staring at lights. They can be resistant to change and may have interests that are abnormally intense or narrow. PDD-NOS, which includes "atypical autism," is diagnosed when an individual meets some of the criteria, but not full criteria for autistic disorder because of late age of onset, atypical symptomatology, and/or subthreshold symptomatology.

Children with autism/PDD-NOS are a heterogeneous group and, more so than typically developing children, individual differences tend to greatly influence the success of interventions (Frith, 2003; Loveland & Tunali-Kotiski, 2005; Wing, 2005). Due to the heterogeneity, therapies address social, adaptive, communication, and sensorimotor skills via skills training, traditional special education support services (e.g., speech, occupational, and physical therapies), and a myriad of other methods, including less conventional ones such as diet, pharmacology, vitamin and herbal supplements, music therapy, and auditory integration therapy (Baranek, 2002; Goin-Kochel, Myers, & Mackintosh, 2007; Goldstein, 2002; Horner, Carr, Strain, Todd, & Reed, 2002; McConnell, 2002). In one study, parents of children with ASD reported having previously tried an average of 6.2 different treatments and that they were currently using an average of 3.6 treatments (Mandell, Novak, & Levy, 2005). In another study, parents reported having previously tried an average of 8 different treatments

and that they were currently using an average of 6.8 (Green et al., 2006). The variety of interventions and the number tried by parents could be indicative that treatment for ASD is not one-size-fits-all and that there is considerable interest in finding interventions and treatments that meet the individual needs of children with autism.

One such avenue is through the use of animals in therapy. There is preliminary evidence that therapies based on the human-animal bond can have positive effects on children with autism (Betts, 2008; Condoret, 1983; Heimlich, Schiro-Geist, & Broadbent, 2003; Law & Scott, 1995; Lukina, 1999; Martin & Farnum, 2002; Melson, 2005; Philippe, 1995; Redefer & Goodman, 1989; Sams, Fortney, & Willenbring, 2006; Servais, 1999). While benefits of hippotherapy (horses), dolphin therapy, and interaction with companion animals have been documented (Breitenbach, Stumpft, Fersen, & Ebert, 2009; Gasalberti, 2006; Lechner, Kakebeeke, Hegemann, & Baumberger, 2007; Lehrman & Ross, 2001; Macauley & Gutierrez, 2004; Maurer, 2009; Murphy, Kahn-D'Angelo, & Gleason, 2008; Sterba, 2007; Weiss, 2009), most of the literature about animal-assisted interactions with children with autism is based on using dogs as the agent of behavior change. There are fewer barriers to using trained dogs in various settings than other animals: they are more portable, trained to perform toileting activities only outside of buildings, and are more likely to be familiar to children in the United States. Thirty seven percent of U.S. homes have dogs as pets, with an average of 1.7 dogs per home (American Veterinary Medical Association, 2007b). With minimal interruption (compared to dolphins and horses) dogs can interact with children with autism in settings in which they are already comfortable.

Research has established that animals, particularly dogs, have positive effects on humans, both physiologically and psychologically (Albert & Anderson, 1997; Allen,

Blascovich, & Mendes, 2002; Allen, Blascovich, Tomaka, & Kelsey, 1991; Arambašic, Keresteš, Kuterovac-Jagodíc, & Vizek-Vidovic, 2000; Baun, Bergstrom, Langston, & Thoma, 1984; Beck & Katcher, 1996; Bryant & Donnellan, 2007; Charnetski, Riggers, & Brennan, 2004; Crawford, Worsham, & Swinehart, 2006; Friedmann, 1995; Friedmann, Katcher, Lynch, & Thomas, 1980; Friedmann, Katcher, Thomas, Lynch, & Messent, 1983; Lockwood, 1983; Messent, 1983; Nagengast, Baun, Megel, & Leibowitz, 1997; Odendaal, 2000; Shiloh, Sorek, & Terkel, 2003; Wood, Giles-Corti, Bulsara, & Bosch, 2007). There appear to be many benefits of involving dogs in activities that aim to increase skills in deficit areas in children with ASDs. Dogs can act as catalysts for social interaction (McNicholas & Collis, 2000; Messent, 1983; Veevers, 1985) and could serve as a focus for joint attention, the capacity of individuals to coordinate their visual attention with a social partner. There is also evidence to support gains in social skills and communication skills in children with ASDs as a result of canine-assisted interventions (Condoret, 1983; Esteves & Stokes, 2008; Heimlich, 2001; Heimlich, et al., 2003; Martin & Farnum, 2002; Philippe, 1995; Redefer & Goodman, 1989; Sams, et al., 2006).

Purpose of the Study and Hypotheses/Research Questions

Although there is a growing body of research about the human-animal bond, it is a field that is relatively young, having started in the first half of the 1970s (Hines, 2003). There is evidence that there are benefits to people in general and children specifically from pet ownership and animal interventions, but there is a paucity of research specific to how animals, specifically dogs, can be used to increase social and communication skills and decrease restricted repetitive stereotyped patterns of behavior, interests, and activities in children with autism or PDD-NOS. The purpose of this study was to investigate the effect of

semi-structured interaction with a dog on the social and communication skills and restricted repetitive stereotyped patterns of behavior, interests, and activities of elementary school-aged children with autism or PDD-NOS. Data collection included special education record review, demographic data collected from parents, low-inference direct observation via interval time-sampling, a behavior rating scale that was administered to parents across time, and a participant pet history, including allergies and phobias, collected from parents. The variables of interest were, together and separately, five attributes of behaviors characteristic of ASDs (Social Behavior, Non-Social Behavior, Self-Stimulatory Behavior, Social Communication, and Non-Social Communication) in and out of the presence of the dog collected via direct observation.

The research questions addressed were: (a) Do structured interactions with a dog increase social and communicative behaviors in children with autism or PDD-NOS? (b) Do structured interactions with a dog decrease restricted repetitive stereotyped patterns of behavior, interests, and activities in children with autism or PDD-NOS? It was hypothesized that, as measured by direct observation, interaction with a dog would increase social and communicative behaviors of students with autism or PDD-NOS directed toward the dog or adults and decrease restricted repetitive stereotyped patterns of behavior, interests, and activities.

CHAPTER II

LITERATURE REVIEW

History of the Human Animal Bond

Radiocarbon dating of the earliest unambiguous fossils of domestic dogs indicate that dogs and humans have lived together for approximately 13,000 to 17,000 years (Coren, 2006; Sablin & Khlopachev, 2002). Evidence of this companionship pre-dates evidence of organized agriculture by 3,000 to 7,000 years. Further archeological findings suggest that, even at this early date, dogs already were serving as guards and human companions (Beebe, 1980; S. J. M. Davis & Valla, 1978; Day, 1984; Tchernov & Valla, 1997). Thus, there is a long tradition of humans living with pets as well as living with animals in agricultural settings. In more recent history, 9th century citizens of Gheel, Belgium provided family care for people with disabilities, including the use of animals as an essential part of "therapie naturelle" (Catanzaro, 2003). The Society of Friends formed York Retreat in the 1790s as an alternative to the restraints and harsh drugs used in lunatic asylums of the day and used animals to help patients learn self-control and nurturing skills (Digby, 1984). In 1867, the Bethel Institution was founded in Bielefeld, Germany as a treatment center for people with epilepsy; animals were an integral treatment modality for patients there (Catanzaro, 2003). Laws enacted in the 19th century for the prevention of animal cruelty in the United Kingdom and the United States not only pre-dated, but prompted laws for the prevention of child cruelty (Coren, 2002; Harrison, 1972; M. S. Lane & Zawistowski, 2007; New York Society for the Prevention of Cruelty to Children, 2000). The human-animal bond (HAB) movement began in the 20th century with the establishment of the Joint Advisory Committee on Pets in Society in 1974 in the United Kingdom. Within eight years, ten additional advisory

committees, HAB research groups, and societies proliferated around the world (Hines, 2003). The International Association of Human-Animal Interaction Organization was founded in 1990 and has members in 19 countries.

Physiological and Health Effects of HAB

Research from the past 25 years suggests that animals have positive physiological and health effects on humans. An abundance of studies have found that companion animals have the effect of decreasing heart rate and blood pressure in people with whom they come in contact (Friedmann, et al., 1983; Nagengast, et al., 1997). In two studies, Allen and her colleagues hypothesized that, unlike human companions, animal companions serve better as non-evaluative others and, thus, are able to moderate the physiological effects of performing stressful tasks (Allen, et al., 2002; Allen, et al., 1991). They suggested that the presence of pet dogs and cats during the performance of stressful tasks provided non-evaluative social support that buffered physiological responses to stress. In a summary of health effects of pets, Beck and Katcher (1996) reported that, while talking to people usually raises blood pressure, sometimes to very high levels, the touch-talk dialogue we establish with pets reduces stress and lowers blood pressure. Further, they suggested that simply having a pet in a room makes people feel safe and reduces blood pressure. Another study reported that, while petting one's own dog, with whom there is an existing companion bond, results in a greater decrease in blood pressure than when petting a strange dog, there was no difference in heart rate or respiratory rate based on petting one's own dog versus a strange dog (Baun, et al., 1984). Charnetski, Riggers, and Brennan (2004) demonstrated that petting a dog had a positive effect on immune system function, as measured by Immunoglobin A (IgA), the most

prevalent immunoglobins in the body and the bloodstream, which underscores its importance as a first line of defense in the prevention of a wide variety of pathologies.

Based on the theory behind the Latin term *attentionis egens,* Odendaal (2000) measured specific neurochemical plasma levels as indicators of physiological responses associated with positive human-dog interaction. *Attentionis egens* is the need for attention on a normal, basic emotional level that is necessary for successful social interaction. Odendaal opined that social systems can be interspecies in nature and, as such, companion animals can serve a role in fulfilling social and emotional needs in humans and vice versa. In fact, when this relationship is in equilibrium, it becomes socially symbiotic and can be beneficial to both humans and animals. He theorized that the fulfillment of *attentionis egens* explains the positive effects of animals in human therapies and that the success is reinforced because of its positive feedback system. After interacting positively, hormones and neurotransmitters involved in social interaction and bonding (β-endorphin, oxytocin, prolactin, phenylacetic acid [a metabolite of β-phenyethylamine], and dopamine) increased statistically significantly in both humans and animals. Cortisol decreased statistically significantly in humans, although the decrease in dogs was not statistically significant. Positive dog interaction can be as relaxing and stress relieving as quiet book reading (the control condition) and, in some aspects, adds more positive effects such as those caused by increases in oxytocin, prolactin, and β-endorphin levels. Further, the results suggested that physiological effects can be achieved within between 5 and 24 minutes of positive dog interaction, which indicates that shorter sessions are sufficient.

Psychological Effects of HAB

In addition to physiological effects, exposure to and interaction with animals can also have positive psychological effects on humans. In their summary, Beck and Katcher (1996) presented the following research results: pet owners talk to their pets as if they were people and the way people talk to cats, dogs, and birds resembles the way we talk to infants; pets can coax smiles and words out of socially withdrawn institutionalized patients of all ages; pets can help psychotherapy progress faster; and, in children, carefully controlled studies have shown that contact with pets and nature can reduce symptoms of Attention Deficit/Hyperactivity Disorder (ADHD). Shiloh, Sorek, and Terkel (2003) demonstrated that, regardless of whether it was a rabbit or a turtle, a short period of petting an animal resulted in reduced state-anxiety in individuals in a stressful situation. The same effects did not hold when participants petted a toy rabbit or a toy turtle, thus, it seems that touching another living thing (pets and humans) results in positive feelings and reduces stress, pain, and anxiety. The authors suggested an "attentional shift hypothesis," in which pets distract attention from an anxiety-generating stimulus, helping alleviate the anxiety. They said that pets are ideal distracters because of their appealing characteristics; they are complex, unpredictable, interactive, and operate on tactile, auditory, visual, and, probably, other levels.

The psychological effects of pet ownership have a large amount of support in the literature. A relationship with pets can decrease stress, depression, anxiety, and loneliness and increase general psychological wellness (Crawford, et al., 2006). The results of suburban focus groups in Perth, Australia indicated that the odds of frequently feeling lonely were twice as high among non-pet owners than among pet owners and that pet owners were more likely to "rarely or never" find it hard to get to know people (Wood, et al., 2007). Among

children in war-torn Croatia, owning a pet, particularly a dog or cat, had a protective effect against post-traumatic stress reactions (PTSR) (Arambašic, et al., 2000). Compared to children without pets or with pets other than cats and dogs, children with dogs and/or cats expressed emotions, sought social support, and problem solved more often. Children with dogs and/or cats appeared to have a larger repertoire of coping strategies, which may be helpful in reducing PTSR. Among undergraduate students, pet dogs were rated lower than other humans as attachment figures, based on Ainsworth's theory of attachment, yet still compared favorably to fathers and siblings on the attachment feature of proximity maintenance (Kurdek, 2008). Maintaining proximity to pet dogs may be prompted by the dogs' uncritical and unconditional providers of acceptance and affection. Bryant and Donnellan (2007) hypothesized that the feelings of pride, nurturing companionship, and relationship exclusivity with intimacy (i.e., a pet might serve as a target for exclusive and intimate self-disclosure) that can come from pet ownership can moderate the relationship between socio-economic status (SES) and aggressive styles of conflict resolution. Consistent with their hypothesis, the relation between self-enhancing experiences with pets and a decrease in anger retaliation was stronger for boys with socioeconomic concerns than boys without such concerns. Using a projective measure with pictures of people associated with pets or wild animals, Lockwood (1983) found a general tendency of study participants to interpret people with animals in a more positive light than when the pictures did not have the animals.

Pet ownership can also positively affect family interaction. The results of Albert and Anderson's (1997) telephone survey of 85 married adults in Rhode Island indicated that (a) dogs are more popular than cats, (b) compared to cats, dogs are perceived by their owners as

having a larger effect on promoting morale and positive interaction among family members, and (c) dog owners tend to view their pets as helping family members cope with major and minor stressful events and as promoting positive interaction in the family. Similarly, Tannen (2004) reported that families use pets as resources in mediating interactions with each other, using their dogs to buffer criticism, effect frame shifts, deliver praise, teach values, mediate or avoid conflict, and both reflect and constitute familial identities.

Friedman (1995) summarized these physiological and psychological effects of human-animal interaction:

> The hypothesis that friendly animals can decrease anxiety and sympathetic nervous system arousal by providing a pleasant external focus for attention, promoting feelings of safety, and providing a source of contact comfort has been supported by much of the research conducted to date. Both the presence of a friendly animal and interacting with it have significant short term influences on physiological (i.e., blood pressure) and psychological (i.e., anxiety) indicators of stress. The presence of a friendly animal has significant impact both on pet owners and non-owners (p. 51).

Companion Animals as Social Catalysts

Companion animals also serve as catalysts for social interaction or act as "social lubricants." Generally, the terms "companion animals" and "pets" are used interchangeably (B. Beaver, personal communication, May 6, 2010). Messent (1983) found that, even when walking in an unfamiliar location, the presence of a dog significantly increases the likelihood of contact between a stranger and the dog owner. Owners are looked at and greeted more frequently and are engaged in more and longer conversations with strangers. Eventually, some of these contacts can evolve into friendships when owners with their dogs on their

routine walks encounter and socialize with others using the same area. Veevers (1985) found that companion animals provide a medium of expression for the personality and preferences of the owner, e.g., different characteristics may be ascribed to poodle owners than spaniel owners. Regardless, the results indicated that a person with a pet is believed to be somehow nicer than one who does not have a pet. For some people, animals provide a supplement or alternative to human companionship. Thus, being with a pet appears to increase a person's social visibility and facilitates sociability.

The Impact of Animals on Child Development

Companion animals can positively influence children's development in the areas of perception, cognition, and social and emotional growth. As living beings with their own agendas, companion animals are capable of being continuously fresh and novel stimuli for children; as such, they are likely to engage and sustain children's attention and pique their curiosity (Kidd & Kidd, 1987a; Melson, 2003; Prothmann et al., 2005). Melson (2003) cited companion animal behaviors as being characteristic of Piaget's "engine of all learning," i.e., cognitive incongruity, moderate discrepancy from established schema, and novel information (p. 34). She further invoked Vygotsky's concept of cultural mediation (Cole & Wertsch, 1996), suggesting that companion animals are likely powerful motivators for learning because children learn and retain more about subjects they are emotionally invested in and children's learning is most efficient when it occurs within meaningful relationships. There is evidence that pets may help children develop more sophisticated social behaviors and nonverbal communication skills and, thus, to have better overall communication skills in and be more socially integrated with their environments (Filiâtre, Millot, Montagner, Eckerlin, & Gagnon, 1986; Guttman, Predovic, & Zemanek, 1983; Kidd & Kidd, 1987a; Nielsen &

Delude, 1989; Poresky, 1996; Poresky & Hendrix, 1989, 1990; Poresky, Hendrix, & Woroby, 1989). It is possible that pets may allow children to practice a variety of interactions that are later incorporated into other social relationships (Veevers, 1985).

Exposure to companion animals increases empathy and nurturance in children. Daly and Morton (2006) found that children who were highly attached to their pets were higher in empathy than those who were less attached and that children who have positive attitudes toward pets – as measured by the *Pet Attitude Scale* – are more empathic than those with less positive or negative attitudes. Melson's (1990) results suggested that attachment to pets promotes well-being and training in nurturing, as exhibited by empathy, during times that children are making difficult transitions. Further, it was determined that it is socially acceptable for boys to display nurturing toward animals, thus making affiliation between boys and companion animals a valuable source for expressing feelings that may be frowned on by the prevailing culture. The positive influence companion animals have on children's development can be adapted for use across settings.

Use of Animals in Schools to Promote Social and Emotional Learning

Animals can play an integral role in social and emotional learning in educational settings as well. There is a body of evidence that animals in classrooms increase students' empathy and sociability and decrease aggression. Using a year-long school-based humane education curriculum, Ascione (1992) investigated whether and how children's empathic tendencies related to the care and treatment of animals. Four general areas, i.e., human-animal relationships, pets or companion animals, wild animals, and farm animals, were inserted into regular instruction in language arts, math, social studies, health, and science. Results showed a clear generalization effect from animal-related attitudes to human-related

empathy in 4th grade children. In follow-up at one and two years after the intervention, attitudes of the experimental group were more humane than the control group. Although not as large as at Year 1 post-testing, intervention effects for human-directed empathy were still present at Year 2 post-test (Ascione & Weber, 1996). Using Witkin's theory of field dependence/field independence (Witkin, Dyk, Faterson, Goodenough, & Karp, 1962), Hergovich, Monshi, Semmler, and Zieglmayer (2002) found that the presence of a dog in the classroom did not affect sociability between the experimental and control groups, but that the children in the experimental group had significantly higher values on the scale that measured empathy, displayed greater field independence, and were rated by teachers as being significantly better integrated into the class group at the end of the experiment.

Studies that examine the effect of dogs in the classroom on increased empathy and decreased aggression have promising results. Healing Species is a private, nonprofit animal-assisted, school-based violence prevention/intervention and character education program that targets all students in schools' populations (i.e., not only "troubled" students) (Sprinkle, 2008). The basic premise of Healing Species is that the escalating cycle of aggression to violence can be interrupted through the use of animals to teach children how to identify and practice prosocial behaviors and how to be empathic. Lesson topics include grieving, empathy, self-responsibility, sharing, cooperating, and service to others. To evaluate its effectiveness, a group of 310 fourth, fifth, and sixth graders from four schools received the intervention, which is based on the theory of planned behavior and social learning theory. Results of this study indicated that the Healing Species curriculum resulted in an inverse relationship between empathy and aggressive behavior in students. According to the theory of planned behavior, it is likely that participants' resultant attitudes towards violence and

beliefs of aggression were altered as they learned empathy and ways to resolve conflicts without violence. Particularly, the dog's presence increased students' participation in the program by counteracting participant apathy.

There have been investigations to determine whether the critical variable is the presence of the dog or if structured social skills training or intervention is required. Tissen, Hergovich, and Spiel (2007) used the term *animal assisted education* to describe the benefits associated with the presence of animals in a scholastic setting. They investigated how the presence of dogs affected social skills training related to social behavior, empathy, and aggression in 3rd grade students. The results indicated that, while there was an explicit reduction in relational aggression in the "Social Training with Dogs" condition and a smaller magnitude reduction in the "Dog Attendance without Social Training" condition, there was no effect for "Social Training without Dogs." Thus, in this study, the presence of the dogs accounted for variance, with or without social training. In Kotrschal and Ortbauer's (2003) study, one of three dogs was present on a daily basis and was allowed to roam freely in a classroom with a culturally diverse population of young school children (mean age=6.7 years). Results showed that children showed considerable interest in the dog (e.g., watching, touching/stroking), yet paid more attention to the teacher when the dog was in the room. With the dog in the classroom, the children were more socially integrated and engaged in fewer vocal and provocative interactions over a distance. Children showed conspicuous and troublesome behavior less often and for shorter amounts of time and were significantly less aggressive when the dog was in the classroom. For some children, time spent in positive interaction with the dog simply took away the amount of time available to provoke their classmates. Overall, the dog's presence resulted in a decrease of negative and/or aggressive

behaviors, which led to increased social integration of the group. The authors concluded that "the use of dogs at schools would be a cheap and potentially easy means for counteracting individual child behavioral problems, for supporting social and cognitive development, for aiding social integration, and for improving teaching situations" (p. 157).

Animals and People with Disabilities

In addition to examining the effects of animals in general education settings, researchers have found evidence for positive effects of animals in special education settings. In a self-contained classroom of six children diagnosed with severe emotional and behavioral disorders (EBD) (i.e., children with diagnoses of oppositional defiant disorder, attention deficit/hyperactivity disorder, reactive attachment disorder, intermittent explosive disorder, central auditory processing disorder, mood disorder, bipolar disorder, and/or Asperger's Syndrome), Anderson and Olson (2006) found that having a dog present in the classroom contributed to (a) students' overall emotional stability, as evidenced by prevention and de-escalation of episodes of emotional crisis; (b) improved students' attitudes toward school; and (c) facilitated students learning lessons in responsibility, respect, and empathy. In another study, two boys placed in a self-contained classroom for students with EBD worked on training a dog, had therapeutic sessions with a therapist with the dog present, and created an oral presentation to share with peers in their own and other classrooms for students with EBD (Granger, Kogan, Fitchett, & Helmer, 1998). Data showed decreases in negative comments, distractibility, and learned helplessness, as well as variable decreases in pouting and tantrums. There were concomitant increases in the use of praise and positive comments, eye contact with others, and self-control over self and environment and variable increases in

age-appropriate behaviors. Further, there were improvements in tone of voice tone when speaking to others and in relationships with peers.

Limond, Bradshaw, and Cormack (1997) examined the differential effects of a live dog versus a toy dog (stuffed animal) on behaviors in children with Down syndrome. The children were more attracted to the live dog and were more responsive to the adult handler when the live dog was present. For example, in the toy dog condition, children ignored the adult and gave negative verbal responses more frequently. Frequency of verbal responses was similar in both conditions, but nonverbal responses to suggestions (e.g., stroking, brushing, or getting the leash when asked) concerning the dog were statistically significantly more frequent in the live dog condition. The children were both more attentive to the live dog and more responsive to the adult in the live dog's presence. Specifically, the participants were more likely to be cooperative when the live dog was present; the children responded to the handler positively more often when the handler's questions and suggestions concerned the live dog. The increase in prosocial behaviors was also directed toward the dog, as evidenced by more verbal and behavioral initiations directed toward the live dog than the toy dog. The live dog appeared to provide a more positive and sustained focus of interest for interactions over the six-week span of the study.

In addition to companionship, animals can serve in multiple roles for people with disabilities, including as service animals and components of therapy. Hippotherapy (therapy using horses) and dolphin therapy may benefit people with disabilities physically by helping with proprioception as well as fine and gross motor skills; these therapies also help with social-emotional development, as caring for the animals and engaging in recreational activities can help boost self-esteem (Apel, 2007; Cawley, Cawley, & Retter, 1994;

Nathanson, 1998; Nathanson, de Castro, Friend, & McMahon, 1997; Nathanson & de Faria, 1993; Servais, 1999). More than just guide dogs for people who are deaf/hard-of-hearing or visually impaired/blind, dogs serve in many roles as service animals, such as seizure-alert dogs, mental health dogs, and physical assistance dogs for people with orthopedic impairments (B. W. Davis, Nattrass, O'Brien, Patronek, & MacCollin, 2004).

In addition to physical assistance, dogs serve as catalysts for social interaction for people with disabilities. Surveys of children and adults with service dogs found that respondents indicated that dogs facilitated social interaction, improved quality of life, improved the quality of interactions with others, became constant friends of those who are often alienated due to their disabilities, and created perceptions of an overall better social life than before the dog arrived (B. W. Davis, et al., 2004; D. R. Lane, McNicholas, & Collis, 1998). Two studies that used direct observation of the effect of service dogs on people who use wheelchairs for mobility found that the presence of the service dog increased social interaction by acting as a social lubricant (Eddy, Hart, & Boltz, 1988; Hart, Hart, & Bergin, 1987). There were more social approaches from passers-by toward participants with dogs than those without and there were more clear episodes of passer-by gaze-avoidance or path aversion occurring with participants without dogs than those with dogs. Further, there are emotional and developmental benefits of interaction with dogs for people with disabilities. Dogs can provide focus, comfort, esteem, and support; be agents for soothing or calming; moderate moods; decrease aggression and pathological behaviors; increase independence; and be available for close affectionate relationships (B. W. Davis, et al., 2004; Heimlich, 2001; D. R. Lane, et al., 1998).

Animal-Assisted Therapy/Animal-Assisted Activities: Theory and Practice

Boris Levinson (1961) is the psychotherapist who is credited with first publishing the hypothesis that there may be benefits of animal-assisted therapy when he witnessed the positive effects his pet dog, Jingles, had on an eight year-old boy who had been "unsuccessfully treated over a long period of time" (p. 60). At first, the boy interacted only with Jingles, but gradually over the course of subsequent sessions, he allowed Levinson to participate in the play, which established rapport between therapist and client and enabled the therapeutic process. From that point, he offered interaction with Jingles to his other child clients and enumerated some of the roles a dog can play with a child:

> The dog can be and often is a companion, friend, servant, admirer, confidante, toy, teammate, slave, scapegoat, mirror, trustee, or defender for the child. When a child needs to love safely, without fear of losing the loved object and without losing face, the dog supplies this need. When a child craves a close, cuddly, affectionate, nonjudgmental relationship, the dog can provide it. Dogs can't "talk back" when yelled at by a child. And no human being can offer to the child more general "acceptance," in its fullest multiordinal levels of meaning, than the faithful dog, for whom the master can do no wrong (p. 61).

Kruger and Serpell (2006) characterize the current state of animal-assisted interventions as "a category of promising complementary practices that are still struggling to demonstrate their efficacy and validity" (p. 21). The term "animal-assisted therapy" is used to describe a myriad of activities that may or may not qualify as truly therapeutic endeavors (Kruger & Serpell, 2006; LaJoie, 2003). The Delta Society (2003), which is one of the largest organizations responsible for certification of therapy animals in the United States, has

published definitions of animal-assisted activities and animal-assisted therapy that are also endorsed by the American Veterinary Medical Association (2007a):

- Animal-assisted activities (AAA) provide opportunities for motivational, educational, recreational, and/or therapeutic benefits to enhance quality of life. AAA are delivered in a variety of environments by specially trained professionals, paraprofessionals, and/or volunteers, in association with animals that meet specific criteria.
- Animal-assisted therapy (AAT) is a goal-directed intervention in which an animal that meets specific criteria is an integral part of the treatment process. AAT is directed and/or delivered by a health/human service professional with specialized expertise, and within the scope of practice of his/her profession.AAT is designed to promote improvement in human physical, social, emotional, and/or cognitive functioning. AAT is provided in a variety of settings and may be group or individual in nature. This process is documented and evaluated (p. 49).

Just as there is no single theory that explains all of the facets of human interaction, there are multiple theoretical possibilities that add to the understanding of the human-animal bond and its application to AAA/AAT. In their review, Kidd and Kidd (1987b) explained how various areas of psychology can contribute to theoretical models of human-animal interaction. They offered examples of developmental psychology models based on both touch and play. There is empirical support for the benefits of human touch; it follows, then, that physical contact with animals (i.e., touching or being touched by animals) may produce similar benefits. Kidd and Kidd also cited examples of studies that said that play allows people of all ages to have a respite from life's stressors. Frequently, pets are considered to be companions or playmates that can be motivators for (a) play and (b) experiencing and being

reminded of some of the pleasures in life. Social psychology can offer explanations about pets as social lubricants that facilitate, maintain, and extend social interactions between people (Hart, 2006; McNicholas & Collis, 2000; Messent, 1983; Veevers, 1985; Wells, 2004; Wood, et al., 2007).

Kidd and Kidd also pointed out that the field of ethology (the study of animal behavior) focuses on nonverbal social behaviors. Darwinism considers "the human as animal" and this field may be in a prime position to explain a relationship that cannot be based on verbal language, since the players do not speak the same language (Herzog, 2002; Melson, 2002; Serpell, 2005). This could be why humans may find primal pleasure by allowing themselves to simply "be" with companion animals. Wilson's (1984) biophilia hypothesis suggests that humans have evolved to attend to and be attracted to other living organisms. Kahn (1997) explained that the biophilia hypothesis "asserts the existence of a fundamental, genetically based, human need and propensity to affiliate with life and life-like processes" (p. 1).

Brickel (1982) suggested competing-response theory, which comes under the umbrella of learning theory, as one explanation. Using arguments similar to the attentional shift hypothesis (Shiloh, et al., 2003), this theory posits that shifting attention to pets instead of anxiety-provoking stimuli can allow individuals to decrease their feelings of anxiety, which allows a greater feeling of self-control over anxious feelings. Thus, pets offer a competing, calming response to feelings of anxiety. Over time, the individual learns that pets help decrease anxiety, which consequently increases feelings of self-control of one's emotions, which reinforces the individual's bond with the animal.

Additional theories suggest that interacting with animals affects humans by decreasing anxiety levels and increasing social bonding. Wilson (1991) found that petting a friendly dog had a relaxing or anti-anxiety effect similar to other relaxation activities such as quiet reading. This effect was independent of participants' pet ownership. Odendaal (2000) found that social bonding neurochemical changes were similar when people engaged in quiet reading and when they had positive interactions with dogs. The exceptions were increases in oxytocin, prolactin, and β-endorphin in the dog condition. All three neurotransmitters are associated with social bonding, but oxytocin has been identified as being primary (Carter, Williams, Witt, & Insel, 1992; Heinrichs, von Dawans, & Domes, 2009; Insel & Young, 2001; Kikusui, Winslow, & Mori, 2006; Pedersen, Ascher, Monroe, & Prange, 1982; Young & Wang, 2004; Young, Wang, & Insel, 1998) and also has anxiolytic (anti-anxiety) properties (DeVries, Glasper, & Detillion, 2003; Ebner, Bosch, Krömer, Singewald, & Neumann, 2005; Haller et al., 1996; Neumann, 2002; Neumann, Krömer, Toschi, & Ebner, 2000). As stated previously, Shiloh et al. (2003) suggested an "attentional shift hypothesis," in which pets distract attention from an anxiety-generating stimulus, helping alleviate the anxiety. Pets are ideal distracters because of their appealing characteristics; they are complex, unpredictable, interactive, and operate on tactile, auditory, visual, and, probably, other levels. Combining the biophilia hypothesis and evidence of animal's anti-anxiety effects, Kruger and Serpell (2006) stated, "Clinically speaking, it is hard to imagine a better pairing of attributes – a tool that can simultaneously engage and relax the patient" (p. 26).

Because companion animals are parts of our environments, theories such as contextualism (Dixon & Lerner, 1983), ecological systems theory (Bronfenbrenner, 1977), and dynamic systems theory (Thelen, 2000) can provide insight about the human-animal

bond (Melson, 2002). Each of these focuses on the interaction of individuals and their respective environments and offer platforms from which to extend scientific inquiry to examining the human-animal relationship as its own interdependent system. Finally, attachment theory (Bowlby, 1982) has been offered as an explanation for the human-animal bond. Although Kidd and Kidd (1987b) were dismissive of animals as viable attachment figures, Kurdek (2008) found evidence that pets can serve as important figures in the lives of college students.

Using Animals with Children with Autism Spectrum Disorders

As noted earlier, a significantly increasing number of children are being diagnosed with ASD, which is characterized by deficits in social and communication skills. There is support that interaction with companion animals can facilitate development in these areas in children with ASD. Davis et al. (2004) reported that questionnaire responses referenced particular emotional and developmental benefits relevant to children with ASD. Specifically, respondents indicated that pediatric assistance dogs are often used as metaphors to help explain social situations, which can broaden emotional experience and range. Further, respondents noted that the assistance dogs provided a way for children with ASD to learn about living beings, feelings, and needs.

Studies that had children with ASD as participants or that focused on behaviors particularly relevant to children with ASD found that dogs can serve to increase social and communication skills while decreasing maladaptive skills, such as self-stimulatory behaviors and distractibility. With regard to communication skills, in the presence of dogs, children with ASD were more likely to initiate and engage in verbal interactions with adults and dogs and to agree to a request from the adult in the presence of the dog (Filiâtre, Millot, &

Montagner, 1986; Martin & Farnum, 2002; Sams, et al., 2006). Condoret (1983) eloquently explained:

> The display of emotion which is evoked by the presence of an animal can be considered as a facilitator of speech acquisition. The desire to communicate with animals appears to be one of the motives for acquiring language. There is, at this level, an ambiguity, even a paradox, which should be clarified: the animal, who does not speak, allows the child to speak. This phenomenon can make certain prolix educators or talkative parents wonder. (p. 468)

Heimlich, Schiro-Geist, and Broadbent (2003) speculated that the dog may act as a motivator for the child to use the language skills that he or she has, but uses infrequently or not at all. Further, children with autism spoke less about tangential topics when the dog was present compared to when the dog was not present. This finding is consistent with others that indicate that the presence of the dog appears to focus the children's attention, help regulate interactions, and decrease anguish and self-absorption, all of which could contribute to a more structured and socially efficient behavioral repertory (Filiâtre, Millot, & Montagner, 1986; Heimlich, et al., 2003; Martin & Farnum, 2002; Philippe, 1995; Redefer & Goodman, 1989).

Dogs also served to increase positive child-initiated social interactions toward adults and dogs, playful moods, and energy levels (Esteves & Stokes, 2008; Martin & Farnum, 2002; Sams, et al., 2006). Redefer and Goodman (1989) suggested that the dog served to "prime" children with autism so that they were better able to participate in and enjoy social interactions. There are reports that these gains remained evident even after the sessions with the dogs were over (Esteves & Stokes, 2008). Prothmann, Ettrich, and Prothmann (2009)

found that, when given a choice between interacting with a dog, an adult, or inanimate objects, children with autism chose to interact with the dog twice as often as with the adult and 16 times as often as the objects. Further, they interacted with the dog four times as long as with the adult.

Temple Grandin (2005), a noted animal scientist who has autism, suggests that the frontal lobes of people with ASD do not work as well as those of typically developing people and, thus, the brain function of people with ASD "ends up being somewhere between human and animal" (p. 57). She says,

> Autistic people can think the way animals think. Of course, we also think the way people think – we aren't *that* different from normal humans. Autism is a kind of way station on the road from animals to humans, which puts autistic people like me in a perfect position to translate "animal talk" into English (p. 6).

Consistent with Grandin's position, the nonverbal and nonjudgmental nature of dogs may be non-threatening and easier for children with ASD to decode, which may decrease anxiety and increase social bonding. Further, with their roles as social lubricants/transitional objects and, according to the biophilia hypothesis, natural foci of interest, dogs may facilitate social interaction between children with ASD and other people. There is evidence that anxiety is frequently co-morbid with ASD (Bellini, 2004; Chalfant, Rapee, & Carroll, 2007; T. E. Davis et al., 2010; Lang, Regester, Lauderdale, Ashbaugh, & Haring, 2010; Skokauskas & Gallagher, 2010; White et al., 2010); the DSM-IV-TR includes "excessive fearfulness in response to harmless objects" as an associated feature of ASD (American Psychiatric Association, 2000, p. 72). Consistent with increased anxiety and decreased social bonding, deficits in oxytocin have been demonstrated in people with ASD (Guastella et al., 2010;

Heinrichs, et al., 2009; Rossignol, 2009; Strathearn, 2009; Wermter et al., 2010). There is support that positive interactions with dogs decreases anxiety in humans, with associated increases in oxytocin levels, which is also indicated as an important neurotransmitter involved in social bonding. (Brickel, 1982; Carter, et al., 1992; DeVries, et al., 2003; Ebner, et al., 2005; Haller, et al., 1996; Heinrichs, et al., 2009; Insel & Young, 2001; Kikusui, et al., 2006; Kruger & Serpell, 2006; Neumann, 2002; Neumann, et al., 2000; Odendaal, 2000; Pedersen, et al., 1982; Shiloh, et al., 2003; C. C. Wilson, 1991; Young & Wang, 2004; Young, et al., 1998). The apparent state-changes elicited by interacting with dogs (decreased anxiety and increased social bonding) may clear the way for children with ASD to employ dogs as social lubricants or transfer objects as a means of increasing social interaction and communication with others while decreasing restricted repetitive stereotyped patterns of behavior, interests, and activities.

Summary

There is quite a bit of evidence that supports the positive benefits of human interaction with animals, particularly companion animals. Across the spectrum – young to old, people with disabilities and people without, people in good health and bad – and in multiple settings, there seems to be a symbiotic relationship between humans and animals, particularly dogs, that has existed for thousands of years. Many of the benefits of interacting with dogs, such as increased social interaction, increased empathy skills, motivators for language production, and decreased levels of anxiety and stress, may directly impact deficit areas in children with ASD. Not all families are in a position to have companion animals in the home, so inserting dogs into home or school settings may allow children with ASD to experience gains in social and communication skills, regardless of pet ownership status.

Also, parents may not consider using pet dogs in focused attempts to engage with their children. A visiting dog program alleviates the burden of animal care while allowing children with ASD to experience benefits of interacting with dogs in a structured format.

CHAPTER III

METHODS

Participants

Participants were two boys and one girl who were recruited via local parent groups for children with autism spectrum disorders (ASD) in a small metropolitan area. All participants had functional expressive and receptive verbal skills. "Alex" was a 9 year-old (9 years, 1 month old at study onset) White male who was diagnosed with autism at 4 years of age by a developmental pediatrician. He lived in a single family home with his parents, his 12 year-old typically developing brother, and a dog. He attended school in the local public school district and received special education services as a student who met eligibility criteria for autism. The most recent measure of cognitive ability was administered when he was 7 years-old. His composite score on the *Comprehensive Test of Nonverbal Intelligence* was 67. No chronic health conditions were reported.

The other two participants, "Ben" and "Cara," were siblings. They lived in a single family home with their parents and their brother, who was Ben's neurotypical fraternal twin. The family had many pets: one outside dog, one inside dog, three cats, one hamster, one guinea pig, and fish. Ben was a 7 year-old (7 years, 4 months old at the onset of the study) White boy who was diagnosed with Asperger's disorder at the age of 5 years, 7 months by a licensed psychologist in the local school district, although he reportedly had a language delay before the age of 3 years. At the time of data collection, there was no formal measure of cognitive ability, although his abilities were reported by a Licensed Specialist in School Psychology to be in the average range. Ben and his twin brother were born at 37.5 weeks gestation and Ben was diagnosed with intrauterine growth retardation. No chronic health

conditions were reported, although he took Strattera (atomoxetine HCl) to treat symptoms of attention deficit/hyperactivity disorder.

Cara was a 10 year-old (10 years, 7 months old at study onset) White girl with a diagnosis of pervasive developmental disorder - not otherwise specified (PDD-NOS) that was made when she was 4 years, 10 months old by a licensed psychologist who works for a local school district. Her most recent measure of cognitive ability was conducted at 10 years, 6 months and the results were highly variable (*Wechsler Intelligence Scales for Children, 4th edition* Full Scale Score = 93, Verbal Comprehension Index = 87, Perceptual Reasoning Index = 121, Working Memory = 86, and Processing Speed = 83), but her overall cognitive functioning fell in the low average to average range. She was diagnosed at 7 years of age with precocious puberty and adrenal androgen over-production; at the time of the study, she took Lupron (leuprolide) and daily steroids. She also took Strattera (atomoxetine HCl) to treat symptoms of attention deficit/hyperactivity disorder. Cara was very interested in animals of all kinds and liked to draw.

Both families had family pets, including dogs that lived inside; however, it is unlikely that the presence of pets in the homes had an effect on the data. There is evidence that attachment to a pet or bonding with a pet is a more valid and reliable predictor of outcomes than simple pet ownership (Beck & Katcher, 2003; Crawford, et al., 2006; Hyde, Kurdek, & Larson, 1983; Lawrence, 1987; Melson, 1991; Paul & Serpell, 1996; Risley-Curtiss, Holley, & Wolf, 2006; Zasloff, 1996). Pet attachment was not measured in this study.

Canine Visitor/Handler Teams

Two dog and handler teams were recruited via a local Animal-Assisted Activities group. The dogs had passed temperament testing and were up to date on all shots, screened

for zoonotic diseases, and had current veterinary certificates of health. "Polly" was a 5 year old terrier mix who was certified as a canine visitor; canine visitors simply visit individuals or groups without specific goals set for the patients or clients. The animals' role is to simply interact with people. "Danny" was a 9 year-old long-haired dachshund who was a certified therapy dog. Although Danny served as a canine visitor for the purposes of this study, he had achieved a higher level of qualification and had been used to help patients and clients work towards and achieve specific goals in physical, occupational, and speech therapy. A third dog, "Buster," a 5 year-old Labrador retriever, substituted for Polly for two of Ben's sessions and one of Cara's when Polly's handler was unavailable.

Instruments

Data collection was in the following forms: (1) low-inference direct observation; (2) parent perceptions of behavior as measured by the *Social Responsiveness Scale*, (3) special education record review, and (4) demographic data collected from parents. Direct observation was completed with partial interval recording on a hardcopy data collection form (see Appendix B) that contained a minute-by-minute grid for 14 behaviors for 15-minute long data collection sessions.

Data Collection Form

The data collection form was developed by the researcher for use in this study and included both positive behaviors and negative behaviors.

Positive behaviors. Positive behaviors were selected based on low-inference observable behaviors characteristic of DSM-IV-TR (2000) diagnostic criteria of ASD in the areas of socialization and communication. They were separated into two categories: social behavior and social communication. Social behaviors were those that were generally

reciprocal in nature, but did not require a communicative component. Social communication was characterized as verbal or non-verbal reciprocal communication that was directed at another, i.e., it was recognizable as a communication attempt that was contextual and not about tangential topics that were not related to activities or conversations during the session. Social behaviors were:

- Stroking/petting/cuddling: the student engaged in gentle physical contact with the dog in the form of gentle strokes or pats or close bodily contact with the dog;
- Engaged social play: the child engaged in a series of interactions with a human or dog in a range of voluntary, intrinsically motivated activities that were normally associated with pleasure and enjoyment for a minimum of 10 seconds;
- Eye contact: the student looked into the eyes of a human or dog for at least two seconds;
- Joint attention: the student coordinated or shared attention with a social partner regarding an object or event by following the gaze of others and/or by using his or her own eye contact and gestures to show or direct the attention of the people around him or her;
- Smiling: the student displayed a facial expression characterized by flexing the muscles near both ends of the mouth and contracting the muscles of the cheeks and eyes, creating “crow’s feet” at the outer corners of the eyes; and/ or
- Laughing: the student laughed or giggled during a social interaction.

Social communication behaviors were:

- Expressive To: the student directed verbal or manual language toward another (human or dog);

- Nonverbal: the student directed nonverbal communication (e.g., gestures or facial expressions) toward another (human or dog); and/or
- Receptive: the student responded appropriately to directions or questions.

Negative behaviors. Negative behaviors were selected based on low-inference observable behaviors characteristic of DSM-IV-TR diagnostic criteria of ASD. They were separated into three categories: non-social behavior, self-stimulatory behavior, and non-social communication. Non-social behaviors were those that were not reciprocal in nature and were to the exclusion of others. Non-social behaviors were:

- Looking around the environment: the student's gaze was directed away from him- or herself, but was not directed toward the face of another human or the dog and
- Solitary activity: the student engaged in an activity to the exclusion of others (human or dog).

Self-stimulatory behavior was defined as: the student engaged in repetitive body movements or repetitive movements of objects (e.g., hand flapping, finger flicking, body rocking, staring at lights).

Non-social communication was verbal output that was not directed at another and/or contained tangential, non-contextual topics that were not related to activities or conversations during the session. Non-social communication was:

- Expressive About: the student commented about another (human or dog), object, school, or an unrelated topic, but the speech was not directed toward another (human or dog) or apparently relevant to the current setting (e.g., apropos of nothing, the student focused on the topic of local post office locations) and

- Echolalia: the student engaged in the immediate repetition of other's or his or her own vocalizations or the echoing of a phrase after some delay or lapse of time.

Social Responsiveness Scale

Parent perceptions of behaviors were captured the *Social Responsiveness Scale* (SRS), a 65-item questionnaire that is used to screen for and assist in diagnosis of autism spectrum disorders and to measure the progress of children with ASD in response to intervention (Constantino & Gruber, 2005). The SRS is completed by people familiar with the individual children such as parents and teachers, who have observed the children in natural social settings. It can be completed in 15-20 minutes and scored in 5 minutes by professionals who have education, training, and experience with ASDs and in the use of psychological tests. Items are rated using a 4-point Likert scale, which allows for raters to communicate degrees of severity of behaviors. The items include domains of interpersonal behavior, communication, and repetitive/stereotypic behaviors associated with ASDs. The SRS yields an overall score and five treatment subscale scores. The SRS subscales are: Social Awareness, Social Cognition, Social Communication, Social Motivation, and Autistic Mannerisms. Social Awareness measures the ability to pick up on social cues; items on this subscale represent the sensory aspects of reciprocal social behavior. Social Cognition is the ability to interpret social cues once they are picked up and represents the cognitive-interpretive aspects of reciprocal social behavior. Social Communication includes expressive social communication and represents the "motoric" aspect of reciprocal social behavior. Social Motivation measures the extent to which a respondent is generally motivated to engage in social-interpersonal behavior; elements of social anxiety, inhibition, and empathic orientation are included among these items. Autistic Mannerisms includes stereotypical

behaviors or highly restricted interests characteristic of autism. Raw scores are converted into *T*-scores. Total *T*-scores of 76 and higher fall into the severe range and suggest the presence of an autism spectrum condition. *T*-scores of between 60 and 75 are in the moderate range and may suggest presence of mild ASDs such as PDD-NOS or Asperger's disorder. Scores of 59 or less are in the normal range and suggest the absence of an ASD.

Standardization of the SRS was conducted in five different studies over a period of 10 years. The standardization sample included 1,636 individuals from two large diverse metropolitan areas in the western and mid-western United States (Constantino & Gruber, 2005; Conway, 2010; Venn, 2010). The manual does not provide thorough details about the norm development process. The norms were developed from studies that were not designed to yield normative information, e.g., three epidemiological studies that used random samples of more than 800 twins that were conducted to investigate intergenerational transmission of autistic traits rather than for normative research. Finally, the samples were from limited areas of the United States and may not be representative of the general population. Conway (2010), however, suggested that the SRS's psychometric properties, such as rigorous reliability and validation efforts, compensate for any questions that may have arisen during its development.

Evidence of reliability was based on three types of reliability: internal consistency of scores, construct temporal stability, and inter-rater reliability. The internal consistency study estimated split-half reliability using ratings from more than 1,000 parents and 500 teachers. The alpha coefficients from this study for Total *T*-scores were .93 and .94 from the parent ratings and .97 and .96 from the teacher ratings (Constantino et al., 2003). Another investigation of internal consistency came from a clinical sample of 281 children with and

without ASDs who received psychiatric services yielded a coefficient of .97 (Constantino, Przybeck, Friesen, & Todd, 2000). These data provide strong evidence to support the split-half reliability of SRS total scores. Alpha coefficients for SRS subscale scores were not as strong; they ranged from .77 to .92 with a median coefficient of .87. Construct temporal stability was measured by having the same raters rate the children at two points in time that were an average of 17 months between the two administrations. With a sample of 379 children (102 boys and 277 girls) who were twins, the re-test temporal stability for the parent report SRS scores yielded correlations of .85 for the boys and .77 for the girls. Inter-rater reliability was calculated based on mothers', fathers', and teachers' ratings of 62 children. The correlation coefficient was .91 between mothers and fathers, .82 between mothers and teachers, and .75 between fathers and teachers (Conway, 2010; Venn, 2010).

Evidence of validity of SRS scores was investigated in several studies; these include an investigation of reciprocal social behavior, a concurrent validity study, studies of the effectiveness of the SRS as a measure of traits characteristic of autism, and an examination of the validity of SRS subscale scores. Discriminant validity was investigated in a study of 158 children with psychiatric diagnoses (including ASDs) and 287 randomly selected children from a midwestern metropolitan school district. Elevated scores on the SRS were associated with diagnoses on the autism spectrum, but not with other psychiatric conditions (single factor ANOVA: $F = 11.69$, $df = 4.75$, $p < .000001$) (Constantino, et al., 2000). The SRS demonstrated concurrent validity with the *Autism Diagnostic Interview-Revised* (ADI-R); there were statistically significant differences in mean scores between children with developmental disorders and children with an ASD diagnosis ($F = 72.95$, $df = 2, 58$; $p < .0001$) (Constantino, Davis, et al., 2003). Structural validation of the SRS as a quantitative

measure of ASD traits has been supported by evidence of its genetic component in a large epidemiological sample that was comprised of 1,576 twins (Constantino & Todd, 2003). Deficits in social behavior, verbal communication, and stereotypic repetitive behaviors were found to be present consistently in twins. Treatment subscales were added to the SRS after it had been validated. Specific symptom domains were established and shown to be reliable through internal consistency measures, which ranged from .77 to .92 (Venn, 2010). The developers also used data from other studies to establish the effectiveness of the SRS as a measure of the construct of ASD traits (Constantino et al., 2004; Constantino, Hudziak, & Todd, 2003; Constantino & Todd, 2000, 2003). The SRS developers suggest that the results from these investigations support the existence of a single, continuously distributed underlying factor that explains most of the variance in SRS scores. Thus, they concluded that the SRS is an effective measure of overall ASD traits in children.

Procedures

Permission to work with human participants was obtained from the university's Institutional Review Board (IRB). Upon approval from the IRB, the experimenter solicited participants via community resources, including a parent group for children with ASD. The consent form contained a brief description of the study and ascertained information about pet ownership history and possible exclusionary criteria (i.e., Asperger's disorder, Rett's syndrome, childhood disintegration disorder, tuberous sclerosis, and seizure disorder that is not controlled by medication).

Baseline Procedures

The experimenter interviewed the mothers of the three children before data collection began. Study sessions for Alex took place in the family's living room, which was free from

distractions such as televisions or toys. Study sessions for Ben and Cara took place in the twins' bedroom, which was judged to be the location with the fewest distractions and had a door that could be closed for privacy. There was not an opportunity to visit with study participants before data collection began. Participants were engaged in 15-minute sessions at generally the same time of day (± 1-2 hours in the late afternoon or early evening) three times per week; the time of day was determined individually for each child/family, based on their needs and schedule. The experimenter and behavior rater arrived at the same time and went with the participants into the designated data collection area. The raters were instructed to not initiate interaction with the child, but were free to respond briefly to the child if spoken to. The experimenter carried a basket with an assortment of toys (e.g., balls, plush toy dog), developmentally appropriate games (bingo, dots and boxes game), colors (markers and crayons) and paper, and books. Participants chose the activities they wanted to do. The activity choices were as follows: (1) Read: the student could read a book (*I'll Teach My Dog 100 Words*, *Boomer Goes to School*, *Tails Are Not for Pulling*, or *Small Brown Dog's Bad Remembering Day*) aloud to the experimenter or silently to him- or herself or the experimenter read to the child; (2) Play with Toys: the student could engage in play behaviors using available toys in the room; and (3) Play Games: the student could engage in play behaviors using available games in the room. On the first day of data collection, the experimenter showed all of the options to the participants. On subsequent days, the participants understood that they were able to choose what they wanted to do without prompting from the experimenter.

Intervention Procedures

Intervention procedures were the same as baseline procedures with the following additions. The experimenter, rater, handler, and dog arrived at the same time and went with the participants into the designated data collection area. The dog was off-leash once he or she entered the home. The handlers did not have an active role in the intervention. Their role was to monitor the safety of the interaction between the child and the dog. Before the handlers' first intervention sessions, they were instructed to not solicit interaction with the child, but were free to respond briefly to the child if spoken to, e.g., when the child asked a question about the dog or if the child had to be redirected in order to not harm the dog. There were no adverse events (e.g., scratches or other injuries) during the course of data collection. In addition to the activity choices available during the baseline phase, participants also had the following animal-assisted activities: (1) Pet: the participant could pet, stroke, cuddle, or otherwise express affection towards the dog; (2) Read: the participant could read a book aloud to the experimenter and the dog or silently to him-or herself or the experimenter could read to the child and dog; (3) Play: the student could play a game the dog was trained to play (e.g., fetch, tug); (4) Brush: the student could gently brush the back of the dog with a dog brush; (5) Tricks: the student could have the dog perform tricks he or she was trained to do (e.g., sit, down, shake, high five, roll over).

Data Collection

This study was a single-case multiple baseline design across participants (Barger-Anderson, Domaracki, Kearney-Vakulick, & Kubina, 2004; Carr, 2005; Horner et al., 2005; Richards, Taylor, Ramasamy, & Richards, 1999). In this type of design, two or more individuals engage in the same target behavior(s) in the same setting. The individuals should

be reasonably enough like each other to expect that they would change their behavior in response to the same intervention. Once a stable baseline (i.e., low variability and little or no trend) has been established, the intervention begins with one of the participants. Baseline is maintained during this time for the other participants. Once improvement is seen for the first participant (i.e., stable [low variability] improvement in slope, mean, or overlap) or after a pre-determined amount of time (based on a reasonable expectation for when improvement may occur), whichever comes first, the second participant begins the intervention, and so on. A form of replication occurs if all participants show behavior change between baseline and intervention phases.

In addition to data collection, the experimenter maintained an event log to monitor students' life events and environments; these data were ascertained by questioning parents informally at each session about notable events since the previous session. Three volunteer behavior raters were trained to collect frequencies of behaviors of interest via the hardcopy data collection form (see Appendix B). Rater 1 was an undergraduate psychology major with experience working with children with ASD, whose studies had an emphasis on neuropsychology and autism. Two additional raters were added one week into data collection. Raters 2 and 3 were first-year graduate students in a school psychology doctoral program who did not have experience working with people with ASD. Rater 1 continued collecting data for siblings Ben and Cara. Raters 2 and 3 shared data collection responsibilities for Alex. After seven study sessions (two weeks of data collection) when baseline data appeared stable (based on visual and statistical analysis), the intervention began for Alex. The intervention was introduced to Ben once Alex two weeks later and to Cara two weeks after that.

Obtaining Observational Data

Primary data collection via observation focused on the behaviors during the baseline phase and on proximal effects of intervention. Resulting data consisted of partial interval recordings of each behavior for each minute of a 15-minute session that were totaled for each of the categories. Alex had 36 sessions across 14 weeks, Ben had 35 sessions and Cara had 34 sessions, respectively, across 15 weeks. Sessions were scheduled to occur three times per week, however, events such as holidays, family vacations, and study personnel availability resulted in some disruption of the study schedule. Two raters were present for 19% of the sessions with Alex, 11% of sessions with Ben, and 12% of sessions with Cara. Establishing high inter-rater reliability at the beginning of data collection is best practice (Suen & Ary, 1989); however, at the time the two additional volunteer raters began, scheduling and timing did not allow for inter-rater reliability to be established at that time.

An inter-rater reliability (IRR) analysis using Cohen's Kappa statistic (Cohen, 1960) was performed to determine consistency among raters. Interpretation guidelines for strength of agreement of Kappa values are: from 0.21 to 0.40 are considered fair, 0.41 to 0.60 are moderate, 0.61 to 0.80 are substantial, and 0.81 to 1.00 are almost perfect (Landis & Koch, 1977). IRR was examined two sources of agreement: scale agreement or occurrence (i.e., both raters agreed that a behavior occurred in a given minute of data collection) and non-occurrence (i.e., both raters agreed that a behavior did not occur in a given minute of data collection).

Two raters who were trained in collecting frequencies of behaviors of interest were present for 19% of Alex's sessions (sessions 1, 2, 5, 6, 31, 32, and 33). IRR for occurrence was unweighted Kappa = 0.52 ($p < 0.0001$), 90% CI [0.499, 0.541]. Adding agreement that

behaviors did not occur to the analysis resulted in unweighted Kappa = 0.79 ($p < 0.0001$), 90% CI [0.778, 0.803]. Two raters were present for 11% of Ben's sessions (sessions 1, 10, 27, and 28). IRR for occurrence was unweighted Kappa = 0.50 ($p < 0.0001$), 90% CI [0.471, 0.527], which falls in the moderate range of strength of agreement. Adding agreement that behaviors did not occur to the analysis resulted in unweighted Kappa = 0.76 ($p < 0.0001$), 90% CI [0.741, 0.774], which indicates a substantial strength of agreement. Finally, two raters were present for 12% of Cara's sessions (sessions 1, 10, 27, and 28). IRR for occurrence was unweighted Kappa = 0.35 ($p < 0.0001$), 90% CI [0.327, 0.383], which falls in the fair range of strength of agreement. Adding agreement that behaviors did not occur to the analysis resulted in unweighted Kappa = 0.76 ($p < 0.0001$), 90% CI [0.739, 0.772], which indicates a substantial level of agreement. The paucity of IRR sessions is discussed in the Limitations section below.

SRS Data Collection

Secondary data collection via the SRS occurred at each phase change, i.e., pre-baseline, pre-intervention, and post-intervention. The first administration (pre-baseline) measured the participants' behavior in the past 3-4 months. At the subsequent phase changes, raters assessed the participants' behaviors that occurred since the last time they completed the SRS.

Distal Data Collection

An attempt was made to collect distal data to measure the effect of the intervention on behaviors after and outside of the study session; however, distal data were inadvertently not collected during baseline, which rendered it useless and the data were not analyzed. There was a large amount of variability in when distal data were collected relative to the time of the

study session and in the activities the participants engaged in after the sessions were finished for the day. For instance, the participant may have chosen to play computer games, watch television, or play a game. Additionally, data collection did not occur within the same time frame at each instance (e.g., sometimes immediately afterwards, sometimes hours afterwards), which added to the inconsistency of the data.

CHAPTER IV

RESULTS

Data Analysis

Both Non-Overlap of All Pairs (NAP) and visual analysis were used to assess whether interacting with a dog increases social and communicative behaviors and decreases non-social and non-communicative behavior in children with autism or PDD-NOS. NAP is a test of the amount of overlap between phase A and B data points (Parker & Vannest, 2009). Its advantage over a mean or median-based tests (e.g., *t*-tests, analysis of variance, and ordinary least squares [OLS] regression) is that they make some assumptions about distribution shape. Mean-shift tests make assumptions about normality and constant variance and median-based nonparametric tests make assumptions about lack of skewness and outliers. Thus, parametric methods are unreliable when applied to single-case research designs (Fahomme, 2002; Parker & Vannest, 2009; Sawilowsky & Blair, 1992). NAP makes no assumptions about distribution shape and does not assume that a mean or even a median is a good summary of the scores. It works well with skewed and multi-modal data and with outliers. Visual analysis is necessary because statistical analysis accounts only for the percent of non-overlap, but does not account for the direction of the trend (Parker & Brossart, 2003; Parker, Cryer, & Byrns, 2006). While there may be a statistically significant difference between baseline and intervention phases, it is incumbent on visual analysis to verify if the change was in the desired direction, e.g., was the statistically significant NAP value a result of the desired increase in social behavior or an undesired decrease in social behavior?

Data points recorded during the partial interval time-sampling procedure through direct observations and from parent ratings were compiled for analysis; effect sizes were determined using NAP. NAP was selected because of its apparent strengths: (a) interpretability of typical effect size results, which allows (b) discrimination between results of published studies, (c) score precision (narrow confidence intervals), (d) relationship to established effect sizes (Pearson's *r*, r^2, and Kruskal Wallis's *W*), and (e) agreement with visual analysis (Parker & Vannest, 2009).

Ideally, baseline data has little variability and no credible (i.e., narrow confidence intervals around the trend line) positive slope over time, i.e., it is relatively flat (Parker, et al., 2006). Both visual and regression analyses were used to identify the presence of positive baseline trend. When baseline data had credible slopes, the Allison and Gorman correction method was used to adjust the entire dataseries (i.e., both the baseline and treatment phases) for baseline trend (Allison & Gorman, 1993). The analytic method used is semi-partial correlation – baseline trend is semi-partialled out of both phases. The Allison approach is a complete parametric solution; however, the first half of the procedure only (the semi-partialling) can be used to produce a corrected data series which can then be analyzed by any phase shift technique. In this instance, non-parametric NAP non-overlap analysis was used. Thus, a parametric method was used to control for baseline trend, but a non-parametric method was used to measure the final difference between phases.

Rate of improvement (difference in slope) independent of mean differences was measured using multiple regression. Differences between slopes in each phase were tested using the method of barely overlapping 84% confidence intervals. Confidence intervals can be used to compare two or more scores (Browne, 1979; Goldstein & Healy, 1995). The 95%

CI for a single score is equivalent to an 83%-84% CI around the difference between two scores when they are compared. This CI overlap method of comparing means works well even with smaller samples (Payton, Greenstone, & Schenker, 2003). This method relies on constructing a confidence interval for each score at an 84% level; if the confidence intervals do not overlap, then the difference is statistically significant at the $p \leq .05$ level. Authors differ in recommending 82%, 83%, 84% or 85% CI levels around two scores for their comparison (Payton, Miller, & Raun, 2000; Schenker & Gentleman, 2001). The 85% CI is the most conservative and will avoid wrong decisions more than 95% of the time. Independent samples *t*-tests were conducted to compare, respectively, the means of positive and negative behaviors in baseline and intervention phases.

Alex

Although Alex's overall response to intervention was in the desired direction, the effect sizes did not reach statistical significance (Figure 2). On visual analysis, baseline data for Alex showed no credible positive slope over time and, thus, did not require correction. NAP analysis for aggregate positive behaviors revealed that there was non-overlap of .300, 84% CI [0.128, 0.473], which was not statistically significant (see Table 1 to compare NAP values of aggregate behaviors across participants). NAP analysis for aggregate negative behaviors revealed that there was non-overlap of .438, 84% CI [0.267, 0.610], which was not statistically significant. Out of the ordinary events that may have affected Alex's behaviors are plotted on Figure 2. When individual behaviors were considered, there were medium to large statistically significant effect sizes between baseline and intervention with changes in the hypothesized directions for Stroking, Petting, Cuddling; Eye Contact; Looking at Environment; and Solitary Activity (see Table 2). There were statistically significant

changes in the undesired direction for Engaged Social Play and Nonverbal Communication, i.e., there were decreases in each of these behaviors. Graphic results for individual behaviors with statistically significant results can be found in Appendix C.

The difference in Alex's positive behaviors in Phase A and Phase B was not statistically significant; $t(34)=1.76$, $p = 0.088$ (Table 3). Conversely, there was a statistically significant difference in negative behaviors between phases; $t(34)=2.89$, $p = 0.007$. None of the slopes for Alex's data were statistically significant, themselves, and there were no statistically significant differences between positive or negative slopes (i.e., rate of improvement) between phases (Table 6).

Alex's mother completed the SRS at the onset of the baseline phase, the onset of the intervention phase, and at the end of the intervention phase. These data were analyzed using the method of barely overlapping 84% confidence intervals. Alex had statistically significant differences in SRS Total scores between the onset of the study and the onset of the intervention as well as between the onset of the study and the end of the study (Table 10). The Total Score was 86 at study onset, 75 at intervention onset, and 76 at study end; thus, his mother's ratings reflected an overall change in behaviors only during the baseline phase. Similarly, there was a statistically significant decrease in the score on the Autistic Mannerisms between study onset and intervention onset. Although not statistically significantly different, there is a pattern in the data wherein Alex's mother's ratings fell between study onset and intervention onset, but were similar (i.e., within 0-3 points) at intervention onset and study end.

Ben

Ben showed an overall positive response to the intervention. On visual analysis, baseline data for Ben's positive behaviors had credible positive slope over time and, thus, required Allison correction (Figure 3). NAP analysis of uncorrected data for aggregate positive behaviors revealed that there was non-overlap of .840, 84% CI [0.671, 1.009], $p \leq .001$ in the hypothesized direction (Figure 4). NAP analysis with the Allison correction for positive behaviors showed non-overlap of .768, 84% CI [0.622, 0.914], $p \leq .001$. This severe correction, however, results in a negative slope for positive behaviors during the intervention phase with a mean below the baseline mean. NAP analysis for aggregate negative behaviors revealed that there was non-overlap of .902, 84% CI [0.757, 1.046], $p \leq .001$; changes in negative behaviors occurred in the hypothesized direction. Out of the ordinary events that may have affected Ben's behaviors are plotted on Figure 3. When individual behaviors were considered, there were medium to large statistically significant effect sizes between baseline and intervention with changes in the hypothesized directions for the following: Stroking, Petting, Cuddling; Eye Contact; Joint Attention; Looking at Environment; Solitary Activity; Self-Stimulation; Expressive Communication To; Nonverbal Communication; Receptive Language; and Expressive Communication About (see Table 2).

Independent samples *t*-tests were conducted to compare, respectively, the means of positive and negative behaviors in baseline and intervention phases, i.e., Phase A and Phase B (Table 4). The differences in both positive behaviors, $t(33)=4.62$, $p < 0.001$, and negative behaviors, $t(33)=5.05$, $p < 0.001$, in Phase A and Phase B were statistically significant.

Rate of improvement (difference in slope) independent of mean differences was measured using multiple regression. The slopes of positive behaviors in Phase A, $b = .147$,

$F(1, 11) = 5.85$, $p = .04$, 84% CI [.055, .239], and in Phase B, $b = .0.93$, $F(1, 22) = 25.66$, $p < .001$, 84% CI [.066, .120], were both statistically significant. The slopes of negative behaviors were not statistically significant. Differences between slopes in each phase were tested using the method of barely overlapping 84% confidence intervals. There were no statistically significant differences between positive or negative slopes between phases (Table 7).

Ben's mother completed the SRS at the onset of the baseline phase, the onset of the intervention phase, and at the end of the intervention phase. These data were analyzed using the method of barely overlapping 84% confidence intervals. Ben had statistically significant differences in SRS Total scores between the onset of the intervention and the end of the study (Table 11). The Total *T*-Score was 74 at study onset, 77 at intervention onset, and 68 at study end. There was a statistically significant increase in the score on the Social Cognition subscale between study onset ($T = 65$) and intervention onset ($T = 85$); while that score decreased at the end of the study ($T = 74$), the difference was not statistically significant. There was a statistically significant decrease on the Social Motivation subscale between the onset of the study ($T = 75$) and the end of the study ($T = 54$).

Cara

Cara showed an overall positive response to the intervention. On visual analysis, baseline data for Cara's positive behaviors had credible positive slope over time and, thus, required Allison correction. NAP analysis of uncorrected data for positive behaviors revealed that there was non-overlap of .986, 84% CI [0.845, 1.127], $p \leq .001$ in the hypothesized direction (Figure 5). NAP analysis with the Allison correction for positive behaviors showed non-overlap of .451, 84% CI [0.310, 0.592], $p \leq .05$ (Figure 6). This

severe correction, however, results in a negative slope for positive behaviors during the intervention phase, but the mean in the intervention phase was still higher than in the baseline phase. NAP analysis for negative behaviors revealed that there was non-overlap of .996, 84% CI [0.858, 1.135], $p \leq .001$; changes in negative behaviors occurred in the hypothesized direction. Out of the ordinary events that may have affected Cara's behaviors are plotted on Figure 6. When individual behaviors were considered, there were medium to large statistically significant effect sizes between baseline and intervention with changes in the hypothesized directions for the following: Stroking, Petting, Cuddling; Engaged Social Play; Eye Contact; Smiling; Looking at Environment; Solitary Activity; Self-Stimulation; Expressive Communication To; Nonverbal Communication; Receptive Language; and Expressive Communication About (see Table 2).

Independent samples *t*-tests were conducted to compare, respectively, the means of positive and negative behaviors in baseline and intervention phases, i.e., Phase A and Phase B (Table 5). The differences in both positive behaviors, $t(32)=9.53$, $p < 0.001$, and negative behaviors, $t(32)=11.42$, $p < 0.001$, in Phase A and Phase B were statistically significant.

Rate of improvement (difference in slope) independent of mean differences was measured using multiple regression. The slopes of positive behaviors in Phase A, $b = .128$, $F(1, 17) = 20.77$, $p < .001$, 84% CI [.087, .170], and in Phase B, $b = .0.075$, $F(1, 15) = 4.96$, $p = .04$, 84% CI [.025, .126], were both statistically significant. The slopes of negative behaviors were not statistically significant. Differences between slopes in each phase were tested using the method of barely overlapping 84% confidence intervals. There were no statistically significant differences between positive or negative slopes between phases (Table 8).

Cara's mother completed the SRS at the onset of the baseline phase, the onset of the intervention phase, and at the end of the intervention phase. These data were analyzed using the method of barely overlapping 84% confidence intervals. Cara had statistically significant differences in SRS Total scores between the onset of the intervention and the end of the study (Table 12). The Total *T*-Score was 96 at study onset, 85 at intervention onset, and 89 at study end; thus, her mother's ratings reflected an overall change in behaviors only during the baseline phase. There was a statistically significant decrease in the score on the Social Awareness subscale between study onset ($T = 91$) and intervention onset ($T = 70$) and between study onset and the end of the study ($T = 63$). The Social Motivation subscale showed a statistically significant increase between the onset of the intervention study ($T = 67$) and the end of the study ($T = 87$). Finally, there was a decrease in the scores on the Autistic Mannerisms scale from study onset ($T = 99$) and study end ($T = 82$).

CHAPTER V

SUMMARY AND DISCUSSION

The purpose of the current study was to investigate the effects of interacting with dogs on social and communicative behaviors and restricted repetitive stereotyped patterns of behavior, interests, and activities in children with autism or PDD-NOS. It was hypothesized that interacting with dogs would increase social and communicative behaviors and decrease restricted repetitive stereotyped patterns of behavior, interests, and activities. Overall, the data suggest that interacting with dogs had effects in the desired directions for all three participants, although not all effect sizes reached statistical significance. Both families had pet dogs, but the semi-structured study sessions appeared to have effects over and above the participants' relationships with their respective family dogs. Consistent with theories that animals act as social lubricants or transitional objects (Filiâtre, Millot, Montagner, et al., 1986; Guttman, et al., 1983; Heimlich, 2001; Kidd & Kidd, 1987a; Nielsen & Delude, 1989; Poresky, 1996; Poresky & Hendrix, 1989, 1990; Shiloh, et al., 2003; Tannen, 2004), the presence of the dog may have facilitated the interaction with the experimenter, i.e., mediated the social intervention.

Alex's behavior changes exhibited the smallest effects. The differences between his and the other two participants' cognitive abilities and symptoms of autism may explain his smaller effect sizes and lesser behavior change. The other participants' measured cognitive abilities fell in the low average to average range, but Alex's fell just under two standard deviations below the mean. Alex met diagnostic criteria for autistic disorder and, subjectively, displayed more classic symptoms of the disorder, whereas Ben had a diagnosis of Asperger's disorder (even though he had language delays before the age of 3) and Cara

was diagnosed with PDD-NOS. When individual behaviors were considered, Alex showed statistically significant changes in the desired direction on four of them and in the undesired direction on two; there was no statistically significant change on eight behaviors. His mother's ratings of his behaviors on the SRS, as reflected by the Total Score, across the study were statistically significant different between the onset of the study and at both intervention onset and study end. The Total Scores changed by only one point between intervention onset and study end, which indicates that his mother saw the biggest behavior changes in him during the baseline phase, but did not see large changes during the intervention phase. Finally, Alex was the only study participant who was rated by all three behavior raters. It is possible that there was a lack of consistency between behavior raters that decreased reliability and contributed to his depressed results relative to the other participants.

Ben showed large overall effect sizes when the data were uncorrected, but showed credible positive slope in baseline for positive behaviors, which required correction using the Allison and Gorman (1993) method. The Allison correction is a severe one and is a parametric method; although NAP analysis revealed that there remained a large effect size, the correction resulted in a negative slope for positive behaviors in the intervention phase. On individual behaviors, Ben had statistically significant medium to large effect sizes in the desired direction on 10 of 13 behaviors (he did not engage in the 14th behavior, echolalia). Finally, his mother's ratings of his behaviors on the SRS, as reflected by the Total Score, across the study were statistically significant different between intervention onset and study end, which indicates that his mother did not note behavior change during baseline, but did note it after the intervention. Like his sister, and in contrast to Alex, Ben's data may have

benefitted from the consistency of having the same rater, who had previous experience with children with ASD, for all but four study sessions.

Cara also had large effect sizes on uncorrected data and showed credible positive slope in baseline for positive behaviors that required correction. While the effect size for the corrected data was considerably smaller, Cara maintained a positive slope in the intervention phase despite the correction. Her mother reported that the experimenter was physically and temperamentally similar to a former counselor of Cara's, with whom Cara established very good rapport and trust. Thus, it appears that at least some of the positive slope in baseline was a result of the interaction between the experimenter and Cara. On examination of individual behaviors, Cara showed statistically significant effect sizes in the desired direction on 11 of 14 behaviors. In addition to rapport with the experimenter, Cara's love of animals likely contributed to changes in her behavior. Her mother's ratings of Cara's behaviors on the SRS, as reflected by the Total Score, across the study were statistically significant different between study onset and intervention onset. This result reflects the positive behavior change evidenced in the NAP analysis. Statistical significance between SRS scores between phases was analyzed using 84% confidence interval overlap; the scores at study onset and study end missed statistical significance by an overlap of 0.28, which closely approaches statistical significance. Thus, although they did not reach statistical significance, her mother's ratings between study onset and study end may reflect practical significance of Cara's behavior change.

Siblings Ben and Cara both showed statistically significant changes in the desired directions for 11 of 14 behaviors, sharing changes in six of them (Looking At Environment, Solitary Activity, Self-Stimulating, Expressive To, Nonverbal, Receptive, and Expressive

About). Because causation was not measured, it is unknown how much their shared genetic makeup and environmental upbringing accounted for similar responses to the intervention. As stated previously, they displayed fewer outwardly obvious characteristics of ASD, which could also explain their behavioral responses in desired directions.

It is likely that data for Ben did not show large effect sizes for Engaged Social Play or Smiling because of the large amount of time that he engaged in these behaviors during the baseline phase. During baseline, the experimenter and he frequently played interactive games with a ball in which they created rules together and enjoyed, as evidenced by both of them frequently smiling and laughing during play.

Consistent with the findings of Heimlich, Schiro-Geist, and Broadbent (2003), two of the three participants spoke less about tangential topics when the dog was present compared to baseline. All three increased social communication directed to others. All three participants demonstrated statistically significant increases in Stroking, Petting, Cuddling and Eye Contact. While it was not expected that there would be high levels of stroking, peddling, or cuddling in baseline, the very high effect sizes for these behaviors indicated that they were all physically engaged actively with a living being rather than in solitary activity. The participants in the current study also showed decreases in Looking at Environment and Solitary Activity when a dog was present. Taken with the increase in eye contact, the decrease in directing their gazes away from others suggests more social visual attention. Thus, the decrease in solitary activity also evidences an increase in social interaction. These results are consistent with others' findings that dogs served to increase positive social interactions between children with autism and adults and dogs (Esteves & Stokes, 2008; Martin & Farnum, 2002; Sams, et al., 2006).

Limitations

There were a number of limitations in the current study. There was not a consistent standardized assessment to ascertain the students' autism or PDD-NOS diagnoses or level of severity of the disorder; the determination was made based on diagnoses made by other professionals. Children with ASDs are a heterogeneous group and this study's participants were no exception; there appeared to be subjective differences in the participants' expressions of symptoms and mannerisms of autism. The sibling relationship of Ben and Cara also may have accounted for some of their similar responses to intervention. Further, determining current level of cognitive functioning was based on existing data in the students' special education records instead of administering tests of cognitive ability to each student in this study. Because of a lack of control over systematic assessment and diagnosis, the present study was unable to account for variability in these areas.

Rater training was not completed and inter-rater reliability was not established to the standards recommended by Suen and Ary (1989). When the study began, only one rater agreed to the volunteer position. Rater 1, an undergraduate psychology major, had experience in the field of ASDs and did not require extensive training. Raters 2 and 3, first-year doctoral students in school psychology, did not have experience with children with ASDs and volunteered one week after the study began. Data collection schedules with both families were established already and Raters 2 and 3 were trained in real time instead of being given time and practice before collecting study data. Rater 2 mainly collected data for Alex, although she substituted for Rater 1 with the other family for four sessions when Rater 1 was unavailable. Rater 3 collected data for Alex exclusively. There were three sessions scheduled for each week of data collection; Rater 2 was present for two of the sessions

(Tuesdays and Fridays) and Rater 2 was present for one (Thursdays). Although there was a pattern to their presence, the presence of two different raters may have had an effect on Alex. Inter-rater reliability (IRR) should have been established by engaging in a higher concentration of IRR sessions (i.e., with two raters present) for 20% of sessions at the beginning of the study with booster sessions mid-way through, but it was actually driven by the volunteer raters' availability. There were two raters present for 19% of Alex's sessions, 11% of Ben's, and 12% of Cara's. While four of Alex's 7 IRR sessions were concentrated at the beginning of data collection, the remaining three were very near the end. Both Ben's and Cara's IRR sessions occurred at sessions 1, 10, 27, and 28 (out of 35 and 34 total sessions, respectively).

Finally, the initial study design included collecting data about the distal effects of the intervention, but the data were collected incorrectly and were too variable to produce useful information. During the initial stages of the intervention, the main focus of data collection was to be on target behaviors during the 15-minute study sessions (proximal data). Collection of distal data (i.e., after the study sessions) for target behaviors was to be collected at set times following the sessions (i.e., immediately after, then 15 minutes after, then 30 minutes after). The experimenter failed to ask the participants' mothers to collect these data during baseline, which prevented a comparison of the participants' behaviors before and after the dogs were introduced during the intervention phase. Further, there was no consistency related to when distal data were collected since it was dependent on the participants' mothers and the families' respective schedules. Also, the participants engaged in a range of activities after proximal sessions, ranging from watching television, playing video games, and playing

alone or with others. Thus, although distal data were collected on most days that proximal data were collected, it was extremely variable and, therefore, not interpretable.

Recommendations for Future Research

Regardless of the reason for the increased prevalence of children with ASD, there is an increased demand for services for children who have these diagnoses (Croen, et al., 2002; Fombonne, 2001; Frith, 2003; Mandell & Palmer, 2005; Shattuck, 2006; United States Department of Education/Office of Special Education and Rehabilitative Services/Office of Special Education Programs, 2009; United States Government Accountability Office, 2005; Wing & Potter, 2002). While there have been great advances in understanding autism and other pervasive developmental disorders and developing empirically-supported therapies for those affected by them, there remains a multitude of information that is unknown. The field of animal-assisted therapies is still relatively new and there is a paucity of research specifically about using animals with children with autism. Most of the research in this area has occurred in school settings (Condoret, 1983; Esteves & Stokes, 2008; Filiâtre, Millot, & Montagner, 1986; Martin & Farnum, 2002; Sams, et al., 2006), with fewer in residential (Heimlich, et al., 2003) and laboratory settings (Prothmann, et al., 2005; Prothmann, et al., 2009). Continued research in naturalistic settings such as home and school are warranted; children with ASD may benefit from interventions that take place both at home and at school and, thus, provide consistency across setting. Also, considering the links between oxytocin, anxiety, children with ASD, and interacting with dogs, it would be interesting to measure neurotransmitter levels related to anxiety in children with ASD while they interact with dogs.

Particularly in communities with existing groups that promote human-animal interaction, dogs may be reasonable partners in families', schools', and service providers'

efforts to increase interaction with and between children with ASD. Although research supports the positive effects live dogs can have on humans, there are limitations to using them, such as allergies, fears, training, cost, and upkeep that may be insurmountable barriers for some schools or school districts (Rud & Beck, 2003; Zasloff, Hart, & DeArmond, 1999). Therefore, alternatives such as interactive robots, particularly robotic dogs, should be investigated as alternatives for less expensive, hypoallergenic, and low-needs alternatives to increase functioning levels in children with ASD (Banks, Willoughby, & Banks, 2008; Feil-Seifer & Matarić, 2008a, 2008b, 2008c; Robins, Dautenhahn, Boekhorst, & Billard, 2005). Removing the barriers to ownership of a live pet may also allow families with children with ASD who cannot have a dog, but want one, to afford and maintain a technological family member that can help them gain more social and communicative interactions with their loved ones.

REFERENCES

Albert, A., & Anderson, M. (1997). Dogs, cats, and morale maintenance: Some preliminary data. *Anthrozoös, 10*(2/3), 121-124.

Allen, K. M., Blascovich, J., & Mendes, W. B. (2002). Cardiovascular reactivity and the presence of pets, friends, and spouses: The truth about cats and dogs. *Psychosomatic Medicine, 64*(5), 727-739. doi: 10.1097/01.psy.0000024236.11538.41

Allen, K. M., Blascovich, J., Tomaka, J., & Kelsey, R. M. (1991). Presence of human friends and pet dogs as moderators of autonomic responses to stress in women. *Journal of Personality and Social Psychology*(81), 582-589. doi: 10.1037/0022-3514.61.4.582

Allison, D. B., & Gorman, B. S. (1993). Calculating effect sizes for meta-analysis: The case of the single case. *Behavior, Research, and Therapy, 31*, 621-631. doi: 10.1016/0005-7967(93)90115-B

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (4th ed., text revision)*. Washington, DC: Author.

American Veterinary Medical Association. (2007a). Guidelines for animal assisted activity, animal-assisted therapy and resident animal programs. Retrieved from http://www.avma.org/issues/policy/animal_assisted_guidelines.asp

American Veterinary Medical Association. (2007b). *U.S. pet ownership and demographics sourcebook*. Schaumburg, IL: Author.

Anderson, K. L., & Olson, M. R. (2006). The value of a dog in a classroom of children with severe emotional disorders. *Anthrozoos, 19*(1), 35-49.

Apel, L. (2007). Hippotherapy and therapeutic riding highlight. *Exceptional Parent, 37*(6), 28-34.

Arambašic, L., Keresteš, G., Kuterovac-Jagodíc, G., & Vizek-Vidovic, V. (2000). The role of pet ownership as a possible buffer variable in traumatic experiences. *Studia Psychologica, 42*(1-2), 135-146.

Ascione, F. R. (1992). Enhancing children's attitudes about the humane treatment of animals: Generalization to human directed empathy. *Anthrozoös, 5*, 176-191.

Ascione, F. R., & Weber, C. (1996). Children's attitudes about the humane treatment of animals and empathy: One year follow-up of a school-based intervention. *Anthrozoös, 9*, 188-195.

Banks, M. R., Willoughby, L. M., & Banks, W. A. (2008). Animal-assisted therapy and loneliness in nursing homes: Use of robotic versus living dogs. *Journal of the American Medical Directors Association, 9*(3), 173-177. doi: 10.1016/j.jamda.2007.11.007

Baranek, G. T. (2002). Efficacy of sensory and motor interventions for children with autism. *Journal of Autism & Developmental Disorders, 32*(5), 397-422. doi: 10.1023/A:1020541906063

Barger-Anderson, R., Domaracki, J. W., Kearney-Vakulick, N., & Kubina, R. M. (2004). Multiple baseline designs: The use of a single-case experimental design in literacy research. *Reading Improvement, 41*(4), 217-225.

Baun, M. M., Bergstrom, N., Langston, N. F., & Thoma, L. (1984). Physiological effects of human/companion animal bonding. *Nursing Research, 33*(3), 126-129. doi: 10.1097/00006199-198405000-00002

Beck, A., & Katcher, A. H. (1996). *Between pets and people*. West Lafayette, IN: Purdue University Press.

Beck, A., & Katcher, A. H. (2003). Future directions in human-animal bond research. *American Behavioral Scientist, 47*(1), 79-93.

Beebe, B. F. (1980). A domestic dog (*canis familiaris* L.) of probable Pleistocene age from Old Crow, Yukon Territory, Canada. *Canadian Journal of Archaeology, 4*, 161-168.

Bellini, S. (2004). Social skill deficits and anxiety in high-functioning adolescents with autism spectrum disorders. *Focus on Autism & Other Developmental Disabilities, 19*(2), 78-86. doi: 10.1177/10883576040190020201

Betts, S. R. (2008). *Individualized instruction strategies in mainstream classrooms: Including students with autism spectrum disorder.* Master of Science in Education Master's thesis, Dominican University of California, San Rafael.

Blaxill, M. F. (2009). What's going on? The question of time trends in autism. *Public Health Reports, 119*(6), 536-551. doi: 10.1016/j.phr.2004.09.003

Bowlby, J. (1982). *Attachment* (2nd ed.). London: Hogarth Press.

Breitenbach, E., Stumpft, E., Fersen, L. V., & Ebert, H. (2009). Dolphin-assisted therapy: Changes in interaction and communication between children with severe disabilities and their caregivers. *Anthrozoös, 22*(3), 277-289. doi: 10.2752/175303709x457612

Brickel, C. M. (1982). Pet-facilitated psychotherapy: A theoretical explanation via attention shifts. *Psychological Reports, 50*(1), 71-74.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*(7), 513-531. doi: 10.1037/0003-066X.32.7.513

Browne, R. H. (1979). On visual assessment of the significance of a mean difference. *Biometrics, 35*(3), 657-665.

Bryant, B. K., & Donnellan, M. B. (2007). The relation between socio-economic status concerns and angry peer conflict resolution is moderated by pet provisions of support. *Anthrozoös, 20*(3), 213-223. doi: 10.2752/089279307X224764

Carr, J. E. (2005). Recommendations for reporting multiple-baseline designs across participants. *Behavioral Interventions, 20*(3), 219-224. doi: 10.1002/bin.191

Carter, C. S., Williams, J. R., Witt, D. M., & Insel, T. R. (1992). Oxytocin and social bonding. *Annals of the New York Academy of Sciences, 652*(Oxytocin in Materials, Sexual, and Social Behaviors), 204-211. doi: 10.1111/j.1749-6632.1992.tb34356.x

Catanzaro, T. E. (2003). Human-animal bond and primary prevention. *American Behavioral Scientist. Special Issue: Human-Animal Interaction & Wellness., 47*(1), 29-30. doi: 10.1177/0002764203255209

Cawley, R., Cawley, D., & Retter, K. (1994). Therapeutic horseback riding and self-concept in adolescents with special educational needs. *Anthrozoös, 7*(2), 129-134.

Centers for Disease Control and Prevention. (2007). *Prevalence of autism spectrum disorders — Autism and Developmental Disabilities Monitoring Network, six sites, United States, 2000; Prevalence of autism spectrum disorders — Autism and Developmental Disabilities Monitoring Network, 14 sites, United States, 2002; and Evaluation of a methodology for a collaborative multiple source surveillance network for autism spectrum disorders —Autism and Developmental Disabilities Monitoring Network, 14 sites, United States, 2002. Surveillance summaries, February 9, 2007.* (Vol. 56. No SS-1). Washington, DC: U.S. Department of Health and Human Services.

Chakrabarti, S., & Fombonne, E. (2001). Pervasive developmental disorders in preschool children. *Journal of the American Medical Association, 285*(24), 3093-3099. doi: 10.1001/jama.285.24.3093

Chalfant, A. M., Rapee, R., & Carroll, L. (2007). Treating anxiety disorders in children with high functioning autism spectrum disorders: A controlled trial. *Journal of Autism and Developmental Disorders, 37*(10), 1842-1857. doi: 10.1007/s10803-006 -0318-4

Charnetski, C. J., Riggers, S., & Brennan, F. X. (2004). Effect of petting a dog on immune system function. *Psychological Reports, 95*(3,Pt2), 1087-1091.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*(1), 37-46. doi: 10.1177/001316446002000104

Cole, M., & Wertsch, J. V. (1996). Beyond the individual-social antinomy in discussions of Piaget and Vygotsky. *Human Development, 39*(5), 250-256.

Condoret, A. (1983). Speech and companion animals, experience with normal and disturbed nursery school children. In A. H. Katcher & A. M. Beck (Eds.), *New perspectives on our lives with companion animals* (pp. 467-471). Philadelphia: University of Pennsylvania Press.

Constantino, J. N., Davis, S. A., Todd, R. D., Schindler, M. K., Gross, M. M., Brophy, S. L., et al. (2003). Validation of a brief quantitative measure of autistic traits: Comparison of the Social Responsiveness Scale with the Autism Diagnostic Interview-Revised. *Journal of Autism & Developmental Disorders, 33*(4), 427-433. doi: 10.1023/A:1025014929212

Constantino, J. N., & Gruber, C. P. (2005). *Social Responsiveness Scale*. Los Angeles: Western Psychological Services.

Constantino, J. N., Gruber, C. P., Davis, S., Hayes, S., Passanante, N., & Przybeck, T. (2004). The factor structure of autistic traits. *Journal of Child Psychology and Psychiatry, 45*(4), 719-726.

Constantino, J. N., Hudziak, J., & Todd, R. D. (2003). Deficits in reciprocal social behavior in male twins: Evidence for a genetically independent domain of psychopathology. *Journal of the American Academy of Child and Adolescent Psychiatry, 42*(4), 458-467. doi: 10.1097/01.CHI.0000046811.95464.21

Constantino, J. N., Przybeck, T., Friesen, D., & Todd, R. D. (2000). Reciprocal social behavior in children with and without pervasive developmental disorders. *Journal of Developmental and Behavioral Pediatrics, 21*(1), 2-11.

Constantino, J. N., & Todd, R. D. (2000). The genetic structure of reciprocal social behavior. *American Journal of Psychiatry, 157*(12), 2043-2045.

Constantino, J. N., & Todd, R. D. (2003). Autistic traits in the general population: A twin study. *Archives of General Psychiatry, 60*(5), 524-530. doi: 10.1001/archpsyc.60.5.524

Conway, F. (2010). Review of the test Social Responsiveness Scale. *The eighteenth mental measurements yearbook.* Retrieved from http://www.unl.edu/buros/

Coren, S. (2002). *The pawprints of history*. New York: The Free Press.

Coren, S. (2006). *The intelligence of dogs: A guide to the thoughts, emotions, and inner lives of our canine companions*. New York: Free Press.

Crawford, E. K., Worsham, N. L., & Swinehart, E. R. (2006). Benefits derived from companion animals,and the use of the term "attachment". *Anthrozoös, 19*(2), 98-112.

Croen, L. A., Grether, J. K., Hoogstrate, J., & Selvin, S. (2002). The changing prevalence of autism in California. *Journal of Autism & Developmental Disorders, 32*(3), 207-215. doi: 10.1023/A:1015453830880

Daly, B., & Morton, L. L. (2006). An investigation of human--animal interactions and empathy as related to pet preference, ownership, attachment, and attitudes in children. *Anthrozoös, 19*(2), 113-127.

Davis, B. W., Nattrass, K., O'Brien, S., Patronek, G., & MacCollin, M. (2004). Assistance dog placement in the pediatric population: Benefits, risks, and recommendations for future application. *Anthrozoös, 17*(2), 130-145. doi: 10.2752/089279304786991765

Davis, S. J. M., & Valla, F. R. (1978). Evidence for domestication of the dog 12,000 years ago in the Natufian of Israel. *Nature, 276*(5688), 608-610. doi: 10.1038/276608a0

Davis, T. E., Fodstad, J. C., Jenkins, W. S., Hess, J. A., Moree, B. N., Dempsey, T., et al. (2010). Anxiety and avoidance in infants and toddlers with autism spectrum disorders: Evidence for differing symptom severity and presentation. *Research in Autism Spectrum Disorders, 4*(2), 305-313. doi: 10.1016/j.rasd.2009.10.002

Day, L. P. (1984). Dog burials in the Greek world. *American Journal of Archaeology, 88*(1), 21-32.

Delta Society. (2003). *Standards of practice for animal-assisted activities and therapy*. Renton, WA: Author.

DeVries, A. C., Glasper, E. R., & Detillion, C. E. (2003). Social modulation of stress responses. *Physiology & Behavior, 79*(3), 399-407. doi: 10.1016/s0031-9384(03)00152-5

Digby, A. (1984). The changing profile of a nineteenth-century asylum: The York Retreat. *Psychological Medicine, 14*, 739-748. doi: 10.1017/S003329170001970X

Dixon, R. A., & Lerner, R. M. (1983). A history of systems in developmental psychology. In M. H. Bornstein & M. E. Lamb (Eds.), *Developmental psychology: An advanced textbook*. Hillsdale, NJ: Erlbaum.

Ebner, K., Bosch, O. J., Krömer, S. A., Singewald, N., & Neumann, I. D. (2005). Release of oxytocin in the rat central amygdala modulates stress-coping behavior and the release of excitatory amino acids. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology, 30*(2), 223-230. doi: 10.1038/sj.npp.1300607

Eddy, J., Hart, L. A., & Boltz, R. P. (1988). The effects of service dogs on social acknowledgements of people in wheelchairs. *Journal of Psychology, 122*(1), 39-45.

Esteves, S. W., & Stokes, T. (2008). Social effects of a dog's presence on children with disabilities. *Anthrozoös, 21*(1), 5-15. doi: 10.2752/089279308X274029

Fahomme, G. (2002). Twenty nonparametric statistics and their large-sample approximations. *Journal of Modern Applied Statistical Methods, 1*(2), 248-268.

Feil-Seifer, D. J., & Matarić, M. J. (2008a). *B3IA: An architecture for autonomous robot-assisted behavior intervention for children with Autism Spectrum Disorders*. Paper presented at the IEEE Proceedings of the International Workshop on Robot and Human Interactive Communication (RO-MAN), Munich, Germany.

Feil-Seifer, D. J., & Matarić, M. J. (2008b). *Robot-assisted therapy for children with autism spectrum disorders*. Paper presented at the Conference on Interaction Design for Children: Children with Special Needs (IDC), Chicago, IL.

Feil-Seifer, D. J., & Matarić, M. J. (2008c). *Toward socially assistive robotics for augmenting interventions for children with autism spectrum disorders*. Paper presented at the 11th International Symposium on Experimental Robotics 2008 (ISER '08), Athens, Greece.

Filiâtre, J. C., Millot, J. L., & Montagner, H. (1986). New data on communication behaviour between the young child and his pet dog. *Behavioural Processes, 12*(1), 33-44.

Filiâtre, J. C., Millot, J. L., Montagner, H., Eckerlin, A., & Gagnon, A. C. (1986). Advances in the study of the relationship between children and their pet dogs. *Anthrozoös, 21*(1), 22-32.

Fombonne, E. (2001). Is there an epidemic of autism? *Pediatrics, 107*(2), 411-413. doi: 10.1542/peds.107.2.411

Friedmann, E. (1995). The role of pets in enhancing human well-being: Physiological effects. In I. Robinson (Ed.), *The Waltham book of human-animal interaction: Benefits and responsibilities of pet ownership* (1 ed., pp. 33-53). Oxford NY: Pergamon Press.

Friedmann, E., Katcher, A. H., Lynch, J. J., & Thomas, S. A. (1980). Animal companions and one-year survival of patients after discharge from a coronary care unit. *Public Health Reports, 95*(4), 307-312.

Friedmann, E., Katcher, A. H., Thomas, S. A., Lynch, J. J., & Messent, P. R. (1983). Social interaction and blood pressure: The influence of animal companions. *Journal of Nervous and Mental Disease, 171*, 461-465.

Frith, U. (2003). *Autism: Explaining the enigma* (2nd ed.). Malden, MA: Blackwell Publishing.

Gasalberti, D. (2006). Alternative therapies for children and youth with special health care needs. *Journal of Pediatric Health Care, 20*(2), 133-136. doi: DOI: 10.1016/j.pedhc.2005.12.015

Gillberg, C., & Wing, L. (1999). Autism: Not an extremely rare disorder. *Acta psychiatrica Scandinavica, 99*(6), 399-406. doi: 10.1111/j.1600-0447.1999.tb00984.x

Goin-Kochel, R. P., Myers, B. J., & Mackintosh, V. H. (2007). Parental reports on the use of treatments and therapies for children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 1*(3), 195-209. doi: 10.1016/j.rasd.2006.08.006

Goldstein, H. (2002). Communication intervention for children with autism: A review of treatment efficacy. *Journal of Autism & Developmental Disorders, 32*(5), 373-396. doi: 10.1023/A:1020589821992

Goldstein, H., & Healy, M. J. R. (1995). The graphical presentation of a collection of means. *Journal of the Royal Statistical Society. Series A (Statistics in Society), 158*(1), 175-177.

Grandin, T., & Johnson, C. (2005). *Animals in translation: Using the mysteries of autism to decode animal behavior*. New York: Scribner.

Granger, B. P., Kogan, L., Fitchett, J., & Helmer, K. (1998). A human-animal intervention team approach to animal-assisted therapy. *Anthrozoös, 11*(3), 173-176. doi: 10.2752/089279398787000689

Green, V. A., Pituch, K. A., Itchon, J., Choi, A., O'Reilly, M., & Sigafoos, J. (2006). Internet survey of treatments used by parents of children with autism. *Research in Developmental Disabilities, 27*(1), 70-84. doi: 10.1016/j.ridd.2004.12.002

Guastella, A. J., Einfeld, S. L., Gray, K. M., Rinehart, N. J., Tonge, B. J., Lambert, T. J., et al. (2010). Intranasal oxytocin improves emotion recognition for youth with autism spectrum disorders. *Biological Psychiatry, 67*(7), 692-694. doi: DOI: 10.1016/j.biopsych.2009.09.020

Guttman, G., Predovic, M., & Zemanek, M. (1983). *The influence of pet ownership on non-verbal communication and social competence in children.* Paper presented at the Proceedings of the International Symposium on the Human-Pet Relationship.

Haller, J., Makara, G. B., Barna, I., Kovács, K., Nagy, J., & Vecsernyés, M. (1996). Compression of the pituitary stalk elicits chronic increases in CSF vasopressin, oxytocin as well as in social investigation and aggressiveness. *Journal of Neuroendocrinology, 8*(5), 361-365. doi: 10.1046/j.1365-2826.1996.04654.x

Harrison, B. (1972). Animals and the state in nineteenth-century England. *The English Historical Review, 88*(349), 786-820.

Hart, L. A. (2006). Community context and psychosocial benefits of animal companionship. In A. H. Fine (Ed.), *Handbook of animal-assisted therapy: Theoretical foundations and guidelines for practice* (2nd ed., pp. 73-94). San Diego, CA: Academic Press.

Hart, L. A., Hart, B. L., & Bergin, B. (1987). Socializing effects of service dogs for people with disabilities. *Anthrozoös, 1*(1), 41-44.

Heimlich, K. (2001). Animal-assisted therapy and the severely disabled child: A quantitative study. *Journal of Rehabilitation, 67*(4), 48-54.

Heimlich, K., Schiro-Geist, C., & Broadbent, E. (2003). Animal-assisted therapy and the child with severe disabilities: A case study. *Rehabilitation Professional, 11*(2), 41-53.

Heinrichs, M., von Dawans, B., & Domes, G. (2009). Oxytocin, vasopressin, and human social behavior. *Frontiers in Neuroendocrinology, 30*(4), 548-557. doi: DOI: 10.1016/j.yfrne.2009.05.005

Hergovich, A., Monshi, B., Semmler, G., & Zieglmayer, V. (2002). The effects of the presence of a dog in the classroom. *Anthrozoös, 15*(1), 37-50. doi: 10.2752/089279302786992775

Herzog, H. (2002). Darwinism and the study of human-animal interactions. *Society & Animals, 10*(4), 361-367. doi: 10.1163/156853002320936818

Hines, L. M. (2003). Historical perspectives on the human-animal bond. *American Behavioral Scientist, 47*(1), 7-15. doi: 10.1177/0002764203255206

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. [Article]. *Exceptional Children, 71*(2), 165-179.

Horner, R. H., Carr, E. G., Strain, P. S., Todd, A. W., & Reed, H. K. (2002). Problem behavior interventions for young children with autism: A research synthesis. *Journal of Autism & Developmental Disorders, 32*(5), 423-446. doi: 10.1023/A:1020593922901

Hyde, K. R., Kurdek, L., & Larson, P. C. (1983). Relationships between pet ownership and self-esteem, social sensitivity, and interpersonal trust. *Psychological Reports, 52*(1), 110.

Insel, T. R., & Young, L. J. (2001). Opinion: The neurobiology of attachment. *Nature Reviews Neuroscience, 2*(2), 129-136. doi: 10.1038/35053579

Kahn, P. H. (1997). Developmental psychology and the biophilia hypothesis: Children's affiliation with nature. *Developmental Review, 17*(1), 1-61. doi: DOI: 10.1006/drev.1996.0430

Kidd, A. H., & Kidd, R. M. (1987a). Reactions of infants and toddlers to live and toy animals. *Psychological Reports., 61*, 455-464.

Kidd, A. H., & Kidd, R. M. (1987b). Seeking a theory of the human/companion animal bond. *Anthrozoös, 1*(3), 140-157. doi: 10.2752/089279388787058489

Kikusui, T., Winslow, J. T., & Mori, Y. (2006). Social buffering: relief from stress and anxiety. *Philosophical Transactions of the Royal Society B: Biological Sciences, 361*(1476), 2215-2228. doi: 10.1098/rstb.2006.1941

Kotrschal, K., & Ortbauer, B. (2003). Behavioral effects of the presence of a dog in a classroom. *Anthrozoös, 16*(2), 147-159. doi: 10.2752/089279303786992170

Kruger, K. A., & Serpell, J. A. (2006). Animal-assisted interventions in mental health: Definitions and theoretical foundations. In A. H. Fine (Ed.), *Handbook of animal-assisted therapy: Theoretical foundations and guidelines for practice* (2nd ed., pp. 21-38). San Diego, CA: Academic Press.

Kurdek, L. A. (2008). Pet dogs as attachment figures. *Journal of Social and Personal Relationships, 25*(2), 247-266. doi: 10.1177/0265407507087958

LaJoie, K. R. (2003). *An evaluation of the effectiveness of using animals in therapy.* Psy.D. dissertation, Spalding University, Louisville, KY. Available from Dissertations & Theses: Full Text. (Publication No. AAT 3077675)

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*(1), 159-174.

Lane, D. R., McNicholas, J., & Collis, G. M. (1998). Dogs for the disabled: Benefits to recipients and welfare of the dog. *Applied Animal Behaviour Science, 59*, 49-60. doi: 10.1016/S0168-1591(98)00120-8

Lane, M. S., & Zawistowski, S. L. (2007). *Heritage of care: The American Society for the Prevention of Cruelty to Animals*. Westport, CT: Praeger Publishers.

Lang, R., Regester, A., Lauderdale, S., Ashbaugh, K., & Haring, A. (2010). Treatment of anxiety in autism spectrum disorders using cognitive behaviour therapy: A systematic review. *Developmental Neurorehabilitation, 13*(1), 53-63. doi: 10.3109/17518420903236288

Law, S., & Scott, S. (1995). Pet care: A vehicle for learning. *Focus on Autistic Behavior, 10*(2), 17-18.

Lawrence, E. A. (1987). Those who dislike pets. *Anthrozoös, 1*(3), 147-148.

Lechner, H. E., Kakebeeke, T. H., Hegemann, D., & Baumberger, M. (2007). The effect of hippotherapy on spasticity and on mental well-being of persons with spinal cord injury. *Archives of Physical Medicine and Rehabilitation, 88*(10), 1241-1248. doi: DOI: 10.1016/j.apmr.2007.07.015

Lehrman, J., & Ross, D. B. (2001). Therapeutic riding for a student with multiple disabilities and visual impairment: A case study. *Journal of Visual Impairment & Blindness, 95*(2), 108-109.

Levinson, B. M. (1961). The dog as co-therapist. *Mental Hygiene, 46*, 59-65.

Limond, J. A., Bradshaw, J. W. S., & Cormack, K. F. M. (1997). Behavior of children with learning disabilities interacting with a therapy dog. *Anthrozoös, 10*(2/3), 84-89. doi: 10.2752/089279397787001139

Lockwood, R. (1983). The influence of animals on social perception. In A. B. Katcher, A. (Ed.), *New perspectives on our lives with companion animals.* (pp. 64-71). Philadelphia: University of Pennsylvania Press.

Loveland, K. A., & Tunali-Kotiski, B. (2005). The school-age child with an autism spectrum disorder. In F. R. Volkmar, R. Paul, A. Klin & D. Cohen (Eds.), *Handbook of autism and pervasive developmental disorders: Diagnosis, development, neurobiology, and behavior* (3rd ed., Vol. 1, pp. 247-287). Hoboken, NJ: John Wiley & Sons, Inc.

Lukina, L. N. (1999). Influence of dolphin-assisted therapy sessions on the functional state of children with psychoneurological symptoms of diseases. *Human Physiology, 25*(6), 676-679.

Macauley, B. L., & Gutierrez, K. M. (2004). The effectiveness of hippotherapy for children with language-learning disabilities. *Communication Disorders Quarterly, 25*(4), 205-217. doi: 10.1177/15257401040250040501

Mandell, D. S., Novak, M. M., & Levy, S. E. (2005). *Frequency and correlates of treatment use among a community sample of children with autism*. Paper presented at the International Meeting for Autism Research, Boston, MA.

Mandell, D. S., & Palmer, R. (2005). Differences among states in the identification of autistic spectrum disorders. *Archives of Pediatrics & Adolescent Medicine, 159*(3), 266-269. doi: 10.1001/archpedi.159.3.266

Martin, F., & Farnum, J. (2002). Animal-assisted therapy for children with pervasive developmental disorders. *Western Journal of Nursing Research. Special Issue: Human-Animal Interaction, 24*(6), 657-670. doi: 10.1177/019394502320555403

Maurer, M. (2009). A study on the consideration of the child with autism for the dolphin based on two complementary methodologies. *A.N.A.E. Approche Neuropsychologique des Apprentissages chez l'Enfant, 20*(3[98]), 143-145.

McConnell, S. R. (2002). Interventions to facilitate social interaction for young children with autism: Review of available research and recommendations for educational intervention and future research. *Journal of Autism & Developmental Disorders, 32*(5), 351-372. doi: 10.1023/A:1020537805154

McNicholas, J., & Collis, G. M. (2000). Dogs as catalysts for social interactions: Robustness of the effect. *British Journal of Psychology, 91*, 61-70.

Melson, G. F. (1990). Fostering interconnectedness with animals and nature: The developmental benefits for children. *People, Animals, Environment*(Fall), 15-17.

Melson, G. F. (1991). Availability of and involvement with pets by children: Determinants and correlates. *Anthrozoös, 2*(1), 45-52.

Melson, G. F. (2002). Psychology and the study of human-animal relationships. *Society & Animals, 10*(4), 347-352. doi: 10.1163/156853002320936791

Melson, G. F. (2003). Child development and the human-companion animal bond. *American Behavioral Scientist, 47*(1), 31-39. doi: 10.1177/0002764203255210

Melson, G. F. (2005). *Why the wild things are: Animals in the lives of children*. Cambridge, MA: Harvard University Press.

Messent, P. R. (1983). Social facilitation of contact with other people with pet dogs. In A. H. B. Katcher, Alan M. (Ed.), *New perspectives on our lives with companion animals* (pp. 351-359). Philadelphia: University of Pennsylvania Press.

Murphy, D., Kahn-D'Angelo, L., & Gleason, J. (2008). The effect of hippotherapy on functional outcomes for children with disabilities: A pilot study. *Pediatric physical therapy: The official publication of the Section on Pediatrics of the American Physical Therapy Association, 20*(3), 264-270. doi: 10.1097/PEP.0b013e31818256cd

Nagengast, S. L., Baun, M. M., Megel, M., & Leibowitz, J. (1997). The effects of the presence of a companion animal on physiological arousal and behavioral distress in children during a physical examination. *Journal of Pediatric Nursing, 12*(6), 323-330. doi: 10.1016/S0882-5963(97)80058-9

Nathanson, D. E. (1998). Long term effectiveness of dolphin-assisted therapy for children with severe disabilities. *Anthrozoös, 11*(1), 22-32. doi: 10.2752/089279398787000896

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

Nathanson, D. E., & de Faria, S. (1993). Cognitive improvement of children in water with and without dolphins. *Anthrozoös, 6*(1), 17-29.

Neumann, I. D. (2002). Involvement of the brain oxytocin system in stress coping: Interactions with the hypothalamo-pituitary-adrenal axis. [10.1016/S0079-6123(02)39014-9]. *Progress in Brain Research, 139*, 147-162.

Neumann, I. D., Krömer, S. A., Toschi, N., & Ebner, K. (2000). Brain oxytocin inhibits the (re)activity of the hypothalamo-pituitary-adrenal axis in male rats: Involvement of hypothalamic and limbic brain regions. *Regulatory Peptides, 96*(1-2), 31-38. doi: Doi: 10.1016/s0167-0115(00)00197-x

New York Society for the Prevention of Cruelty to Children. (2000). New York Society for the Prevention of Cruelty to Children: 125th Anniversary, 1875-2000 Retrieved September 1, 2008, from http://www.nyspcc.org/beta_history/index_history.htm

Nielsen, J. A., & Delude, L. A. (1989). Behavior of young children in the presence of different kinds of animals. *Anthrozoös, 3*(2), 119-129. doi: 10.2752/089279390787057711

Odendaal, J. S. J. (2000). Animal-assisted therapy -- magic or medicine? *Journal of Psychosomatic Research, 49*(4), 275-280. doi: 10.1016/S0022-3999(00)00183-5

Parker, R. I., & Brossart, D. F. (2003). Evaluating single-case research data: A comparison of seven statistical methods. *Behavior Therapy, 34*(2), 189-211. doi: 10.1016/S0005-7894(03)80013-8

Parker, R. I., Cryer, J., & Byrns, G. (2006). Controlling trend in single case research. *School Psychology Quarterly, 21*(3), 418-440.

Parker, R. I., & Vannest, K. J. (2009). An improved effect size for single-case research: Nonoverlap of all pairs. *Behavior Therapy, 40*(4), 357-367. doi: 10.1016/j.beth.2008.10.006

Paul, E. S., & Serpell, J. A. (1996). Obtaining a new pet dog: Effects on middle childhood children and their families. *Applied Animal Behaviour Science, 47*, 17-29.

Payton, M. E., Greenstone, M. H., & Schenker, N. (2003). Overlapping confidence intervals or standard error intervals: What do they mean in terms of statistical significance? *Journal of Insect Science, 34*(3). Retrieved from insectscience.org/3.34

Payton, M. E., Miller, A. E., & Raun, W. R. (2000). Testing statistical hypotheses using standard error bars and confidence intervals. *Communications in Soil Science and Plant Analysis, 31*(5), 547 - 551. doi: 10.1080/00103620009370458

Pedersen, C. A., Ascher, J. A., Monroe, Y. L., & Prange, A. J. (1982). Oxytocin induces maternal behavior in virgin female rats. *Science, 216*(4546), 648-650.

Philippe, S. (1995). *Animal-assisted therapy (educational and psychological aspects) with dogs for psychotic and autistic children*. Paper presented at the 7th International Conference on Human-Animal Interactions, Geneva, Switzerland.

Poresky, R. H. (1996). Companion animals and other factors affecting young children's development. *Anthrozoös, 9*(4), 159-168. doi: 10.2752/089279396787001437

Poresky, R. H., & Hendrix, C. (1989). Companion animal bonding, children's home environments, and young children's social development. *Anthrozoös, 9*(4), 159-168.

Poresky, R. H., & Hendrix, C. (1990). Differential effects of pet presence and pet-bonding on young children. *Psychological Reports., 67*(1), 51-54.

Poresky, R. H., Hendrix, C., & Woroby, M. (1989). *Developmental benefits of pets for young children. Final report for the Delta Society*. Paper presented at the National Biennial Meeting of the Society for Research in Child Development, Kansas City, MO.

Prothmann, A., Aibrecht, K., Dietrich, S., Hornfeck, U., Stieber, S., & Ettrich, C. (2005). Analysis of child-dog play behavior in child psychiatry. *Anthrozoös, 18*(1), 43-58.

Prothmann, A., Ettrich, C., & Prothmann, S. (2009). Preference for, and responsiveness to, people, dogs and objects in children with autism. *Anthrozoös, 22*(2), 161-171. doi: 10.2752/175303709X434185

Redefer, L. A., & Goodman, J. F. (1989). Pet-facilitated therapy with autistic children. *Journal of Autism and Developmental Disorders., 19*(3), 461-467. doi: 10.1007/BF02212943

Richards, S. B., Taylor, R. L., Ramasamy, R., & Richards, R. Y. (1999). *Single subject research: Applications in educational and clinical setting*. Belmont, CA: Wadsworth.

Risley-Curtiss, C., Holley, L. C., & Wolf, S. (2006). The animal-human bond and ethnic diversity. *Social Work, 51*(3), 257-268.

Robins, B., Dautenhahn, K., Boekhorst, R., & Billard, A. (2005). Robotic assistants in therapy and education of children with autism: Can a small humanoid robot help encourage social interaction skills? *Universal Access in the Information Society, 4*(2), 105-120. doi: 10.1007/s10209-005-0116-3

Rossignol, D. A. (2009). Novel and emerging treatments for autism spectrum disorders: A systematic review. *Annals of Clinical Psychiatry: The Official Journal of the American Academy of Clinical Psychiatrists, 21*(4), 213-236.

Rud, A. G., & Beck, A. M. (2003). Companion animals in Indiana elementary schools. *Anthrozoös, 16*(3), 241-251.

Sablin, M. V., & Khlopachev, G. A. (2002). The earliest ice age dogs: Evidence from Eliseevichi. *Current Anthropology, 43*(5), 795-799. doi: doi:10.1086/344372

Sams, M. J., Fortney, E. V., & Willenbring, S. (2006). Occupational therapy incorporating animals for children with autism: A pilot investigation. *American Journal of Occupational Therapy., 60*(3), 268-274.

Sawilowsky, S. S., & Blair, R. C. (1992). A more realistic look at the robustness and Type II error properties of the *t* test to departures from population normality. *Psychological Bulletin, 111*(2), 352-360. doi: 10.1037/0033-2909.111.2.352

Schenker, N., & Gentleman, J. F. (2001). On judging the significance of differences by examining overlap between confidence intervals. *The American Statistician, 55*(3), 182-186. doi: 10.1198/000313001317097960

Serpell, J. A. (2005). Creatures of the unconscious: Companion animals as mediators. In A. L. Podberscek, E. S. Paul & J. A. Serpell (Eds.), *Companion animals and us: Exploring the relationships between people and pets* (pp. 108-121). Cambridge, UK: Cambridge University Press.

Servais, V. (1999). Some comments on context embodiment in zootherapy: The case of the Autidolfin project. *Anthrozoös, 12*(1), 5-15.

Shattuck, P. T. (2006). The contribution of diagnostic substitution to the growing administrative prevalence of autism in US special education. *Pediatrics, 117*(4), 1028-1037. doi: 10.1542/peds.2005-1516

Shiloh, S., Sorek, G., & Terkel, J. (2003). Reduction of state-anxiety by petting animals in a controlled laboratory experiment. *Anxiety, Stress & Coping, 16*(4), 387-395. doi: 10.1080/1061580031000091582

Skokauskas, N., & Gallagher, L. (2010). Psychosis, affective disorders and anxiety in autistic spectrum disorder: prevalence and nosological considerations. *Psychopathology, 43*(1), 8-16.

Sprinkle, J. E. (2008). Animals, empathy, and violence: Can animals be used to convey principles of prosocial behavior to children? *Youth Violence & Juvenile Justice, 6*(1), 47-58. doi: 10.1177/1541204007305525

Sterba, J. A. (2007). Does horseback riding therapy or therapist-directed hippotherapy rehabilitate children with cerebral palsy? *Developmental Medicine and Child Neurology, 49*(1), 68-73.

Strathearn, L. (2009). The elusive etiology of autism: Nature and nurture? *Frontiers in Behavioral Neuroscience, 3*(ArtID 11), 3 pgs. doi: 10.3389/neuro.08.011.2009

Suen, H. K., & Ary, D. (1989). *Analyzing quantitative behavioral observation data*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Tannen, D. (2004). Talking the dog: Framing Pets as interactional resources in family discourse. *Research on Language & Social Interaction, 37*(4), 399-420. doi: 10.1207/s15327973rlsi3704_1

Tchernov, E., & Valla, F. F. (1997). Two new dogs, and other Natufian dogs, from Southern Levant. *Journal of Archaeological Science, 24*, 65-95. doi: 10.1006/jasc.1995.0096

Thelen, E. (2000). Grounded in the world: Developmental origins of the embodied mind. *Infancy, 1*(1), 3-28. doi: 10.1207/S15327078IN0101_02

Tissen, I., Hergovich, A., & Spiel, C. (2007). School-based social training with and without dogs: Evaluation of their effectiveness. *Anthrozoös, 20*(4), 365-373. doi: 10.2752/089279307X245491

United States Department of Education/Office of Special Education and Rehabilitative Services/Office of Special Education Programs. (2009). *28th annual (2006) report to*

congress on the implementation of the Individuals with Disabilities Education Act, parts B and C. Washington, DC: Author.

United States Government Accountability Office. (2005). *Special education: Children with autism*. Washington, DC: Author.

Veevers, J. E. (1985). The social meanings of pets: Alternative roles for companion animals. In M. B. Sussman (Ed.), *Pets and the family* (pp. 11-30). New York: Haworth Press.

Venn, J. J. (2010). Review of the Social Responsiveness Scale. *The eighteenth mental measurements yearbook.* Retrieved from http://www.unl.edu/buros/

Weiss, D. (2009). Equine assisted therapy and Theraplay. In E. Munns (Ed.), *Applications of family and group Theraplay* (pp. 225-233). Lanham, MD, US: Jason Aronson.

Wells, D. L. (2004). The facilitation of social interactions by domestic dogs. *Anthrozoös, 17*(4), 340-352. doi: 10.2752/089279304785643203

Wermter, A., Kamp-Becker, I., Hesse, P., Schulte-Körne, G., Strauch, K., & Remschmidt, H. (2010). Evidence for the involvement of genetic variation in the *oxytocin receptor* gene (*OXTR*) in the etiology of autistic disorders on high-functioning level. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics, 153B*(2), 629-639. doi: 10.1002/ajmg.b.31032

White, S. W., Albano, A. M., Johnson, C. R., Kasari, C., Ollendick, T., Klin, A., et al. (2010). Development of a cognitive-behavioral intervention program to treat anxiety and social deficits in teens with high-functioning autism *Clinical Child and Family Psychology Review, 13*(1), 77-90. doi: 10.1007/s10567-009-0062-3

Wilson, C. C. (1991). The pet as anxiolytic intervention. *Journal of Nervous and Mental Disease, 179*(8), 482-489.

Wilson, E. O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.

Wing, L. (2005). Problems of categorical classification systems. In F. R. Volkmar, R. Paul, A. Klin & D. Cohen (Eds.), *Handbook of autism and pervasive developmental disorders: Diagnosis, development, neurobiology, and behavior* (3rd ed., Vol. 1, pp. 583-605). Hoboken, NJ: John Wiley & Sons, Inc.

Wing, L., & Potter, D. (2002). The epidemiology of autistic spectrum disorders: Is the prevalence rising? *Mental Retardation & Developmental Disabilities Research Reviews, 8*(3), 151-161. doi: 10.1002/mrdd.10029

Witkin, H. A., Dyk, R. B., Faterson, H. F., Goodenough, D. R., & Karp, S. A. (1962). *Psychological differentiation. Studies of development*. New York: John Wiley and Sons.

Wood, L. J., Giles-Corti, B., Bulsara, M. K., & Bosch, D. A. (2007). More than a furry companion: The ripple effect of companion animals on neighborhood interactions and sense of community. *Society and Animals, 15*, 43-56. doi: 10.1163/156853007X169333

Young, L. J., & Wang, Z. (2004). The neurobiology of pair bonding. *Nat Neurosci, 7*(10), 1048-1054. doi: 10.1038/nn1327

Young, L. J., Wang, Z., & Insel, T. R. (1998). Neuroendocrine bases of monogamy. *Trends in Neurosciences, 21*(2), 71-75. doi: 10.1016/s0166-2236(97)01167-3

Zasloff, R. L. (1996). Measuring attachment to companion animals: A dog is not a cat is not a bird. *Applied Animal Behaviour Science, 47*(1-2), 43-48. doi: 10.2460/javma.234.7.896

Zasloff, R. L., Hart, L. A., & DeArmond, H. (1999). Animals in elementary school education in California. *Journal of Applied Animal Welfare Science, 2*(4), 347-357. doi: 10.1207/s15327604jaws0204_8

APPENDIX A

FIGURES AND TABLES

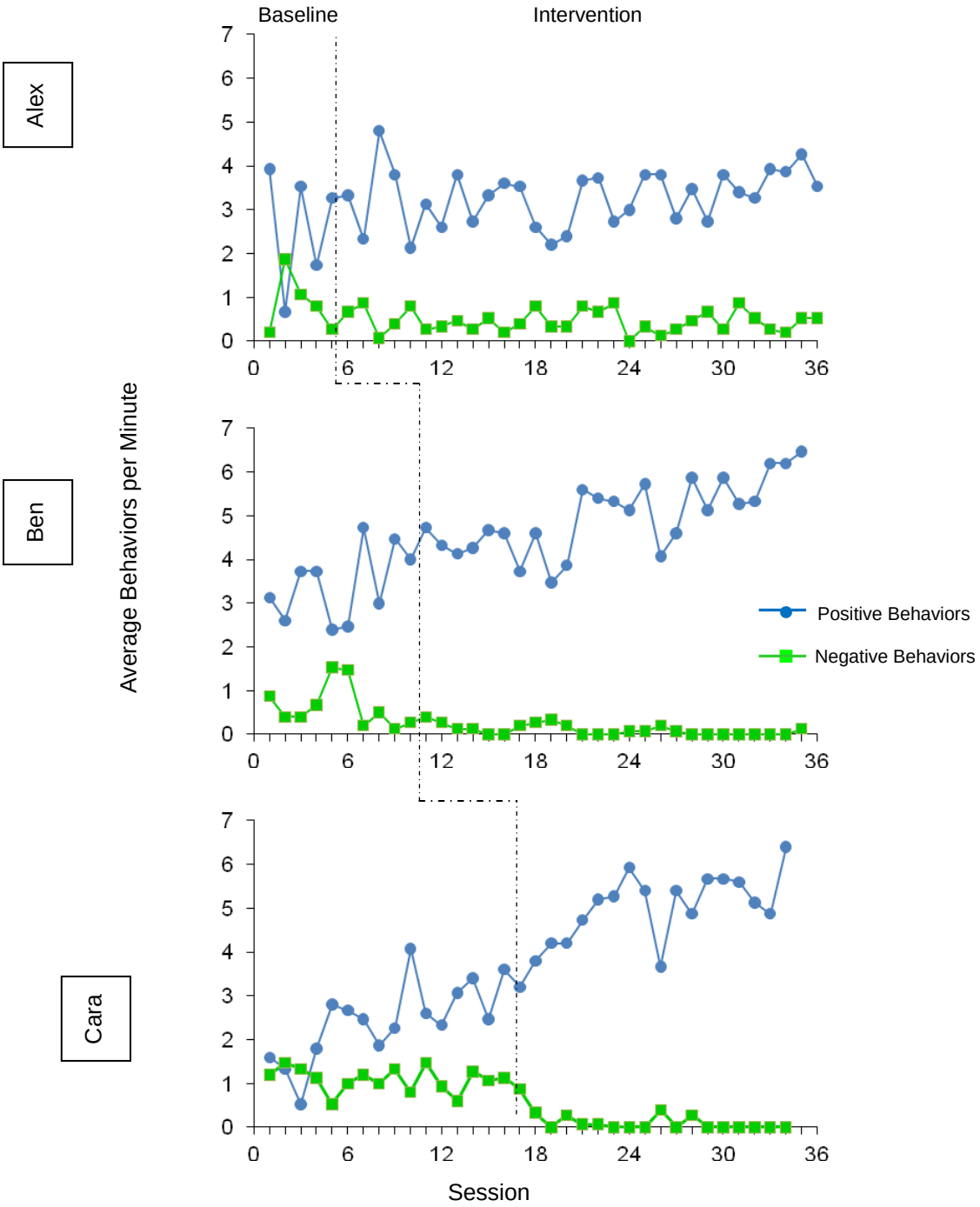
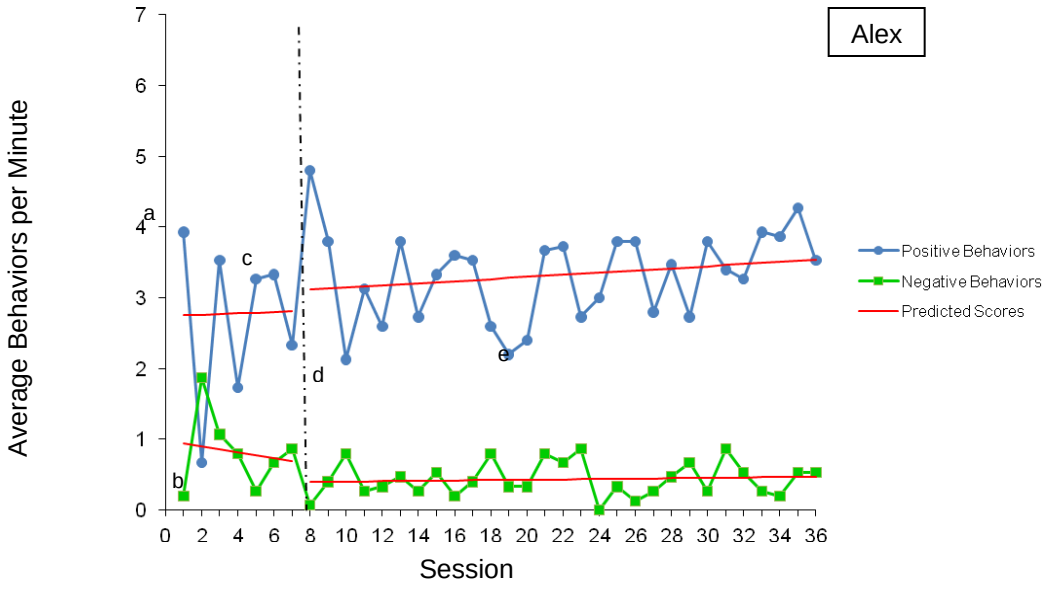
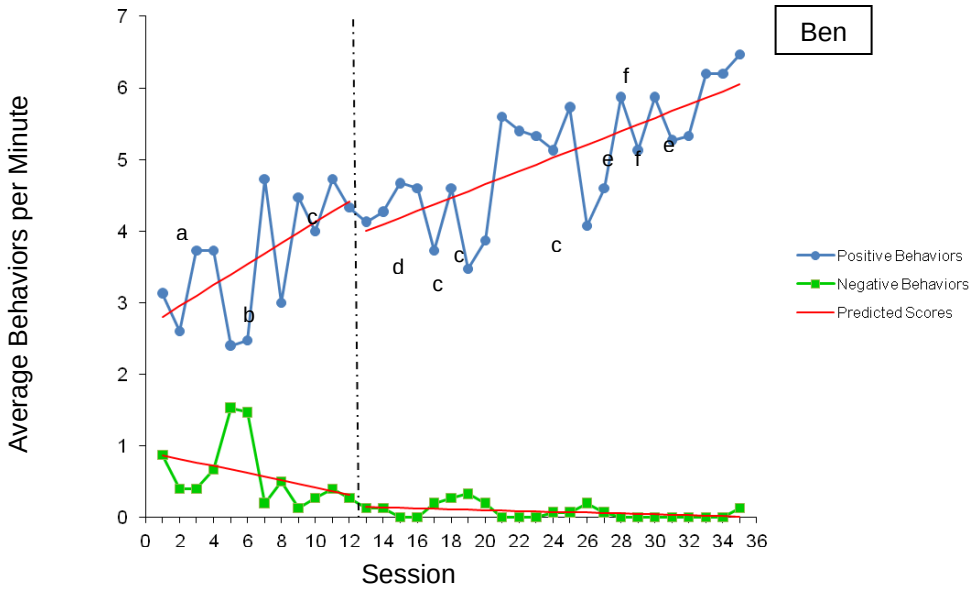


Figure 1. Average positive and negative behaviors of study participants across sessions.



Note. [a]Father returned after the session on this day after having been out of the country for 10 days. [b]Crawled under a table and refused to participate. [c]Raters 2 and 3 were introduced. [d]Mother was out of town for 3 days. [e]In trouble at school and home. He was non-interactive for the first third of the session.

Figure 2. Alex's average positive and negative behaviors across sessions with regression lines and data from the event log for changes in his life and environment.



Note. [a]Had not had Strattera for 2 days. Was playing outside with brother and did not want to come inside. [b]Had trouble coming in from outside and was angry and yelling. Mother talked to him and he laid down on the bed to calm down. He did not acknowledge the experimenter when entering the room. Had to go first because Cara had a meltdown and was in a cooling off pe d. Accidentally hit head 10 minutes into session and session was discontinued. [c]Rater 2 substituted for Rate 1. [d]Not fe g well; got shots on this day. [e]Alternate dog (Buster). [f]Alternate dog (Danny).

Figure 3. Ben's uncorrected average positive and negative behaviors across sessions with regression lines and data from the event log for changes in his life and environment.

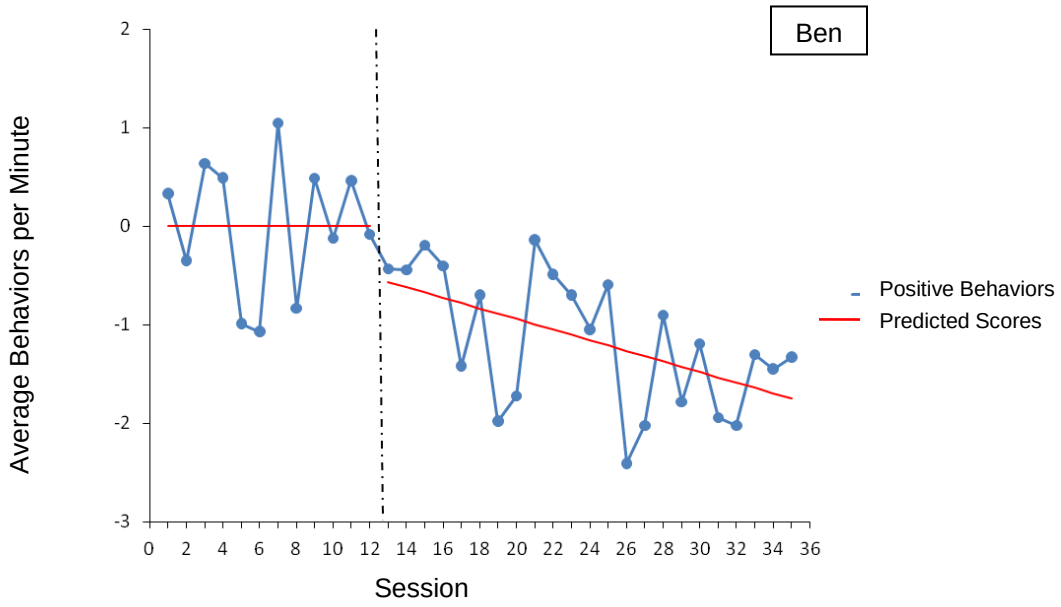
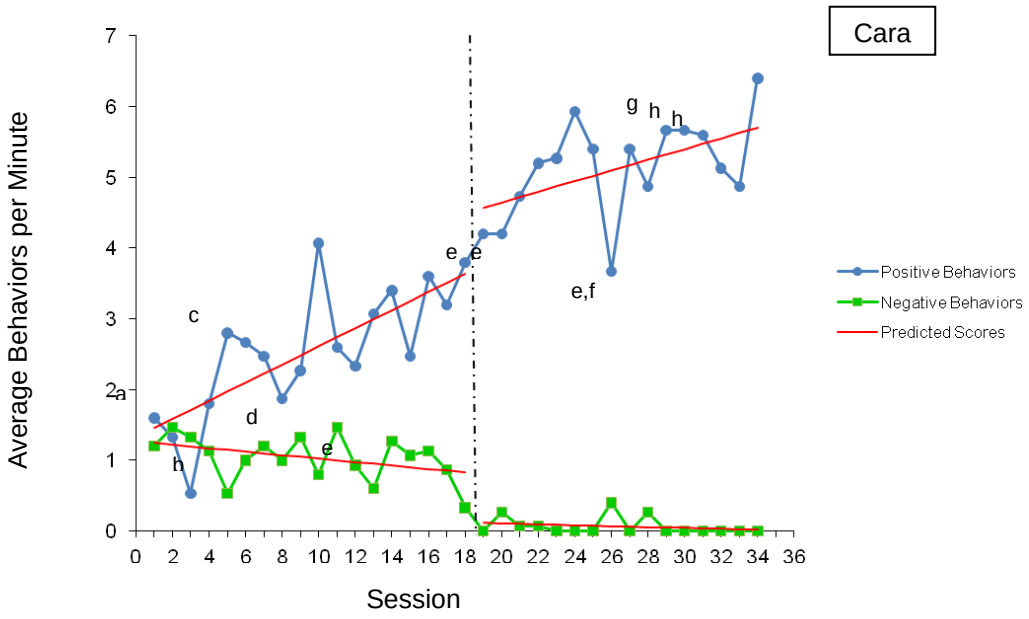


Figure 4. Ben's corrected average positive behaviors across sessions.



Note. [a]Received Lupron shot the day before. [b]Had not had Strattera for 2 days. [c]Was suicidal and tantruming on previous day. [d]Meltdown before experimenter arrived. Hard day at school. Met with psychologist. [e]Rater 2 substituted for Rater 1. [f]Nervous about upcoming trip to stay with family out of town for a week. [g]Alternate dog (Buster). [h]Alternate dog (Danny).

Figure 5. Cara's uncorrected average positive and negative behaviors across sessions with regression lines and data from the event log for changes in her life and environment.

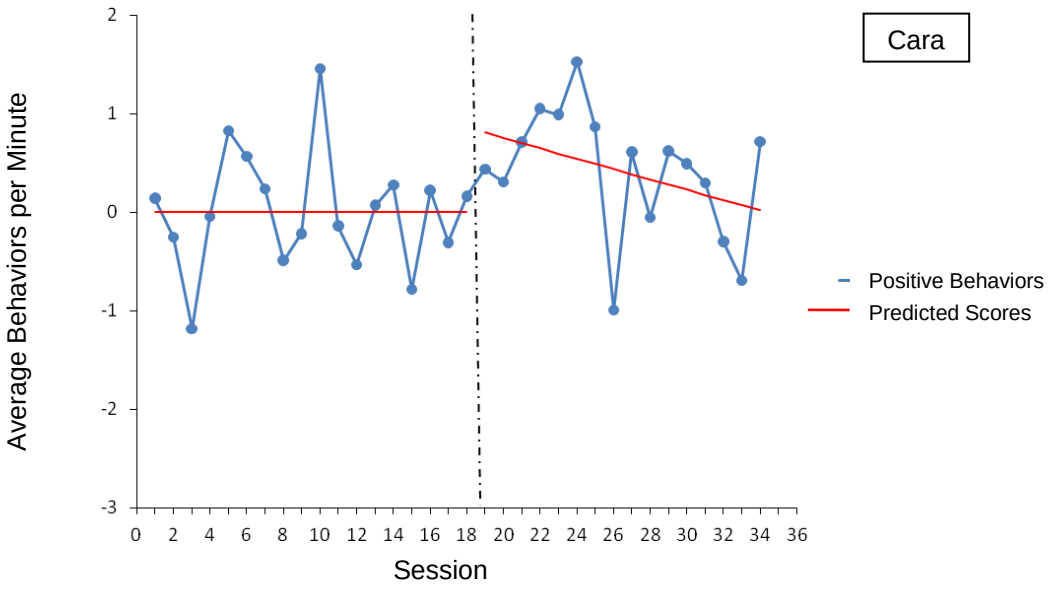


Figure 6. Cara's corrected average positive behaviors across sessions.

Table 1

Non-Overlap of All Pairs Effect Sizes for Aggregate Behaviors Across Participants

	Alex		Ben		Cara	
Behaviors	NAP	84% CI	NAP	84% CI	NAP	84% CI
Positive – Uncorrected	.300	[0.128, 0.473]	.840***	[0.671, 1.009]	.986***	[0.845, 1.127]
Positive – Corrected			.768***	[0.622, 0.914]	.451*	[0.310, 0.592]
Negative – Uncorrected	.438	[0.267, 0.610]	.902***	[0.757, 1.046]	.996***	[0.858, 1.135]

Note. NAP = Non-Overlap of All Pairs; * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Table 2

Non-Overlap of All Pairs Effect Sizes for Individual Behaviors Across Participants

	Alex	Ben	Cara
Behavior	%	%	%
Stroking, Petting, Cuddling	1.00*** [a]	.966***[a]	1.00*** [a]
Engaged Social Play	.807**[b]	.330	.439*** [a]
Eye Contact	.522* [a]	.829*** [a]	.763*** [a]
Joint Attention	.123	.619** [a]	.145
Smiling	.064	.177	.816*** [a]
Laughing	.060	.329	.229
Looking At Environment	.517** [a]	.467** [a]	.593*** [a]
Solitary Activity	.670** [a]	.576* [a]	.993*** [a]
Self-Stimulating	.305	.818*** [a]	.809*** [a]
Expressive Communication To	.305	.681*** [a]	.621*** [a]
Nonverbal Communication	.512**[b]	.583** [a]	.694*** [a]
Receptive Language	.364	.579** [a]	.441* [a]
Expressive Communication About	.261	.960*** [a]	.951*** [a]
Echolalia	.206	NA	.062

Note. NAP = Non-Overlap of All Pairs; NA = Participant did not engage in this behavior; * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$; [a]change in desired direction; [b]change in undesired direction.

Table 3

Alex: Descriptive Statistics

Phase	Data-points	Behaviors	Mean	Median	SD	Std Error	Min	Max
A	7	Positive	2.78	3.27	1.10	.41	0.67	3.93
		Negative	0.82**	0.80	0.56	.21	0.20	1.87
B	29	Positive	3.33	3.47	0.64	.19	2.13	4.80
		Negative	0.43**	0.40	0.24	.04	0.00	0.87

Note. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Table 4

Ben: Descriptive Statistics

Phase	Data-points	Behaviors	Mean	Median	SD	Std Error	Min	Max
A	12	Positive	3.61***	3.73	0.87	.25	2.40	4.73
		Negative	0.59***	0.40	0.47	.14	0.13	1.53
B	23	Positive	5.02***	5.13	0.85	.17	3.47	6.47
		Negative	0.08***	0.00	0.10	.02	0.00	0.33

Note. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Table 5

Cara: Descriptive Statistics

Phase	Data-points	Behaviors	Mean	Median	SD	Std Error	Min	Max
A	18	Positive	2.55***	2.53	0.91	0.21	0.53	4.07
		Negative	1.04	1.10	0.32	0.07	0.33	1.47
B	16	Positive	5.23***	5.23	0.70	0.18	3.67	6.40
		Negative	0.07	0.00	0.12	0.03	0.00	0.40

Note. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Table 6

Alex: Slope Across Phases

Behaviors	Phase	R^2	Slope	84% CI
Positive	A	.00	.010	[-.366, .385]
	B	.04	.015	[-.005, .036]
Negative	A	.03	-.043	[-.231, .145]
	B	.01	.003	[-.005, .010]

Note. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Table 7

Ben: Slope Across Phases

Behaviors	Phase	R^2	Slope	84% CI
Positive	A	.37*	.147*	[.055, .239]
	B	.55***	.093***	[.066, .120]
Negative	A	.15	-.051	[-.109, .007]
	B	.16*	-.006*	[-.010, -.002]

Note. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Table 8

Cara: Slope Across Phases

Behaviors	Phase	R^2	Slope	84% CI
Positive	A	.57***	.128***	[.087, .170]
	B	.26*	.075*	[.025, .126]
Negative	A	.17	-.025	[-.044, -.005]
	B	.06	-.007	[-.017, .004]

Note. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Table 9

Differences in Parent Rating on the Social Responsiveness Scale at Each Phase Change

	Statistically Significant Difference at $p = .05$		
Participant	Study Onset & Intervention	Intervention & Study End	Study Onset & Study End
Alex	Y	N	Y
Ben	N	Y	N
Cara	Y	N	N

Table 10

Alex: Social Responsiveness Scale T-scores

	Study Onset		Intervention		Study End	
Scale	*T* score	84% CI	*T* score	84% CI	*T* score	84% CI
Total Score	86[a,c]	[82.64, 89.36]	75[a]	[71.64, 78.36]	76[c]	[72.64, 79.36]
Social Awareness	65	[55.06, 74.94]	59	[49.06, 68.94]	59	[49.06, 68.94]
Social Cognition	81	[72.88, 89.12]	68	[59.88, 76.12]	68	[59.88, 76.12]
Social Communication	80	[74.12, 85.88]	75	[69.12, 80.88]	76	[70.12, 81.88]
Social Motivation	73	[65.02, 80.98]	66	[58.02, 73.98]	63	[55.02, 70.98]
Autistic Mannerisms	101[a]	[93.3, 108.7]	85[a]	[77.3, 92.7]	87	[79.3, 94.7]

Note. [a]Statistically significant difference between study onset and intervention onset at $p \leq .05$. [b]Statistically significant difference between intervention onset and study end at $p \leq .05$. [c]Statistically significant difference between study onset and study end at $p \leq .05$.

Table 11

Ben: Social Responsiveness Scale T-scores

	Study Onset		Intervention		Study End	
Scale	*T* score	84% CI	*T* score	84% CI	*T* score	84% CI
Total Score	74	[70.64, 77.36]	77[b]	[73.64, 80.36]	68[b]	[64.64, 71.36]
Social Awareness	75	[65.06, 84.94]	78	[68.06, 87.94]	78	[68.06, 87.94]
Social Cognition	65[a]	[56.88, 73.12]	85[a]	[76.88, 93.12]	74	[65.88, 82.12]
Social Communication	65	[59.12, 70.88]	66	[60.12, 71.88]	62	[56.12, 67.88]
Social Motivation	75[c]	[67.02, 82.98]	66	[58.02, 73.98]	54[c]	[46.02, 61.98]
Autistic Mannerisms	78	[70.3, 85.7]	78	[70.3, 85.7]	67	[59.3, 74.7]

Note. [a]Statistically significant difference between study onset and intervention onset at $p \leq .05$. [b]Statistically significant difference between intervention onset and study end at $p \leq .05$. [c]Statistically significant difference between study onset and study end at $p \leq .05$.

Table 12

Cara: Social Responsiveness Scale T-scores

	Study Onset		Intervention		Study End	
Scale	*T* score	84% CI	*T* score	84% CI	*T* score	84% CI
Total Score	96[a]	[92.36, 99.64]	85[a]	[81.36, 88.64]	89	[85.36, 92.64]
Social Awareness	91[a,c]	[81.06, 100.94]	70[a]	[60.06, 79.94]	63[c]	[53.06, 72.94]
Social Cognition	94	[85.88, 102.12]	94	[85.88, 102.12]	99	[90.88, 107.12]
Social Communication	87	[81.12, 92.88]	81	[75.12, 86.88]	83	[77.12, 88.88]
Social Motivation	77	[69.02, 84.98]	67[b]	[59.02, 74.98]	87[b]	[79.02, 94.98]
Autistic Mannerisms	99[c]	[91.3, 106.7]	85	[77.3, 92.7]	82[c]	[74.3, 89.7]

Note. [a]Statistically significant difference between study onset and intervention onset at $p \leq .05$. [b]Statistically significant difference between intervention onset and study end at $p \leq .05$. [c]Statistically significant difference between study onset and study end at $p \leq .05$.

APPENDIX B

DSM-IV-TR DIAGNOSTIC CRITERIA FOR AUTISTIC DISORDER PERVASIVE DEVELOPMENTAL DISORDER – NOT OTHERWISE SPECIFIED (PDD-NOS)

Autistic Disorder

A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):

   (1) qualitative impairment in social interaction, as manifested by at least two of the following:

      (a) marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
      (b) failure to develop peer relationships appropriate to developmental level
      (c) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)
      (d) lack of social or emotional reciprocity

   (2) qualitative impairments in communication as manifested by at least one of the following:

      (a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
      (b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
      (c) stereotyped and repetitive use of language or idiosyncratic language
      (d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

   (3) restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:

      (a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
      (b) apparently inflexible adherence to specific, nonfunctional routines or rituals
      (c) stereotyped and repetitive motor mannerism (e.g., hand or finger flapping or twisting, or complex whole body movements)

(d) persistent preoccupation with parts of objects

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic play.
C. The disturbance is not better accounted for by Rett's disorder or childhood disintegrative disorder

Pervasive developmental disorder not otherwise specified (including atypical autism)

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction associated with impairment in either verbal or nonverbal communication skills or with the presence of stereotyped behavior, interests, and activities, but the criteria are not met for a specific pervasive developmental disorder, schizophrenia, schizotypal personality disorder, or avoidant personality disorder. For example, this category includes "atypical autism" – presentations that do not meet the criteria for autistic disorder because of age at onset, atypical symptomatology, or subthreshold symptomatology, or all of these.

APPENDIX C

DATA COLLECTION FORM

Child's Study Code: _____ Rater's Code: _____

Date: _____/_____/_____ Day of the Week: _____ Time Observation Began: _____ AM / PM
(circle one)

	Frequency per minute														
Behavior	0:00 – 0:59	1:00 – 1:59	2:00 – 2:59	3:00 – 3:59	4:00 – 4:59	5:00 – 5:59	6:00 – 6:59	7:00 – 7:59	8:00 – 8:59	9:00 – 9:59	10:00 – 10:59	11:00 – 11:59	12:00 – 12:59	13:00 – 13:59	14:00 – 15:00
Social Behavior															
Stroking/petting/cuddling															
Engaged Social Play															
Eye Contact															
Joint Attention															
Smiling															
Laughing															
Non-Social Behavior															
Looking @ Environment															
Solitary Activity															
Self-Stimulatory Behavior															
Self-stimulating															
Social Communication															
Expressive To															
Nonverbal															
Receptive															
Non-Social Communication															
Expressive About															
Echolalia															

Social Behavior**:** (1) **Stroking/petting/cuddling:** the child engages in gentle physical contact with a human or dog in the form of gentle strokes or pats or close bodily contact with a human or dog; (2) **Engaged social play:** the child engages in a series of interactions with a human or dog in a range of voluntary, intrinsically motivated activities that are normally associated with pleasure and enjoyment for a minimum of 10 seconds (3) **Eye contact:** the child looks into the eyes of a human or dog for at least two seconds; (4) **Joint attention:** the child coordinates or shares attention with a social partner regarding an object or event by following the gaze of others and/or by using his or her own eye contact and gestures to show or direct the attention of the people around him or her; (5) **Smiling:** the child displays a facial expression characterized by flexing the muscles near both ends of the mouth and contracting the muscles of the cheeks and eyes, creating "crow's feet" at the outer corners of the eyes; and/ or (6) **Laughing:** the child laughs or giggles during a social interaction

Non-Social Behavior**:** (1) **Looking around the environment:** the child's gaze is directed away from him- or herself, but is not directed toward the face of another human or the dog and/or (2) **Solitary activity:** the child engages in an activity to the exclusion of others (human or dog).

Self-Stimulatory Behavior**:** the child engages in repetitive body movements, movements of objects (e.g., hand flapping, finger flicking, body rocking, staring at lights), vocalizations, or noises.

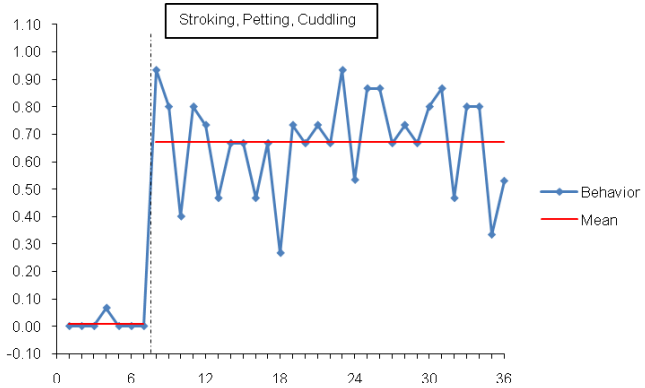
Social Communication**:** (1) **Expressive To:** the child directs verbal or manual language (including language produced via an augmentive and alternative communication [AAC] device) toward another (human or dog); (2) **Nonverbal:** the child directs nonverbal communication (e.g., gestures or facial expressions) toward another (human or dog); and/or (3) **Receptive:** the child responds appropriately to directions or questions.

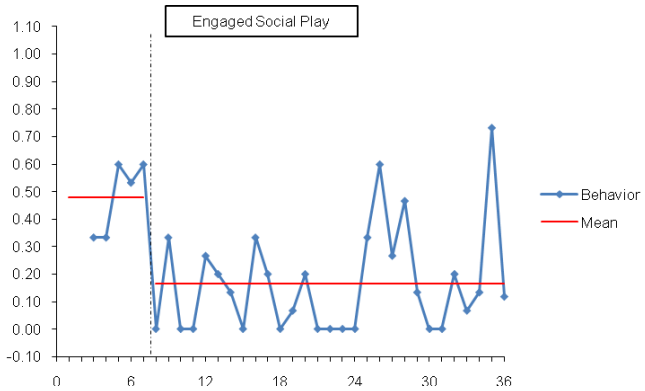
Non-Social Communication**:** (1) **Expressive About:** the child comments (through speech, manual language, or an AAC device) about another (human or dog), object, school, or an unrelated topic, but the speech is not directed toward another (human or dog) or apparently relevant to the current setting (e.g., apropos of nothing, the child focuses on the topic of local post office locations) and/or (2) **Echolalia:** the child engages in the immediate repetition of other's or his or her own vocalizations or the echoing of a phrase after some delay or lapse of time.

APPENDIX D

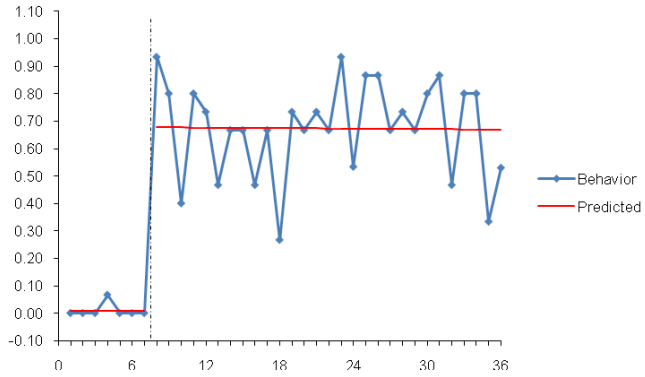
GRAPHS OF ALEX'S STATISTICALLY SIGNIFICANT INDIVIDUAL BEHAVIORS

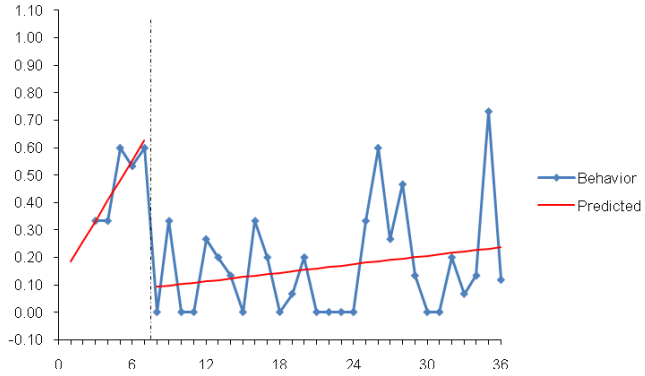
Simple Mean Shift





Mean + Trend Shift





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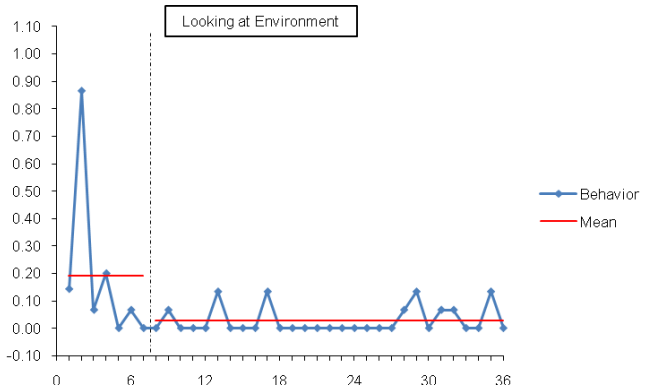
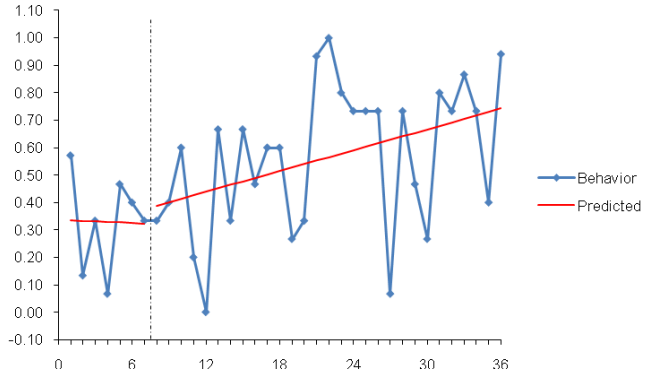
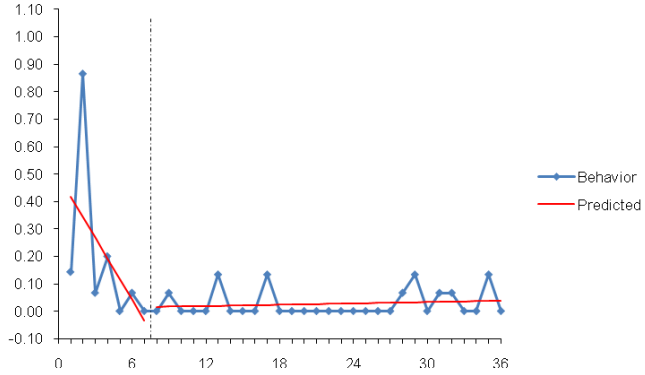


Mean + Trend Shift





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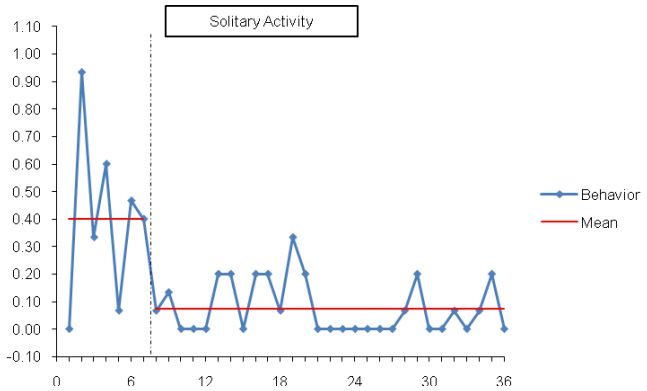
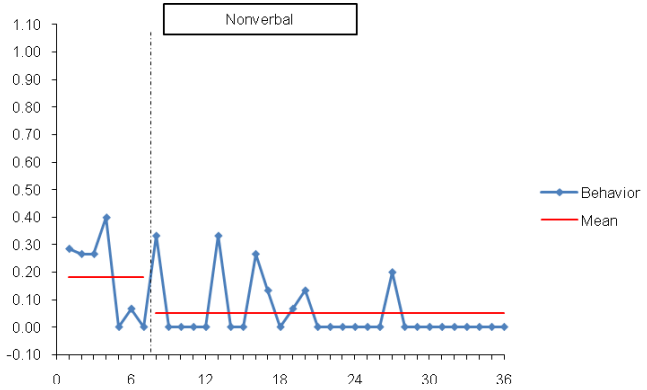
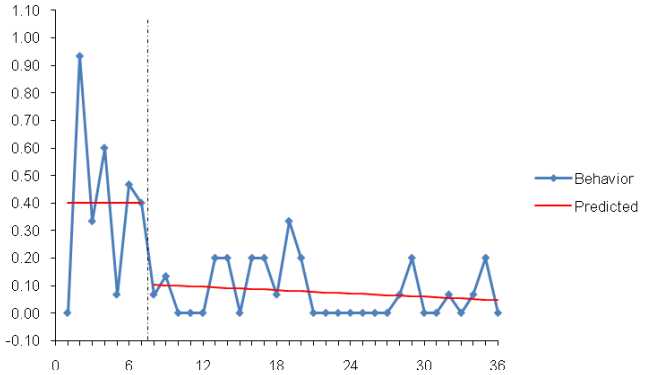
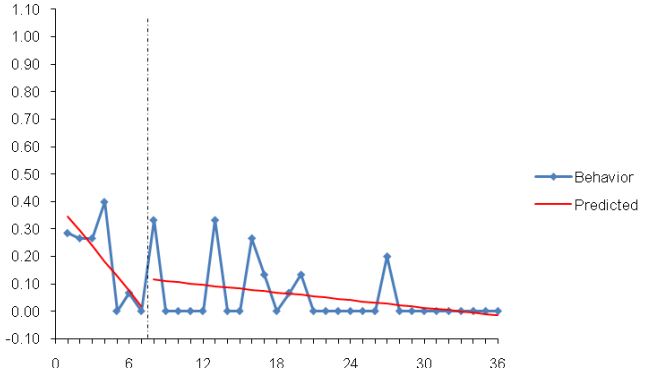




Mean + Trend Shift

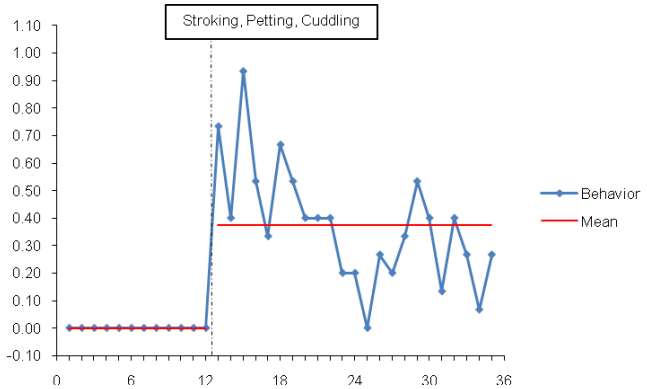


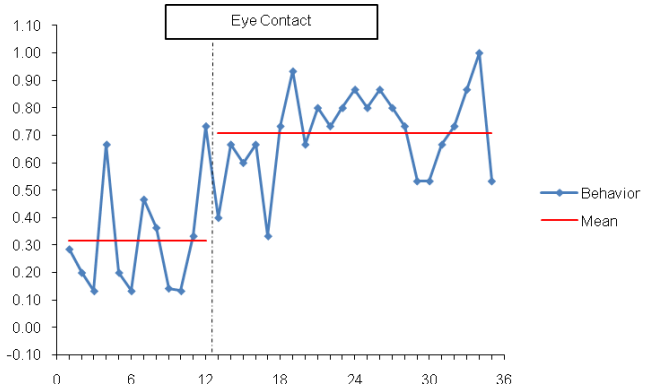


APPENDIX E

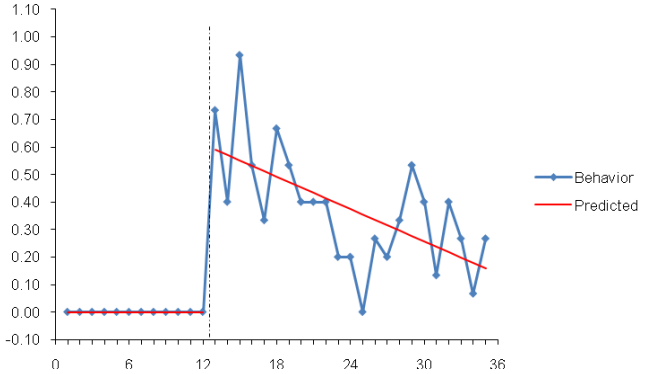
GRAPHS OF BEN'S STATISTICALLY SIGNIFICANT INDIVIDUAL BEHAVIORS

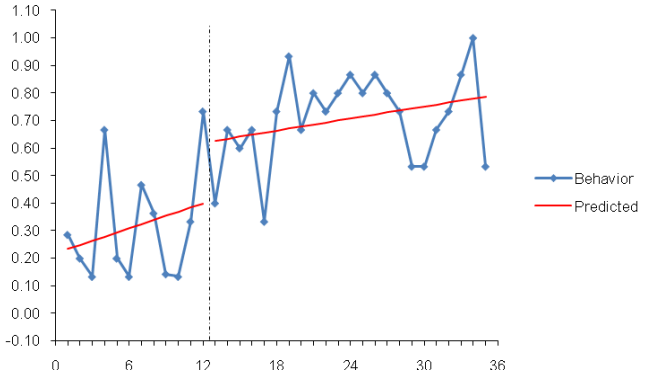
Simple Mean Shift





Mean + Trend Shift





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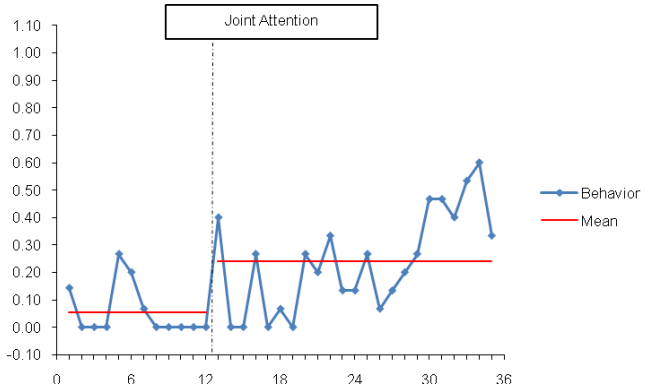
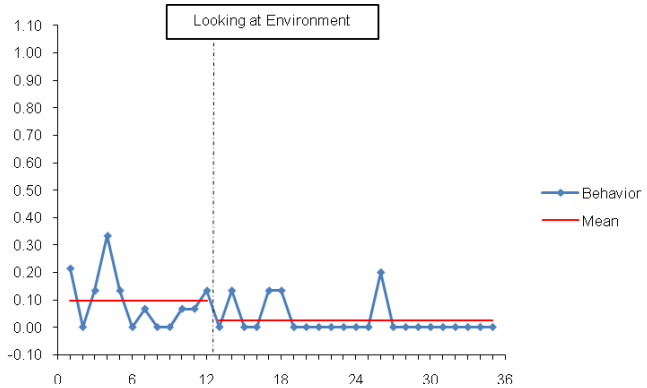
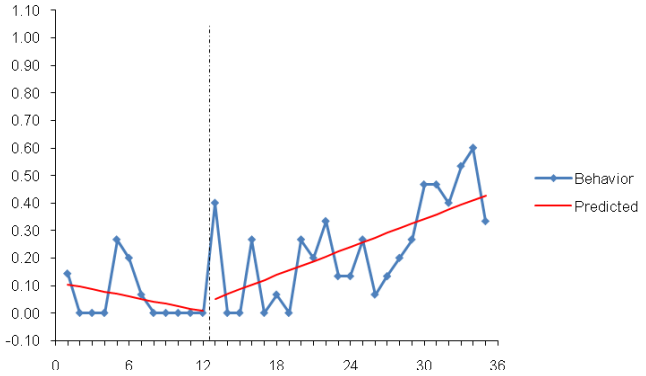
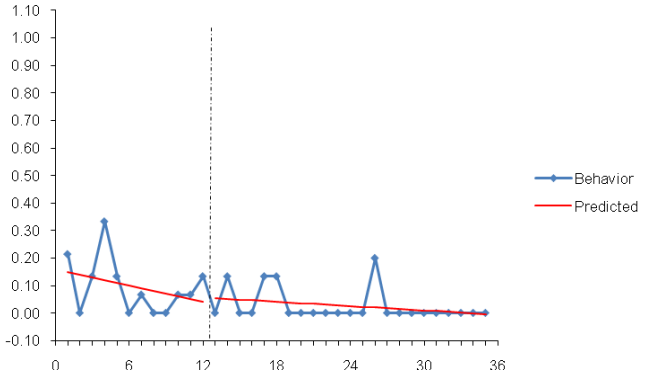




Mean + Trend Shift





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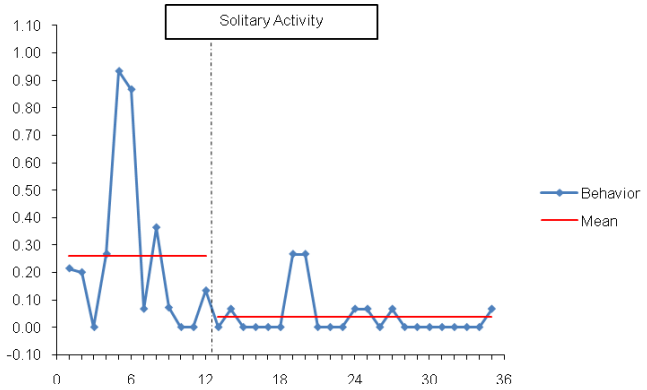
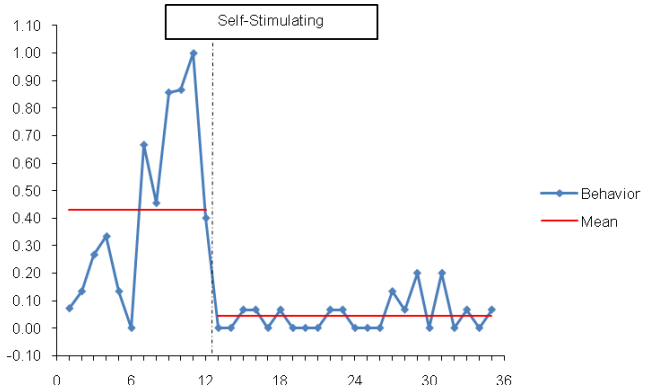
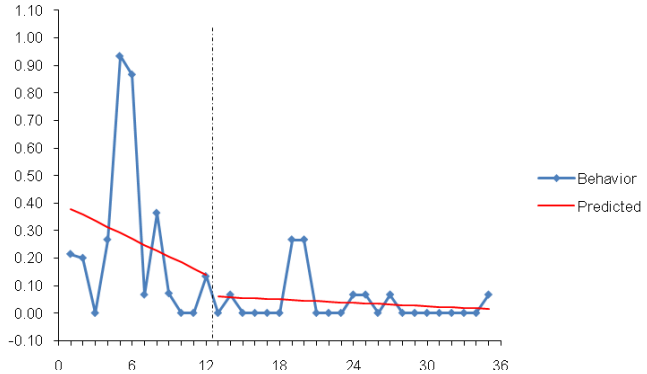
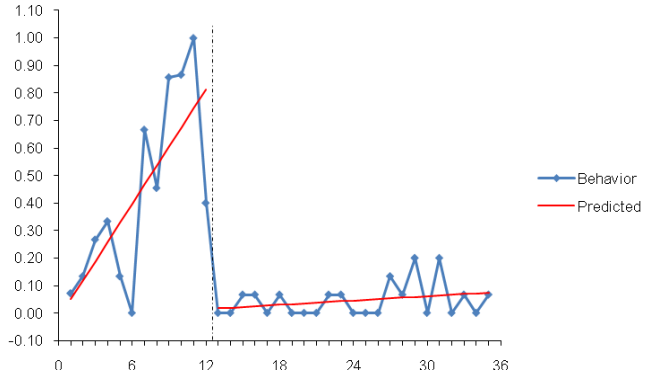




Mean + Trend Shift





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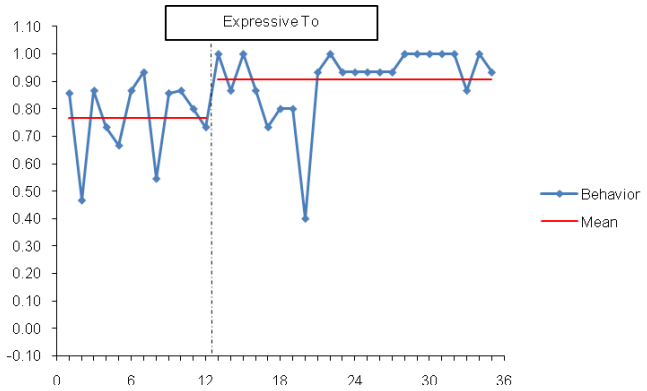
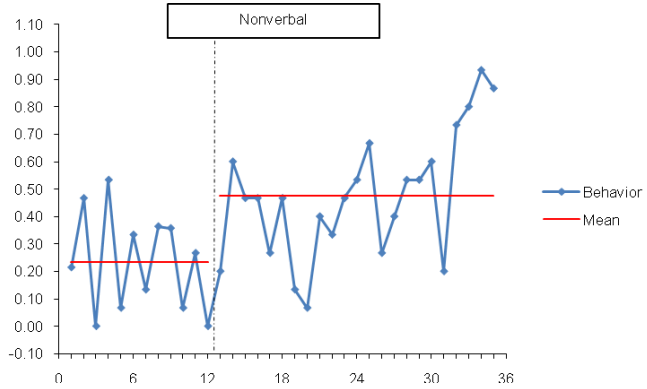
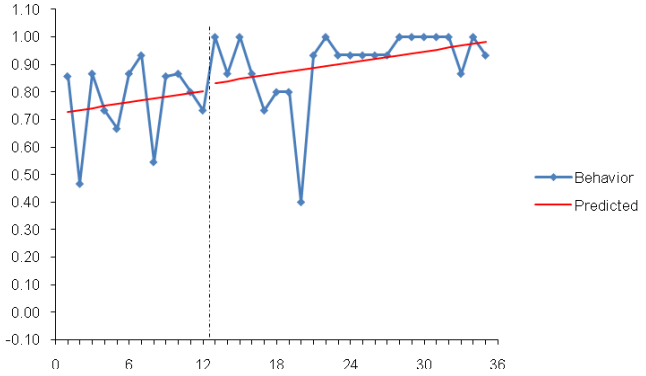
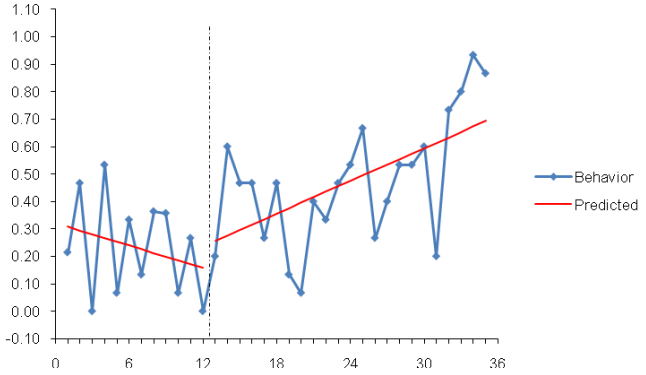




Mean + Trend Shift





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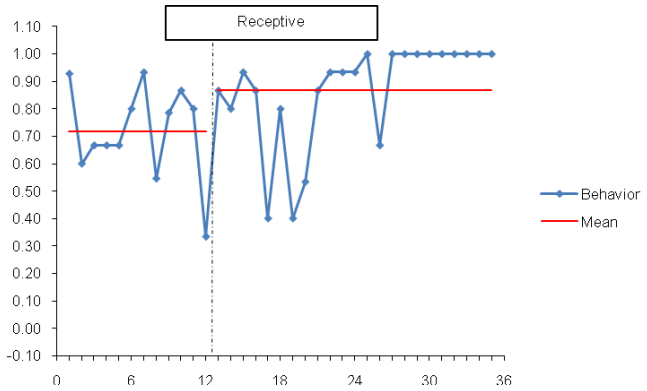
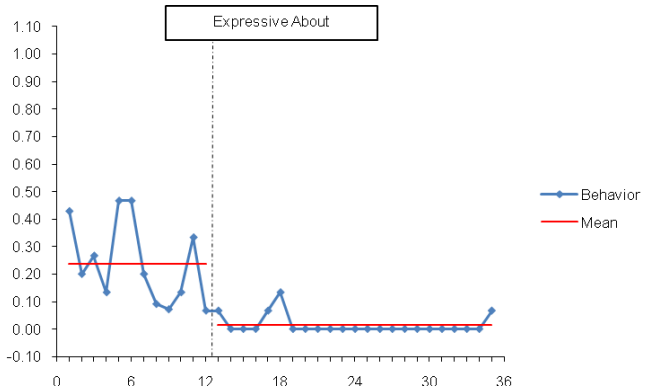
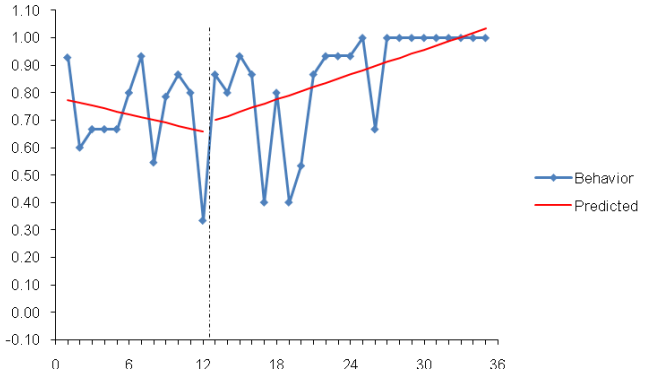
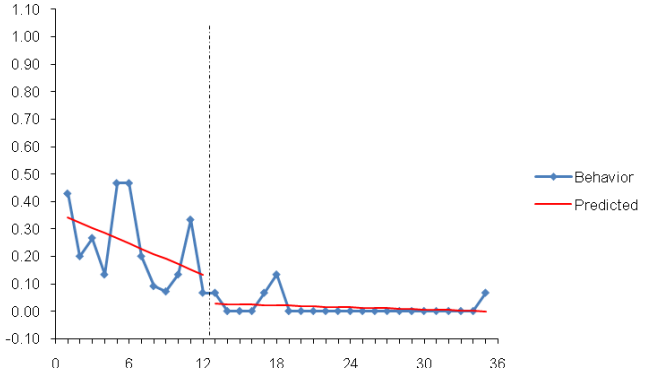




Mean + Trend Shift

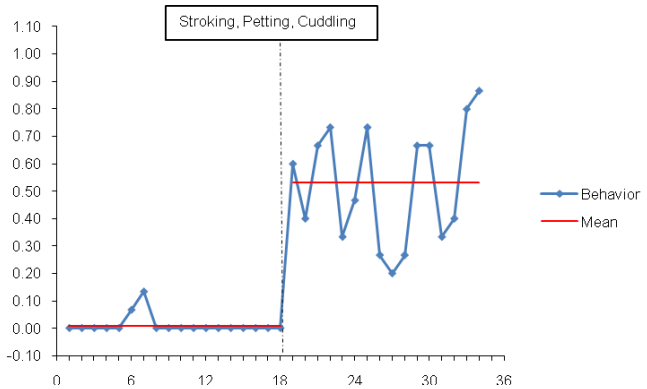


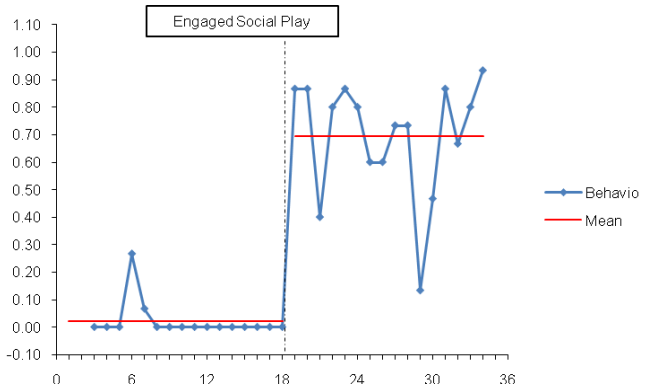


APPENDIX F

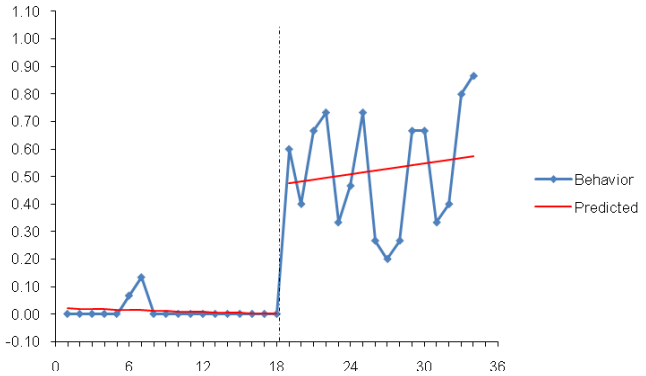
GRAPHS OF CARA'S STATISTICALLY SIGNIFICANT INDIVIDUAL BEHAVIORS

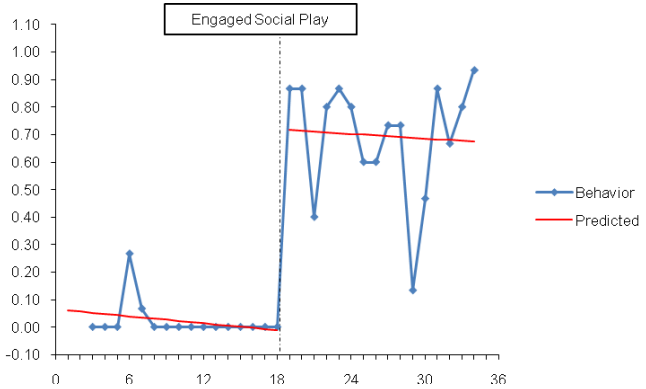
Simple Mean Shift





Mean + Trend Shift





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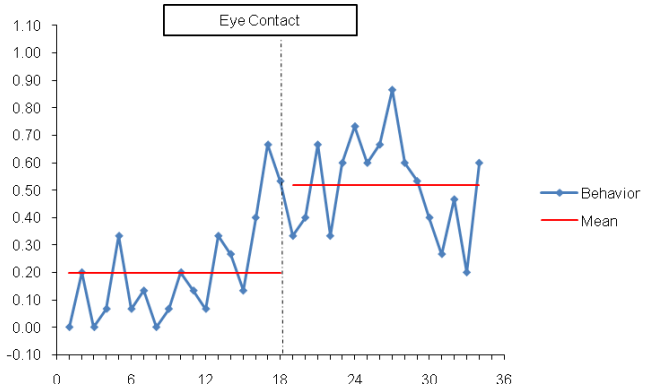
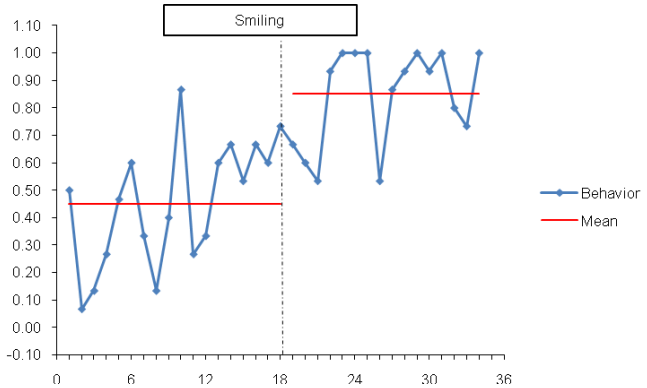
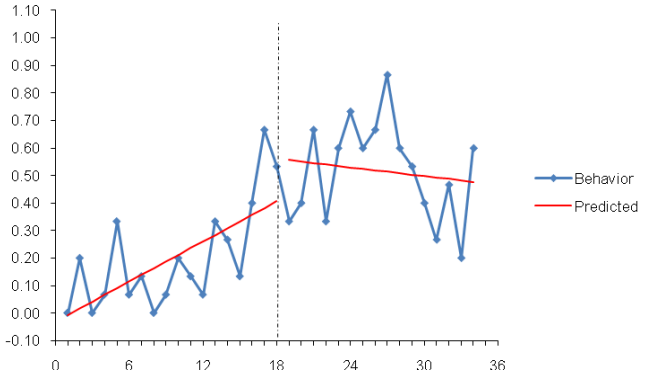
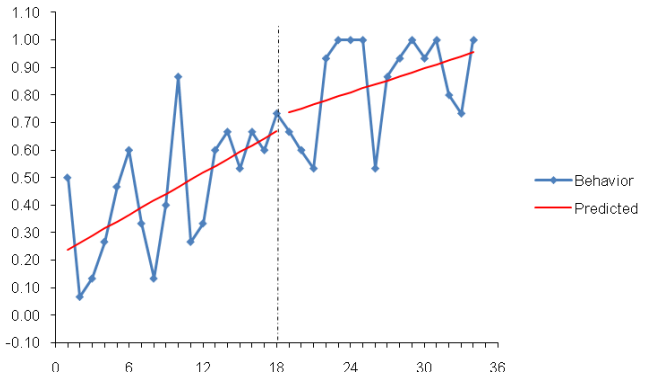




Mean + Trend Shift





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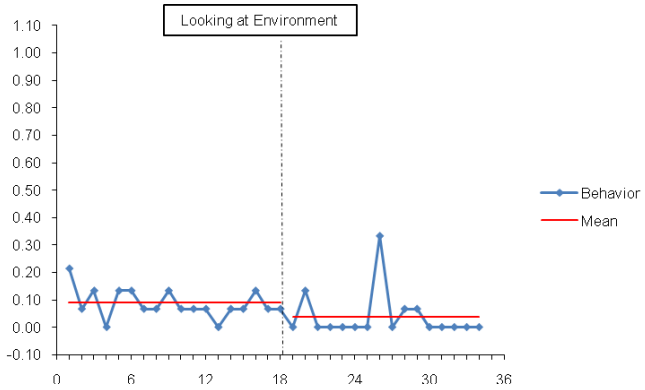

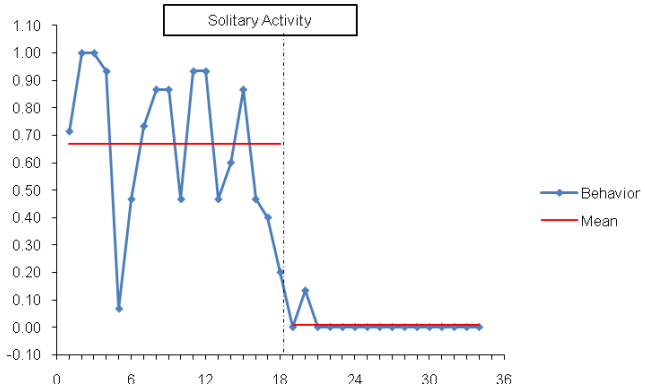

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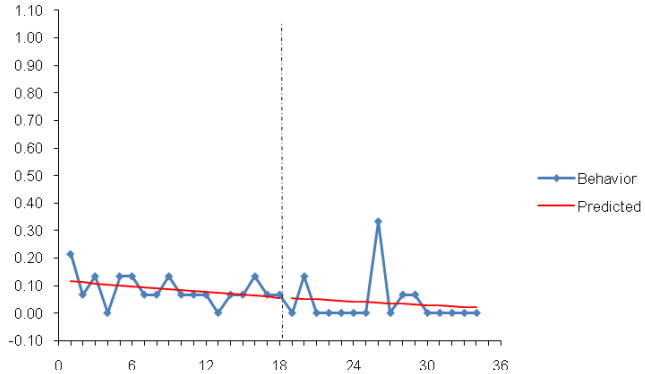

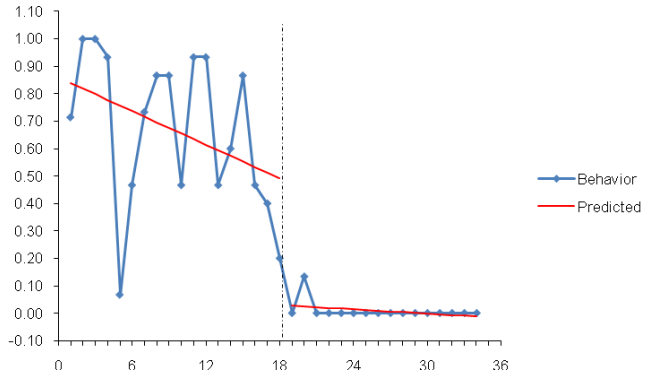

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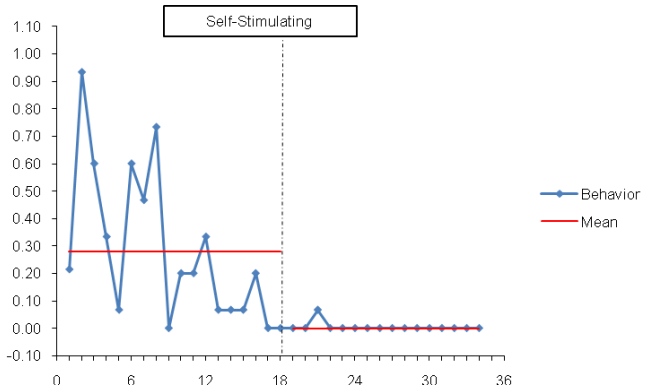
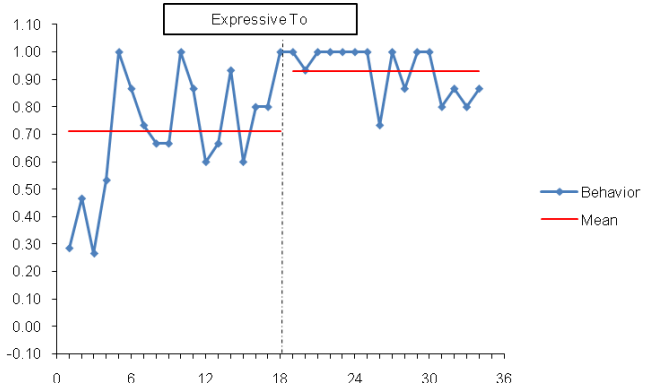
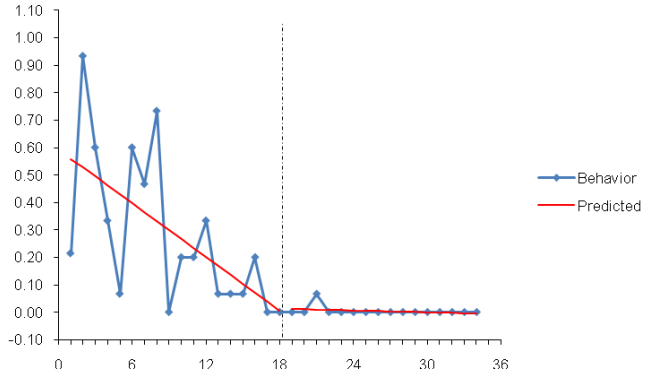
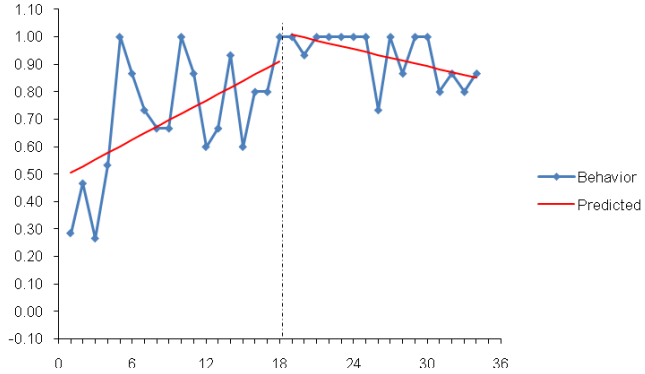




Mean + Trend Shift





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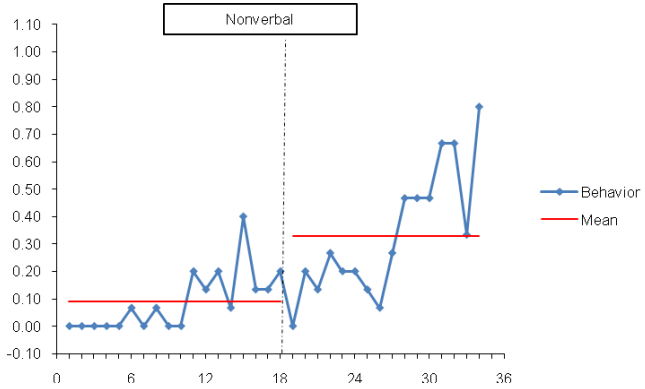
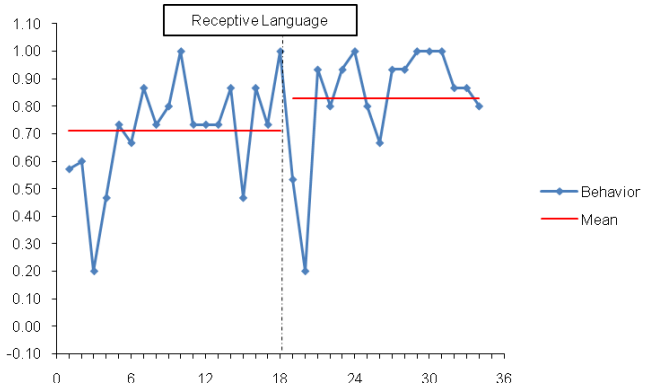
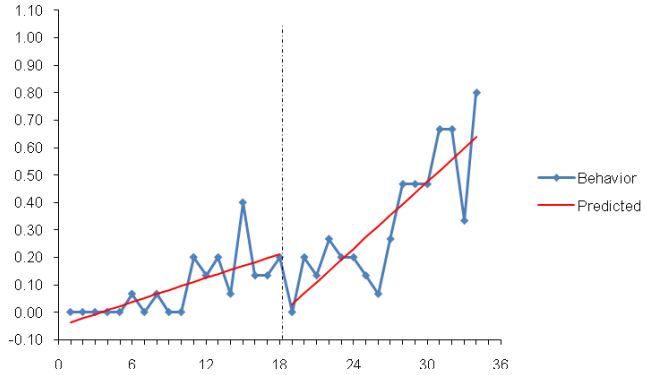
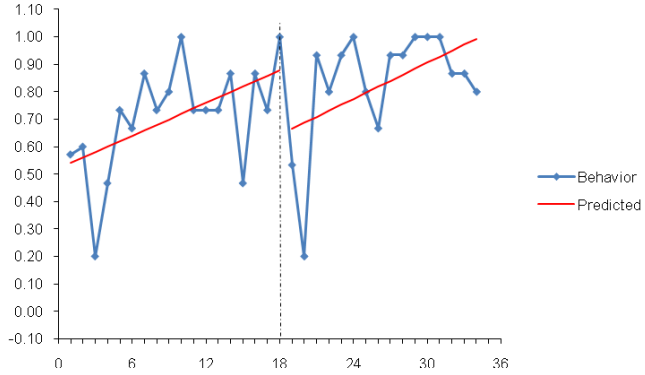




Mean + Trend Shift





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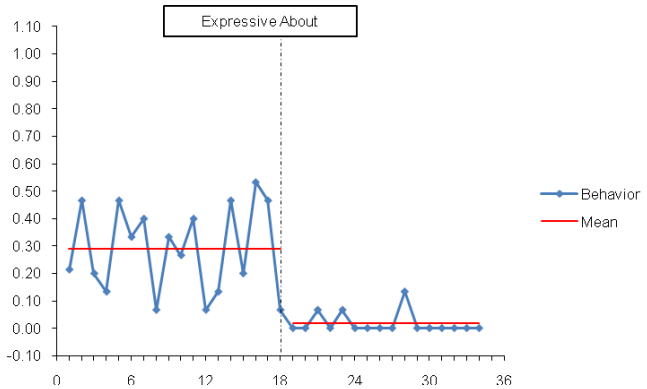
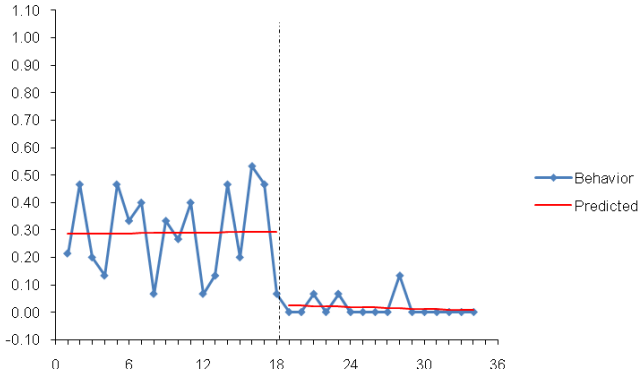


Mean + Trend Shift



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