Parent-Mediated Targeted Intervention for Young Children At-Risk for Autism Spectrum

Disorder

Alicia Azzano

Applied Disability Studies

Submitted in partial fulfillment
of the requirements for the degree of

Master of Arts in Applied Disability Studies

Faculty of Social Sciences, Brock University
St. Catharines, Ontario

© 2019

Abstract

Given that screeners can now detect markers of Autism Spectrum Disorder (ASD) as early as six to nine months of age, conducting pre-diagnostic interventions for young children at risk for developing ASD is important to improve key developmental skills. Parents of three pre-diagnostic at-risk children (aged 19, 23 and 26 months old) first identified potential target problems on the Parent Observation of Early Markers Scale (POEMS, Feldman et al., 2012) that were confirmed in baseline observations. A multiple baseline design across parent and child behaviours was used to evaluate a parent-mediated behavioral intervention to increase targeted developmental skills (e.g. responding to name, pointing to request, motor imitation) and reduce ASD-like symptoms. Parents received individual training in their home one hour per week over $M=19$ weeks (range: 11 to 29 weeks) on teaching strategies incorporating applied behaviour analysis and natural teaching environment techniques. Parent training consisted of behavioural skills training (instructions, modeling, practice and feedback). Some trained child behaviors include the child responding to their name being called with eye contact, pointing to request and motor imitation. All parents and children improved skills that were maintained in a 4 or 8 week follow-up period. For the most part, child skills did not improve until parents reached 80% teaching fidelity. There was some evidence of child response generalization for untrained behaviors. Post-intervention, parents rated many targeted developmental skills as less concerning on the POEMS, suggesting that parents may be able to mitigate target developmental concerns in young children showing early symptoms of ASD.

Table of Contents

List of Tables and Figures

Parent-Mediated Targeted Intervention for Young Children At-Risk for Autism Spectrum Disorder

Format of this Thesis

This thesis includes an extended introduction comprised of a detailed literature review. Then a manuscript prepared for a peer-reviewed journal is included. Therefore, there will be some repetition with the extended introduction and the introduction prepared to follow in the manuscript.

Purpose and Hypothesis

Little intervention research has been conducted with young children at-risk for Autism Spectrum Disorder (ASD). Parent-mediated interventions using naturalistic behavioural strategies have been shown to yield significant developmental gains in children diagnosed with ASD (Schaill et al., 2016). The purpose of this study is to determine whether training parents to use teaching techniques based on Applied Behavior Analysis (ABA) increases targeted developmental skills and reduces ASD-like symptoms in pre-diagnostic at-risk infants. We hypothesized that parent training will increase parent teaching fidelity that will in turn result in a substantial reduction of ASD-like symptoms and increased skill development in infants at-risk for ASD.

Autism Spectrum Disorder (ASD)

ASD is a neurodevelopmental disorder characterized by persistent deficits in social communication and interaction, as well as repetitive and stereotyped patterns of behavior (DSM-5 - American Psychiatric Association, 2013). ASD is one of the most common childhood disorders and demonstrates an increasing prevalence, now affecting 1 in 59 children (Baio et al., 2018). Core signs of ASD include impairments in social communication, such as deficits in joint attention. Children with ASD are less likely to use gestures to direct the attention of another

person than otherwise typically developing children, and are less likely to recognize the gesture of communication being displayed by another (Rozga et al., 2011; Cangialose & Allen, 2014). Other areas of deficit may include language, motor control and eye gaze (Jones, Gliga, Bedford, Chapman & Johnson, 2014; Jones & Klin, 2013). While the median age of the earliest known ASD diagnosis is around 52-53 months (Baio et al, 2018), symptoms of ASD may be noticed by 12 to 18 months of age (Feldman et al., 2012; Ozonoff et al., 2010). This results in a lag between the time of recognizable signs, diagnosis and access to evidence-based behavioral interventions.

Infants At-Risk for ASD

Risk for ASD can be identified through expressed through several avenues. It can be expressed through parent concern to a family physician, failure to meet milestones and other symptoms identified through an ASD screening instrument, and/or children showing ASD symptoms who have been referred to a clinician for evaluation (Towle & Patrick, 2016). A group of infants at substantial risk of developing ASD, or ASD-related characteristics include those who have an older sibling or close biological family member diagnosed with ASD (Messinger et al., 2013; Ozonoff et al., 2011). Previous research has shown that about 20% of infants with an older sibling affected by ASD developed the disorder themselves (Messinger et al., 2015; Ozonoff et al., 2011). The risk increases with more than one affected sibling (Ozonoff et al., 2011). It is important to study and conduct pre-diagnostic interventions for infant siblings of children diagnosed with ASD due to their increased genetic risk of developing ASD.

Other risk factors for ASD include a family history of developmental, medical and psychiatric disorders (Brimacombe, Ming, & Parikh, 2007; Feldman et al., 2019; Guisso et al., 2018), perinatal conditions such as prematurity (Hadjkacem et al., 2016), postnatal conditions such as respiratory infections (Hadjkacem et al., 2016), and postpartum feeding difficulties

(Guisso et al., 2018). Being born male is also a risk factor as males are four times more likely than females to develop ASD (Baio et al., 2018).

Recognizing Early Signs of ASD

As about 40% of at-risk infants who are eventually diagnosed with ASD show symptoms of ASD by 18 months of age (Szatmari et al., 2016), it is important to detect early markers of ASD in at-risk infants so that they can receive evidence-based behavioural interventions (e.g., Lovaas 1987) as soon as possible. Previous literature found that it can be difficult to measure symptoms of ASD in children younger than 18 months of age as measurement instruments show better stability and sensitivity following that age (Towle & Patrick, 2016). Differences between to-be diagnosed infants and undiagnosed at-risk infants become increasingly clear as the child ages (Feldman et al., 2012; 2015).

Parents can detect possible early signs of ASD as early as 6-9 months of age in at- risk infants (Feldman et al., 2012; Sacrey et al., 2018). The Parent Observation of Early Markers Scale (POEMS) is a validated parent-report early screener that monitors the behavioral development of infants at-risk for ASD (Feldman et al. 2012). The POEMS differentiated between infants 3-24 months of age who were and were not subsequently diagnosed with ASD at 36 months of age. POEMS items that were commonly identified as concerning for infants later diagnosed with ASD included social communicative behaviors such as responding to name and imitation. Prior to six months of age there usually are no noticeable differences in the social communicative behaviors between low and high-risk infants (Ozonoff et al., 2010); however, differences have been detected between infants who develop ASD and typically developing infants based upon spontaneous head movements in infants who were born with low birth weight between nine and 20 weeks of post term birth age (Gima et al., 2018). After six months of age, the trajectories of varying social communicative behaviors such as gaze to faces, smiles, and

vocalizations were found to slowly decline in infants that were eventually later diagnosed with ASD (Ozonoff et al., 2010). Additional symptoms detectable in the 6-12 month age range include disinterest in others' facial expressions, irritability and intolerance to waiting (Feldman et al., 2012). By 18 months a common discriminating factor between high risk infants who will or will not be diagnosed with ASD at the age of three is temperament, including difficulty with waiting and with transitions (Brian et al., 2008; Feldman et al., 2012). Given the ability of parents and clinicians to detect early signs of ASD in at-risk infants, it may be imprudent to wait until the children are diagnosed with ASD when they are 3-4 years old as this delays provision of critical intervention.

Applied Behavior Analysis (ABA)

Evidence-based early intervention for children with ASD is primarily based on ABA principles (Blocher-Rubin & Krabill, 2017). ABA is an applied science rooted in principles of behavior that are used to improve socially significant behavior through evidence-based practice (Cooper, Heron, & Heward, 2007). Effective intervention is individualized for each participant and is based on an analysis of the environmental conditions controlling behaviour (Stocco & Thompson, 2015). Early Intensive Behavioral Intervention (EIBI) is the most effective evidence-based treatment for young children with ASD (Blocher-Rubin & Krabill, 2017). EIBI is based on the principles of ABA and yield significant improvements for young children with ASD. It is one of the most commonly used and well-researched interventions for children with ASD, and can result in the reduction of symptom severity, gains in IQ, adaptive behavior and language (Reichow, Barton, Boyd, & Hume, 2012). EIBI is delivered on a one-to-one basis in a highly structured setting for 20-40 hours per week (Reichow et al., 2012).

EIBI originated from the work of Ivar Lovaas (1981, 1987). In Lovaas' 1987 nonrandomized between group design, 19 infants under 40 months of age with ASD were

provided with 40 hours a week of intensive behavior therapy compared to a control group of 19 infants who received ten hours or less. In the experimental group parents were trained to provide treatment so that infants could be receiving treatment during any time of the day. Results found that 47% of infants receiving 40 hours a week of EIBI achieved normal intellectual functioning compared to only 2% of the control group (Lovaas, 1987). Although results of treatment were broad, recent studies have identified more specific benefits of EIBI. Meta-analyses indicate that children with ASD who received EIBI made more significant gains in verbal and nonverbal IQ, language, adaptive behavior and ASD symptom reduction than children in the control group receiving other treatments (Peters-Scheffer, Didden, Korzilius, & Sturmey, 2011; Reichow et al., 2012; Virués-Ortega, 2010).

A meta-analysis of 35 single-case experimental design studies with children with ASD or at-risk for ASD under 36 months of age found that intervention is effective during the first three years of life (Burns, Lang, & Ledbetter Cho, 2017). Intervention occurred in the home or clinical setting with clinicians, parents or researchers. Although significant treatment effects were found for ABA and other methods of intervention using ABA strategies, including Reciprocal Imitation Training (RIT), Pivotal Response Training (PRT), Picture Exchange Communication System, Early Start Denver Model (ESDM), and video modeling, the evidence was strongest for naturalistic ABA interventions and also interventions that target social communication skills. The most common target skills were imitation, social communication and joint attention.

There are several predictors for effective outcomes following IBI, including a younger age when initially starting IBI (Flanagan et al., 2012; Virues-Ortega, Rodríguez, & Yu, 2013; Landa, 2018), higher initial adaptive skills (Flanagan et al., 2012), increased intervention time (Virues-Ortega et al., 2013), and a higher functioning level before the onset of intervention

(Virues-Ortega et al., 2013). Gains made from IBI were found to maintain for individuals approximately 10 years following the conclusion of EIBI (Perry et al., 2017). Although effective, EIBI can often be demanding on parents and requires careful consideration of family well-being for successful outcomes (Blocher-Rubin & Krabil, 2017).

Parent Training for Children with ASD

Parent training for young children with ASD is an emerging field of research and practice. Training parents to implement intervention with their child has many benefits. It is beneficial for reducing parental stress and increasing self-efficacy (Keen, Couzens, Muspratt, & Rodger, 2010). Parent-mediated intervention is also effective for increasing child skills. A meta-analysis of 17 studies of randomized control trials (RCT) between 2002 and 2012 for children between one year of age and six years and 11 months of age diagnosed with ASD found parent-mediated interventions to be effective for improving child skills, specifically in the area of language (Oono, Honey, & McConachie, 2013). There was a statistically significant difference in reduction of ASD symptoms post parent mediated intervention. Another recent meta-analysis by Nevill, Lecavalier, and Stratis (2018) analyzed 19 RCT's between 2000 and 2015 of parent-mediated interventions for children between the ages of one and six diagnosed with ASD. Several studies analyzed overlapped with the meta-analysis by Oono et al. (2013). Nevill et al. (2018) concluded that there were small effects of parent training on ASD symptom severity, socialization and cognition, but highlighted the improving quality of research in the field. Effect sizes reported were similar to that of Oono et al. (2013).

The ESDM (Rogers & Dawson, 2009) is one treatment approach for children with ASD. Vismara, Colombi, and Rogers (2009) found that just one hour a week of parent training using the ESDM resulted in parents successfully teaching social communicative skills in recently

ASD-diagnosed toddlers. ESDM is a combination of the Denver Model (Rogers, Herbison, Lewis, Pantone & Reis, 1986) consisting of ABA elements and Pivotal Response Training (Vismara et al., 2009). In a randomized controlled trial, Dawson et al. (2010) found that 48 children aged 18-30 months diagnosed with ASD in the ESDM intervention group increased cognitive and adaptive behavior, as well as reduced the severity of ASD symptoms, compared to a treatment as usual control group. In a recent randomized control trial of 45 children aged 12 to 30 months with ASD, children were randomized into two groups; each group represented a different version of the ESDM (Rogers et al., 2019). Group one was the basic ESDM with 1.5-hour weekly coaching at the clinic, while the other group was enhanced and included motivational interviewing, multimodal learning and 1.5-hour weekly home visits. Parents improved their teaching more in the enhanced group rather than basic group; but children showed similar gains in both groups. There was also a significant positive relationship between parent teaching fidelity and increased child social-communication skills and decreases in ASD symptoms. However, a systematic review of 10 studies demonstrated that ESDM may not be more effective than control groups receiving other treatment options for children with ASD (Baril & Humphreys, 2017).

ABA is one of the most commonly used treatments for young children with ASD. A RCT of 180 children with ASD aged three to seven found greater gains in adaptive behavior in the group receiving parent training with behavior principles compared to the solely parent education group (Scahill et al., 2016). Parents can be taught ABA-based intervention strategies using Behavior Skills Training (BST; Sarokoff & Sturmey, 2004). BST is a training package that includes instructions, modelling, rehearsing and feedback (Miles & Wilder, 2009). BST has demonstrated large improvements in teachers' implementation of discrete-trial teaching (DTT;

Sarokoff & Sturmey, 2004), and also has been used to teach parents to implement DTT with their children with developmental disabilities (Lafasakis & Sturmey, 2007). With ABA's long history of effectiveness in the young ASD population, can it have the same effectiveness on mitigating symptoms of ASD for pre-diagnostic at-risk children?

Parent Training for Children At-Risk for ASD

While there is growing research teaching parents who have children with ASD, only recently have researchers studied effects of parent training of pre-diagnosed infants and young children at-risk for ASD. Bradshaw et al. (2015) reviewed nine studies investigating interventions for young children 24 months of age or under who were diagnosed with ASD or are at-risk for ASD, all of which included the involvement of parents in the intervention in some way. While most studies in the review determined risk for ASD through behavioral assessments and quantifiable early screeners, two studies intervened on all infants at genetic risk of ASD (Green et al., 2015; Steiner et al., 2013). Doing so made interpreting the effectiveness of treatment difficult, as some infants were expected to have regular developmental trajectories. Bradshaw et al. (2015) found that parent-mediated interventions resulted in improved short-term outcomes for infants at-risk for ASD. Specifically, research using a multiple baseline design found improvements in social engagement and communication behaviors following intervention, while the RCTs had mixed results on the effectiveness of treatment and the quasi-experimental studies provided preliminary support for treatment effectiveness on infant behavior.

There are some studies that have conducted a RCT with infants at-risk for ASD that have found improvements for child skills. Green et al. (2015) assessed parent mediated intervention versus no intervention for 54 infants at-risk for ASD aged 7-10 months. The parent mediated intervention included using the Video Interaction to Promote Positive Parenting (iBASIS-VIPP),

which uses video feedback to help parents adapt to their infant's communication and develop sensitive responding and patterns of verbal and nonverbal interaction. Twenty-eight families were randomly assigned to the intervention group and 26 to the no intervention group. The infants in the parent training group displayed increased infant attentiveness to the parent and reduced autism-risk related behaviors such as responding to their name when called, imitation and social reciprocity. Jones, Dawson, Estes, and Webb (2017) used the manualized Promoting First Relationships (PFR; Kelly, Zuckerman, Sandoval, & Buehlman, 2008) curriculum which promotes parent responsivity to social communicative infant cues and behaviors. In this RCT of 19 at-risk infants, compared to 14 low-risk infants, all infants enrolled at 6 months of age. Intervention using PFR was conducted for the treatment group between 9 and 11 months of age. It was found that low-intensity parent-mediated intervention, where parents received training just once per week by a master's student, resulted in improvements in neurocognitive social attention measures at 12 and 18 months for infants at-risk for ASD (as demonstrated by a greater increase in habituation speed to faces versus objects) compared to the infants who were only assessed and monitored (Jones et al., 2017).

Two RCTs did not have effective outcomes for young children at-risk for ASD. In the first study, Carter et al. (2011) used Hanen's 'More Than Words' Program (HMTW) which was administered by a speech-language pathologist who led a parent training group that provided support and education for increasing child communication skills. It includes eight weekly group sessions and three individual sessions (Carter et al., 2011). They conducted a RCT with 62 young children between the age of 15 and 25 months who were showing early signs of ASD. Thirty-two children were placed in the treatment group and 30 in the no treatment group. Results indicated that although some children showed growth in communication, there were no main effects of the

HMTW treatment on child communication outcomes, suggesting that this intervention is not appropriate for all children. As well, Watson et al. (2017) used a RCT for a parent-mediated intervention for 87 infants one year of age who screened at-risk for ASD. Parents were trained using Adaptive Responsive Teaching (ART), which is an adapted version of the Responsive Teaching Curriculum (RTC; Mahoney & MacDonald, 2007). ART targets pivotal behaviors in the social communication and sensory regulation domains that is intended to lead to improvements in broader areas. It also focuses on the interplay between parent responsiveness and child outcomes. Parent responsiveness broadly includes themes such as reciprocity, support and physical affection. Although parents demonstrated greater responsiveness to their infants compared to parents in control groups, the intervention resulted in minimal effects on child outcomes of pivotal behaviors and no evidence of reduced ASD symptoms.

Other studies have used a multiple baseline design to determine treatment effectiveness for parent-mediated intervention administered with young children at-risk for ASD. Pivotal response training (PRT; Koegel & Koegel, 2006) has been used within a parent training model for infants at-risk for ASD. PRT is a naturalistic behavioral intervention rooted in ABA (Steiner, Gengoux, Klin, & Chawarska, 2013). PRT targets pivotal areas that affect broad areas of functioning across multiple developmental domains. PRT was adapted to be used in a parent training model with three infants at-risk for ASD. Using a multiple baseline design across participants, the PRT intervention resulted in gains for parent teaching fidelity of the PRT procedures used to elicit the functional communication from the infants, and increased frequency of functional communication expressed by the infants (Steiner et al., 2013). Further, Bradshaw, Koegel, and Koegel (2017) used a parent-mediated PRT intervention for three infants who showed concerning behaviors representative of ASD aged 15-21 months. Using a non-concurrent

multiple baseline across participants, improvements were found in expressive verbal communication for all infants. In addition, reduction of ASD symptoms was also observed during post intervention assessment measures.

The Joint Attention Mediated Learning (JAML; Schertz, 2005) was another parent-mediated intervention studied using a multiple baseline design. Three toddlers between 22 and 33 months of age screened positively for ASD but did not initially have formal diagnoses (Schertz & Odom, 2007). Intervention used a manualized framework focusing on joint attention. A multiple baseline design determined treatment effectiveness across four phases of intervention: focusing on faces, turn-taking, responding to joint attention and initiating joint attention. Two participants improved on each skill from baseline levels; however, one participant showed only slight increases. Although training appeared to have maintained into follow-up, there was only one follow-up data point at 5-weeks post intervention.

Two other parent-mediated intervention methods used with at-risk infants include the ESDM and Social ABC's. Both incorporate some elements of ABA. Rogers et al. (2014) studied seven highly symptomatic infants aged 7-15 months using an intervention derived from techniques of the ESDM. Intervention was parent training for 1 hour per week for 12 consecutive weeks, and consisted of parents implementing teaching strategies for six target symptoms of ASD, including: visual fixation on objects, abnormal repetitive behaviors, lack of intention communicative acts, lack of coordination of gaze, lack of age-appropriate phonemic development, and decreasing gaze and social interest. After reviewing a new topic through verbal discussion and written materials, parents were coached by the therapist as they practiced the new techniques. Parents practiced the technique and were coached until they reached a fidelity of implementation of 80% or higher. Results indicated that compared to comparison

groups of infants of initial similar symptomology who did not enroll in the study, at 36 months of age the seven infants in the treatment group displayed lower rates of ASD symptoms and developmental delays. Comparison groups included high risk children who had an older sibling with ASD but did not develop ASD themselves, low-risk children with an older sibling who did not have a developmental disability, and children who were younger siblings and subsequently diagnosed with ASD by 36 months of age. Each child in the comparison groups was directly matched to a child in the treatment group based on pre-intervention assessment scores. One limitation was that this study was not a RCT, making further research necessary for determining efficacy of the intervention.

Further, the Social ABC's is another parent-mediated intervention geared towards infants and toddlers suspected of having ASD or with diagnoses. It is a manualized intervention based on ABA techniques that targets two domains including verbal communication and positive affect sharing (Brian, Smith, Zwaigenbaum, Roberts & Bryson, 2016). The study included 20 toddlers between the ages of 12 and 32 months who were suspected of having ASD or diagnosed. Parents achieved a high of level fidelity (at least 75%) during implementation. Post-intervention significant gains were found in child communication skills. Language skills were maintained at the 3 month follow up. Despite initial gains in shared smiling and social orienting, gains in those skills were not consistently maintained into follow-up once coaching ended.

Filling the Gaps

Early ABA based intervention has been shown to improve long-term outcomes of young children displaying early signs of ASD (Dawson et al., 2010; Lovaas, 1987). Currently little research exists on using individualized, targeted parent-mediated behavioral intervention strategies with at-risk infants showing pre-diagnostic ASD signs. As evidence supports

naturalistic behavioral interventions to have the strongest evidence of treatment effectiveness for children with ASD (Burns et al., 2017), it is important to apply the treatment strategies to the at-risk population to determine its effectiveness in preventing or mitigating the severity of ASD symptoms. Therefore, this research will focus on behavioural interventions administered in the home by trained parents of young children at-risk for ASD. We hypothesize an increase in both parent teaching fidelity and child targeted skills following parent training of behavior analytic teaching strategies.

References (Extended Introduction)

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders

    (5thed.). Washington, DC: Author

Baio, J., Wiggins, L., Christensen, D., Maenner, M., Daniels, J., Warren, Z.,… Dowling, N. (2018).

    Prevalence of autism spectrum disorder among children aged 8 years — Autism and

    developmental disabilities monitoring network, 11 sites, United States, 2014, *Surveillance*

    Summaries, 67(6),1–23. doi: 10.15585/mmwr.ss6706a1

Baril, E. M., & Humphreys, B. P. (2017). An evaluation of the research evidence on the early start

    denver model. *Journal of Early Intervention, 39*(4), 321-338.

    doi:10.1177/1053815117722618

Blocher-Rubin, A., & Krabill, P. (2017). Initial development of the early intensive behavioral

    intervention parental self-efficacy scale: A pilot study. *Autism Research and Treatment*,

    2017, 1-11. doi.org/10.1155/2017/9512180

Bradshaw, J., Steiner, A. M., Gengoux, G., & Koegel, L. K. (2015). Feasibility and effectiveness of

    very early intervention for infants at-risk for autism spectrum disorder: A systematic review,

    Journal of Autism and Developmental Disorders, *45*(3), 778-794. doi:10.1007/s10803-014-

    2235-2

Bradshaw, J., Koegel, L. K., & Koegel, R. L. (2017). Improving functional language and social

    motivation with a parent-mediated intervention for toddlers with autism spectrum disorder.

    Journal of Autism and Developmental Disorders, (8), 2443-2458. doi:10.1007/s10803-017-

    3155-8

Brian, J., Bryson, S. E., Garon, N., Roberts, W., Smith, I. M., Szatmari, P., & Zwaigenbaum, L. (2008). Clinical assessment of autism in high-risk 18-month-olds. *Autism, 12*(5), 433-456. doi:10.1177/1362361308094500

Brian, J. A., Smith, I. M., Zwaigenbaum, L., Roberts, W., & Bryson, S. E. (2016). The social ABCs caregiver-mediated intervention for toddlers with autism spectrum disorder: Feasibility, acceptability, and evidence of promise from a multisite study. *Autism Research*, (8), 899-912. doi: 10.1002/aur.1582

Brimacombe, M., Ming, X., & Parikh, A. (2007). Familial risk factors in autism. *Journal of Child Neurology, 22*(5), 593-597. doi: 10.1177/0883073807302609.

Burns, C., Lang, R., & Ledbetter Cho, K. (2017). Meta-analysis of single-case experimental design studies involving children with or at risk of autism spectrum disorder suggests intervention is effective during first three years of life. *Evidence-Based Communication Assessment & Intervention*, *11*(3/4), 119–123. doi: 10.1080/17489539.2017.1401038

Cangialose, A., & Allen, P. J. (2014). Screening for autism spectrum disorders in infants before 18 months of age. *Pediatric Nursing, 40*(1), 33-37.

Carter, A. S., Messinger, D. S., Stone, W. L., Celimli, S., Nahmias, A. S., & Yoder, P. (2011). A randomized controlled trial of hanen's "more than words" in toddlers with early autism symptoms. *Journal of Child Psychology & Psychiatry*, *52*(7), 741–752. doi: 10.1111/j.1469-7610.2011.02395.x

Cooper, J.O., Heron, T.E. & Heward, W.L. (2007). *Applied behavior analysis – second edition*. Upper Saddle River, NJ: Pearson Education.

Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., & ... Varley, J. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The early start Denver model. *Pediatrics*, *125*(1), e17-23. doi:10.1542/peds.2009-0958

Feldman, M. A., Ward, R. A., Savona, D., Regehr, K., Parker, K., Hudson, M., & ... Holden, J. A. (2012). Development and initial validation of a parent report measure of the behavioral development of infants at risk for Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, *42*(1), 13-22. doi: 10.1007/s10803-011-1208-y

Feldman, M. A., Hendry, A. M., Ward, R. A., Hudson, M., & Liu, X. (2015). Behavioral development and sociodemographics of infants and young children at higher and lower risk for autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *45*(5), 1167-1175. doi:10.1007/s10803-014-2277-5

Feldman, M. A., Azzano, A., Ward, R. A., Hudson, M., Sjaarda, C. P., & Liu, X. (2019). Relationship of family history conditions and early signs of autism spectrum disorder in low and high-risk infants. *Research in Autism Spectrum Disorders*, *65*, 25–33. doi: 10.1016/j.rasd.2019.05.002

Flanagan, H. E., Perry, A., & Freeman, N. L. (2012). Effectiveness of large-scale community-based intensive behavioral intervention: A waitlist comparison study exploring outcomes and predictors. *Research in Autism Spectrum Disorders*, *6*(2), 673-682. doi:10.1016/j.rasd.2011.09.011

Gima, H., Kihara, H., Watanabe, H., Nakano, H., Nakano, J., Konishi, Y., . . . Taga, G. (2018). Early motor signs of autism spectrum disorder in spontaneous position and movement of the head. *Experimental Brain Research, 236*(4), 1139-1148. doi:10.1007/s00221-018-5202-x

Green, J., Charman, T., Pickles, A., Wan, M. W., Elsabbagh, M., Slonims, V., & ... Johnson, M. H.
   (2015). Parent-mediated intervention versus no intervention for infants at high risk of autism:
   a parallel, single-blind, randomised trial. *The Lancet Psychiatry*, *2,* 133-140.
   doi:10.1016/S2215-0366(14)00091-1

Guisso, D. R., Saadeh, F. S., Saab, D., El Deek, J., Chamseddine, S., El Hassan, H. A., & ...
   Boustany, R. (2018). Association of autism with maternal infections, perinatal and other risk
   factors: A case-control study. *Journal of Autism & Developmental Disorders*, *48*(6), 2010-
   2021. doi:10.1007/s10803-017-3449-x

Hadjkacem, I., Ayadi, H., Turki, M., Yaich, S., Khemekhem, K., Walha, A., & ... Ghribi, F. (2016).
   Original article: Prenatal, perinatal and postnatal factors associated with autism spectrum
   disorder. *Jornal De Pediatria*, 92(6), 595-601. doi: 10.1016/j.jped.2016.01.012

Jones, W., & Klin, A. (2013). Attention to eyes is present but in decline in 2-6-month-old infants
   later diagnosed with autism. *Nature*, *504*(7480), 427-431. doi:10.1038/nature12715

Jones, E. J. H., Gliga, T., Bedford, R., Charman, T., Johnson, M.H. (2014). Developmental pathways
   to autism: A review of prospective studies of infants at risk. *Neuroscience and Biobehavioral
   Reviews, 3,* 1-33.

Jones, E. J., Dawson, G., Kelly, J., Estes, A., & Jane Webb, S. (2017). Parent-delivered early
   intervention in infants at risk for ASD: Effects on electrophysiological and habituation
   measures of social attention. *Autism Research*, *10*(5), 961-972. doi:10.1002/aur.1754

Keen, D., Couzens, D., Muspratt, S., & Rodger, S. (2010). The effects of a parent-focused
   intervention for children with a recent diagnosis of autism spectrum disorder on parenting
   stress and competence. *Research in Autism Spectrum Disorders, 4*(2), 229-241.
   doi:10.1016/j.rasd.2009.09.009

Kelly, J., Zuckerman, T., Sandoval, D., & Buehlman, K. (2008). A curriculum for service providers to help parents and other caregivers meet young children's social and emotional needs. Seattle, WA: NCAST-AVENUW Publications.

Koegel, R. L., & Koegel, L. K. (2006). *Pivotal response treatments for autism.* Baltimore, MD: Paul H Brookes Publishing.

Lafasakis, M., & Sturmey, P. (2007). Training parent implementation of discrete-trial teaching: effects on generalization of parent teaching and child correct responding. *Journal of Applied Behavior Analysis*, *40*(4), 685-689. doi: 10.1901/jaba.2007.685–689

Landa, R. J. (2018). Efficacy of early interventions for infants and young children with, and at risk for, autism spectrum disorders. *International Review of Psychiatry, 30*(1), 25-39. doi:10.1080/09540261.2018.1432574

Lovaas, I. (1981). The ME book. *Austin, TX: Pro-Ed*.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*(1), 3-9.

Mahoney, G., & Macdonald, J. (2007). Autism and developmental delays in young children: The responsive teaching curriculum for parents and professionals. Austin: PRO-ED.

Messinger, D., Young, G. S., Ozonoff, S., Dobkins, K., Carter, A., Zwaigenbaum, L., & ... Sigman, M. (2013). Beyond Autism: A baby siblings research consortium study of high-risk children at three years of age. *Journal of The American Academy of Child & Adolescent Psychiatry*, *52*(3), 300-308.

Messinger, D. S., Young, G. S., Webb, S. J., Ozonoff, S., Bryson, S. E., Carter, A., & ... Zwaigenbaum, L. (2015). Early sex differences are not autism-specific: A baby siblings

research consortium (BSRC) study. *Molecular Autism*, *6*(1), 1-11. doi:10.1186/s13229-015-0027-y

Miles, N. I., & Wilder, D. A. (2009). The effects of behavioral skills training on caregiver implementation of guided compliance. *Journal of Applied Behavior Analysis*, *42*(2), 405-410. doi:10.1901/jaba.2009.42-405

Nevill, R. E., Lecavalier, L., & Stratis, E. A. (2018). Meta-analysis of parent-mediated interventions for young children with autism spectrum disorder. *Autism: The International Journal of Research and Practice*, *22*(2), 84–98. doi: 10.1177/1362361316677838

Oono I.P., Honey, E.J., McConachie, H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders (ASD) (Review). *The Cochrane Collaboration*, *4,* 1-98. doi: 10.1002/14651858.CD009774.pub2.

Ozonoff, S., Iosif, A.-M., Baguio, F., Cook, I. C., Hill, M. M., Hutman, T., … Young, G. S. (2010). A prospective study of the emergence of early behavioral signs of autism. *Journal of the American Academy of Child & Adolescent Psychiatry*, *49*(3), 256–266. doi: 10.1016/j.jaac.2009.11.009

Ozonoff, S., Young, G., Carter, A., Messinger, D., Yirmiya, N., Zwaigenbaum, L., & ... Stone, W. (2011). Recurrence risk for Autism Spectrum Disorders: A baby siblings research consortium study. *Pediatrics*, *128*(3), 488-495.

Perry, A., Koudys, J., Prichard, A., & Ho, H. (2017). Follow-up study of youth who received EIBI as young children. *Behavior Modification*, *43*(2), 181–201. doi: 10.1177/0145445517746916

Peters-Scheffer, N., Didden, R., Korzilius, H., & Sturmey, P. (2011). A meta-analytic study on the effectiveness of comprehensive ABA-based early intervention programs for children with

autism spectrum disorders, *Research in Autism Spectrum Disorders*, *5*(1), 60-69. doi: 10.1016/j.rasd.2010.03.011

Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2012). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *The Cochrane Library*, *10*, 1-60. doi: 10.1002/14651858.CD009260.pub2.

Reichow, B., Hume, K., Barton, E., & Boyd, B. (2018). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD) [ABSTRACT]. *Cochrane Database of Systematic Reviews*, (5). doi:10.1002/14651858.CD009260.pub3

Rogers, S., Herbison, J., Lewis, H., Pantone, J., & Reis, K. (1986). An approach for enhancing the symbolic, communicative, and interpersonal functioning of young children with autism or severe emotional handicaps. *Journal of Early Intervention, 10*(2), 135-148. doi:10.1177/105381518601000205

Rogers, S. J., & Dawson, G. (2009). *Early Start Denver Model for Young Children with Autism: Promoting Language, Learning, and Engagement*. Guilford Publications.

Rogers, S., Vismara, L., Wagner, A., McCormick, C., Young, G., & Ozonoff, S. (2014). Autism treatment in the first year of life: A pilot study of infant start, a parent-implemented intervention for symptomatic infants. *Journal of Autism & Developmental Disorders*, *44*(12), 2981-2995. doi:10.1007/s10803-014-2202-y

Rogers, S. J., Estes, A., Vismara, L., Munson, J., Zierhut, C., Greenson, J., … Talbott, M. (2019). Enhancing low-intensity coaching in parent implemented early start denver model intervention for early autism: A randomized comparison treatment trial. *Journal of Autism & Developmental Disorders*, *49*(2), 632–646. doi: 10.1007/s10803-018-3740-5

Rozga, A., Hutman, T., Young, G.S., Rogers, S. J., Ozonoff, S., Dapretto, M., & Sigman, M. (2011). Behavioral profiles of affected and unaffected siblings of children with autism: Contribution of measures of mother-infant interaction and nonverbal communication. *Journal of Autism and Developmental Disorders, 41,* 287-301.

Sacrey, L., Bryson, S., Zwaigenbaum, L., Brian, J., Smith, I. M., Roberts, W., & ... Garon, N. (2018). The Autism Parent Screen for Infants: Predicting risk of autism spectrum disorder based on parent-reported behavior observed at 6-24 months of age. *Autism: The International Journal of Research & Practice*, *22*(3), 322-334. doi:10.1177/1362361316675120

Sarokoff, R. A., & Sturmey, P. (2004). The effects of behavioral skills training on staff implementation of discrete-trial teaching. *Journal of Applied Behavior Analysis*, *37*, 535-538.

Scahill, L., Bearss, K., Lecavalier, L., Smith, T., Swiezy, N., Aman, M. G., & ... Johnson, C. (2016). Effect of parent training on adaptive behavior in children with autism spectrum disorder and disruptive behavior: Results of a randomized trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, *55*(7), 602-609.

Schertz, H. H. (2005c). Joint attention mediated learning (JAML) manual. Unpublished manuscript.

Schertz, H. H., & Odom, S. L. (2007). Promoting Joint Attention in Toddlers with Autism: A Parent-Mediated Developmental Model. *Journal of Autism and Developmental Disorders*, *37*(8), 1562–1575. doi: 10.1007/s10803-006-0290-z

Steiner, A. M., Gengoux, G. W., Klin, A., & Chawarska, K. (2013). Pivotal response treatment for infants at-risk for autism spectrum disorders: a pilot study. *Journal of Autism and Developmental Disorders*, *43*(1), 91-102. Doi: 10.1007/s10803-012-1542-8

Stocco, C. S., & Thompson, R. H. (2015). Contingency analysis of caregiver behavior: implications for parent training and future directions. *Journal of Applied Behavior Analysis*, (2), 417-435. doi:10.1002/jaba.206

Szatmari, P., Chawarska, K., Dawson, G., Georgiades, S., Landa, R., Lord, C., . . . Halladay, A. (2016). Prospective longitudinal studies of infant siblings of children with autism: Lessons learned and future directions. *Journal of the American Academy of Child & Adolescent Psychiatry, 55*(3), 179-187. doi: 10.1016/j.jaac.2015.12.014

Virués-Ortega, J. (2010). Applied behavior analytic intervention for autism in early childhood: Meta-analysis, meta-regression and dose–response meta-analysis of multiple outcomes. *Clinical Psychology Review*, *30,* 387-399. doi: 10.1016/j.cpr.2010.01.008

Virués-Ortega, J., Rodríguez, V., & Yu, C. (2013). Prediction of treatment outcomes and longitudinal analysis in children with autism undergoing intensive behavioral intervention. *International Journal of Clinical and Health Psychology*, *13*(2)*,* 91-100. Doi:10.1016/S1697-2600(13)70012-7

Vismara, L., Colombi, C., & Rogers, S. (2009). Can one hour per week of therapy lead to lasting changes in young children with autism? *Autism, 13*(1), 93-115. doi:10.1177/1362361307098516

Wang, C., Hudson, M., Liu, X., Ward, R., & Feldman, M. (2016). Parent prediction of autism spectrum disorder in infants at risk: A follow-up study. *Journal of Child & Family Studies*, *25*(12), 3593-3606. doi:10.1007/s10826-016-0508-4

Watson, L. R., Crais, E. R., Baranek, G. T., Turner-Brown, L., Sideris, J., Wakeford, L., & ... Nowell, S. W. (2017). Parent-mediated intervention for one-year-olds screened as at-risk for

autism spectrum disorder: A randomized controlled trial. *Journal of Autism and*

Developmental Disorders, *47*(11), 3520-3540. doi:10.1007/s10803-017-3268-0

Draft Manuscript

Parent-Mediated Targeted Intervention for Young Children At-Risk for Autism Spectrum

Disorder

(note: the student will be first author and the draft manuscript below is the student's

work)

Abstract

Given that screeners can now detect markers of Autism Spectrum Disorder (ASD) as early as six

to nine months of age, conducting pre-diagnostic interventions for young children at risk for

developing ASD is important to improve key developmental skills. Parents of three pre-

diagnostic at-risk children (aged 19, 23 and 26 months old) first identified potential target

problems on the Parent Observation of Early Markers Scale (POEMS, Feldman et al., 2012) that

were confirmed in baseline observations. A multiple baseline design across parent and child

behaviours was used to evaluate a parent-mediated behavioral intervention to increase targeted

developmental skills (e.g. responding to name, pointing to request, motor imitation) and reduce

ASD-like symptoms. Parents received individual training in their home one hour per week over

M=19 weeks (range: 11 to 29 weeks) on teaching strategies incorporating applied behaviour

analysis and natural teaching environment techniques. Parent training consisted of behavioural

skills training (instructions, modeling, practice and feedback). All parents and children improved

skills that were maintained in a 4 or 8 week follow-up period. For the most part, child skills did

not improve until parents reached 80% teaching fidelity. There was some evidence of child

response generalization for untrained behaviors. Post-intervention, parents rated many targeted

developmental skills as less concerning on the POEMS, suggesting that parents may be able to

mitigate target developmental concerns in young children showing early symptoms of ASD.

Parent-Mediated Targeted Intervention for Young Children At-Risk for Autism

Spectrum Disorder

Previous research has shown that 20% of infants with an older sibling affected by Autism Spectrum Disorder (ASD) developed the disorder themselves (Messinger et al., 2015; Ozonoff et al., 2011). It is important to study and conduct pre-diagnostic interventions for younger siblings of children diagnosed with ASD due to their increased genetic risk of developing ASD. Other risk factors for ASD include a family history of developmental, medical and psychiatric disorders (Brimacombe, Ming, & Parikh, 2007; Feldman et al., 2019; Guisso et al., 2018), perinatal conditions such as prematurity (Hadjkacem et al., 2016), postnatal conditions such as respiratory infections (Hadjkacem et al., 2016), and postpartum feeding difficulties (Guisso et al., 2018).

With an already increased risk of developing ASD, it is important to detect early markers of ASD in at-risk infants. Parents can detect possible early signs of ASD as early as 6-9 months of age in at- risk infants (Feldman et al., 2012; Sacrey et al., 2018). The Parent Observation of Early Markers Scale (POEMS) is a validated parent-report early screener that monitors the behavioral development of infants at-risk for ASD (Feldman et al. 2012). The POEMS differentiated between infants 3-24 months of age who were and were not subsequently diagnosed with ASD at 36 months of age. Identifying early signs of ASD allows for early intensive behavioral intervention (EIBI; Lovaas 1987). Early intervention could contribute to reducing severity or eliminating symptoms of ASD early in the child's life. About 40% of at-risk infants who are eventually diagnosed with ASD already show symptoms of ASD by 18 months of age (Szatmari et al., 2016).

Early Intensive Behavioral Intervention (EIBI) originated from a study by Lovaas (1987) and is based on the principles of Applied Behavior Analysis (ABA). It is the most effective evidence-based treatment for young children with ASD (Blocher-Rubin & Krabill, 2017; National Autism Center, 2009), and can result in the reduction of symptom severity, gains in IQ, adaptive behavior and language (Reichow, Barton, Boyd & Hume, 2012). Gains made from EIBI were found to maintain for individuals approximately 10 years following the conclusion of EIBI (Perry et al., 2017).

Parent training for young children with ASD is an emerging field of research and practice. Training parents to implement intervention with their child has many benefits. It is beneficial for reducing parental stress and increasing self-efficacy (Keen, Couzens, Muspratt, & Rodger, 2010). Vismara, Colombi, and Rogers (2009) found that just one hour a week of parent training using the Early Start Denver Model (ESDM; Rogers & Dawson, 2009), a manualized intervention that incorporates components of ABA, resulted in parents successfully teaching social communication skills in recently ASD-diagnosed toddlers. Further, a RCT of 180 children with ASD aged three to seven found greater gains in adaptive behavior in the group receiving parent training with embedded behavior principles compared to the solely parent education group (Scahill et al., 2016).

Parents can be taught ABA-based intervention strategies using Behavior Skills Training (BST; Sarokoff & Sturmey, 2004). BST is a training package that includes instructions, modelling, rehearsing and feedback (Miles & Wilder, 2009). BST has demonstrated large improvements in teachers' implementation of discrete-trial teaching (DTT) often used in EIBI (Sarokoff & Sturmey, 2004). BST also has been shown to be effective in teaching parents to implement DTT with their children with developmental disabilities (Lafasakis & Sturmey, 2007)

and teaching social skills (Hassan et al. 2018). With ABA's long history of effectiveness in the young ASD population, can it have the same effectiveness on mitigating symptoms of ASD for pre-diagnostic at-risk children?

While there is growing research on teaching parents who have children with ASD, only recently have researchers studied the effects on parent training of pre-diagnosed infants and young children at-risk for ASD. Green et al. (2015) assessed parent mediated intervention versus no intervention using a randomised control trial (RCT) for 54 infants at-risk for ASD aged 7-10 months using the Video Interaction to Promote Positive Parenting (iBASIS-VIPP). Although the infants in the parent training group displayed increased attentiveness to the parent and reduced autism-risk related behaviors, all infants at genetic risk of ASD received intervention rather than just the infants that were showing concerning behaviors. Doing so is problematic as some infants were expected to have regular developmental trajectories.

Several studies used manualized curricula that followed a standardized procedure. Jones, Dawson, Estes and Webb (2017) used the manualized Promoting First Relationships (PFR; Kelly, Zuckerman, Sandoval, & Buehlman, 2008) curriculum, which aims to promote parent responsivity to social communicative infant cues and behaviors. Within an RCT, 19 at-risk infants in a treatment group were compared to 14 at-risk infants who received assessment and monitoring. The intervention resulted in improvements in neurocognitive social attention measures at 12 and 18 months for infants at-risk for ASD compared to the infants who were only assessed and monitored (Jones et al., 2017). The Joint Attention Mediated Learning (JAML; Schertz, 2005) was another parent-mediated intervention using a manualized framework focusing solely on joint attention skills (Schertz & Odom, 2007). A multiple baseline design was used across the four phases of intervention: focusing on faces, turn taking, responding to joint

attention and initiating joint attention. All three toddlers who were between 22 and 33 months of age screened positive for ASD but did not have formal diagnoses at entry. Two toddlers improved on each joint attention skill from baseline levels. However, one participant showed only slight increases in joint attention.

Several intervention studies with infants at-risk for ASD have used strategies that are based on the principles of ABA. Pivotal response training (PRT; Koegel & Koegel, 2006) is a naturalistic behavioral intervention rooted in ABA (Steiner, Gengoux, Klin, & Chawarska, 2013). Bradshaw, Koegel and Koegel (2017) used a parent-mediated PRT intervention for three infants aged 15- 21 months who showed concerning behaviors representative of ASD. Using a non-concurrent multiple baseline across participants, improvements were found in expressive verbal communication for all infants. Reduction of ASD symptoms was also observed during the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) post intervention assessment. Despite promising results, this study focused only on verbal language and all toddlers who participated had at least three-word approximations and scored in the mild-moderate range of the ADOS-T (toddler module) administered pre-intervention. The intervention was not conducted with toddlers with more severe symptoms of ASD. In a small, nonrandomized group design, Rogers et al. (2014) studied seven infants showing early symptoms of ASD aged 6-15 months using an intervention based on techniques from ESDM. Intervention consisted of parents implementing teaching strategies for six standard symptoms of ASD including social communicative deficits and abnormally repetitive behaviors. Results indicated that at 36 months of age the seven infants in the treatment group displayed significantly lower rates of ASD symptoms and developmental delays compared to 126 infants with initial similar symptoms who did not enroll in the study but were divided into three different comparison groups. Finally, the

Social ABC's is another manualized parent-mediated intervention geared towards infants and toddlers suspected of having ASD or diagnosed that is based on ABA techniques (Brian, Smith, Zwaigenbaum, Roberts & Bryson, 2016). The multisite research study evaluated feasibility and acceptability of the Social ABC's and identified trends in parent and child behavior. It included 20 toddlers between the ages of 12 and 32 months who were suspected of having ASD or diagnosed. Nine participants had a confirmed diagnosis at entry. Parents achieved a high level of fidelity (at least 75%) during implementation; however, video data (10-minute video clips) were only collected at three points in the study (i.e. at baseline, post-training and follow-up) and not throughout the entire study. Post-intervention significant gains were found in child communication skills such as responsivity, initiations and vocal utterances, as well as shared smiling and social orienting; but the latter two skills did not maintain at the 3-month follow-up. This study did not separate results of at-risk toddlers versus diagnosed toddlers, making interpretation difficult.

Purpose

Parent-mediated interventions using naturalistic behavioural strategies have been shown to yield significant developmental gains in children with ASD (Schaill et al., 2016) and a few studies have evaluated interventions for infants and young children at risk for ASD using set curricula (Bradshaw et al., 2017; Brian et al., 2016; Green et al., 2015; Jones et al., 2017; Rogers et al., 2014; Schertz & Odom, 2007). This study fills a gap in the literature by evaluating individualized and targeted parent-mediated behavioral intervention strategies with young children at-risk for ASD showing pre-diagnostic ASD signs as identified through a parent report early screener called the Parent Observation of Early Markers Scale (POEMS) and direct observations. We hypothesize an increase in both parent teaching fidelity and child targeted

skills following parent training of behavior analytic teaching strategies. Further, we question: Will a functional relation be documented between parent training and both parent teaching fidelity and child targeted skills?

Method

Participants

This study was cleared by the Brock University Research Ethics Board. Three families were recruited through pediatricians, other professionals, online sites, and other sources such as word of mouth. To be included in the intervention study, the child had to be between 6-36 months of age, be at-risk for (but not diagnosed with) ASD because they have an older sibling with ASD or other risk factors (e.g., prematurity), and the parents reported developmental/behavioural issues related to early signs of ASD.

The three participants in this study were three males. Carl was 19 months old at the start of the study. He was born premature. His initial total Parent Observation of Early Markers Scale (POEMS) score at entry was 95 with 10 elevated items. Parent reported concerns included lack of vocal imitation and vocal communication. Carl's 34-year-old mother was Chinese, had a Master's degree and was an accountant. Amir was 26 months old and, had an older sibling diagnosed with ASD. His initial total POEMS score was 130.5 with 28 elevated items. The parent reported concerns for Amir involved unresponsiveness when his name was called, lack of pointing to request items, limited communication using words, and inability to follow simple directions. Amir's mother was 39 years old, an Arabic recent immigrant to Canada, with a Bachelor's degree in medicine and in the process of becoming a family physician. Pablo was 23 months old. His initial total POEMS score was 141 with 30 elevated items. Pablo's parents identified concerns with responding to his name being called, lack of pointing to request, little

motor and vocal imitation, and inability to follow simple directions. Pablo's mother was 33 years old and was Latin American. She had a degree in Business Administration and was a cleaner. English was a second language for all mothers with only Pablo's mother requiring translation during intervention. The mother of each child completed the training and implemented the teaching in the home setting. Fathers or other caregivers had the option to participate in the training (which two fathers did for some sessions), but data were only recorded for the primary caregiver administering the teaching on a regular basis.

Setting

The setting of this study occurred within the home of each participant. For all participants training occurred predominately in the living room or area where the child would play on a daily basis.

Measures

Parent Observation of Early Markers Scale. The Parent Observation of Early Markers Scale (Feldman et al., 2012) is a validated parent report early screener that monitors the behavioral development of infants at risk for ASD. It is comprised of 61 items which cover areas of deficits and symptoms related to ASD. Parents score each item from one to four (1/2 scores allowed), with one being no evidence of any problem with the item and four being a severe problem with the item. Total POEMS scores can range from 61 to 244. Seventy is the cut-off score used in the validation study (Feldman et al., 2012). In this study, scores of 2.5 or above for each individual item were considered elevated items and potential intervention targets. The POEMS shows strong predictive validity, as it was able to discriminate between at-risk infants as young as 9 months of age who eventually became independently diagnosed with ASD (Feldman et al., 2012; Wang, Hudson, Liu, Ward, & Feldman, 2016). The POEMS was administered upon

entry into the study, at least once during intervention, post-intervention, at follow-up, and when the child was 35-36 months of age.

Parent Teaching Skills Checklist. The Parent Teaching Skills Checklist (PTSC) is a 10-item parent self-monitoring checklist that allows parents to monitor skills that assist them with implementing effective behavior analytic based techniques to increase their child's target skill. Table 1 below shows the observational version of the checklist with the items used to score parent teaching. Appendix A is the self-monitoring version that parents were encouraged to use during the week to self-monitor their teaching. The PTSC includes teaching strategies such as prompting and reinforcement that allow parents to teach skills similar to DTT (Sarokoff & Sturmey, 2004) but in ongoing natural interactions using Natural Environment Teaching (NET; Sundberg & Partington, 1998). NET involves using current establishing operations of the learner, teaching in the natural contexts and playful interactions (Weiss, 2001). The PTSC is scored based on percentage of steps completed correctly for each teaching trial. The terminal goal was for parents to achieve an average of 80% or higher correct teaching steps for each trained skill.

Table 1

Parent Teaching Skills Checklist

Parent sets up environment for success (e.g., distractions minimized, television/computer off, toys put away)

Parent creates natural opportunities for the child to exhibit target skill (e.g., preferred activity the child enjoys doing with others)

Parent attains child's attention prior to delivery of request (e.g., child looks in direction of parent, child responds to previous interaction). Exception – if attentional skills are being trained (e.g., eye contact, responding to name being called).

Parent provides clear instruction, or natural cues, when required

Parent utilizes appropriate prompt when necessary (e.g., least amount of prompting to produce a correct response such as a gesture; holding up an object)

Parent provides natural reinforcement for correct response (e.g., praise, item the child wants)

Parent utilizes error correction used for incorrect, or no response (e.g., gentle physical guidance)

Parent provides appropriate time before delivery of next instruction (e.g., 5-10 seconds)

Parent fades prompts over trials, and/or introduces time delay between instruction/cue and prompts

Following no response, or an incorrect response, the parent adjusts cueing and prompting strategies to increase success in child's response (e.g., uses a more obvious cue)

Parent Sense of Competence Scale (PSOC). The PSOC (Gibaud-Wallston & Wandersman, 1978, as cited in Johnston & Mash, 1989; see Appendix D) is a validated 17-item questionnaire that measures parenting self-competency using two scales. Internal consistencies of 0.75 for the Satisfaction scale and 0.76 for the Efficacy scale were reported (Johnston & Mash, 1989). Each item was scored pre and post intervention on a Likert scale ranging from one being "strongly disagree" to six being "strongly agree". Nine items are reverse coded. Each participant received an overall numerical score ranging from 17-102; with a higher score indicating higher parenting sense of self-competency.

Consumer Satisfaction Feedback. Parents completed a consumer satisfaction feedback form (see Appendix B) in follow-up. The consumer satisfaction feedback is divided into four subscales: satisfaction, perceived change, recommendation and researcher professionalism. A mean score was calculated of each subscale, and then each subscale mean was used to generate an overall consumer satisfaction mean score. In the satisfaction subscale there are three questions that were scored using a Likert scale ranging from a score of one (extremely dissatisfied) to seven (extremely satisfied). The questions target how satisfied parents were with the overall training program, the curriculum tips sheets and the hands-on training. In perceived change there are two questions that use a four-point Likert scale ranging from one (no change) to four (a great deal). The items allowed participants to rate how much they felt they learned and how much they felt their child benefitted from the program. The recommendation subscale includes two questions that use a four-point Likert scale ranging from one (not likely at all) to four (extremely likely) to score how likely parents are to recommend the POC tip sheets and "hands on"

approach to training. Researcher professionalism has four questions scored either zero (no) or one (yes) for participants to score researcher responsiveness to questions, consideration of time, respectfulness, and professionalism towards the family.

Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord, Rutter, DiLavore, & Risi, 1999). The ADOS-2 was administered by a clinical psychologist with formal ADOS training following the third birthday of each child. The ADOS-2 is considered a "gold standard" ASD assessment instrument. The ADOS-2 assesses developmental markers such as communication, play, social interaction and repetitive behaviors at 36 months of age. It took 45-60 minutes to administer, and results were used to identify whether each participant scored at the cut-off for ASD diagnosis. The cut off score for ASD for children with no words is 10, and 7 for children with some words.

Child Behaviours

Vocal imitation. The child verbally repeats any sound or word utterance within five seconds of the sound being presented by a parent. This includes the exact sound or a close approximation.

Verbal manding. The child independently, verbally requests an item or activity from their parent. This includes when the item is within or outside of sight, and excludes when the name of the item is verbally stated first by another individual.

Motor imitation. The child independently completes a motor action modelled by their parent within five seconds of the action being modeled. This includes imitation of body actions or actions using objects.

Responding to name. Following the parent verbally saying the child's name to draw his/her attention, the child directs his eye gaze towards the parent within five seconds of their name being called.

Pointing to request. The child independently uses their index finger to point towards an object to request it when a parent holds up one or more options. The point must occur within five seconds following the onset of the visual or verbal cue. This excludes when someone asks the child to point to receptively identify an object (e.g. Point to the pig).

Following simple instructions. The child independently completes an instruction presented by their parent within five seconds of the instruction being verbally presented. This may include a gestural prompt provided by the parent.

Data Collection

All sessions were video recorded. Data were collected for child skills and parent teaching performance. From observation of the videos, data of the child target skills were recorded based upon the percentage of correct responses out of the number of potential opportunities for the target behavior to occur. Most opportunities were contrived (e.g., parent says, "do this" for motor imitation). The self-initiated child skill of manding was the only skill recorded as rate throughout the observation session for one participant. Furthermore, parent teaching performance was recorded from observation of the videos and was based upon the percentage of steps correctly completed from the PTSC. The first five teaching opportunities for each separate child target skill were scored during each session and averaged to create a mean percentage of correct implementation of the PTSC for each separate child skill being taught.

Interobserver Agreement

Interobserver agreement (IOA) was obtained by having two trained observers record data independently from 40% of randomly selected parent teaching sessions and 36% of randomly selected child skill sessions across all participants and conditions. Trial by trial IOA was used to determine the percentage of agreement for child behaviour and item-by-item checklist correspondence for parent teaching skills (Cooper, Heron & Heward, 2007). For baseline, training and follow-up probes parents were asked to contrive instructional trials. A trial was defined as the onset of an instruction or natural cue delivered by the parent as the discriminative stimulus to evoke a child response, and ended following a 3-5 second pause following a correct or incorrect child response or the presentation of a new discriminative stimulus signalling the onset of a new trial. Observers were naïve to the purpose of the study and the phase of the videos (e.g., baseline, training, follow-up) that they were scoring. Results of IOA for child target skills were 93% (range 67-100) for Carl, 90% (range 56-100) for Amir and 94% (range 75-100) for Pablo. Results of IOA for parent teaching skills were 83% (range 67-100) for Carl, 89% (range 66-100) for Amir and 88% (range 64-100) for Pablo.

Treatment integrity. One researcher observed the other researcher implementing parent training based upon a treatment integrity checklist outlining all required components of the intervention (see Appendix C). Afterwards a third-party observer naïve to the purpose of the study observed the 15 videos of the intervention from all three participants and scored the treatment integrity using the same checklist. Treatment integrity scored by the third-party observer was 100%.

Experimental Design

A within-subject concurrent multiple baseline design across parent and child behaviors was used for each participant to demonstrate experimental control of the intervention on child and parent behaviors (Cooper et al., 2007). The order of child skills was chosen based upon developmental sequence and parent input. Between three and five target behaviors were observed during baseline, intervention and follow-up, alongside parent teaching skills for each target behavior.

Procedure

The four procedural steps followed in this study can be found below in Figure 1.

Identification of target behavior
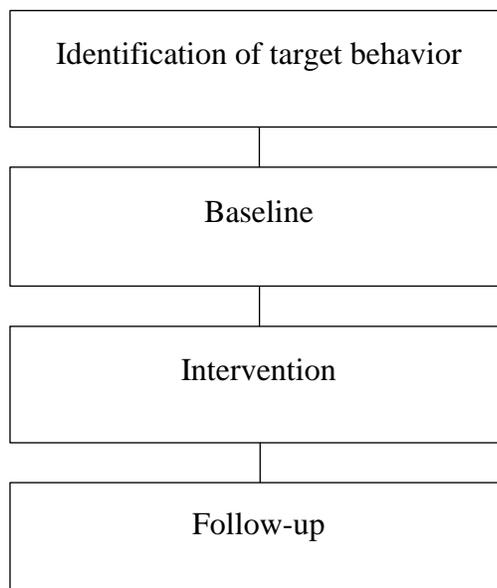
Baseline

Intervention

Follow-up

Figure 1. Four procedural steps.

Identification target behaviors. After providing formal written consent, the parents completed the POEMS (the parent knew the POEMS under the more generic name, Parent Observation Checklist). The parents completed the POEMS monthly throughout the duration of the study and up to child age of three years. The POEMS elevated items were used to help identify potential child target behaviors. Following the POEMS parents completed the PSOC.

Researchers then conducted one set of baseline probe trials in the home for each elevated item to verify whether indeed the child did not perform the skill as would be expected given the child's age. This involved at least four trials of each skill other than manding for Carl which was recorded based on spontaneous mands during the session. The final set of child target behaviours (see above) were selected based on low baseline scores and parent preference.

Baseline. Young children and their parents were observed and videotaped within their naturalistic home setting once per week based on researcher and parent availability. Parent teaching skills and child behavior were observed. Parents were given some verbal instruction on how to contrive a situation that would evoke the child target skill, without being provided with any teaching strategies. Baseline continued until a stable baseline occurred for the first child skill to be trained. The other identified target behaviors remained in baseline as per the multiple baseline design. During baseline parents were given the instruction to teach the target skill to their infant in any way they usually would. No training or feedback was given to parents at this time.

Intervention. Sessions for each participant lasted around one hour, once a week for about 8-12 weeks, depending how long it took the parent to perform at 80% on the PTSC for each skill and for the child to show observable improvement on the skills the parents taught. Each session began with a videotaped probe of the parents attempting to teach the target behaviors to their infant using baseline procedures.

The parent trainers (first and second authors) used Behavior Skills Training (BST; Sarokoff & Sturmey, 2004) to train the parent how to teach the child. BST consisted of written instructions (going over the PTSC and suggestions for teaching the target behaviour), modeling correct teaching trials with the child, and then rehearsing the teaching tactics with the parents

with coaching. Once the parents met a rehearsal mastery criterion of at least 80% three consecutive times on the PTSC, they implemented the strategies with their child. Parents received immediate feedback while working with the child. Parents were trained to conduct an informal preference assessment at the start of teaching to determine child interests, set up the environment for success and find frequent natural teaching opportunities in everyday routines. They were given the PTSC with teaching examples for target behaviors to review and self-monitor and self-record if they wished to do so. The PTSC was translated into Spanish for Pablo's mother.

Follow-Up. Follow-up started when all child target behaviours taught by the parent showed improvement based on visual inspection of graphed data and consensus of the research team. It continued until the child turned 36 months of age. Follow-up observations followed baseline procedures. However, if the parents teaching skills fell below the 80% mastery criteria on the PTSC, they were given booster training in the subsequent session (see Appendix D for booster session procedure). Follow-up began eight weeks post-intervention for Carl and Amir, and 4 weeks post-intervention for Pablo. During follow-up, the parents again completed the PSOC and the consumer satisfaction form. Follow-up lasted 9 months for Carl, 3 months for Amir and 3 weeks for Pablo. The ADOS-2 was administered when the child turned three years old.

Results

Parent teaching fidelity and child target skills increased in all participants. In general, as parent teaching fidelity improved so did child target skills, and as child target skills improved parents had decreased concerns for most skills.

Carl

The research design followed for Carl can be found below in Figure 2.

Baseline 1: Vocal Imitation	Intervention: Parent Training	Follow-Up

Baseline 2: Manding	Intervention: Parent Training	Follow-Up

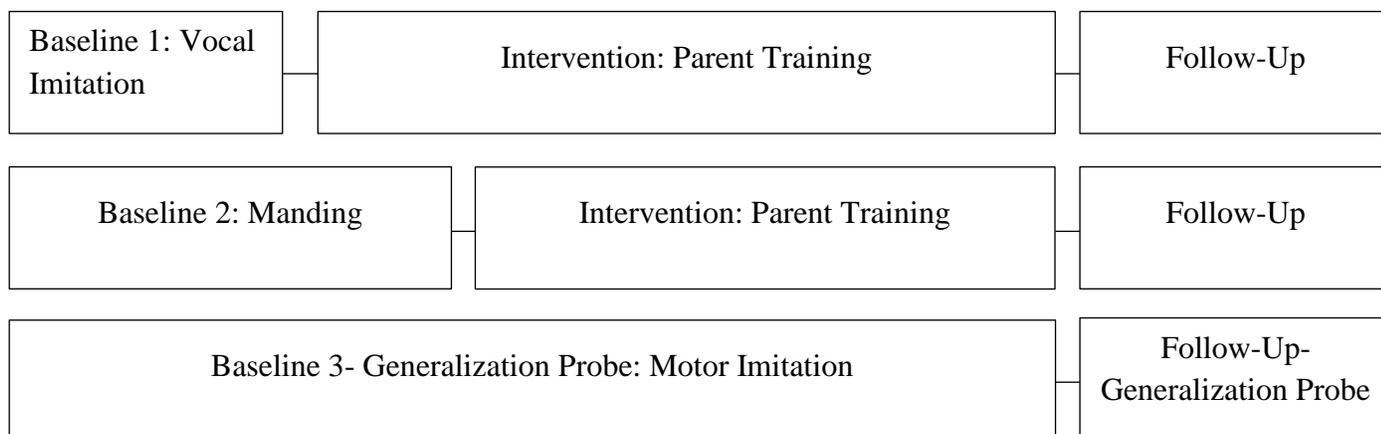| Baseline 3- Generalization Probe: Motor Imitation	Follow-Up-Generalization Probe

Figure 2. Outline of the design followed for Carl.

As seen in the multiple baseline in Figure 3, increased level change and trend were found for both parent teaching and child target skills from baseline to intervention and follow-up. For vocal imitation, parent teaching skills increased from a baseline of $M=18\%$ to $M=78\%$ during intervention and $M=82\%$ during follow-up. Carl's vocal imitation skills increased from $M=13\%$ at baseline to $M=65\%$ during intervention and $M=81\%$ at follow-up. For manding, parent teaching increased from a baseline of $M=35\%$ to $M=94\%$ during intervention and $M=84\%$ during follow-up. Carl's manding skills increased from a rate of $M=0.03$ at baseline to $M=0.35$ during intervention and $M=0.57$ at follow-up. Parent teaching and child target skills maintained at follow-up, with some variability. Parent teaching fidelity initially decreased during the first follow-up visit but remained over 78% following booster training.

Although motor imitation was not trained as it was not an elevated POEMS item, some generalization in parent teaching skills and child target skills from vocal imitation to motor imitation was demonstrated. During baseline for vocal imitation, parent teaching skills for motor imitation was $M=33\%$, which increased to $M=76\%$ during vocal imitation intervention, and

M=65% at follow-up. Similarly, during baseline for vocal imitation, Carl's motor imitation skills were *M*=45%, which increased to *M*=78% during vocal imitation intervention, and *M*=60% at follow-up. The POEMS targeted elevated item scores went from 2.5 at baseline to 1.0 at the end of intervention for vocal imitation, and from 3.5 at baseline to 1.0 at the end of intervention for verbal manding. Results of the ADOS-2 administered at 36 months of age revealed that Carl scored below the cut-off for autism (Overall Total Score = 4). Carl demonstrated vocal imitation, manding and motor imitation with the assessor. PSOC measures were not taken for Carl's mother as that was a later addition to the study. Consumer satisfaction scores for Carls' mother include: satisfaction *M*=6.7 (range 6-7), perceived change *M*= 4(range 4), recommendation *M*= 3.5(range 3-4), researcher professionalism *M*= 1(range 1), and overall consumer satisfaction *M*=3.8.
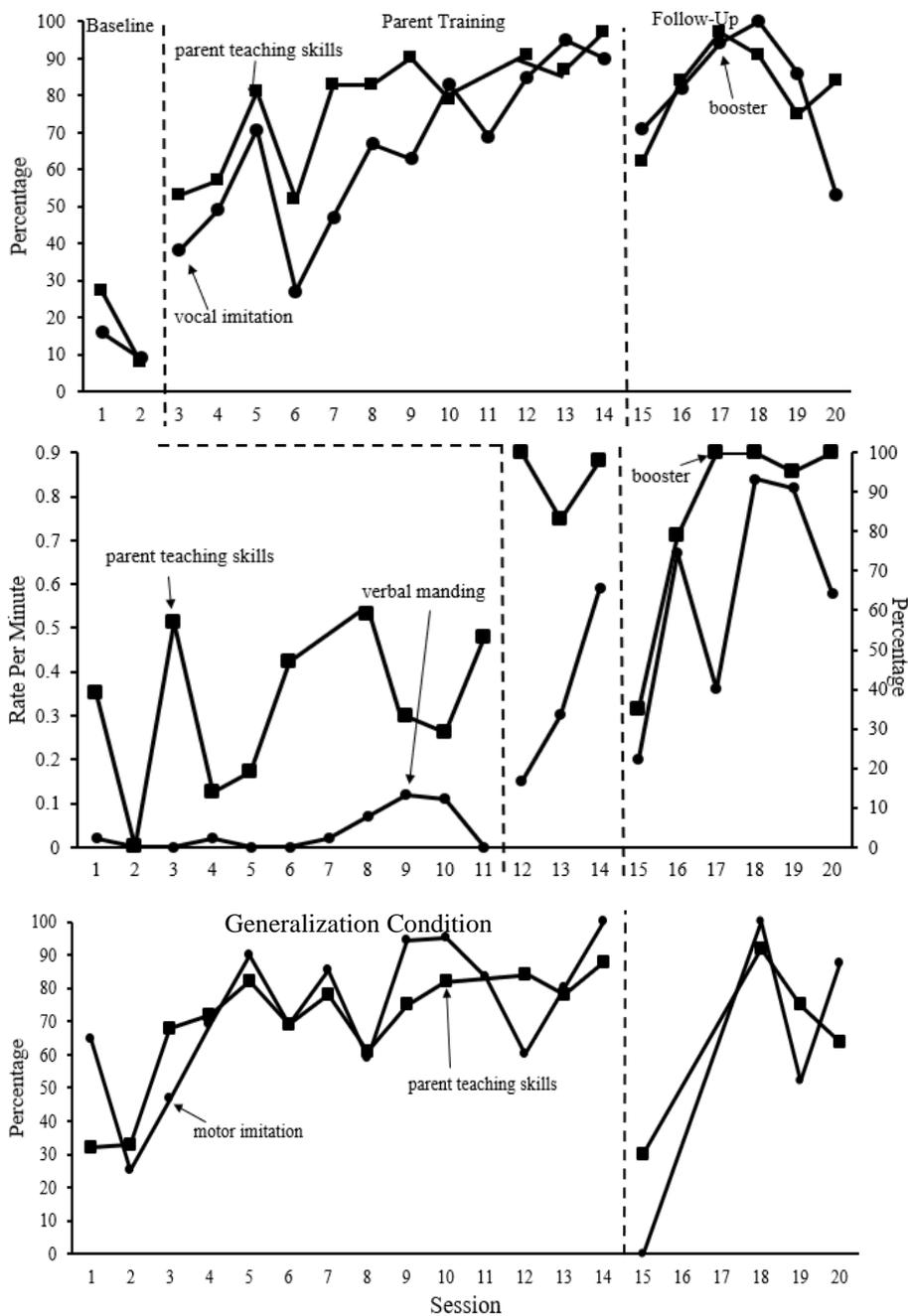
Figure 3. Multiple baseline across parent teaching skills and child behaviors for Carl.

Amir

Figure 4 shows the multiple baseline across parent teaching skills and child behaviors for Amir. Increases in parent teaching skills from baseline to intervention and follow-up were found for each child target skill. For responding to name, parent teaching skills increased from a baseline of $M=53\%$ to $M=85\%$ during intervention and $M=88\%$ during follow-up. Amir's responding to name skills increased from $M=11\%$ at baseline to $M=48\%$ during intervention and $M=56\%$ at follow-up. For pointing to request, parent teaching increased from a baseline of $M=58\%$ to $M=94\%$ during intervention. Amir's pointing to request skills increased from a baseline of $M=2\%$ to $M=67\%$ during intervention. For following simple directions, parent teaching increased from a baseline of $M=78\%$ to $M=88\%$ during intervention and $M=95\%$ during follow-up. Amir's following of simple directions increased from a $M=32\%$ at baseline to $M=72\%$ during intervention and $M=79\%$ at follow-up. For verbal manding, parent teaching increased from a baseline of $M=50\%$ to $M=87\%$ during intervention and $M=95\%$ during follow-up. Amir's verbal manding skills increased from a $M=1\%$ at baseline to $M=34\%$ during intervention and $M=93\%$ at follow-up. Parent teaching skills maintained above 78% for all skills at follow-up. While the plan was to not train the parent to teach verbal manding until pointing to request was acquired, Amir emitted a spontaneous verbal mand in session 8. At that point the trainer told mother to reinforce spontaneous verbal mands. Although mother did not receive the full BST package for teaching verbal manding until session 20, Amir gradually increased verbal manding starting in session 12 corresponding to mother's increasing teaching skills and his increase in gestural manding. As verbal manding increased, pointing to request gradually decreased as mands were being emitted rather than points, and reinforcement was provided for manding and withheld for pointing to request after session 18.

Amir's POEMS elevated targeted responding to name score remained at 3.0 from baseline to the end of intervention; pointing to request went from 4.0 to 2.5; following simple directions changed from 3.5 to 2.5; and verbal manding went from 4.0 to 1.5. Results of the ADOS-2 Module 1 administered at 36 months of age revealed that Amir scored above the cut-off for autism (Overall Total Score=20), indicating a significant number of autism related symptoms. Amir did not demonstrate directing eye gaze consistently when the assessor called his name. He did not demonstrate pointing to request with the assessor but did emit verbal mands. Amir did not follow simple instructions with the assessor. PSOC scores decreased slightly from 79 pre intervention to 70 post intervention, indicating a decrease in parent sense of self-competency. Consumer satisfaction scores for Amir's' mother include: satisfaction M=7(7), perceived change M= 4(4), recommendation M= 4(4), researcher professionalism M= 1(1), and overall consumer satisfaction M=4. Amir's mother was extremely satisfied with the overall parent training program, felt she learned a great deal and felt her child benefitted a great deal.
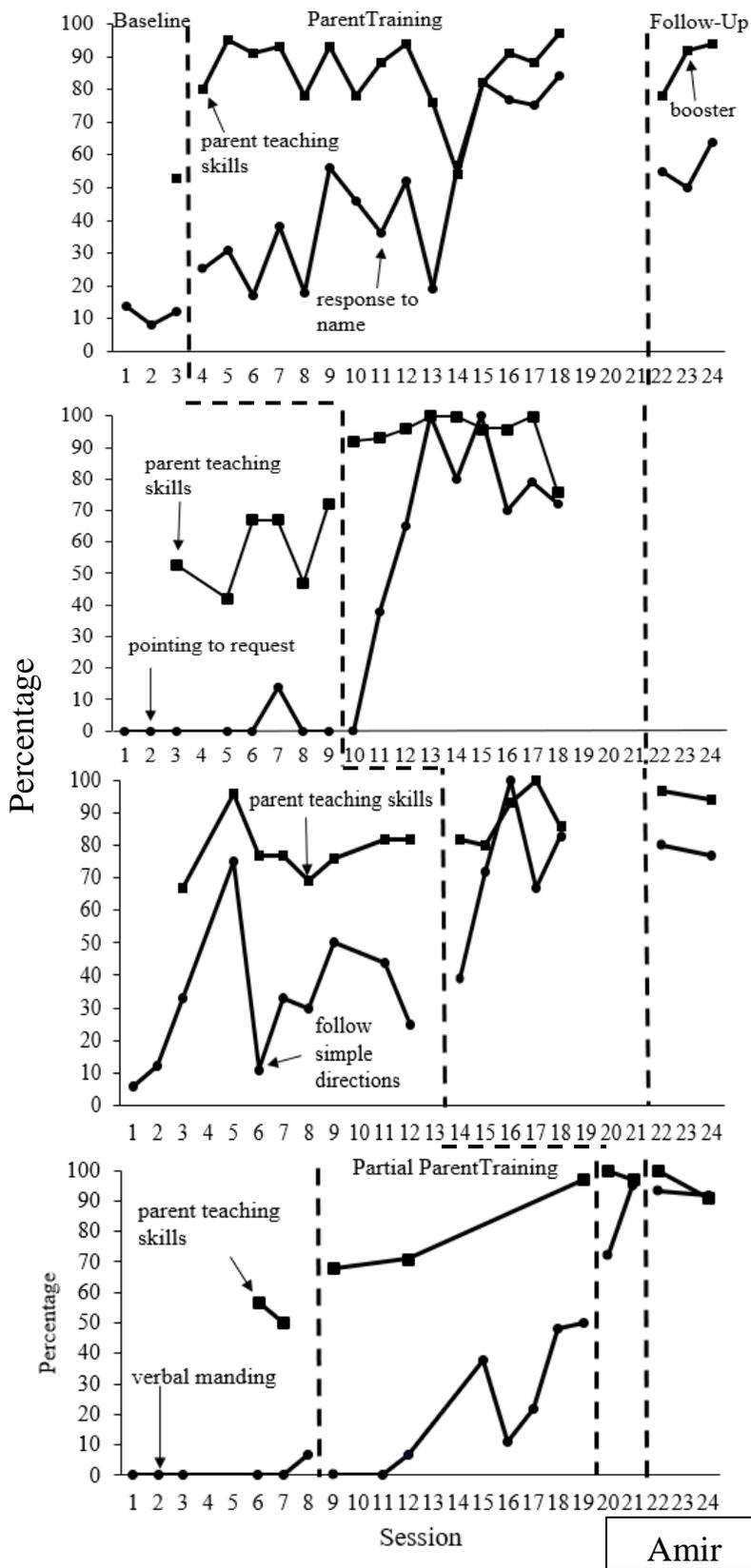
Figure 4. Multiple baseline across parent teaching skills and child behaviors for Amir.

Pablo

Figure 5 shows the multiple baseline across parent teaching skills and child behaviors for Pablo. Other than motor imitation which showed some variability during intervention, parent teaching and child skills demonstrated increases following the onset of intervention. For responding to name, parent teaching skills increased from a baseline of *M*=31% to *M*=85% during intervention and *M*=90% during follow-up. Pablo's responding to name skills increased from *M*=7% at baseline to *M*=44% during intervention and *M*=55% at follow-up. For motor imitation, parent teaching increased from a baseline of *M*=57% to *M*=76% during intervention and *M*=85% during follow-up. Pablo's motor imitation skills increased from *M*=19% at baseline to *M*=47% during intervention to *M*=37% at follow-up. For pointing to request, parent teaching increased from a baseline of *M*=67% to *M*=97% during intervention and *M*=97% during follow up. Pablo's pointing to request skills increased from *M*=0% at baseline to *M*=52% during intervention and *M*=52% during follow-up. For following simple directions, parent teaching increased from a baseline of *M*=66% to *M*=84% during intervention and *M*=92% during follow-up. Pablo's following of simple directions increased from a *M*=0% at baseline to *M*=47% during intervention and *M*=42% at follow-up. Parent teaching of vocal imitation increased from 46% at baseline to 96% during intervention and *M*=91% at follow-up. Pablo's vocal imitation skills increased from *M*=7% at baseline to *M*=32% during intervention and *M*=68% at follow-up. At follow-up parent teaching fidelity maintained above 75% for all skills. However, in follow-up, slight decreases were found in all child target skills other than vocal imitation, which improved during the next follow up point. Pablo's POEMS elevated targeted item scores for responding to name and motor imitation stayed at 4.0 at baseline and the end of intervention; pointing to request changed from 4.0 to 2.0; and imitating sounds and words went from 4.0 to 3.0. Results of the ADOS-2 Module 1 administered at 36 months of age, revealed that Pablo scored above the

cut-off for autism (Overall Total Score = 21), indicating a significant number of autism related symptoms. Pablo did not use eye gaze consistently when the assessor called his name. He did imitate some motor actions using objects with the assessor. He did not demonstrate pointing to request with the assessor but did point to request with his mother. Pablo followed some simple instructions with the assessor such as "sit down," but not "come here." PSOC scores increased from 68 pre intervention to 85 post intervention, indicating an increase in parent sense of self-competency. Consumer satisfaction scores for Pablo's mother include: satisfaction $M=$ 6.7(range: 6-7), perceived change $M=$ 4(range: 4), recommendation $M=$ 4(range: 4), researcher professionalism $M=$ 1(range:1), and overall consumer satisfaction $M=3.9$. Pablo's mother was extremely satisfied with the overall parent training program, felt she learned a great deal and felt her child benefitted a great deal.
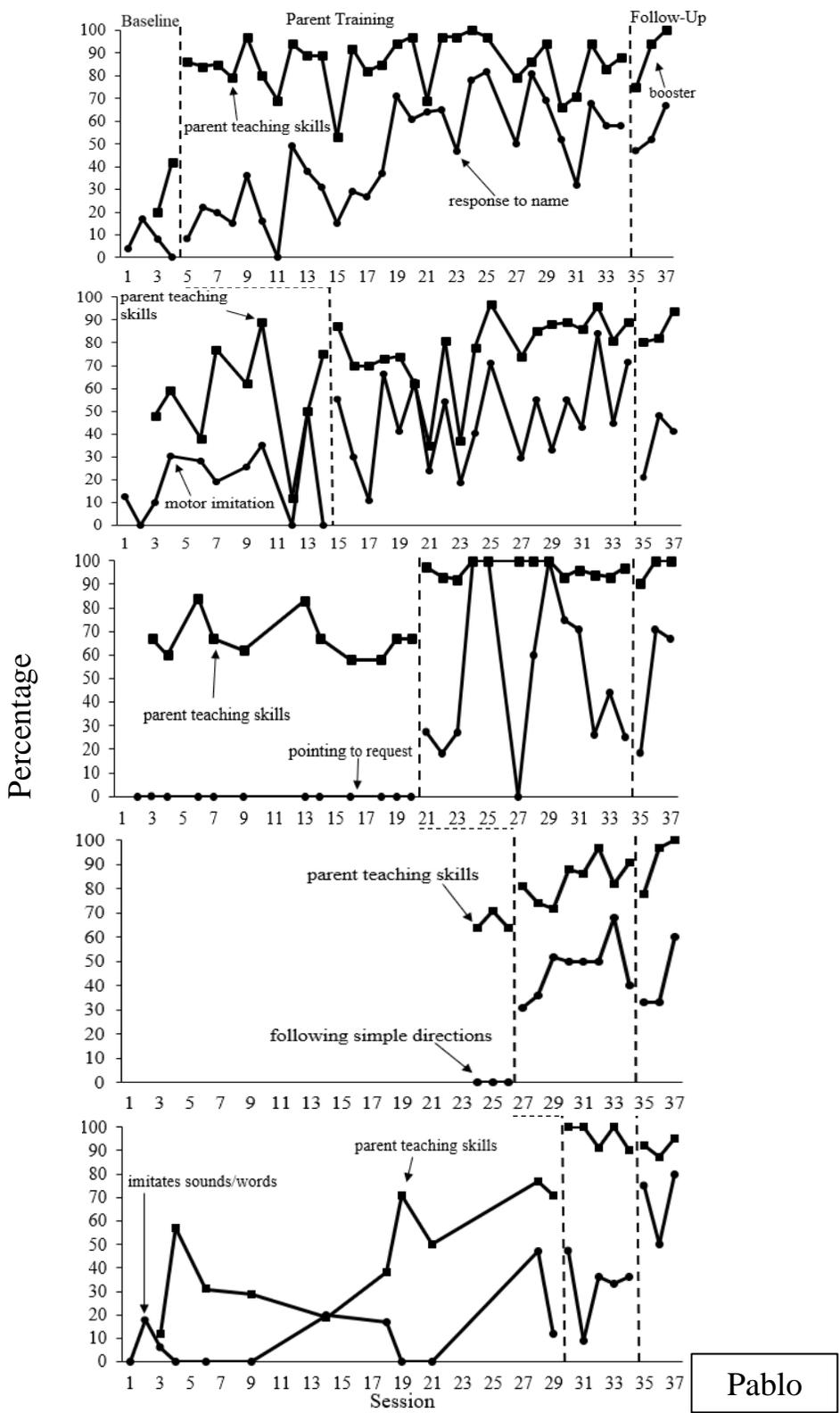
Figure 5. Multiple baseline across parent teaching skills and child behavior for Pablo.

ASD symptoms based on the total POEMS scores (sum of all items) gradually decreased for Carl and Amir but increased for Pablo over the course of the study. Both Amir and Pablo scored over the 70-point cut-off for ASD, and Carl scored just above. The total number of POEMS elevated items (items that were scored 2.5 or higher) followed a similar trend, with Carl having very few remaining elevated items, Amir having decreased elevated items and Pablo having increased elevated items. Figure 4 presents a graph of total POEMS scores for all participants and Figure 5 presents a graph of elevated items for all participants. At 36 months of age Pablo received an independent diagnosis of ASD.
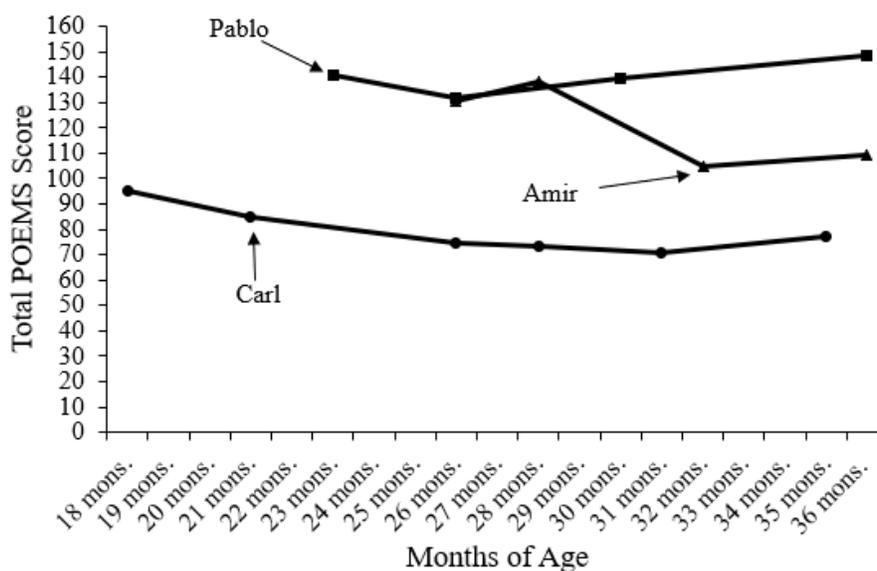

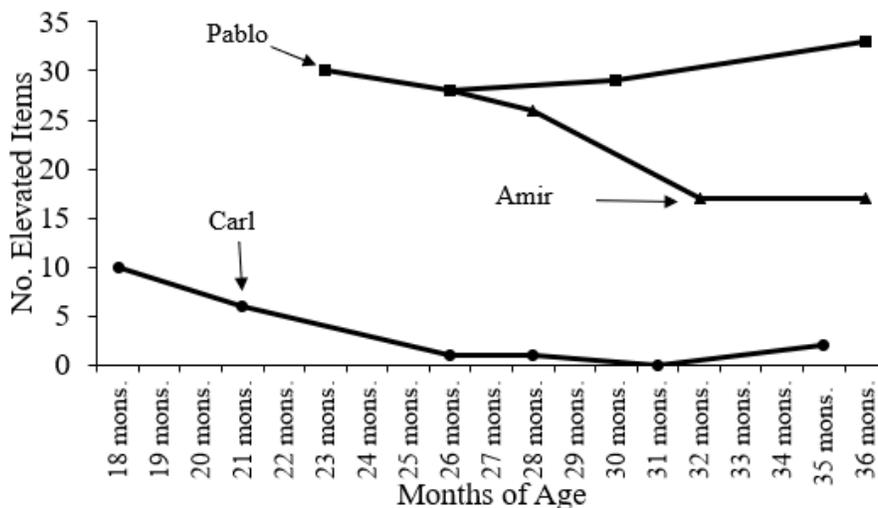Figure 6. Total POEMS scores for each participant.

Figure 7. Total POEMS elevated items for each participant.

Discussion

This study employed a quasi-experimental multiple baseline design for Carl and

experimental multiple baseline design for Amir and Pablo across parent teaching skills and child

behaviors. With documented level change, trend and immediacy of effect, two basic effects of

intervention were documented for parent teaching skills and child target behaviors for Carl, and a

functional relation was documented between parent training and both parent teaching skills and

child target behaviors for Amir and Pablo. This study contributes to the emerging literature of

training parents to teach developmental skills to young pre-diagnosed children at-risk for ASD.

Receiving only one hour of training per week at home and a teaching self-checklist that outlined

core teaching principles (e.g. prompting, reinforcement, error correction), all parents improved

teaching fidelity following training for each skill and the young children increased skill

acquisition in several target skills. Overall, as parent teaching fidelity improved, child targeted

skills improved as well. Unlike previous interventions with infants and young children at-risk for

ASD that provided set curricula for every child, this study provided a targeted intervention based

on an individualized assessment of developmental skills. Targeted intervention is beneficial for

only providing and exposing families to intervention where needed. This study also closely monitored child skill acquisition and parent teaching fidelity throughout the study using direct observation and data collection from every session using a single-case experimental design, with acceptable levels of treatment integrity and interobserver agreement. We were able to show direct correspondence between parent teaching fidelity and child skill acquisition of targeted skills. ASD symptoms were also monitored throughout the study using the POEMS, showing decreased symptoms for two participants. This study included multicultural families, and unlike some studies that included all infants at genetic risk of ASD regardless of whether they were showing regular developmental trajectories, our study included at-risk infants who demonstrated developmental concerns.

The findings of this study reveal a gradual increase in child skills following intervention. Consistent with previous research (Vismara et al., 2009), this may be common within this young population and with teaching grounded in naturalistic routines that vary from day to day. It can be noted that motivating operations for young children changed so quickly that parents needed to learn to adapt their teaching to the changing interests of their child. Further, symptom severity differed for each participant and could have affected the rate of skill acquisition. For example, Carl was able to acquire skills more consistently and in a shorter time span than Amir and Pablo, who had higher symptom severity scores according to the POEMS and ADOS-2. This study provides further support that higher functioning prior to the onset of intervention is associated with better outcomes of EIBI (Virues-Ortega et al., 2013).

Some generalized parent teaching between skills was demonstrated in this study. For Carl's mother, as teaching for vocal imitation improved, teaching for motor imitation also demonstrated an increasing trend, subsequently improving both child skills. The similarities

between teaching the imitative skills could account for generalization in parent teaching. Some generalized teaching was also demonstrated for teaching vocal imitation with Pablo following teaching four other skills including motor imitation. Overall, parent teaching skills for Carl's mother showed generalization across both subsequent child behaviors following the first trained child behavior. Amir's mother showed generalized teaching across two out of three of skills following previously trained behaviors; including verbal manding as teaching generalized for all steps of the PTSC that did not received partial parent training. Pablo's mother showed generalized teaching across one out of four skills following previously trained behaviors.

Other than for Carl's mother, teaching fidelity for all skills maintained above 75% at the first follow-up visit which was eight weeks post-intervention for Carl and Amir and four weeks post-intervention for Pablo. For Pablo's mother, although parent teaching fidelity remained above 75% for all skills at the first follow-up visit, child target skills decreased, suggesting the possibility that practicing the skills ceased or reduced during the time between intervention and follow-up.

This study capitalized on the parents' ongoing concern for their children and commitment to practice with their child as much as possible each day using natural environment teaching strategies. Parents also tracked and identified core symptoms of ASD using the POEMS throughout the study, which demonstrated the reduction of concerns for most targeted symptoms. Both of Carl's targeted skills trained in intervention changed from being an elevated item at baseline to not concerning at the end of intervention. While one of Amir's targeted skills (responding to name) was scored the same pre and post intervention, two of Amir's targeted symptoms (pointing to request, following simple directions) decreased in concern and one was no longer elevated (communicating with words). For Pablo, two targeted and trained skills,

(responding to name, motor imitation) slightly decreased during intervention but then increased at 36 months of age. Imitating sounds and words slightly decreased in concern post-intervention and pointing to request was no longer elevated. This suggests that parents noticed substantial difference in the trained, targeted skills post intervention. At 36 months of age Carl was not referred for a diagnostic assessment for ASD, Amir received a diagnostic assessment from a developmental pediatrician but was not given a diagnosis, and Pablo received a diagnostic assessment from a developmental pediatrician and was given an ASD diagnosis.

Training affected parents' sense of self-competency differently for two mothers, as self-competence scores increased for Pablo's mother but decreased for Amir's mother. Although it is not clear how parent sense of self-competency affected training effectiveness, it is nonetheless important to monitor given the important role of the parent to the child and the need to establish social validity. According to the consumer satisfaction questionnaire all parents were extremely satisfied with our program and felt their child greatly benefited.

One limitation to this study is that it was not possible to know exactly how often parents practiced the skills with their child each day. Different amounts of practice each week could affect the variability of results. Although parents were encouraged to practice frequently throughout the week and self-monitor their teaching, they were not required to look at or use the PTSC between sessions. Future studies may consider collecting completed self-monitoring sheets from parents. Further, a language barrier was present for Pablo's family, possibly affecting communication and Pablo's mothers' ability to follow instructions provided by the trainer. However, a translator was present for almost all sessions to provide immediate translation. Another limitation to this study is that the 80% rehearsal criterion during training was not in place for Carl, which could account for the slower acquisition of parent teaching of

vocal imitation. Finally, the three children were already in their second or third year of life. The youngest participant, Carl, was the only child to score below the cut-off on the ADOS after training. It is possible that starting the parent training intervention earlier in the child's life would have allowed the parent to work on more skills and prevent developmental problems indicative of ASD from arising or reducing their severity.

Overall, this study found an association between parent training and improved parent teaching fidelity and improved targeted child behaviors for one child at-risk for ASD (Carl), and a causal effect between parent training of behavior analytic teaching strategies with improved parent teaching fidelity and improved targeted child behaviors of two young children at-risk for ASD (Amir and Pablo). Early symptom identification using the POEMS screener and parent delivered behavioral intervention was associated with improved core symptoms of ASD which has the potential to impact the severity of diagnosis and long-term child outcomes. This intervention study suggests that it is possible to effectively intervene during the time gap between identification of concerning behaviors and diagnosis of ASD. While more research is needed using this targeted ABA intervention with children at-risk for ASD (i.e., a RCT study), future research might explore the effectiveness of parent training for at-risk infants using a telehealth format to reach families living at a distance from ABA providers; as well, future research needs to look at more explicit programming for generalization and maintenance of parent and child skills. Future research for generalized parent teaching skills across child target behaviors could occur in the form of general case parent training (Ward-Horner & Sturmey, 2008). As previous studies have demonstrated the effectiveness of EIBI (Lovaas, 1987), targeting core symptoms of ASD at a much younger age could impact the severity of the diagnosis and long-term outcomes (Perry et al., 2017).

References

Blocher-Rubin, A., & Krabill, P. (2017). Initial development of the early intensive behavioral

    intervention parental self-efficacy scale: A pilot study. *Autism Research and Treatment*,

    2017, 1-11. doi.org/10.1155/2017/9512180

Bradshaw, J., Steiner, A. M., Gengoux, G., & Koegel, L. K. (2015). Feasibility and effectiveness of

    very early intervention for infants at-risk for autism spectrum disorder: A systematic review,

    Journal of Autism and Developmental Disorders, *45*(3), 778-794. doi:10.1007/s10803-014-

    2235-2

Bradshaw, J., Koegel, L. K., & Koegel, R. L. (2017). Improving functional language and social

    motivation with a parent-mediated intervention for toddlers with autism spectrum disorder.

    Journal of Autism and Developmental Disorders, (8), 2443-2458. doi:10.1007/s10803-017-

    3155-8

Brimacombe, M., Ming, X., & Parikh, A. (2007). Familial risk factors in autism. *Journal of Child

    Neurology, 22*(5), 593-597. doi: 10.1177/0883073807302609.

Brian, J. A., Smith, I. M., Zwaigenbaum, L., Roberts, W., & Bryson, S. E. (2016). The social ABCs

    caregiver-mediated intervention for toddlers with autism spectrum disorder: Feasibility,

    acceptability, and evidence of promise from a multisite study. *Autism Research*, (8), 899-912.

    doi: 10.1002/aur.1582

Cooper, J.O., Heron, T.E. & Heward, W.L. (2007). *Applied behavior analysis – second edition*.

    Upper Saddle River, NJ: Pearson Education.

Feldman, M. A., Ward, R. A., Savona, D., Regehr, K., Parker, K., Hudson, M., & ... Holden, J. A.

    (2012). Development and initial validation of a parent report measure of the behavioral

development of infants at risk for Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, *42*(1), 13-22. doi: 10.1007/s10803-011-1208-y

Feldman, M. A., Azzano, A., Ward, R. A., Hudson, M., Sjaarda, C. P., & Liu, X. (2019). Relationship of family history conditions and early signs of autism spectrum disorder in low and high-risk infants. *Research in Autism Spectrum Disorders*, *65*, 25–33. doi: 10.1016/j.rasd.2019.05.002

Green, J., Charman, T., Pickles, A., Wan, M. W., Elsabbagh, M., Slonims, V., & ... Johnson, M. H. (2015). Parent-mediated intervention versus no intervention for infants at high risk of autism: a parallel, single-blind, randomised trial. *The Lancet Psychiatry*, *2,* 133-140. doi:10.1016/S2215-0366(14)00091-1

Gibaud-Wallston, J., & Wandersman, L. P. (1978). Development and utility of the parenting sense of competence scale. *Paper presented at the meeting of the American Psychological Association,* Toronto.

Guisso, D. R., Saadeh, F. S., Saab, D., El Deek, J., Chamseddine, S., El Hassan, H. A., & ... Boustany, R. (2018). Association of autism with maternal infections, perinatal and other risk factors: A case-control study. *Journal of Autism & Developmental Disorders*, *48*(6), 2010-2021. doi:10.1007/s10803-017-3449-x

Hadjkacem, I., Ayadi, H., Turki, M., Yaich, S., Khemekhem, K., Walha, A., & ... Ghribi, F. (2016). Original article: Prenatal, perinatal and postnatal factors associated with autism spectrum disorder. *Jornal De Pediatria*, 92(6), 595-601. doi: 10.1016/j.jped.2016.01.012

Hassan, M., Simpson, A., Danaher, K., Haesen, J., Makela, T., & Thomson, K. (2018). An evaluation of behavioral skills training for teaching caregivers how to support social skill

development in their child with autism spectrum disorder. *Journal of Autism & Developmental Disorders*, *48*(6), 1957–1970. doi: 10.1007/s10803-017-3455-z

Jones, E. J., Dawson, G., Kelly, J., Estes, A., & Jane Webb, S. (2017). Parent-delivered early intervention in infants at risk for ASD: Effects on electrophysiological and habituation measures of social attention. *Autism Research*, *10*(5), 961-972. doi:10.1002/aur.1754

Keen, D., Couzens, D., Muspratt, S., & Rodger, S. (2010). The effects of a parent-focused intervention for children with a recent diagnosis of autism spectrum disorder on parenting stress and competence. *Research in Autism Spectrum Disorders, 4*(2), 229-241. doi:10.1016/j.rasd.2009.09.009

Kelly, J., Zuckerman, T., Sandoval, D., & Buehlman, K. (2008). A curriculum for service providers to help parents and other caregivers meet young children's social and emotional needs. Seattle, WA: NCAST-AVENUW Publications.

Koegel, R. L., & Koegel, L. K. (2006). *Pivotal response treatments for autism.* Baltimore, MD: Paul H Brookes Publishing.

Lafasakis, M., & Sturmey, P. (2007). Training parent implementation of discrete-trial teaching: effects on generalization of parent teaching and child correct responding. *Journal of Applied Behavior Analysis*, *40*(4), 685-689. doi: 10.1901/jaba.2007.685–689

Lord, C., Rutter, M., DiLavore, P., & Risi, S. (1999). Autism diagnostic observation schedule: Manual. Los Angeles: Western Psychological Services.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*(1), 3-9.

Messinger, D. S., Young, G. S., Webb, S. J., Ozonoff, S., Bryson, S. E., Carter, A., & ... Zwaigenbaum, L. (2015). Early sex differences are not autism-specific: A baby siblings

research consortium (BSRC) study. *Molecular Autism*, *6*(1), 1-11. doi:10.1186/s13229-015-0027-y

National Autism Center (2009). *National Standards Report*. Randolph, Massachusetts: National Autism Center.

Ozonoff, S., Young, G., Carter, A., Messinger, D., Yirmiya, N., Zwaigenbaum, L., & ... Stone, W. (2011). Recurrence risk for Autism Spectrum Disorders: A baby siblings research consortium study. *Pediatrics*, *128*(3), 488-495.

Perry, A., Koudys, J., Prichard, A., & Ho, H. (2017). Follow-up study of youth who received EIBI as young children. *Behavior Modification*, *43*(2), 181–201. doi: 10.1177/0145445517746916

Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2012). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *The Cochrane Library*, *10*, 1-60. doi: 10.1002/14651858.CD009260.pub2.

Rogers, S. J., & Dawson, G. (2009). *Early Start Denver Model for Young Children with Autism: Promoting Language, Learning, and Engagement*. Guilford Publications.

Rogers, S., Vismara, L., Wagner, A., McCormick, C., Young, G., & Ozonoff, S. (2014). Autism treatment in the first year of life: A pilot study of infant start, a parent-implemented intervention for symptomatic infants. *Journal of Autism & Developmental Disorders*, *44*(12), 2981-2995. doi:10.1007/s10803-014-2202-y

Sacrey, L., Bryson, S., Zwaigenbaum, L., Brian, J., Smith, I. M., Roberts, W., & ... Garon, N. (2018). The Autism Parent Screen for Infants: Predicting risk of autism spectrum disorder based on parent-reported behavior observed at 6-24 months of age. *Autism: The International Journal of Research & Practice*, *22*(3), 322-334. doi:10.1177/1362361316675120

Sarokoff, R. A., & Sturmey, P. (2004). The effects of behavioral skills training on staff

    implementation of discrete-trial teaching. *Journal of Applied Behavior Analysis*, *37*, 535-538.

Scahill, L., Bearss, K., Lecavalier, L., Smith, T., Swiezy, N., Aman, M. G., & ... Johnson, C. (2016).

    Effect of parent training on adaptive behavior in children with autism spectrum disorder and

    disruptive behavior: Results of a randomized trial. *Journal of the American Academy of Child*

    and Adolescent Psychiatry, *55*(7), 602-609.

Schertz, H. H. (2005). Joint Attention Mediated Learning (JAML) manual. Unpublished manuscript.

Schertz, H. H., & Odom, S. L. (2007). Promoting Joint Attention in Toddlers with Autism: A Parent-

    Mediated Developmental Model. *Journal of Autism and Developmental Disorders*, *37*(8),

    1562–1575. doi: 10.1007/s10803-006-0290-z

Steiner, A. M., Gengoux, G. W., Klin, A., & Chawarska, K. (2013). Pivotal response treatment for

    infants at-risk for autism spectrum disorders: a pilot study. *Journal of Autism and*

    Developmental Disorders, *43*(1), 91-102. Doi: 10.1007/s10803-012-1542-8

Sundberg, M. L. & Partington, J. W. (1998). Teaching language to children with autism or other

    developmental disabilities. Pleasant Hill, CA: Behavior Analysts, Inc.

Szatmari, P., Chawarska, K., Dawson, G., Georgiades, S., Landa, R., Lord, C., . . . Halladay, A.

    (2016). Prospective longitudinal studies of infant siblings of children with autism: Lessons

    learned and future directions. *Journal of the American Academy of Child & Adolescent*

    Psychiatry, 55(3), 179-187. doi: 10.1016/j.jaac.2015.12.014

Vismara, L., Colombi, C., & Rogers, S. (2009). Can one hour per week of therapy lead to lasting

    changes in young children with autism? *Autism, 13*(1), 93-115.

    doi:10.1177/1362361307098516

Ward-Horner J., & Sturmey P. (2008). The effects of general-case training and behavioral skills training on the generalization of parents' use of discrete-trial teaching, child correct responses, and child maladaptive behavior. *Behavioral Interventions*, *23*(4), 271–284. doi: 10.1002/bin.268

Weiss, M. J. (2001). Expanding aba intervention in intensive programs for children with autism: The inclusion of natural environment training and fluency based instruction. *The Behavior Analyst Today*, *2*(3), 182-186.

Appendix A

Parent Teaching Skills Checklist – Parent Self-Monitoring

Brock | **Brock University**

Centre for Applied Disability Studies | Phone: (905)688-5550 ext. 5778
St. Catharines, Ontario, Canada L2S 3A1 | Fax: (905)378-5719

Date: _____   **Parent Name:** _____

Child Target Skill: _____

Scoring: Mark as follows: √   skill observed
X   skill not observed and
NA   not applicable

	Parent Teaching Skills Checklist	**Score**
1	I have sets up the environment for success (e.g. distractions minimized, television/computer off, toys put away)	
2	I have created natural opportunities for my child to exhibit the target skill (e.g. preferred activity the child enjoys doing with others)	
3	I gained my child's attention before asking them to perform the target skill (e.g. child looks the parent, child responds to previous interaction).	
4	I provided my child with clear instructions, or natural cues, when required	
5	I utilized an appropriate prompt when necessary (e.g. least amount of prompting to produce the correct holding up an object)	
6	I provided my child with natural reinforcement for correct responses (e.g. praise, item the child wants)	
7	I utilized an error correction strategy for incorrect, or no response (e.g. gentle physical guidance)	
8	I waited 5-10 seconds before giving my child the next instruction	
9	I gradually reduced the use of prompts over trials, and/or introduced a time delay between instruction/cue & prompts	

10	I varied the cues and prompts that I gave my child, when they either didn't respond, or gave the wrong answer	
	TOTAL TEACHING SKILLS OBSERVED	
	PERCENT OF TEACHING SKILLS OBSERVED	

This study has been reviewed and received ethics clearance through Brock University's Research Ethics Board (file # 18-050-FELDMAN)

Appendix B

Brock University

Consumer Satisfaction Questionnaire

Date: _____   **Parent Name:** _____

_____

Child Name: _____   **Child DOB:** _____

1. How satisfied were you with the overall parent-training program provided to you and your family?
   [   ]   Extremely satisfied
   [   ]   Somewhat satisfied
   [   ]   A little satisfied
   [   ]   Neither satisfied, nor dissatisfied
   [   ]   A little dissatisfied
   [   ]   Somewhat dissatisfied
   [   ]   Extremely dissatisfied

2. How much do you feel you have learned from your participation in this parent training program?
   [   ]   I have learned a **great deal** from participating in this parent training program
   [   ]   I have learned a **moderate amount** from participating in this parent training program
   [   ]   I have learned a **small amount** from participating in this parent training program
   [   ]   I have **not** learned anything from my participation in this parent training program

3. How much do you feel your child has benefitted from your participation in this parent-training program?
   [   ]   My child has benefitted a **great deal** from participation in this training program
   [   ]   My child has benefitted a **moderate amount** from participation in this training program
   [   ]   My child has benefitted a **small amount** from participation in this training program
   [   ]   My child has **not** benefitted from participation in this training program

4. How satisfied were you with the Parent Observation Checklist (POC) Curriculum Tip Sheets?

   [   ] Extremely satisfied
   [   ] Somewhat satisfied
   [   ] A little satisfied
   [   ] Neither satisfied, nor dissatisfied
   [   ] A little dissatisfied
   [   ] Somewhat dissatisfied
   [   ] Extremely dissatisfied

5. How satisfied were you with the "hands-on" full training provided by the researcher in this parent-training program?

   [   ] Extremely satisfied
   [   ] Somewhat satisfied
   [   ] A little satisfied
   [   ] Neither satisfied, nor dissatisfied
   [   ] A little dissatisfied
   [   ] Somewhat dissatisfied
   [   ] Extremely dissatisfied

6. How likely are you to recommend use of the Parent Observation Checklist (POC) Tip Sheets to other parents?

   [   ] Extremely likely
   [   ] Somewhat likely
   [   ] Only a little likely
   [   ] Not likely at all to recommend use of the Parent Observation Checklist (POC) tip sheets

7. How likely are you to recommend use of the "hands on" full training provided by the researcher in this parent-training program, to other parents?

   [   ] Extremely likely
   [   ] Somewhat likely
   [   ] Only a little likely
   [   ] Not likely at all to recommend use of the "hands on" full training, to other parents

8. Was the researcher responsive to your questions, considerate of your time, respectful and professional, to you and your family?

	Yes	No
Responsive to your questions		
Considerate of your time		
Respectful to you and your family		
Professional to you and your family		

9. Please identify any areas you feel should have been included/addressed within this parent training program, but were excluded

_____

_____
_____   _____
_____
_____   _____

Thank you for participating in this parent training program ☺

This study has been reviewed and received ethics clearance through Brock University's Research Ethics Board (file # 18-050-FELDMAN)

Appendix C

Treatment Checklist

Date:

Target Skill:

Parent Name:

Instructor Name:

Observer:

PROCEDURAL STEPS FOR INITIAL TREATMENT SESSION	Completed Correctly?		Not Applicable?
1. The researchers conducted probes on parent and child behaviors	Y	N	
2. The instructor orally reviews the written instructions of the teaching strategies with the parent (and has given the parents a copy).	Y	N	
3. The instructor physically and verbally models the teaching strategies with the child, and videotapes the trial.	Y	N	
4. The instructor reviews the videotaped trial with the parents. If possible, leave the video file with the parents.	Y	N	
5. The instructor prompts the parent to rehearse the same teaching strategies with the instructor through role playing.	Y	N	
6. The instructor continues to prompt the parent to rehearse the teaching strategies until the second researcher confirms that the parent has met the rehearsal mastery criterion (80% correct on the PTSC three times in a row). The second researcher will be scoring the checklist as the parent is rehearsing with the other researcher.	Y	N	
7. The instructor prompts the parent to practice the teaching strategies for the target skill with their infant.	Y	N	
8. The instructor provides immediate feedback following each trial when appropriate.	Y	N	
9. The instructor discusses with the parent on how to teach the skill incidentally, throughout the day.	Y	N	
10. After the parent training session, the researchers end the visit with a video probe of child skill and a separate probe of parent teaching child skill – no parent training.	Y	N	
% of Steps Followed Correctly			

Appendix C (continued)

BOOSTER TRAINING		
Step	**Completed Correctly?**	**Not Applicable?**
IN THE CASE THAT THE PARENT FELL BELOW THE 80% MASTERY CRITERION IN FOLLOW-UP	Y N	
1. Ask the parent to teach the specific skills that they were previously trained on to the child, while the researchers make notes of the teaching on the parent self-monitoring checklist (videotaped).	Y N	
2. With the parent, review the taped video of the parent teaching the skills. Discuss the strengths and areas for improvement in accordance with the parent self-monitoring checklist.	Y N	
3. The parent will rehearse the teaching protocol with the researcher.	Y N	
4. The parent will meet a rehearsal criterion of 90% or higher, for three trials in a row (scored by the researchers).	Y N	
5. Parents will practice the teaching protocol with their infant, and will be given immediate feedback.	Y N	
6. One episode of the parent teaching while following the correct teaching protocol will be videotaped and given to the parents if possible (by transferring the video from the SD card to their computer).	Y N	
7. Parents will be asked to post the parent self-monitoring checklist on the fridge and refer to it when teaching during natural routines.	Y N	
For the next session, researchers will observe parent teaching skills and not train the parent.		

Appendix D

Parenting Sense of Competence Scale (Gibaud-Wallston & Wandersman, 1978)

Please rate the extent to which you agree or disagree with each of the following statements.

Strongly Disagree	Somewhat Disagree	Disagree	Agree	Somewhat Agree	Strongly Agree
1	2	3	4	5	6

1. The problems of taking care of a child are easy to solve once you know how your actions affect your child, an understanding I have acquired.   1 2 3 4 5 6

2. Even though being a parent could be rewarding, I am frustrated now while my child is at his / her present age.   1 2 3 4 5 6

3. I go to bed the same way I wake up in the morning, feeling I have not accomplished a whole lot.   1 2 3 4 5 6

4. I do not know why it is, but sometimes when I'm supposed to be in control, I feel more like the one being manipulated.   1 2 3 4 5 6

5. My mother was better prepared to be a good mother than I am.   1 2 3 4 5 6

6. I would make a fine model for a new mother to follow in order to learn what she would need to know in order to be a good parent.   1 2 3 4 5 6

7. Being a parent is manageable, and any problems are easily solved.   1 2 3 4 5 6

8. A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one.   1 2 3 4 5 6

9. Sometimes I feel like I'm not getting anything done.   1 2 3 4 5 6

10. I meet by own personal expectations for expertise in caring for my child.

   1 2 3 4 5 6

11. If anyone can find the answer to what is troubling my child, I am the one.

   1 2 3 4 5 6

12. My talents and interests are in other areas, not being a parent.   1 2 3 4 5 6

13. Considering how long I've been a mother, I feel thoroughly familiar with this role.

   1 2 3 4 5 6

14. If being a mother of a child were only more interesting, I would be motivated to do a better job as a parent.   1 2 3 4 5 6

15. I honestly believe I have all the skills necessary to be a good mother to my child.

   1 2 3 4 5 6

16. Being a parent makes me tense and anxious.   1 2 3 4 5 6

17. Being a good mother is a reward in itself.   1 2 3 4 5 6