UNIVERSITY OF CALIFORNIA

Santa Barbara

Pilot RCT of an Online Pivotal Response Treatment Training Program for Parents of Toddlers with Autism Spectrum Disorder

A dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy in Counseling, Clinical, and School Psychology

by

Elizabeth Greenfield

Committee in charge:

Professor Ty Vernon, Chair

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September 2020

The dissertation of Elizabeth Greenfield is approved.

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August 2020

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Curriculum Vitae of Elizabeth S. Greenfield
AUGUST 2020

EDUCATION

University of California, Santa Barbara, Santa Barbara, CA
Doctoral Candidate in Counseling, Clinical and School Psychology (Clinical Emphasis)
Dissertation: Pilot RCT of an Online PRT Training Program for Parents of Toddlers with Autism Spectrum Disorder

Tufts University, Medford, MA
Bachelor of Science, *May 2013*
Summa Cum Laude, GPA: 3.87
Double Major: Psychology and Child Development

CLINICAL EXPERIENCE

Doctoral Intern: Chapel Hill TEACCH Center
University of North Carolina, Chapel Hill
August 2019-Present

- Primary rotation as part of the UNC School of Medicine Clinical Psychology Internship
- Administered standardized assessments as part of a comprehensive diagnostic evaluation for ASD.
- Provided feedback to families and compiled detailed integrated reports.
- Utilized TEACCH strategies to promote social, behavioral, and daily living skills for individuals with ASD across the lifespan.
- Led Facing Your Fears cognitive behavior therapy groups for school-aged children with ASD and comorbid anxiety.
- Led Dialectical Behavior Therapy groups for adults with ASD to promote emotion regulation, distress tolerance and interpersonal effectiveness.
- Supervisor: Mary Van Bourgondien, PhD

Doctoral Intern: UNC Center for Rehabilitation Care
University of North Carolina, Chapel Hill
August 2019-Present

- Minor rotation as part of the UNC School of Medicine Clinical Psychology Internship
- Administered neuropsychological testing to children with behavioral concerns or medical conditions, including leukemia, cystic fibrosis, spina bifida, epilepsy, and traumatic brain injury.
- Provided consultation for parents regarding strategies to promote academic and behavioral success for children with developmental delays.
- Supervisor: Peter Duquette, PhD

Senior Clinician
Assessment Clinic, Koegel Autism Center, Santa Barbara, CA
August 2016-July 2019

- Administered standardized assessments as part of a comprehensive diagnostic evaluation.
- Assisted with differential diagnosis for children and adults with ASD, ADHD, anxiety, and related disorders.
- Led feedback sessions for families and compiled integrated reports.
- Supervisor: Ty Vernon, PhD

Senior Clinician
Treatment Clinic, Koegel Autism Center, Santa Barbara, CA
August 2016-July 2019

- As a parent educator, coached parents to implement socially-embedded Pivotal Response Treatment to improve social engagement and communication for their child with ASD.
- Emphasized positive behavior principles within a naturalistic play context.
- Coordinated a group-based social skills intervention program for adolescents and young adults.
- Developed and presented community workshops to train preschool teachers and other community providers to screen for early signs of ASD.
- Supervisors: Ty Vernon, PhD, Anna Krasno, PhD

Senior Clinician
Department of Rehabilitation: Personal, Vocational, Social and Adjustment Services Program, Koegel Autism Center, Santa Barbara, CA
September 2017-July 2019

- Served as a clinician in cooperation with the California State Department of Rehabilitation (DOR) to mitigate barriers to success in higher education and employment settings for adults with ASD.
- Supported adults with ASD to develop pre-vocational skills including: social communication, organization, time management, and daily living skills.
- Supervised undergraduate peer mentors to encourage generalization of skills in real-world settings.
- Supervisor: Anna Krasno, PhD

Parent-Child Interaction Therapy (PCIT) Therapist
UCSB PCIT Clinic, Santa Barbara, CA
June 2018-July 2019

- Served as a PCIT therapist for children ages 2 to 7 with challenging behaviors.
- Taught parents and caregivers how to enhance their relationship with their child, increase positive behaviors, and reduce problem behaviors in home, school, and public places.
- Provided parent coaching in behavior management strategies via a one-way mirror and blue tooth earpiece.
- Received 2 hours of group supervision per week from a licensed clinical psychologist.
- Supervisor: Miya Barnett, PhD

Psychological Assistant
Child Abuse Listening and Mediation (CALM), Santa Barbara, CA
August 2017-August 2018

- Served as a psychological assistant for the Great Beginnings program, supporting families and caregivers with children ages 0-5 at risk for abuse and neglect.
- Facilitated a support group for children ages 8-10 who have witnessed domestic violence. Utilized a Trauma Focused Cognitive Behavioral Therapy (TF-CBT) model.
- Received 2 hours of group supervision and 1 hour of individual supervision per week from a licensed clinical psychologist.
- Supervisor: Rachel Hopsicker, PhD

Clinician
Hosford Clinic Advanced Practicum, Santa Barbara, CA
September 2016-August 2017

- Utilized a cognitive behavioral approach for children ages 12-14 experiencing depression, anxiety, ADHD and selective mutism.
- Conducted intake interviews for potential clients and developed case presentations.
- Received 3 weekly group supervision hours from a licensed clinical psychologist.
- Supervisor: Ronald Brooks, PhD

Clinician
Hosford Clinic Basic Practicum, Santa Barbara, CA
September 2015-May 2016

- Received weekly instruction in theoretical foundations and basic helping skills.
- Utilized basic helping skills in a peer context with supervision from graduate-level clinicians and a licensed clinical psychologist.
- Supervisor: Andres Consoli, PhD

ASSESSMENT TRAINING

- Autism Diagnostic Observation Schedule, all modules (Clinical Certification)
- Autism Diagnostic Interview- Revised
- Beery-Buktenica Developmental Test of Visual-Motor Integration, Sixth Edition
- Child and Adolescent Memory Profile
- Clinical Evaluation of Language Fundamentals, Fifth Edition
- Communication and Symbolic Behavior Scales
- Delis-Kaplan Executive Function System
- Differential Abilities Scale, Second Edition
- Expressive Vocabulary Test, Second Edition
- Kaufman Brief Intelligence Test, Second Edition
- Mullen Scales of Early Learning

- Peabody Picture Vocabulary Test, Fourth Edition
- Preschool Language Scales, 5th Edition
- Thematic Apperception Test
- Vineland Adaptive Behavior Scales, Third Edition, Comprehensive Interview Form
- Wechsler Adult Intelligence Scale, Fourth Edition
- Wechsler Intelligence Scale for Children, Fifth Edition
- Woodcock-Johnson Tests of Cognitive Abilities, Fourth Edition

RESEARCH EXPERIENCE

Dissertation
Pilot RCT of an online PRT training program for parents of toddlers with autism spectrum disorder.
University of California, Santa Barbara
August 2017-Present

- Developed and implemented a 6-week online course to train parents of toddlers with ASD in Pivotal Response Treatment.
- Collected and analyzed data related to improvements in parent fidelity of implementation and child behaviors.
- Presented preliminary findings at the UCSB Annual Research Festival in November 2017 to fulfill the requirements for Master of Arts in Counseling Psychology.
- Dissertation defense scheduled for spring 2020.
- Supervisor: Ty Vernon, PhD

Co-Investigator/Graduate Student Researcher (Funding Agency: Department of Defense)
Clinicianless training in autism treatment: An adaptive online parent education program.
University of California, Santa Barbara
December 2019-Present

- Served as co-investigator on a research grant that was recently funded by the Department of Defense Autism Research Program (ARP) Clinical Translational Research Award.
- Expanded on preliminary findings from the online PRT program by incorporating course material into a comprehensive phone application.
- Investigated the benefits of encouraging parents to monitor their own treatment fidelity.
- Supervisor: Ty Vernon, PhD

Co-Investigator/Graduate Student Researcher (Funding Agency: Organization for Autism Research)
A peer-facilitated, multi-component social skills group intervention for adolescents with ASD.
Social Tools And Rules for Transitions (START): A young adult social intervention package.
University of California, Santa Barbara
September 2015-July 2019

- Assisted with two grant-funded studies of the START (Social Tools and Rules for Teens/Transitions) social skills programs for adolescents and young adults with ASD.

- Implemented a research project examining experiential and didactic strategies to improve social motivation and social competence within a group social club format.
- Trained and supervised undergraduate research assistants to serve as peer mentors for adolescents and young adults with ASD.
- Supervisor: Ty Vernon, PhD

Co-Investigator/Graduate Student Researcher

Rewarding engagement and adaptive communication in childhood (REACCH): An infant-toddler playgroup to support early social development.

University of California, Santa Barbara

September 2017- July 2019

- Facilitated a research study of a parent-child playgroup to promote social engagement in infants and toddlers at-risk for ASD.
- Distributed screening measures to the local community to identify young children who may be at-risk.
- Developed a group-based curriculum to train parents in motivating, play-based intervention strategies to promote gestures, eye contact, positive facial expressions, and vocalizations.
- Supervisor: Ty Vernon, PhD, Anna Krasno, PhD

Co-Investigator/Graduate Student Researcher (Funding Agency: Cottage Hospital Research Institute)

Parent-child bio-behavioral synchrony in autism.

University of California, Santa Barbara

August 2018-July 2019

- Facilitated a grant-funded research study examining how ASD affects the ability of parents and children to be in sync with one another both behaviorally and physiologically.
- Utilized biosensors to obtain biobehavioral data from parent-child dyads engaged in play interactions.
- Collected data to examine the relationship between baseline bio-behavioral synchrony in parent-child dyads and developmental outcomes.
- Supervisor: Ty Vernon, PhD

Co-Investigator/Graduate Student Researcher (Funding Agency: Autism Speaks)

The use of eye-tracking as an outcome measure for an innovative early social intervention for ASD.

University of California, Santa Barbara

August 2015-August 2017

- Assisted with a grant-funded research study examining the use of eye-tracking as an outcome measure for a social engagement intervention for toddlers with ASD.
- Trained and supervised undergraduate students to serve as clinicians.
- Supervisor: Ty Vernon, PhD

Research Coordinator

Marcus Autism Center, Emory University, Children's Healthcare of Atlanta
June 2013-May 2015

- Assisted with an NIH-funded longitudinal eye-tracking study of infants at risk for ASD, including consenting parents, preparing and recording assessments, and managing all paperwork.
- As Data Manager, queried data on a monthly basis and attended monthly audit meetings.
- Represented all Research Coordinators as a member of the Marcus Research Informatics Core committee. Assisted with modeling data entry forms, entering data, and training Research Assistants.
- Collaborated with Dr. John Constantino and his research team at Washington University in St. Louis to analyze early quantitative characterization data of reciprocal social behavior in infant twin pairs.
- Utilized eye tracking data and MATLAB to create salience maps of attention to eyes, mouth, body, and objects.
- Supervisor: Celine Saulnier, PhD

Senior Honors Thesis
Department of Child Development, Tufts University
August 2012-May 2013

- Conducted research examining the parent-pediatrician relationship among parents of children with autism who choose to use complementary and alternative medicine (CAM).
- Recruited online survey participants, completed data collection, entry, and analysis.
- Completed thesis defense in May 2013; awarded the title of *Thesis with Honors.*
- Supervisor: Martha Pott, PhD

Research Volunteer
Harvard Weisz Laboratory for Youth Mental Health: Judge Baker Children's Center, Boston, MA,
September 2012-May 2013

- Assisted with data entry, literature searches, and basic analyses for a study examining the effectiveness and feasibility of the Modular Approach to Therapy for Children with Anxiety, Depression, Trauma, or Conduct Problems (MATCH-ADTC).
- Organized assessment materials, scored and prepared assessments for clinician review.
- Attended weekly research meetings alongside clinicians and research coordinators. Received training in various topics of child psychology.
- Supervisor: Elana Weil

Research Intern
Children's Hospital of Philadelphia: Center for Autism Research, Philadelphia, PA
May 2011 -August 2011

- Assisted with mock MRI scans, eye tracking tasks, and a computerized test of facial expression discrimination.
- Wrote blog posts summarizing current research projects.
- Observed clinical assessments and attended diagnostic meetings.

- Assisted with data entry.
- Supervisor: Tiffany Ryan, MS

PUBLICATIONS

- Barrett, A., Vernon, T., McGarry, E., Holden, A., Bradshaw, J., Ko, J., Horowitz, E., German, T. (In Press). Social responsiveness and language use associated with an enhanced PRT approach for young children with ASD: Results from a pilot RCT of the PRISM model. *Research in Autism Spectrum Disorders*.

- McGarry, E., Vernon, T.W., Baktha, A. (2019). Brief report: A pilot online pivotal response treatment training program for parents of toddlers with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 1-8.*

- Vernon, T.W., Holden, A., Barrett, A., Bradshaw, J., Ko, J.A., McGarry, E., Horowitz, E. Tagavi, D., German, T. (2019). A pilot randomized clinical trial of an enhanced pivotal response treatment approach for young children with autism: The PRISM model. *Journal of Autism and Developmental Disorders, 49, 2358-2373.*

- Vernon, T.W., Miller, A. R., Ko, J.A., Barrett, A., & McGarry, E. (2019). Social Tools And Rules for Teens (START) Program. In F. Volkmar (Ed), *The Encyclopedia of Autism Spectrum Disorders*. New York: Springer.

- Vernon, T.W., Miller, A., Ko, J.A. Barrett, A., McGarry, E. (2018). A randomized controlled trial of the Social Tools And Rules for Teens (START) Program: An immersive socialization intervention for adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 48*, 892-904.

PRESENTATIONS

- Brane, N., Lewis, M., McGarry, E., Fiorello, K., Gillespie, S. E., & Wetherby, A. (2015). Measuring restricted interests and repetitive behaviors in infant siblings at-Risk for ASD: Comparing home setting versus clinic performance of 12-Month-Olds. Presented at the International Meeting for Autism Research, Salt Lake City, Utah.

- Cohen, S., Vernon, T., Ko, J., Miller, A., Barrett, A., McGarry, E. (2018). Impacting real world social outcomes: An examination of changes in social engagement and friendships associated with START program participation. Presented at the International Society for Autism Research Annual Meeting, Rotterdam, Netherlands.

- Ferguson, E.F., Ko, J.A., McGarry, E. Cohen, S.J., Miller, A.R., Vernon, T. (2019). Emotion regulation and empathy in an adult social skills intervention. Presented at the International Society for Autism Research Annual Meeting, Montreal, Canada.

- Klaiman, C., Caravella, K., McGarry, E., Lense, M. (2014). Profiles of developmental level, adaptive skills, and diagnostic symptoms in late preterm, early term, and full-term toddlers with autism. Presented at the International Meeting for Autism Research, Atlanta, Georgia.

- Klaiman, C., Saulnier, C., McGarry, E., Lense, M. (2015). Profiles of developmental level, adaptive skills, and diagnostic symptoms in late preterm, early term, and full-term toddlers with autism. Presented at the Biennial Meeting of the Society for Research in Child Development, Philadelphia, Pennsylvania.

- Ko, J., Miller, A., Chiu, A., Allison, M., Graef, R., Said, S., Rathore, A., Rincon, R., Barrett, A., McGarry, E., Vernon T. (2019). Improving the social interactions and peer perceptions of adolescents with ASD: Results from a randomized clinical trial of the START socialization program. Presented at the International Society for Autism Research Annual Meeting, Montreal, Canada.

- Ko, J., Miller, A., Vernon, T., Chiu, A., Allison, M., Graef, R., Prado, E., Barrett, A., McGarry, E. (2018). Gender differences among the social conversational profiles of adolescents with ASD participating in the START socialization program clinical trial. Presented at the International Society for Autism Research Annual Meeting, Rotterdam, Netherlands.

- McGarry, E. (2014). Innovations in Early Screening for Autism Spectrum Disorders. Presented at the Atlanta Science Festival, Atlanta, Georgia.

- McGarry, E., Fiorello, K., Heldenberg, S., Reifler, A., Klaiman, C., Saulnier, C., Lewis, M. (2014). Language comprehension predicts later cognitive ability and symptom severity in toddlers with ASD. Presented at the American Speech Language Hearing Association Convention, Orlando, Florida.

- McGarry, E., Hughart, L., Barrett, A., Navab, A., Bradshaw, J., Horowitz, E., German, T., Vernon, T. (2017). Using engaging social interactions within a pivotal response treatment framework to improve adaptive communication skills and autism symptom severity in toddlers with ASD: Evidence from a randomized controlled trial. Presented at the International Meeting for Autism Research, San Francisco, CA.

- McGarry, E., Baktha, A., Tharakan, A., Vernon, T. (2018). An online pivotal response treatment intervention for toddlers with autism spectrum disorder. Presented at the Association for Behavior Analysis International Annual Autism Conference, Miami, Florida.

- McGarry, E., Baktha, A., Tharakan, A., Vernon, T. (2018). Overcoming barriers to mass dissemination: A pilot online pivotal response treatment training program for parents of toddlers with autism spectrum disorder. Presented at the International Society for Autism Research Annual Meeting, Rotterdam, Netherlands.

- McGarry, E. (2018). Know the signs: Autism in early childhood. Lecture presented to the Santa Barbara City College Early Childhood Education program.

- McGarry, E., Tagavi, D. (2018). Development of ASD in Infancy and Toddlerhood. Lecture presented to ED 190: Introduction to Autism. Counseling, Clinical and School Psychology Department, University of California, Santa Barbara.

- McGarry, E., Baktha, A., Vernon, T. (2019). Randomized Clinical Trial of an Online Pivotal Response Treatment Training Program: Parent and Child Outcomes. Presented at the International Society for Autism Research Annual Meeting, Montreal, Canada.

- Vernon, T., Barrett, A., Navab, A., Ko, J., McGarry, E., Bradshaw, J., Gong, J., Horowitz, E., German, T. (2018). Pivotal Response Treatment 2.0: Development and evaluation of an enhanced model to target social motivation and engagement using microanalytic and RCT methodologies. Presented at the International Society for Autism Research Annual Meeting, Rotterdam, Netherlands.

- Vernon, T., Ko, J., McGarry, E., Chiu, A., Graef, R., Prado, E., Torres, C., Chuor, K., Said, S., Littleton, J., Huerta, A. (2018). Improving social motivation, competency, and empathy in young adults with ASD: Results from a RCT of the START adult program. Presented at the International Society for Autism Research Annual Meeting, Rotterdam, Netherlands.

- Vernon, T., Miller, A., Ko, J., Barrett, A., & McGarry, E. (2016). Social Tools and Rules for Teens (The START Program): Results of a randomized controlled trial of an experiential/didactic socialization program for adolescents with ASD. Presented at the International Meeting for Autism Research, Baltimore, Maryland.

- Voos, A. C., Vernon, T., Navab, A., McGarry, E. (2016). Mindful parenting: A new approach to supporting parents of children with autism spectrum disorder. Presented at the International Meeting for Autism Research, Baltimore, Maryland.

TEACHING EXPERIENCE

Teaching Assistant
University of California, Santa Barbara
December 2018-March 2019

- Served as a Teaching Assistant for the following courses: CNCSP 110: Introduction to Educational and Vocational Guidance (Winter 2018); ED 190: Introduction to Autism (Spring 2018); CNCSP 101: Introduction to Helping Skills- Theory, Research and Practice (Winter 2019).
- Developed and presented lectures.
- Held weekly sections to support students' active engagement with course content.
- Met with students individually during office hours to respond to questions and clarify course material.

ABSTRACT

Pilot RCT of an Online Pivotal Response Treatment Training Program for Parents of Toddlers with Autism Spectrum Disorder

by

Elizabeth Greenfield

Despite advances in early interventions for autism spectrum disorder (ASD), disparities in access to contemporary evidence-based treatments remain a serious concern. Numerous barriers, including delays in translating research to community practice, cost of services, extensive time commitments, and geographical distance to trained providers limit the ability for families to take advantage of the latest scientifically based autism interventions. To address this, recent studies have begun to explore parent-implemented interventions via an online or telehealth format. These approaches are particularly beneficial as they improve access to training for families, can fit into busy family schedules, and lower the cost of treatment. The current project examined the feasibility, utility, and preliminary efficacy of a newly developed online course designed to help parents implement an evidence-based naturalistic developmental behavioral intervention, Pivotal Response Treatment (PRT), for their young children with ASD. The new program was examined using a randomized waitlist control trial design. Parents submitted weekly videos capturing their use of treatment strategies, which were coded for PRT fidelity of implementation (FOI) and child social communication behaviors. Results indicate that parent PRT fidelity significantly improved from pre- to post-treatment for those in the immediate treatment condition. Changes in child social communication behaviors were not statistically significant. However, there was a

strong trend toward improvements in eye contact following course completion. Qualitative feedback from parents also indicated a high level of satisfaction with the program. Results are discussed in terms of implications for the continued use of online intervention programs for parents of children with ASD.

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Chapter 1: Introduction

The development of new evidence-based approaches to mental health treatment is an essential goal of psychological research. Unfortunately, the road from research to clinical practice is a long and complex process; many well-intended treatments never make it into the hands of those who need them the most. New interventions must move through several phases of development before they are ready to be implemented in real world contexts (Gitlin, 2013). Even when an intervention has reached the final stages of research, barriers to mass dissemination often hinder access to treatment. As a result of this research to practice gap, researchers have begun to focus on adapting existing treatments so that they may be easily delivered on a larger scale, resulting in a sustainable community impact. Recent funding trends reflect this need to balance discovery with dissemination and implementation; this new emphasis has generated a major shift across the field of psychology (Glasgow, Vinson, Chambers, Khoury, Kaplan, & Hunter, 2012).

Research on autism spectrum disorder (ASD) is a prime example of a field that has witnessed an influx of new intervention approaches. Across a 10-year period, 40 randomized control trials were published involving treatments for young children with or at-risk for ASD, consisting of 32 different intervention models (French & Kennedy, 2017). Although these advances in evidence-based intervention for ASD are promising, recent studies suggest that this progress has not successfully translated to community practice. One study by McIntyre and Barton (2010) found that fewer than 20% of children with ASD were receiving evidence-based behavioral interventions. However, the study did find high rates of complementary and alternative medical (CAM) treatments. Many CAM treatments not only lack empirical support, but also carry significant risks and have the potential to cause harm. These findings

suggest that despite the high volume of ASD interventions, families are not consistently receiving treatments that are scientifically based. This supports the need to shift the focus of ASD research toward issues of dissemination science.

There are many barriers that may prevent families from accessing empirically supported autism interventions. The high cost and extensive time commitment required for most treatments proves prohibitive for many (Johnson & Hastings, 2002.) Additionally, those living in rural or low-income areas are often unable to access trained providers (Antezana, Scarpa, Valdespino, Albright & Richey, 2017; Mello, Urbano, Goldman & Hodapp, 2016.) These barriers have resulted in an increased interest in the use of parent-implemented teletherapy programs as methods of treatment dissemination. These methods increase access to treatment by using remote instruction to empower parents with the tools to support their child's development. Although online service methods are not intended to replace face-to-face intervention, they can be a valuable alternative when these treatments would be otherwise unavailable (Ritterband et al., 2003).

In recent years, numerous evidence-based ASD treatments have been translated into teletherapy intervention programs. These programs target a variety of developmental areas, including reducing problem behaviors (Bearss et al., 2017; Lindgren et al., 2016; Wacker et al., 2012), and promoting social communication skills (Vismara et al., 2013; Wainer & Ingersoll, 2013). Although research on these programs is still emerging, preliminary evidence supports their effectiveness for both parent and child outcomes (Parsons et al., 2017). However, due to methodological limitations of current studies, including limited sample sizes and a lack of standardized measures, more research is needed to better understand the impact of online treatment models.

Pivotal Response Treatment (PRT) is an example of an evidence-based intervention for ASD that was recently translated into an online format. PRT is a naturalistic developmental behavioral intervention (NDBI) that uses behavioral strategies within the child's natural environment. This approach targets pivotal areas of development, such as a child's social motivation, to support widespread gains across a number of developmental areas (Koegel et al., 1987). McGarry, Vernon, and Baktha (2019) published a pilot study examining the benefits of a new online PRT program for parents of toddlers with ASD. The study examined outcomes for 11 families who completed the course. Families were required to submit weekly videos demonstrating their use of treatment strategies which were coded for child communicative behaviors and parent treatment fidelity. Results of this study indicated significant improvements in treatment fidelity from pre- to post-treatment: 90% of parents met fidelity of implementation following course completion. Additionally, child participants showed significantly increased rates of social engagement, as measured by vocalizations, eye contact, and positive facial expressions.

Despite these promising findings, this pilot study presented with several limitations. Most notably, the small sample size and lack of control group limit the interpretation of these results. Additionally, outcome measures were restricted to behavioral coding and did not include standardized measures of autism symptoms or communication skills. The present study built on these initial findings by examining the benefits of the online PRT program using a randomized waitlist control trial design. This study further examined whether parents can learn PRT strategies via the online training program and effectively implement these strategies at home with their child. Parents received weekly modules consisting of presentation slides, video examples, and brief multiple-choice quizzes. They were also asked

to submit weekly videos capturing their use of treatment strategies, which were coded for PRT fidelity of implementation (FOI) and social communication behaviors. Social validity measures were obtained to determine whether this form of intervention is acceptable to parents. Analysis involved a number of measures related to program feasibility, including: social validity measures intended to assess parents' perceptions of the program and confidence in their therapeutic skills; quantitative data related to rates of program completion; and weekly video probes scored for parent PRT implementation and child communicative improvements. Standardized assessment measures were also collected pre-treatment and 3 month's post-treatment to assess preliminary treatment efficacy.

Chapter 2: Review of the Literature

Evidence-Based Practice for ASD

Qualities of Evidence-Based Practice. As the quantity of ASD intervention research continues to rapidly proliferate, concerns have arisen over the quality of proposed interventions. Schertz, Baker, Hurwitz, and Benner (2011) identified four critical principles for ASD early intervention for toddlers. These principles were drawn from the Individuals with Disabilities Education Improvement Act of 2004 (IDEIA), as well as practice recommendations from the Division for Early Childhood of the Council for Exceptional Children (DEC), and the National Association for the Education of Young Children (NAYEC). The authors proposed that evidence-based early interventions should include the following: family-centered practice, a natural environment, active learning, and functional and systematic practices that consider developmental readiness and unique variations in

learning. The principle of family-centered practice dictates a developmental approach and emphasizes parent and family involvement. The principle of a natural environment indicates that treatment should be implemented as part of the child's daily routines, within their home and community settings. Active learning involves promoting the child's motivation through the use of scaffolding, ensuring ample opportunities for success through practice. Finally, the fourth principle, functional and systemic practices, calls for interventions that are individualized to a particular child and focused on meaningful, data-based outcomes. Taken together, these guidelines can help inform approaches to ASD intervention.

In 2015, a diverse group of autism researchers collaborated with a similar goal in mind: to characterize the key components of evidence based ASD interventions. Specifically, Schreibman and colleagues published a consensus statement regarding interventions that integrate developmental and behavioral principles (Schreibman et al., 2015). The authors recognized that although evidence based ASD interventions may go by different names, many share key features that contribute to their effectiveness. These treatments, known as Naturalistic Developmental Behavioral Interventions (NDBI's) utilize behavioral principles within the child's natural environment to promote a number of developmental domains. They also share many key treatment strategies, including using natural reinforcers and shared control over materials. Although NDBI's have garnered extensive empirical support, Schreibman and colleagues express concern that new and innovative methods are needed in order to deliver these interventions to community settings.

Pivotal Response Treatment. Pivotal Response Treatment (PRT) represents one example of an NDBI that has received extensive empirical support. Rather than focus on specific skills, PRT targets pivotal areas of development, such as a child's motivation, to

improve skills across a wide range of areas (Koegel et al., 1987). Consistent with the principles described by Schertz and colleagues, PRT incorporates parent involvement, utilizes the child's natural environment, and promotes motivation by using child-selected activities, rewarding child attempts, and interspersing maintenance and acquisition tasks. PRT can also be individualized for a particular child's needs and has been associated with a number of meaningful outcomes. Research indicates that participation in PRT leads to a reduction in core ASD symptoms, as well as improvements in verbal communication and overall social engagement (Bradshaw, Koegel, Koegel, 2017; Koegel, Vernon, Koegel, 2009; Vernon, Koegel, Dauterman & Stolen, 2012).

Additionally, extensive research indicates that parents are able to successfully learn and implement PRT at home with their child (Bradshaw, Koegel, Koegel, 2017; Coolican, Smith & Bryson, 2010; Gengoux et al., 2015; Hardan, et al., 2014; Koegel, Symon, & Koegel, 2002; Vernon, Koegel, Dauterman, & Stolen, 2012). For example, one study by Bradshaw and colleagues (2017) assessed the efficacy of a brief parent training program for toddlers with ASD ages 15 to 21 months. The study utilized a multiple baseline design across three toddlers. Treatment involved training parents in PRT strategies through a combination of clinician modeling and parent practice with feedback. Parents participated in weekly 1-hour sessions over the course of 12 weeks. All 3 parents showed significant improvements in PRT treatment fidelity following treatment. Furthermore, all 3 toddlers showed significant gains in verbal communication skills.

Similar results have been achieved when parents are taught PRT strategies in a group format. Hardan and colleagues (2014) evaluated the impact of a 12-week parent education program to train parents to implement PRT for their child with ASD. Participants included 53

children with ASD ages 2 to 6 years. Participants were randomly assigned to a PRT group parent training group or a general ASD psychoeducation group. Results indicated that the majority of parents in the PRT group (84%) met fidelity of implementation standards following intervention. Children assigned to the PRT group also showed significantly greater improvements in frequency of verbal utterances than those in the psychoeducation group. These results were maintained at a 3-month follow up probe (Gengoux, Berquist, Salzman, Schapp, Phillips, Frazier, et al., 2015). These results further support the notion that parents can effectively learn and implement PRT strategies.

In addition to child behavior outcomes, parent training in PRT has been shown to lead to collateral gains in other aspects of family life. For example, a study by Koegel, Bimbela and Shreibman (1996) compared the impact of two parent training programs: one that focused on teaching individual target behaviors serially (ITB), and one that incorporated PRT strategies. Both interventions were implemented in the context of an unstructured dinnertime interaction. 17 children with ASD and their families were randomly assigned to one of the treatment conditions. Parent-child interactions videos were recorded pre- and post-intervention and rated using a 6-point likert scale. Variables included: level of happiness, interest, stress, and communication style. Following treatment, participants in the ITB showed no significant differences in any of the four domains. However, those in the PRT group showed improvements in all four scales. Parent's affect improved, they appeared more interested in their child, more relaxed, and used a more positive communication style. This suggests that not only can parent-mediated PRT help children become more socially motivated, but it may also help parents feel more confident when engaging with their child.

Parent-mediated PRT may also lead to reductions in parent stress and help parents to feel more empowered (Minjarez, Mercier, Williams & Harden, 2012). Minjarez and colleagues examined the impact of a group PRT parent education program on parents' level of stress and empowerment. 17 families participated in the 10-week training group which focused on improving child language using PRT strategies. Following participation in the program, parents reported lower levels of stress as measured by the Parenting Stress Index/Short Form. The most significant improvements were noted within the Parent-Child Dysfunctional Interaction (PCDI) subscale, which measures stress associated with parent-child interactions. Parents also reported higher levels of empowerment according to the Family Empowerment Scale. These results are consistent with findings from Koegel, Bimbela, and Schreibman (1996) and indicate that parent-mediated PRT can be beneficial for both parent and child.

Research suggests that documented improvements in both parent and child social behaviors following parent-implemented PRT may be reciprocal in nature. As parents gain new skills and become more confident engaging with their children, children become more motivated to seek out their parents for playful social interactions. Similarly, as children become more easily engaged, parents may experience these interactions more positively and be more likely to initiate with their child moving forward. Vernon (2014) utilized time-window sequential analysis to examine this cyclical relationship. 3 parents participated in the PRT intervention, which focused on rewarding child language attempts with motivating social interactions. Results indicated that parent social behaviors (e.g. eye contact, positive affect, offering a reinforcer) were followed by increases in child positive affect and eye contact. Similarly, child social behaviors resulted in increased positive affect from their

parents. This suggests that parent-implemented PRT may contribute to a positive feedback loop, through which parent and child social behaviors reciprocally influence one another.

Barriers to Treatment Dissemination

Delays in Translating Research to Practice. Although significant resources have been devoted to the development of evidence-based intervention programs for ASD, these approaches have not yet successfully translated into real world settings. For example, one study of 73 children found that fewer than 20% of participants received interventions based on behavioral principles, the gold standard for ASD intervention. However, 95% received sensory integration therapy, an approach with very little empirical support. Additionally, many children were reported to use complementary and alternative medical treatments, which not only lack any empirical support but can actually cause harm to children (McIntyre & Barton, 2010). Considering the high volume and rapid development of the ASD intervention literature, the quality of clinical services currently accessible to children and families is particularly concerning.

The gap between research and practice in ASD intervention was further highlighted in a study by Ziskind and colleagues (2020). This study analyzed data from the Autism Speaks Autism Treatment Network (AS-ATN), a research registry that draws from 17 sites across the United States and Canada. Results from 805 participants indicated children received a median of 5.5 hours of treatment per week. This is in contrast to the American Academy of Pediatrics guidelines, which recommend a treatment intensity of 25 hours per week (Myers, 2007). In addition, consistent with previous research, relatively few children were receiving evidence-based intervention. Only 33.4% of participants were reported to receive intervention based on behavioral principles. Although most children appear to be receiving

fewer hours than recommended, children from racial and ethnic minority backgrounds were particularly impacted. It should be noted that participants in this study were predominately white males. However, analysis indicated that Hispanic children who participated in the registry received on average 1.80 fewer hours of therapy than their non-Hispanic peers. This gap is critically important given previous research indicating that a higher treatment intensity is associated with more positive outcomes, particularly when provided at a young age (Linstead et al., 2017; Lovaas, 1987; Reed, Osborne, & Corness, 2007). Young children with ASD of all backgrounds are consistently missing out on a critical window for early intervention that has the potential to impact their developmental trajectory.

Issues in translating research to practice are neither new nor limited to ASD research. For example, Balas & Boren (2001) refer to an 1843 article that advocated for pregnant women to wash their hands as a method of disease prevention. Despite the significance of this innovative concept, it took decades before this suggestion was universally accepted into practice. Currently, it may take up to 17 years to translate 14 percent of original research into patient care settings. Each stage of the research pipeline, including journal submission, publication, and systematic reviews of best practices, contributes to this delay (Balas & Boren, 2001). Persistent gaps in research-to-practice indicate a need for increased attention and funding directed toward community effectiveness and dissemination research. While many studies have focused on identifying or evaluating interventions for children, relatively few have focused specifically on dissemination (Herschell, McNeil, & McNeil, 2001). More research is needed to identify optimal methods for treatment dissemination. It is likely this effort will require creativity on the part of researchers to ensure their interventions present as

a practical and appealing option for the families and providers they aim to serve (Dingfelder & Mandell, 2011).

Limitations of Traditional Treatment Models. A review of ASD research also highlights specific limitations of current intervention models that may discourage families from engaging in essential services. Among these barriers, three of the most critical may include the prohibitive cost of services, the extensive time commitment required on a weekly basis, and limited access to trained providers. Any treatment program intended for mass dissemination would benefit from addressing these three domains.

Cost. Research indicates the cost of raising an individual with ASD in the United States is approximately 1.4 million dollars across the lifespan. This figure is even higher for individuals with comorbid intellectual disability, totaling up to 2.4 million. Early intervention represents one of the largest contributors to this financial burden: 79% of the total cost can be accounted for by intervention services (Buescher, A.V., Cidav, Z., Knapp, M. et al., 2014). Most families of children with ASD experience significant out-of-pocket expenses related to their child's care on a monthly basis (Parish et al., 2012), as autism-related services have been historically excluded from private insurance coverage (Peele et al., 2002). Additionally, although 37 states had adopted mandates requiring coverage for ASD services as of 2014, research suggests that these mandates have done little to reduce the financial burden experienced by families (Chatterji, Decker & Markowitz, 2015). Considering the high cost associated with most early intervention programs, it should not be surprising that families view this as one of the primary barriers to treatment access. One survey of 141 parents of children with ASD revealed that 68.1% of parents perceived the high cost of intervention to be a significant barrier to treatment (Johnson & Hastings, 2002). Similarly, data from the

National Survey of Children with Special Healthcare Needs found that 53.2% of caregivers of individuals with ASD experienced financial problems as a result of their child's diagnosis. This level of perceived financial burden was significantly higher than that experienced by families of children with other developmental disabilities or mental health conditions (Vohra, Madhavan, Sambamoorthi, & St Peter, 2014). It appears that finding ways to reduce the cost of expensive intervention approaches will be an important step toward promoting treatment dissemination.

Time Commitment. Most early intervention programs are not only costly, but time-intensive as well. The National Research Council (2001) proposed that evidence-based services for ASD should consist of a minimum of 25 direct service hours per week. The Behavior Analyst Certification Board recommends an even greater commitment, totaling 30-40 hours of recommended intervention per week (BACB, 2014). Although specific guidelines may vary, research has generally supported an association between higher treatment intensity and positive outcomes for children with ASD (Linstead et al., 2017; Lovaas, 1987; Reed, Osborne, & Corness, 2007). Unfortunately, it appears that this level of commitment is not feasible for many families. Research suggests that, in practice, the majority of children with ASD receive far fewer than the recommended service hours per week (Love, Carr, Almason & Pettursdottir, 2009; McInyre & Barton, 2010). This may be explained in part by restrictions placed by insurance providers, who may limit the hours of treatment covered per week (Autism Self Advocacy Network, 2016). Additionally, this gap may reflect the high demands placed on caregivers, who must balance lengthy in-home sessions or trips to a clinic with their own busy work schedules and other daily commitments. This hypothesis is supported by research highlighting "lack of time and energy" as a

commonly perceived barrier to intervention utilization (Johnson & Hastings, 2002). Considering the heightened stress levels parents of children with ASD already experience (Karst & Van Hecke, 2012; Schieve, Blumberg, Rice, Visser & Boyle, 2007), an important route to increasing service utilization should consider how best to accommodate the scheduling needs of busy families.

Limited Access to Trained Service Providers. Even if a family has adequate time and energy to devote to their child's treatment, they may continue to experience barriers to accessing desired services. This is particularly the case in low income or rural areas, where trained professionals are scarce (Antezana, Scarpa, Valdespino, Albright & Richey, 2017; Mello, Urbano, Goldman & Hodapp, 2016). Furthermore, even among communities where services are available, many practitioners lack adequate training in ASD or possess limited understanding of evidence-based practices (Heidgerken, Geffken, Modi, & Frakey, 2005; Stahmer, Collings & Palinkas, 2005). The National Early Childhood Teacher Assistance System (NECTAS) echoed this sentiment, citing a "lack of availability of diagnostic centers or experts" and "inequities in access to expertise, resources, and appropriate services" as top concerns (Lord et al., 2005). Concerns about limited access to service providers has prompted increased interest in parent-implemented intervention programs. These treatment models are based on the premise that a child's primary caregiver, the individual they spend the most time with on a daily basis, has the greatest potential to impact learning. Thus, parents are trained to serve as an interventionist for their own child. Research surrounding parent training programs have generated promising results (Matson, Mahan & Matson, 2009; McConachie, Diggle, T., 2007), suggesting that they may serve as a lower cost, practical alternative to traditional early intervention programs. Unfortunately, the extent to which

parent involvement is encouraged varies greatly among intervention models, and the majority continue to utilize trained professionals as the primary agent of intervention (Schertz, Baker, Hurtwitz, & Benner, 2011).

Models of Telepsychology

As was previously noted, concerns regarding barriers to treatment dissemination and implementation are not unique to ASD research. In fact, the field of psychology as a whole has been grappling with identifying optimal methods to increase service access. As a result, the use of telepsychology has gained traction as a primary method of service delivery (Nelson, Bui, & Velasquez, 2011; Ritterband et al., 2003). According to the APA, telepsychology is defined as "the provision of psychological services using telecommunication technologies" (APA, 2013). This broad category may include, but is not limited to, services conducted via video conferencing, phone calls, texting, email, or websites (APA, 2013). Telepsychology interventions have been utilized by psychologists from diverse theoretical orientations serving a variety of patient populations. Research has supported their use for a range of mental health conditions, with studies highlighting positive treatment outcomes for anxiety, depression, OCD, PTSD, schizophrenia, and eating disorders, among others (Nelson, Bui, & Velasquez, 2011; Varker et al., 2019). These interventions offer a myriad of benefits, including increasing access to skilled professionals, decreasing stigmas associated with seeking out services, lowering the cost of expensive treatments, and allowing patients to move through material at their own pace. While telepsychology interventions are not intended to replace face-to-face treatments, they can serve as a valuable alternative for those who would otherwise be unable to access services (Ritterband et al., 2003).

Telepsychology programs can generally be categorized as either "synchronous" or "asynchronous" programs (APA, 2013). Synchronous programs involve real time interaction between the patient and their provider. This would include sessions that are conducted live via videoconference or telephone. Asynchronous programs, on the other hand, do not incorporate real time communication. Asynchronous methods include the "store and forward" technique, in which a clinician reviews patient information and provides feedback at a later time. (Mechanic & Kimball, 2019). For example, this might include a therapist reviewing a parent's video of their interaction with their child and then subsequently providing verbal or written feedback on their use of treatment strategies. Email communication, bulletin boards, and psychoeducational websites are also within the scope of asynchronous telepsychology (APA, 2013). Research has indicated that both synchronous and asynchronous telepsychology programs can have therapeutic benefits for a variety of patient populations (Hilty et al., 2013).

Much of the literature surrounding telepsychology has focused on synchronous methods of telepsychology delivered via phone or video conference, a format that requires extensive clinician involvement (Amichai-Hamburger et al., 2014; Backhaus et al., 2012). However, technology-based therapeutic interventions can take many forms. These programs vary greatly in terms of the method of intervention delivery and the level of clinician feedback required (Barak, Klein, Psych & Proudfoot, 2009). For example, "web-based interventions" represent one subcategory of telepsychology programs. Barak and colleagues (2009) define a web-based intervention as:

> a primarily self-guided intervention program that is executed by means of a prescriptive online program operated through a website and used by consumers

> seeking health- and mental-health related assistance. The intervention program itself attempts to create positive change and or improve/enhance knowledge, awareness, and understanding via the provision of sound health-related material and use of interactive web-based components. (p. 5)

The authors proceed to break down web-based interventions into three subtypes: web-based education interventions, self-guided web-based therapeutic interventions, and human-supported web-based therapeutic interventions. Web-based education interventions generally provide didactic content about a condition in a fairly static manner with minimal to no feedback involved. Both self-guided and human-supported web-based interventions provide information in a more dynamic way and differ mainly in regard to clinician involvement. While self-guided interventions may include some level of automatic feedback (e.g. whether or not the patient answered correctly on an assessment), they do not involve more individualized support. On the other hand, human-supported web-based interventions involve dynamic feedback and guidance from a peer or trained provider. The authors note that each type of web-based intervention carries its own strengths and weaknesses. However, in terms of reducing the cost and widening the reach of an intervention program, self-guided programs may be particularly beneficial (Barak et al., 2009).

Although telepsychology interventions have historically focused on supporting adult clients, an emerging evidence base supports the application of this model to pediatric populations (Myers et al, 2017). Many of these programs, especially those intended for younger children, focus on training parents to implement evidence-based interventions. Telepsychology parent training programs target a wide variety of skills and conditions, spanning topics such as infant social-emotional development (Baggett et al., 2010), youth

mental health prevention (Deitz, Cook, Billings & Hendrickson, 2009) and child behavior problems (Funderburk, Ware, Altshulur & Chaffin, 2008; Taylor, Webster-Stratton et al., 2008). A meta-analysis conducted by Nieuwboer, Fukkink & Hermanns (2013) revealed that these programs vary greatly in their delivery, ranging from those that are entirely self-guided, to those offering email consultation as needed, and those intensively guided by a therapist via teleconference. The authors concluded that regardless of format, telepsychology programs appear to be an effective tool to disseminate parent training interventions; analysis revealed promising effect sizes for both parent and child outcomes across all programs (Nieuwboer, Fukkink & Hermanns, 2013). Another review of online parent training highlighted core features common across programs. These included the use of the internet to delivery therapy materials and the incorporation of video modeling to demonstrate treatment strategies. Additionally, the authors noted that while many programs included additional human support, such as direct coaching and feedback, few examined whether this additional component was necessary for positive outcomes. This is particularly important to consider as this degree of clinician involvement can significantly increase the cost of services (Breitenstein, Gross & Christophersen, 2014).

Telepsychology and ASD

The rising trend toward telepsychology parent training programs is reflected in recent literature surrounding behavioral interventions for ASD. Studies have begun to explore the impact of online parent-training interventions for caregivers of children with ASD (Ingersoll et al., 2016; Parsons et al., 2017; Vismara et al., 2012; Wainer & Ingersoll, 2013). These programs have targeted a range of outcomes, with a particular focus on reducing problem

behaviors (Bearss et al., 2017; Lindgren et al., 2016; Wacker et al., 2012), and promoting social communication skills (Vismara et al., 2013; Wainer & Ingersoll, 2013). A recent review by Parsons et al. (2017) highlighted the potential benefits of online parent-mediated behavioral interventions. The authors examined 7 studies of online programs targeting the social communication skills of children with ASD living in rural areas. Despite some methodological limitations, including limited sample sizes and a lack of standardized measures, the review established preliminary support for both parent and child outcomes (Parsons et al., 2017).

Despite increasing interest in online ASD programs, few studies have focused on translating established evidence-based intervention programs into an online format. This area of research is particularly important, as treatment programs should ideally have garnered sufficient empirical support prior to the onset of dissemination and implementation efforts (Smith et al., 2007). Preliminary efforts to disseminate evidence-based ASD interventions via the internet appear promising. For example, Vismara et al. (2013) have examined the benefits of a telepsychology program based on the Early Start Denver Model, a comprehensive NDBI with extensive empirical support (Dawson et al., 2010). Eight families completed the 12-week telehealth intervention, which consisted of a combination of weekly parent coaching sessions via live video conferencing and access to a self-guided website. Survey data indicated that parents generally reported high satisfaction with this format. Additionally, levels of treatment fidelity, parental engagement, and child communication skills improved over the course of the program.

Wainer & Ingersoll (2015) utilized a similar approach by translating an evidence-based model, Reciprocal Imitation Training (RIT), into a telepsychology format. RIT is an

NBDI that targets imitation skills as a means to promote early social communication (Ingersoll & Lalonde, 2010). Ingersoll utilized a single-subject, multiple-baseline design across five parent-child dyads. The "hybrid telehealth program" was comprised of two components. The initial self-directed condition included four online lessons consisting of an animated slide show, self-check questions, and a homework plan. This was followed by a parent coaching condition, in which parents received three 30-minute feedback sessions via teleconference. Analysis revealed that participation in the program was associated with improvements in fidelity of implementation. Additionally, social validity data revealed that parents perceived the intervention to be acceptable, useful, and effective (Wainer & Ingersoll, 2015).

In a follow-up study, Ingersoll and colleagues (2016) conducted a randomized controlled trial to compare outcomes for those who received both the self-directed and parent-coaching components with those who received only the self-directed intervention. Findings indicate that parent and child outcomes improved across both conditions, as parents in both groups showed gains in treatment fidelity, self-efficacy, stress, and positive perceptions of their child. However, the therapist-assisted group showed greater gains in terms of treatment fidelity and positive perceptions. Similarly, children in both groups improved on language measures, although only those in the therapist-assisted group showed gains in social skills. These results suggest that incorporating therapist feedback may provide an additional benefit for some children, although families may vary in terms of the level of care required (Ingersoll et al., 2016).

Despite the extensive literature surrounding the efficacy of PRT for children with ASD, this model had not previously been translated into an online format. However, one

study by Nefdt and colleagues (2010) examined the effects of a self-directed DVD training to disseminate PRT strategies. The DVD program consisted of approximately 1 hour of training materials, including video examples, multiple choice quizzes, and an accompanying written workbook. The authors found that parents in the treatment group demonstrated high rates of treatment fidelity post-training. Additionally, children in the treatment group demonstrated significantly greater gains in the use of functional utterances when compared to a waitlist control group. These findings indicate that video modeling may be an effective strategy to train parents in PRT strategies. Additionally, the success of the DVD format suggests that remote instruction in PRT strategies warrants additional study. However, this study also included a number of limitations. Notably, 82% of study participants were white, significantly limiting the generalizability of these findings. Additionally, the use of a single, lengthy training video may limit parents' ability to move through material flexibly and at their own pace. It is also worth noting that due to advances in technology since the original article was published, including a shift toward more internet-based media sources, some families may no longer have access to a DVD player.

Purpose and Contribution of the Study

The present study examined a new self-guided web-based PRT training program for parents of toddlers with ASD. Unlike other PRT programs, this intervention was delivered incrementally over the course of approximately six weeks. This design was intended to accommodate families' busy schedules and allow ample time for parents to practice strategies between each lesson. Course modules focused on core intervention strategies to elicit communication and social engagement through playful interactions, child-selected

materials, and positive behavior principles. In a pre-pilot investigation of the program with ten participants, data was indicative of significant improvements in pre-post measures of parent FOI with medium-to-large effect sizes. Data also indicated significant improvements in child eye contact, positive affect, and rate of vocalizations. These results were supported by social validity data from families indicating a promising level of satisfaction with the course. On a 0-5 scale (0= Strongly Disagree, 5= Strongly Agree), all families reported that the course was clearly written and well organized (M= 4.5, SD=0.53), that they would recommend the course to a friend (M=4.5, SD=0.53), and that the course provided them with a clear understanding of Pivotal Response Treatment (M= 4.2, SD=0.42).

The present study expanded upon previous findings by examining the aforementioned online program using a randomized waitlist control design. This study further examined the impact of the online course on parents' level of treatment fidelity and more closely investigated child behavior outcomes. This included administering standardized assessments and coding for child behaviors within weekly and follow-up video probes. Child behaviors that were coded included vocalizations, eye contact, and positive affect, as these social communication skills have been demonstrated to improve following PRT intervention (Bradshaw, Koegel, Koegel, 2017; Koegel, Vernon, Koegel, 2009; Vernon, Koegel, Dauterman & Stolen, 2012).

Research Questions

The following specific research questions were raised:

1. Can an online training program serve as a feasible method of service delivery to disseminate evidence-based treatment strategies for parents of young children with ASD?

2. Do parents perceive an online training program to be an acceptable and appealing form of intervention?
3. Will preliminary child outcome measures support the efficacy of an online parent training program to enhance the social communication skills of young children with ASD?

Chapter 3: Methods

Research Design

This investigation utilized a randomized, waitlist control design to evaluate the feasibility, utility, and preliminary efficacy of the online PRT parent education program. After completing an initial online battery of intake assessments, participants were randomized to either an immediate or delayed treatment condition. Following intake, participants assigned to the immediate treatment condition were enrolled in the 6-week online course. After a two-month waiting period, the delayed treatment group then participated in the program. This design allowed for a treatment comparison group while also fulfilling the ethical obligation of ensuring that all participants with ASD eventually received the experimental online intervention. Video probes were collected from parents following each weekly lesson to assess gains in PRT fidelity over the course of the 6-week program. Feedback measures were also collected from parent participants to assess parent perceptions of program acceptability. An additional video probe and standardized measures were also collected three months after each family completed the program to evaluate generalization and sustainability of gains.

Participants

A total of 28 parent-child dyads with ASD participated in the project (14 dyads per treatment condition). A sample size based on multiples of 14 per group was selected based on existing guidance for pilot study development (Julious, 2005). For child participants, inclusionary criteria consisted of the following: child participants were (a) between the ages of 1.0 and 5 years (12 and 60 months), (b) had an existing diagnosis of ASD per parent report (c) had parent endorsements of significant language delay as a major area of concern for their child, and (d) parent was willing to complete 6 weekly app-based lessons and had access to an iOS smartphone/tablet device with the ability to download the required software application to record and upload videos. Children with comorbid medical or psychiatric conditions were excluded from participation. Recruitment was conducted using targeted social media advertisements.

Child participants were ages 22 to 46 months (M= 36, SD= 7.46) and were predominately male (85.7%). This gender distribution is consistent with current rates of ASD diagnosis (Baio et al., 2018). See Table 1 for a summary of participant demographic information. In terms of geographical location, 13 participants (46%) were located in California. The remainder were spread across several U.S. states (Massachusetts, Maryland, Colorado, Texas, Virginia, Oklahoma, Arkansas, Florida, Georgia) as well as other countries (Russia, Belize, Trinidad and Tobego, Pakistan). Participants mean ASD symptom severity, as measured by the Social Responsiveness Scale, fell in the moderate range (M=68.71, SD= 10.59), indicating “deficiencies in reciprocal social behavior that are clinically significant and lead to substantial interference with everyday social interactions” (Constantino, 2012). Table 2 provides an overview of participant SRS scores at baseline. Additional clinical characterization data is available in Tables 3 and 4, including measures of adaptive behavior

and expressive and receptive vocabulary. All participating families identified language development as a major area of concern for their child.

Table 1
Participant Demographic Information

Race and Ethnicity	*n*	%
Asian	11	39.3
White	6	21.4
Hispanic or Latino	4	14.3
More Than One Race	3	10.7
Other	3	10.7
Black or African American	1	3.6
Child Gender		
Male	24	85.7
Female	4	14.3
Parent Gender		
Mother	22	78.6
Father	6	21.4
Marital Status		
Married	24	85.7
Single	4	14.3
Level of Education		
Some College	2	7.1
Associate Degree	1	3.6
Bachelor's Degree	4	14.3
Master's Degree	14	50
Professional Degree	3	10.7
Doctoral Degree	4	14.3

Table 2
Baseline ASD Symptom Severity

	Minimum	Maximum	*M*	*SD*
Child Age	22.00	46.00	36.00	7.46
SRS-2 Total [a]	48.00	88.00	68.71	10.59
SRS-2 Social Communication &Interaction [a]	48.00	84.00	68.05	10.41

SRS-2 Restricted Interests/Repetitive Behavior [a]	48.00	98.00	69.24	12.77

[a]As measured by the Social Responsiveness Scale, Second Edition, Preschool Form (Constantino, 2012).

Table 3
Baseline Adaptive Behavior Profiles

	Minimum	Maximum	*M*	*SD*
Adaptive Behavior Composite [a]	53	89	73.41	1.74
Communication Standard Score [a]	38	100	71.26	2.87
Daily Living Standard Score [a]	57	98	77.19	2.22
Social Standard Score [a]	44	94	74.67	2.28

[a]As measured by the Vineland Adaptive Behavior Scales, Third Edition, Parent Survey Form (Sparrow, Cicchetti & Saulnier, 2016)

Table 4
Baseline Receptive and Expressive Communication

	Minimum	Maximum	*M*	*SD*
Total Comprehension [a]	11	358	118.27	87.36
Total Word Production [a]	0	395	129.22	120.41
Early Gestures [a]	3	91	23.70	20.48
Later Gestures [a]	2	51	14.81	14.61

[a]As measured by the MacArthur-Bates Communicative Development Inventory (CDI), Level I Short Form (Fenson et al., 2000).

Parent-Child Video Probes

At intake, parents were instructed to submit a 5-minute video of a parent-child interaction using their child's preferred toys. After completing each online PRT lesson, parents were then instructed to submit a 5-minute video capturing their use of PRT strategies with their child. Videos were uploaded through the Box website or phone application, a secure online file sharing system. Submission of these videos was required in order to unlock access to the next lesson in the online PRT curriculum. Because the program was designed to be an autonomous training program, families did not receive clinician feedback on their performance.

Outcome Measures

Fidelity of Implementation. Video submissions were independently coded by trained research assistants to monitor improvements in parent FOI over the course of the program. Each learning opportunity was scored on a trial by trial basis. PRT FOI was defined as the parent properly demonstrating all core motivational PRT components with competency at least 80% of the time. Pre- and post-project parent–child videos were scored for fidelity. FOI was coded for each video based on the following core PRT strategies: Child Attending (parent obtained the child's attention before presenting an opportunity); Clear Opportunity (the parent's prompt for the child to respond was simple, clear, and appropriate to the task); Child Choice (the parent followed the child's choice/lead with tasks and activities); Contingency (parent reinforcement delivery was contingent upon child's verbal request); Natural Reinforcement (the parent's choice of reinforcer was logically/directly related to the child's request); Reinforced Attempts (the parent accepted any reasonable vocalization or word attempt and did not require a perfect verbal request); and Maintenance/Acquisition Tasks (parent varied prompts to balance child motivation and new skill acquisition). During the 5-minute probe, each individual learning opportunity was scored on a trial by trial basis. After each trial, the video was paused and PRT components were scored as either 1 (the component was demonstrated) or 0 (the component was not demonstrated).

Fidelity scores were calculated using two methods: a traditional method as well as a more conservative approach. The traditional method, which served as the primary outcome measure, involved examining each PRT strategy individually and determining the percentage of trials in which the parent demonstrated correct use of that strategy. The fidelity score for each PRT strategy was then averaged to calculate a "mean fidelity score." The conservative

method involved calculating the percentage of passed PRT trials. A "passed trial" was defined as a parent utilizing all PRT strategies correctly within a given language opportunity. The number of passed trials was divided by the total number of trials within the 5-minute period. This measure is more conservative than the mean fidelity score, as it requires the parent use every strategy correctly within a given trial to meet FOI standards. Within each method, parents were required to achieve a score of 80% to meet fidelity of implementation standards (See Appendix A for Fidelity Coding Sheet).

Child Social Communication Behaviors. Videos were also coded for the following social communicative behaviors: vocalizations, eye contact, and positive affect. These behaviors were selected due to prior research indicating that these social communication skills are particularly important for development and may improve following PRT intervention (Bradshaw et al. 2017; Koegel et al. 2009; Vernon et al. 2012). Child Vocalizations are an indicator of attempts to use social communication and were defined as any verbal communication attempt and included both intelligible words and directed word-attempts and vocalizations. Non-communicative sounds (e.g. whining, crying) were excluded from analysis. These were coded using a frequency count. Child Eye Contact is a measure of social attention and engagement and was defined as the child looking toward the parent's eyes. Eye contact was coded on a continuous basis. Child Positive Affect is another measure of social attention and engagement. It was defined as visible smiling or laughing and was also coded on a continuous basis.

Reliability. Videos were coded by two trained undergraduate research assistants. Research assistants were trained on PRT procedures and provided with operational definitions for each PRT component and child social communication behavior. Research

assistants practiced coding to establish interrater reliability prior to coding research videos. Cohen's kappa was calculated to determine the level of agreement between the video coders while controlling for agreement due to chance. Interobserver reliability was calculated for 10% of all video probes. Probes coded for reliability were randomly selected. Results were indicative of a substantial level of agreement for child social communication behaviors: $\kappa = 0.620$, and PRT fidelity: $\kappa = 0.627$, $p < .005$.

Parent Exit Survey. Feedback information was obtained to assess parents' satisfaction with the program, confidence in their therapeutic skills, and perceptions of child behavior change. At the end of the 6-week course, parents were asked to complete an online exit survey (Appendix B). This survey consisted of both quantitative and qualitative elements. They were first asked to respond to a variety of statements using a scale of 0 (Strongly Disagree) to 5 (Strongly Agree). Items assessed for in this measure will include statements such as: "Over the last 6 weeks, I have seen my child's language skills improve," "Over the last 6 weeks, I have seen my child's social engagement improve," "I have a clear understanding of Pivotal Response Treatment," and "I would recommend the course to a friend." Parents were also asked to provide written feedback on their experience of the course and suggestions for improvement. This information was intended to help identify potential barriers to program completion and to modify the program for future study.

Standardized Survey Measures. Digital versions of the following survey measures were used for baseline clinical characterization purposes. These measures were also administered at a 3-month follow-up time point to obtain preliminary child outcome data:

Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012). The SRS-2 is a caregiver-completed measure of a child's autism symptom severity. Parents completed a digital version of the Toddler SRS-2.

Vineland Adaptive Behavior Scales, Third Edition (Sparrow, et al, 2016). The Vineland-III is a caregiver-completed measure of adaptive functioning in children. Parents completed the digital version of the Vineland-III Parent/Caregiver Rating Form.

MacArthur-Bates Communicative Development Inventory (CDI), Level I Short Form (Fenson et al., 2000). The MacArthur-Bates CDI is a caregiver-reported measure of child expressive vocabulary use. Parents completed a digital version of the CDI to obtain information on baseline word usage.

Intervention

The online PRT parent education program consisted of six weekly 15 to 30-minute lessons. Each module was entirely self-guided and progressively build upon skills learned in prior lessons. All informational slides were accompanied by video examples to model proper use of PRT strategies. Brief multiple-choice quizzes and self-assessments were also incorporated to assess comprehension of the material. Parents were encouraged to incorporate treatment strategies into their routines and play activities on a daily basis. Each lesson also included a brief review sheet capturing key points to reference when practicing strategies home. See Table 5 for a detailed curriculum.

Table 5
Online PRT Training Curriculum

Lesson	Topics Covered
1. The ABCs of PRT	Introduction to parent-mediated Pivotal Response Treatment. Overview of core behavioral strategies (antecedent, behavior, consequence).
2. Setting Up a Learning Opportunity	PRT Antecedent Strategies: Child Choice/Shared Control, Clear Learning Opportunities, Interspersing Maintenance and Acquisition Tasks
3. Rewarding Your Child's Language	PRT Consequence Strategies: Natural Reinforcers, Reinforcing Attempts, Immediate and Contingent Reinforcement.
4. Choosing a Treatment Plan	Adapting PRT for a variety of developmental levels. Identifying appropriate target skills. Using model, open-ended, and time-delay prompts.
5. Using Social Reinforcers	Strategies to increase social motivation (e.g. incorporating child interests within social activities.) Highlights from the PRISM model (Vernon et. al, 2019)
6. Frequently Asked Questions.	Addressing questions and concerns commonly raised by parents (e.g. slow progress, challenging behaviors)

Analyses

The current pilot study evaluated several critical aspects of clinical trial feasibility and acceptability. Post-participation feedback data was collected from parent participants to capture participant's reactions to the program. Adequate parent acceptability was defined as a mean rating of 4.00 on the 0-5 agreement scale for parent exit survey rating items Additionally, program completion and attrition statistics were examined to determine whether this program format is feasible for families. Analyses also focused on the impact of

the online PRT program on treatment fidelity and observational data. Changes across all submitted parent-child video-clips in both parent PRT fidelity procedures and coded child communicative behaviors were evaluated using a two-way mixed Group X Time ANOVA. This analysis was underpowered due to the small sample size associated with the present study. Given this concern, changes within the treatment and waitlist groups were also analyzed separately using paired samples t-tests.

Chapter 4: Results

Feasibility and Acceptability

Among the 14 families who were assigned to the immediate treatment condition, 8 families (57%) completed all 6 course modules and uploaded the corresponding video. The 6 families who discontinued their participation did not formally withdraw from the program by contacting the research team. Rather, they gradually stopped accessing lessons or uploading videos. Families were considered withdrawn from the study after failing to respond to three weekly email reminders. Within the waitlist condition, 11 participants (79%) uploaded a second video probe following the 3-month waiting period. The remainder were unable to be re-contacted. Few families in either condition were responsive to attempts to collect follow-up survey measures and video probes: 3 families in the immediate condition and 1 in the waitlist condition. As a result, these measures were included for baseline clinical characterization but not utilized as outcome measures. See Figure 1 for an overview of participant study completion utilizing the CONSORT Flow Diagram (Schulz, Altman, & Moher, 2010).

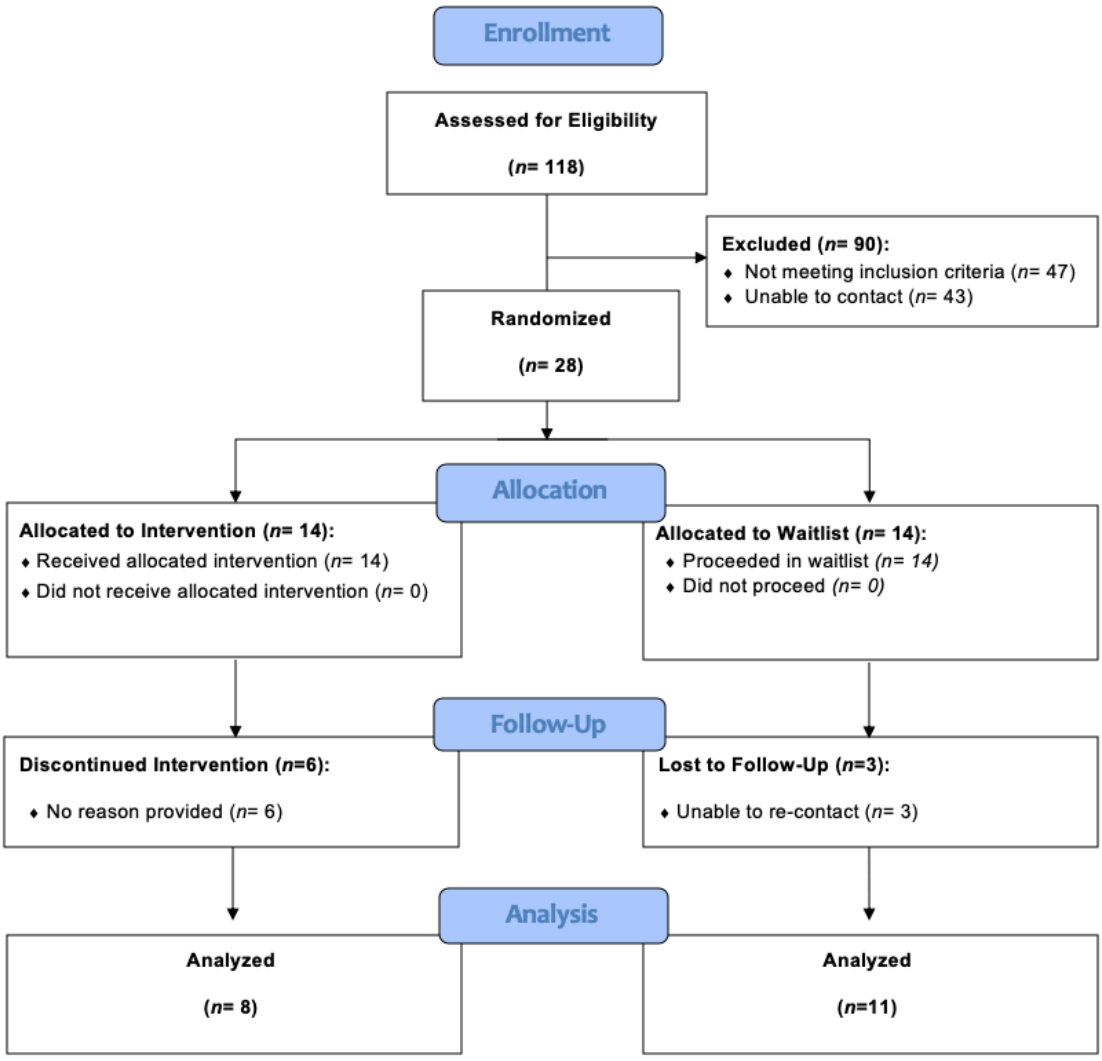

Figure 1. Online PRT CONSORT Diagram.

Families who completed the course spent an average of 84 days to complete the program (SD=50.99). Because participants were permitted to complete the course at their own pace, the length of course duration varied significantly, ranging from 41 days to 214 days. Mean duration of each lesson could not be calculated, as some families appeared to leave the lesson open on their computer for days at a time before submitting the survey. This

makes it difficult to know exactly how much time parents devoted to each lesson. However, many families were able to complete the lessons in as little as 10 to 20 minutes.

Exit survey data was collected from the families in the immediate treatment condition who completed all 6 weeks of the course. This data was indicative of high satisfaction with the course. On a 0–5 scale (0 = Strongly Disagree, 5 = Strongly Agree), families reported that the course was clearly written and well organized: five parents (55.56%) selected "strongly agree," three (33.33%) selected "agree" and one (11.11%) selected "slightly agree" (M = 4.44, SD = 0.24). All families also indicated that they would recommend the course to a friend: six parents (66.67%) selected "strongly agree" and three (33.33%) selected "agree" (M = 4.67, SD = .17). Families also reported that the course provided them with a clear understanding of PRT: seven parents (72.73%) selected "agree," one selected strongly agree (11.11%), and one (11.11%) selected slightly agree (M = 4.00, SD = .17). The majority of parents reported that their child's social engagement improved over the course of participation (M = 3.89, SD= .26): four parents (44.44%) agreed, three parents (33.33%) slightly agreed, and two parents (22.22%) strongly agreed. Parents generally reported an improvement in their child's language skills (M = 3.67, SD = .41): four parents (44.44%) agreed, two (22.22%) slightly agreed, two (22.22%) strongly agreed, and one (11.11%) disagreed.

Parents also submitted qualitative feedback regarding their experiences with the course. This feedback highlighted many positive themes, including a sense that the course strategies were easy to learn and implement at home. For example, one parent shared that "the course is logical, well organized, concise. Each concept or strategy is explained in few simple words with relevant examples." Similarly, another reported that the course "provides

handy, common sense tools that are easy to remember for parents" and "provides good examples of strategy applications." Parents also expressed appreciation for the naturalistic approach emphasized in the course: "the most important thing is that PRT is child friendly and parents can implement it in a naturalistic way. Its [*sic*] also help in building strong bond with child." Similarly, another parent wrote: "We feel that being exposed to Verbal Behavior Approach, ABA, and PRT….PRT has definitely stood out amongst these different techniques and frankly we appreciate the influence it's had on our parenting and our son." Finally, parents noted that they plan to share what they have learned with other caregivers and service providers: "I have been discussing things that I have learned with everyone (SLP, BCBA) and they were very surprised and interested in learning PRT."

In terms of areas for improvement, one parent expressed concern that her child's language level may have been too advanced for the course curriculum: "I feel that we are at a different place with (child's) language level and were seeking different methods on how to increase pragmatic language. We are interested in receiving information on techniques regarding pragmatic language and how PRT can increase this area of concern." Another parent requested that future iterations of the program allow more connection and interaction with other parents: "I would suggest to keep a website open for parents to check additional examples of PRT strategies. Also to open a forum for parents to exchange ideas/concerns among them."

Fidelity of Implementation

Mean Fidelity Score. Fidelity was initially calculated using a traditional method utilized by previous PRT trials. This method involved examining each PRT strategy individually and determining the percentage of trials in which the parent demonstrated

correct use of that strategy. The fidelity score for each PRT strategy was then averaged to calculate a "mean fidelity score." According to this fidelity measure, three participants in the immediate group met FOI standards at baseline. This increased to four participants by Week 6. Within the waitlist group, only one participant met FOI at baseline and Week 6. A two-way mixed Group X Time ANOVA was used to assess improvements in PRT treatment fidelity over the course of treatment. Analysis indicated there was a statistically significant interaction between the intervention and time on PRT fidelity score, $F(1, 17) = 6.41$, $p = .022$, partial $\eta^2 = .274$. There was not a statistically significant difference in fidelity between groups at baseline, $F(1, 26) = 1.05$, $p = .314$, partial $\eta 2 = .039$. However, by week 6 this difference was statistically significant: $F(1,17) = 6.42$, $p = .021$, partial $\eta 2 = .274$. At time 2, PRT fidelity was significantly higher for those in the treatment condition (M= .77, SE= .04, p=.02) than those in the waitlist condition (M= .63, SE= .04, p=.02). These results are depicted below in Figure 2.

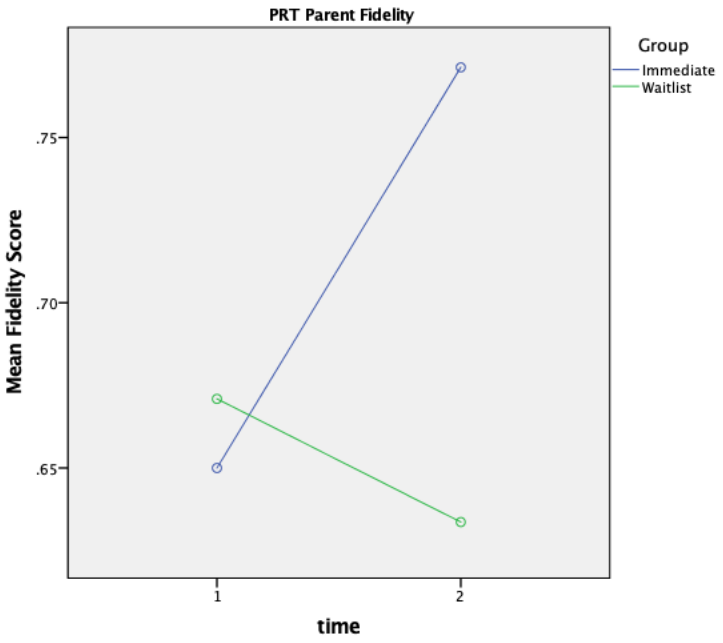

Figure 2. Mean Fidelity Score

Changes within the treatment and waitlist groups were also analyzed separately using a paired samples t-test. Those in the immediate condition showed an increase in mean fidelity score from pre (M=.65, SD=.13) to post-treatment (M=.77, SD=.10). This trend was not statistically significant: t(7)= -2.18, p=.066. However, analyses revealed a medium to large effect size: *d*=0.77. Those in the waitlist group did not show a statistically significant difference from pre (M=.67, SD=.09) to post-treatment (M=.63, SD=.13), t(10)= 1.07 , p= .312, *d*=0.32.

Percentage of Trials Passed. Fidelity was also calculated using a new, more conservative approach. A "passed trial" was defined as a parent utilizing all PRT strategies correctly within a given language opportunity. The number of passed trials was divided by the total number of trials within the 5-minute video. According to this fidelity measure, no participants in either condition achieved the 80% criteria required to meet PRT fidelity. However, those in the immediate treatment condition did show improvement in their level of fidelity from pre to post-treatment. A two-way mixed Group X Time ANOVA was used to assess improvements in PRT treatment fidelity over the course of treatment. Analysis indicated there was a statistically significant interaction between the intervention and time on PRT fidelity score, $F(1, 17) = 8.85$, $p = .008$, partial $\eta^2 = .342$. There was not a statistically significant difference in fidelity between groups at baseline, F(1, 26) = .397, p = .534, partial η2 = .015. However, by week 6 this difference was statistically significant: F(1,17)= 8.78, p=.009, partial η2 = .341. At time 2, PRT fidelity was significantly higher for those in the treatment condition (M= .42, SE= .05, p=.009) than those in the waitlist condition (M= .23, SE= .04, p=.009). These results are depicted below in Figure 3.

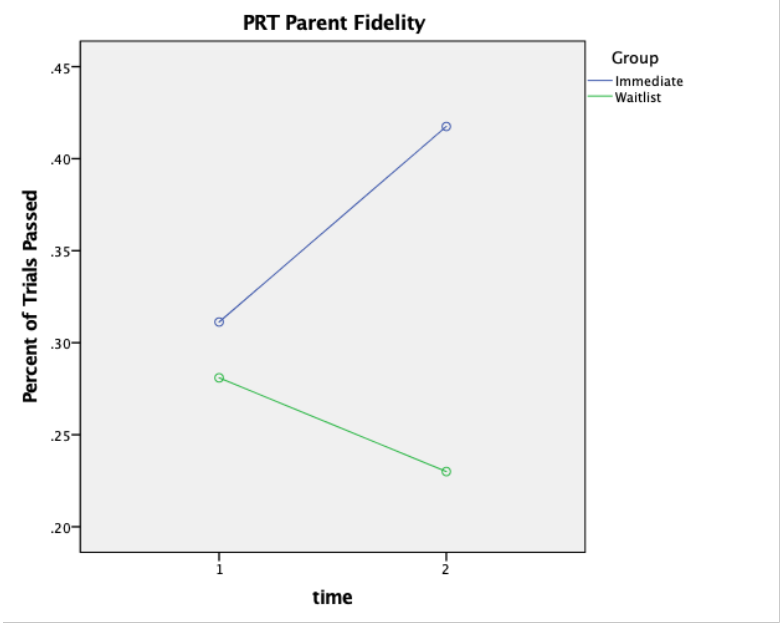

Figure 3. Percentage of Trials Passed

Due to the small size of the current sample, the two-way mixed Group X Time ANOVA was significantly underpowered. Given this concern, changes within the treatment and waitlist groups were also analyzed separately using a paired samples t-test. Those in the immediate condition showed a statistically significant increase in percentage of passed trials from pre (M= .31, SD=.08) to post-treatment (M=.42, SD=.12): t(7)= -4.23, p=.004, *d*= 1.49. Those in the waitlist group did not show a statistically significant difference from pre (M=.28, SD=.12) to post-treatment (M=.23, SD=.14), t(10)= 1.24, p= .242, *d*=0.38.

Child Social Communication Behaviors

Vocalizations. A two-way mixed Group X Time ANOVA was used to assess improvements in the frequency of vocalizations over the course of treatment. Analysis indicated there was not a statistically significant interaction between the intervention and

time on number of vocalizations, $F(1, 17) = 0.011$, $p = .919$, partial $\eta^2 = .001$. The main effect of time showed that there was not a statistically significant difference in mean number of vocalizations at the different time points, $F(1, 17) = 0.019$, $p = .893$, partial $\eta^2 = .001$. The main effect of group also showed that there was not a statistically significant difference in mean number of vocalizations between groups $F(1, 17) = 0.579$, $p = .457$ partial $\eta^2 = .033$. These results are highlighted in Figure 4.

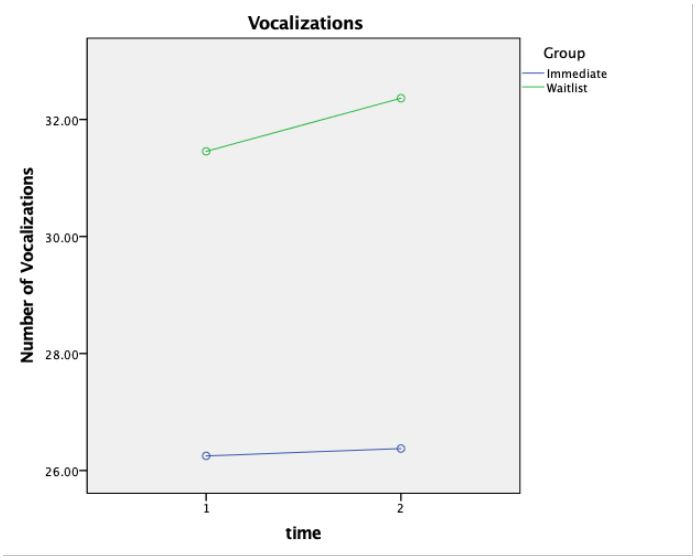

Figure 4. Number of Vocalizations

Due to the small size of the current sample, the two-way mixed Group X Time ANOVA was significantly underpowered. Given this concern, changes within the treatment and waitlist groups were also analyzed separately using a paired samples t-test. Those in the immediate condition did not show a statistically significant difference in number of vocalizations from pre (M= 26.25, SD=22.99) to post-treatment (M=26.38, SD=.12): t(7)= -.02, p=.984, *d*=0.007. Those in the waitlist condition also did not show a statistically

significant difference from pre (M= 31.45, SD=16.67) to post-treatment (M=32.36, SD=17.33): t(10)= -.194, p=.850, *d*=0.06.

Eye Contact. A two-way mixed Group X Time ANOVA was used to assess improvements in the duration of eye contact over the course of treatment. Analysis indicated there was not a statistically significant interaction between the intervention and time on duration of eye contact, $F(1, 17) = 0.604$, $p = .448$, partial $\eta^2 = .034$. The main effect of time showed that there was not a statistically significant difference in mean duration of eye contact at the different time points, $F(1, 17) = 2.50$, $p = .132$, partial $\eta^2 = .128$. The main effect of group also showed that there was not a statistically significant difference in duration of eye contact between groups $F(1, 17) = <.001$, $p = .994$, partial $\eta^2 = <.001$. It should be noted that although both groups showed some level of improvement in eye contact, this trend appeared stronger for those in the immediate treatment condition. These results are represented in Figure 5.

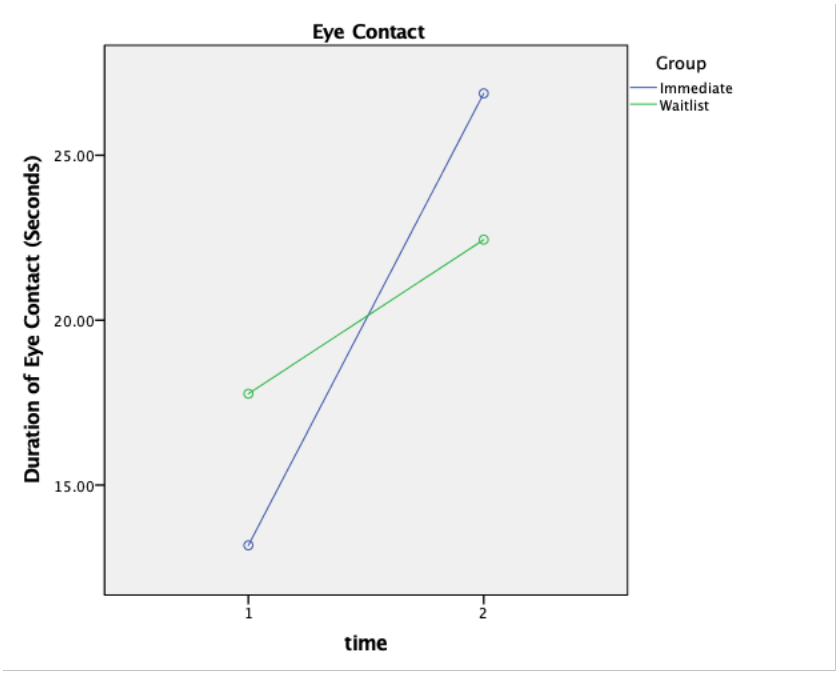

Figure 5. Duration of Eye Contact

Changes within the treatment and waitlist groups were also analyzed separately using a paired samples t-test. Those in the immediate condition did not show a statistically significant difference in duration of eye contact from pre (M= 13.17, SD=8.97) to post-treatment (M=26.88, SD=20.64): t(7)= -.1.75, p=.123. However, this trend was associated with a medium to large effect size: *d*=0.62. Those in the waitlist condition also did not show a statistically significant difference from pre (M= 17.77, SD=23.19) to post-treatment (M=22.44, SD=38.21): t(10)= -.58, p=.577, *d*=0.17.

Positive Affect. A two-way mixed Group X Time ANOVA was used to assess improvements in the duration of positive affect over the course of treatment. Analysis indicated there was not a statistically significant interaction between the intervention and time on duration of positive affect, $F(1, 17) = 0.058$, $p = .81$, partial $\eta^2 = .003$. The main effect of time showed that there was not a statistically significant difference in mean duration of positive affect at the different time points, $F(1, 17) = 1.292$, $p = .27$, partial $\eta^2 = .071$. The main effect of group also showed that there was not a statistically significant difference in duration of positive affect between groups $F(1, 17) = 3.746$, $p = .07$, partial $\eta^2 = .181$. These results are highlighted in Figure 6.

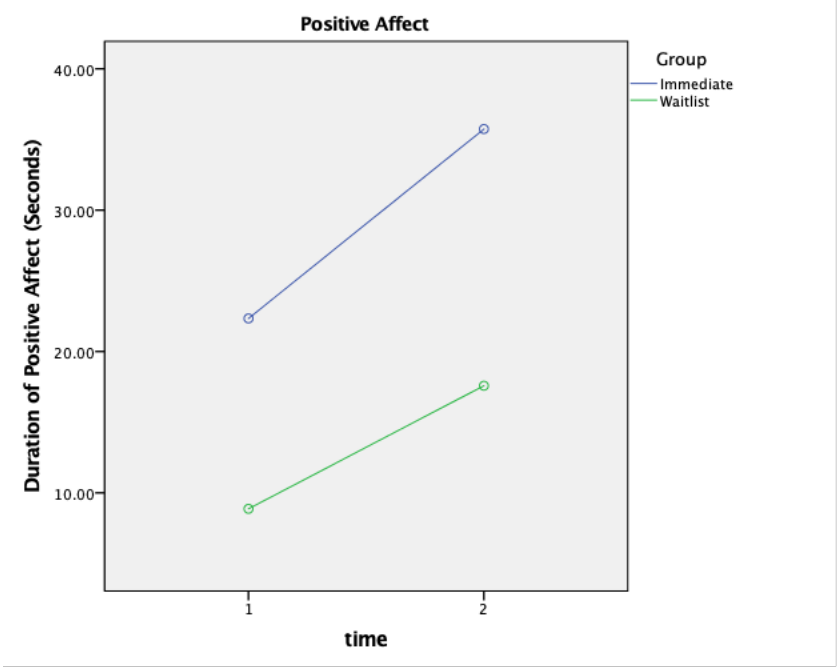

Figure 6. Duration of Positive Affect

Changes within the treatment and waitlist groups were also analyzed separately using a paired samples t-test. Those in the immediate condition did not show a statistically significant difference in duration of positive affect from pre (M= 22.34, SD=23.12) to post-treatment (M=35.74, SD=44.92): t(7)= -.63, p=.546, *d*=0.22. Those in the waitlist condition also did not show a statistically significant difference from pre (M= 8.87, SD=10.19) to post-treatment (M=17.58, SD=25.48): t(10)= -.1.33, p=.214, *d*=0.40.

Chapter 5: Discussion

Summary of Results

Parent Exit Survey. Social validity data indicated high parental satisfaction with the program. Parent ratings indicated that the course was well-written, clearly organized, and they would recommend the course to a friend. This level of parent buy-in is essential for caregiver mediated programs, the perceived cost–benefit ratio must be highly favorable to be

worth their time and energy. The responsibility falls solely on parents to accurately learn and implement these strategies at home with their child. If a parent finds treatment strategies to be personally meaningful and useful, they may be more likely to adhere to measures of treatment fidelity and integrate strategies into their everyday life (Durlak & DuPre, 2008; Wainer et al. 2017). While these comments are encouraging, other families did not successfully complete the program and we were unable to obtain their feedback to gain a more balanced perspective on program strengths and areas for improvement. It is difficult to know what encouraged some families to complete the course and others to discontinue their participation. Some possible factors that may have contributed to these results will be highlighted later in this section.

Fidelity of Implementation. Participants in the immediate condition showed significant improvements in their levels of PRT fidelity from pre- to post-treatment. This finding was not present for those in the waitlist condition. This suggests that parents were able to learn and apply many of the strategies covered in the course. This finding is significant given that many families completed the course over a relatively brief period of time. In addition, this indicates that parents were able to improve their skill use without ever receiving feedback from a clinician. According to traditional measures of PRT fidelity, four participants in the treatment group met fidelity following course completion, in comparison to one participant in the waitlist group. However, when using a newer more conservative measure these scores did not reach the 80% level required to meet FOI standards. Additional research is needed to determine the most accurate measures of PRT fidelity and what additional levels of support may be necessary to help parents achieve these standards.

Child Behavioral Outcome Measures. Three forms of child social communication behaviors were assessed: child vocalizations, duration of eye contact, and positive affect. These skills were selected based on previous research indicating that they are particularly important for development and may improve following PRT intervention (Bradshaw et al. 2017; Koegel et al. 2009; Vernon et al. 2012). There were no statistically significant interactions between the intervention and time for any of these variables. However, those in the immediate treatment condition did appear to show a stronger trend toward improvements in eye contact than those in the waitlist condition. Additionally, positive affect appeared to increase over the course of intervention, although this increase was not statistically significant and did not differ based on treatment condition. These results do not replicate previous findings by McGarry, Vernon and Baktha (2019) regarding improvements in child social communication behaviors following participation in the program.

Implications

Results of the present investigation suggest that a self-directed online PRT program may serve as a feasible and appealing method of service delivery for parents of children with ASD. This format reduces the cost of intervention, allows parents to flexibly implement strategies into their own schedule, and improves access to evidence-based intervention for families who would otherwise be unable to locate trained service providers. This level of accessibility is crucial, given previous research surrounding the multitude of barriers to evidence based ASD intervention (Johnson & Hastings, 2002). Parents endorsed high levels of satisfaction with the program. Additionally, families who completed the course showed increased levels of PRT treatment fidelity. However, more research is needed to better understand who may benefit from this self-directed approach and who may require a higher

level of care. This study did not replicate previous findings by McGarry, Vernon and Baktha (2019) regarding improvements in child social communication behaviors following participation in the program. Similarly, although parents showed significant improvements in their level of PRT fidelity, most did not achieve the 80% criteria required to meet fidelity of implementation standards. There are several factors that may have contributed to these results that warrant further study: the gradual rate of behavior change associated with social communication interventions, variation in individual characteristics of parent and child participants, as well as high rates of attrition resulting in a limited sample size and underpowered analysis.

Gradual Behavior Change. The brief nature of the current intervention represents a key factor to consider when interpreting these results. Currently, research regarding the ideal duration for PRT parent training programs is limited. It is unclear how much time is required for parents to effectively learn treatment strategies (Verschuur, Didden, Lang, Sigafoos & Huskens, 2013). However, face-to-face intervention programs involving Pivotal Response Treatment often consist of 6 to 12 months of direct intervention (Vernon, Holden, Barrett, Bradshaw, Ko, et al., 2019). It is possible that approximately 6 weeks of intervention was not sufficient to generate clinically significant differences in child social communication behaviors for the current sample. Treatment gains may have become more apparent over time with continued parent implementation of treatment strategies. However, due to limited parent response to follow-up measures, longer term outcomes were not able to be captured. Future studies may consider the inclusion of incentives to encourage parent's response to follow-up probes to better understand the potential longer-term benefits of course participation.

Even when an intervention is implemented over a longer period of time, child behavior change may be subtle and difficult to capture with standardized measures. For example, at the start of this study, many parents appeared highly directive when playing with their children. They provided frequent prompts for language in the absence of clear reinforcers. For example, a parent might ask: "What are you doing? How many blocks do you have? What color is that?" Although a child might respond to these prompts, they often appeared to do so without engaging in a true dyadic interaction with their parent. For example, they might avert their gaze and respond "blue" as a means to escape the interaction and return to their preferred solo activity. Over the course of the online PRT program, parents may have become less directive and lowered their language demands. It is possible that this resulted in children making fewer vocalizations overall. However, when children did vocalize, it is possible these sounds were more likely to be self-initiated or accompanied by eye contact and positive affect. Although in the short term this could present as a reduction in the frequency of vocalizations, it may actually represent an increase in social motivation and engagement. More research is needed to better understand the impact of the online PRT program on social communication behaviors.

Child Participant Characteristics. Another important area for future study involves identifying the subpopulation of children with ASD who would benefit most from this online program. Factors such as the child's developmental and language level likely impacted whether they demonstrated improvements over the course of intervention. The current program was designed for children with language delays and primarily emphasized strategies for teaching first words. Although the study inclusion criteria required that parents endorse language delay as a major area of concern, child language level varied significantly among

participants. While some children did not produce any words at the start of intervention, others were already using phrase speech at baseline. It is possible that children with more limited language benefited most from the program, while children with more advanced skills did not demonstrate gains. A larger sample size would be necessary to investigate language level as a potential outcome predictor. Alternatively, future studies may utilize narrower inclusion criteria with a specific focus on children who are minimally verbal. Future versions of the course may also modify the curriculum to target children with more advanced language skills.

Some participants with limited initial language skills demonstrated noticeable gains following the course. For example, one participant who will be referred to as "James" did not use any words prior to treatment per parent report. At baseline, he vocalized only 3 times over the course of a 5-minute parent-child interaction. By Week 6 of the course, James was observed to vocalize 12 times during that same 5-minute period. Similarly, his eye contact total duration increased from a total of 19.65 seconds to 65.34 seconds, and his positive affect total duration increased from 5.03 seconds to 80.99 seconds. Additionally, James learned how to sign 3 words over the course treatment (drink, milk, open). His receptive language showed similar gains: his MCDI total comprehension score increased from 80 to 97. Although this case represents just one example, other minimally verbal child participants appeared to show similar gains. For example, "Henry" also did not use any words at the start of treatment. By follow up he had learned to produce 4 words (cat, car, bubbles, coffee). He vocalized only 3 times during his initial baseline video. This increased to 13 vocalizations in the same 5-minute period following treatment. Although it is not possible to draw definitive

conclusions from these examples, the potential impact of this program for children who have limited language warrants further exploration.

In addition to variation in pre-treatment language skills, varying levels of child behavior challenges may have impacted child outcomes. For example, some parents reported concerns that their child became distracted or exhibited challenging behavior when the parent attempted to record the session with their phone. Other parents expressed concern that their child would cry or tantrum when the parent provided a prompt or placed any demands on the child. These behaviors are likely to be discouraging for parents who are attempting PRT strategies for the first time. Although behavior challenges are common during in-person PRT practice, typically a clinician is present to help the parent troubleshoot these concerns as they arise. Within the online PRT program, the topic of managing challenging behavior was addressed briefly during the final module. However, more support surrounding these behaviors may be necessary to help parents properly implement PRT strategies.

Parent Participant Characteristics. In addition to factors within the child participants, it is likely that individual parent factors also influenced the study outcome. This investigation did not examine characteristics such as levels of parent stress, which may have impacted parent's ability to follow through with course completion. Research suggests that higher parent stress levels are associated with poorer treatment outcomes following ASD intervention (Osborne et al., 2008). Additionally, more information is needed to better understand the impact of parents' socioeconomic status or level of education on their ability to meet fidelity. Literature suggests that web-based interventions may be more appealing to highly educated families or those with higher income levels (Hall & Bierman, 2015). Family structure may also play a role in parents' ability to carry out the treatment. For example,

single parent households likely had a more difficult time simultaneously recording sessions and implementing the PRT strategies. Families with multiple siblings in the home may have had more challenges recording a session without interruption or distraction. Each of these factors warrants further examination within the context of a larger randomized control trial.

Evidence from in-person clinical practice indicate that some parents are able to learn PRT strategies more easily than others (Steiner, Koegel, Koegel, & Ence, 2012). Many parents may require additional support or feedback to effectively implement this intervention. Models for parent-implemented intervention often identify "practice with feedback" as a key component for parent learning (Rush & Shelden, 2011; Kaiser & Hancock, 2003). Because this program was designed as an asynchronous, fully self-directed online course, parents did not receive any feedback on their implementation of strategies. One step up from this level of care might involve helping parents to review their own videos for treatment fidelity to enhance their learning. Research supports the use of video feedback to help parents self-monitor their implementation of treatment strategies. This technique has been shown to help parents meet standards for fidelity of implementation and enhance treatment outcomes (Tran, 2007; Ence, 2013). This modification could be a useful first step, as it does not require the additional cost or time commitment associated with direct clinician contact.

For some families, self-monitoring may not be sufficient to help them reach fidelity. These parents may require direct feedback from a clinician to troubleshoot ongoing concerns or challenges. Studies have shown that providing asynchronous feedback on parent videos can help enhance treatment outcomes (Ingersoll et al., 2016). This involves parents recording and uploading videos for a clinician to review. The clinician then watches the video and provides written or verbal feedback on areas for improvement. For parents who require an

even higher level of support, live coaching via videoconference may be more appropriate. Several studies have indicated that this method can achieve results similar to face-to-face therapy (Backhaus, Agha, Maglione, Repp, Ross, et al., 2012; Vismara, Young & Rogers, 2012). Finally, there are some parents for whom telepsychology may not be a viable option. Ethical guidelines for the use of telehealth from the American Telemedicine Association suggest that some families may not be a good fit for online interventions. This could be related to a lack of resources (e.g. appropriate technology, play materials) or due to the presence of severe behaviors that may disrupt treatment (Myers, Nelson, Rabinowitz, Hilty, Baker, et al., 2017.) Future studies should focus on identifying factors within the parent and child that predict which level of care will be most appropriate. Wainer and Ingersoll (2015) proposed a stepped-care model, in which parents start at the lowest level of care and clinician involvement is gradually increased as clinically indicated. A similar approach may be beneficial for future modifications of the online PRT program.

Participant Attrition. Challenges with participant course completion represent another important area for consideration. Research indicates that high attrition rates are common among online intervention programs, due in part to the lack of personal contact and ease with which families can discontinue their participation (Eysenbach, 2005). Unlike in-person treatments, when termination of services requires actively calling and canceling appointments, discontinuing an online program may happen in a more passive, gradual way. Parents may become busy with in-person appointments or other commitments and forget to upload videos or review a lesson. Within the present study, only two families actively requested to withdraw their participation from the study. These families reported that in-person NBDI treatments had become available for their child within their local community.

The other families who did not complete the course simply stopped accessing new lessons or uploading videos. As data was not collected from those who discontinued their participation, it is unclear what may have motivated some families to complete the course and not others.

The aforementioned challenges with attrition resulted in a lower sample size than was initially anticipated. As a result, data analysis was significantly underpowered. It is possible that limited statistical power contributed to the lack of significant differences in child social communication behaviors. Future studies would benefit from recruiting a larger sample size with the expectation that some families may not complete the full program. Additionally, incorporating daily text message reminders or other notifications may encourage ongoing parent participation. The present study offered a brief phone consultation as an incentive for study completion. However, study participants did not opt to utilize this offer. Future research should explore other incentives such as a financial compensation to promote study completion.

Limitations and Future Directions

Method of Online Delivery. As mentioned in the previous section, high rates of attrition and the resulting limited sample size represented an important limitation of this study. It is possible that frustration with the technology required for study participation discouraged course completion. To participate in the program, participants were required to navigate two separate websites: one to access the course (Qualtrics) and another to upload videos (Box). Video uploading also required multiple steps, include creating a Box account, recording the video from a camera or cell phone, and uploading the file into a shared folder. Multiple parents reported technical difficulties related to uploading and sharing videos. For

example, some parents reported that their video files were too large to be uploaded to the Box folder. Future studies should aim to simplify the video upload process. Ideally, parents would access the course and upload videos via a single comprehensive phone application. This would offer an easier solution for parents and potentially reduce the rate of attrition. This application could also include automatic prompts and reminders for course participation, as well as an option for parents to self-monitor their use of treatment strategies to help enhance treatment outcomes.

Participant Diversity. Research has demonstrated disparities in access to care for children with ASD from racial/ethnic minority backgrounds. African-American and Latino children receive an ASD diagnosis on average up to two years later than their white peers (Mandell et al., 2002). When finally diagnosed, these children are also less likely to receive critical intervention services (Liptak et al., 2008; Thomas et al., 2007). Similarly, children living in rural areas are less likely to access evidence-based treatment (Antezana, Scarpa, Valdespino, Albright & Richey, 2017; Mello, Urbano, Goldman & Hodapp, 2016). Telepsychology approaches may be an important avenue to begin addressing these disparities. It is promising that the current study included a sample that was racially and ethnically diverse. This represents an important step, as ASD research has historically included primarily white families (West et al., 2016). However, this sample was notably homogenous in terms of level of education and marital status. All parents reported at least some college education, and the majority held a master's degree or higher. Additionally, most parents in this sample were married, which provided the advantage of allowing one parent to record the video while the other parent implemented PRT strategies. More research is needed to understand how this program may support more socioeconomically diverse

families. This is especially important to help increase access to care for those who need it most.

Role of Outside Intervention. Another important limitation is that the current study did not collect any information regarding other interventions families were receiving in conjunction with the online program. Monitoring of control groups is especially important within implementation research, as researchers often incorrectly assume that control participants are not receiving outside treatment. Several studies have found that individuals who were supposed to be assigned to a control condition did in fact receive alternative services (Durlak & DuPre, 2008). In the current study, inclusion criteria required that parents had not received any prior training in PRT before enrolling in the course. However, it is unclear what other interventions children may have been participating in. For example, it is possible that all families were receiving some form of ABA intervention through their local early intervention providers. If families were benefiting from outside intervention, this could help explain why many children in both the immediate and waitlist group appeared to improve over time. Future studies should collect more detailed information regarding what other forms of intervention children are receiving and the intensity of that treatment.

Limited Standardized Measures. Due to limited parent responses to requests for follow-up measures, this study relied primarily on behavioral coding of parent-child videos to assess treatment outcome. There are many benefits of using observational measures, including the capacity to measure more subtle changes in parent and child behavior (Aspland & Gardner, 2003). However, it would be helpful to augment these measures with standardized assessments to better understand how children's behaviors compare to their same-aged peers. Additionally, collecting these standardized measures 3 to 6 months

following course participation would be necessary to examine longer term treatment outcomes.

Relationship Between PRT Fidelity and Treatment Outcomes. Another key area for future research involves clarifying the relationship between measures of PRT fidelity of implementation and treatment outcomes. Several studies of other evidence-based interventions have indicated that parents and providers who achieve a high level of treatment fidelity are more likely to experience positive treatment outcomes (Durlak &DuPre, 2008). However, more research is needed to consider whether current fidelity measures correlate with specific target behaviors in children with ASD. It is currently unclear what level of parent fidelity is necessary to generate clinically significant changes. Parents are generally considered to have met PRT fidelity when properly implementing strategies during 80% of trials. However, recent research from other intervention models suggest that expecting near-perfect implementation may not be an attainable goal (Durlak &DuPre, 2008). Moreover, this high level of fidelity may not be necessary for treatment gains. For example, studies of other interventions have suggested that 60% fidelity may be sufficient for attaining positive treatment results. This suggests that the exact level of implementation may be less important as long as key ingredients of the intervention are delivered (Durlak & DuPre, 2008). Future research should explore the level of fidelity necessary to facilitate behavior change.

Future studies should also consider optimal methods for measuring PRT fidelity. The current study examined parent use of strategies on a trial-by-trial basis. Each time a parent provided a prompt, the video was paused and core PRT components were scored as present (1) or absent (0). Once coded, fidelity scores were calculated using two methods: the traditional PRT approach and a more conservative approach. The traditional approach

involved examining each PRT strategy individually and determining the percentage of trials in which the parent demonstrated correct use of that strategy. The fidelity score for each PRT strategy was then averaged to calculate a "mean fidelity score". Within the conservative approach, parents were required to use all PRT strategies correctly within a given trial. Fidelity was calculated based on the percentage of "passing trials." This measure is more conservative, as it requires the parent to use every strategy correctly within a given trial in order to pass. Given that the resulting fidelity scores were significantly lower using the conservative approach, future research should consider which method more accurately predicts treatment outcomes.

Other studies have explored alternatives to the trial-by-trial coding method. For example, some have utilized an interval approach, in which each PRT component was scored over a series of 1-minute intervals (Nefdt, Koegel, Singer, & Gerber, 2010). Although this high level of detail can be advantageous, these approaches are time-intensive and require a team of trained research assistants and expensive video coding software. This method may not be feasible for community use or for parent self-monitoring. Suhrheinrich and colleagues (2013) developed a likert scale to score PRT fidelity in a school setting. Raters watched an entire 10-minute clip of a teacher interacting with a student and subsequently rated each PRT component on a scale of 1 (teacher did not use strategy or never implemented it correctly) to 5 (teacher implemented the component competently throughout the session). This simplified method of coding fidelity was significantly correlated with the trial by trial method and may serve as a more feasible alternative. Future research should aim to identify the most efficient and accurate measures of fidelity for parent-implemented PRT.

Conclusions

In conclusion, these findings suggest that an online parent training program may serve as a feasible and appealing method to promote dissemination of PRT strategies. This method of service delivery has the potential to help bridge the gap between research and practice and reduce barriers to service access for families of children with ASD. As the quantity of evidence-based interventions continues to rise, it has become increasingly critical to explore new methods of treatment dissemination. A treatment is only effective when it is able to impact those who need it most. Currently, families who live in remote areas or those from low-income backgrounds are often unable to access quality care for their child with ASD (Antezana, Scarpa, Valdespino, Albright & Richey, 2017; Mello, Urbano, Goldman & Hodapp, 2016). Even when families receive intervention, recent studies raise concern regarding the quality of available services. Many families are offered treatments that lack sufficient empirical support (McIntyre & Barton, 2010). Additionally, most children receive fewer than the recommended number of treatment hours per week (Ziskind et al, 2020). The online PRT program can begin to address these concerns, by offering a program that is easily accessible to parents and equips them with the tools to help their child at home. Parents can move at their own pace and integrate treatment strategies into their existing daily routines, without the time commitment or expense associated with traditional in-person treatments.

However, more research is needed to better understand who may benefit most from this form of intervention. It is possible that the current program is most suitable for children with limited language, whereas children with more advanced language skills may require a modified curriculum. Additionally, some families may require a higher level of support to effectively learn and implement PRT strategies. Future research should examine factors that predict treatment outcome for parents who complete the online course. Additionally, future

research should focus on the development of a comprehensive PRT phone application. This application could consolidate the video upload process, incorporate automatic study reminders, and allow parents to self-monitor for treatment fidelity. These modifications may not only encourage higher rates of course completion, but also enhance parent fidelity and child treatment outcomes.

The results of this study are promising and indicate that parents are able to independently learn and implement PRT strategies. These findings support the use of online methods of service delivery to increase access to intervention. Online intervention programs may serve a key role in ensuring that young children with ASD do not miss out on a critical window for early intervention. The online PRT program has the potential to impact the developmental trajectory of children who would not otherwise receive adequate treatment. A continued focus on dissemination research will be critical to ensure that all children with ASD have access to high quality, evidence-based care.

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Appendix A

Pivotal Response Treatment Fidelity of Implementation

A 5-minute video probe of the parents implementing PRT is recorded. While reviewing the videotape, each learning opportunity is scored on a trial by trial basis. Parents must demonstrate each PRT component (described below) in 80% of trials to meet fidelity of implementation. After each trial, the video probe is paused and each of the PRT components is scored.

1	The PRT component was demonstrated.
0	The PRT component was not demonstrated.

Child Attending	The parent must have the child's attention (on the stimulus or the parent) prior to presenting an opportunity.
Clear Opportunity	The parent's question/instruction/opportunity for the child to respond must be clear and appropriate to the task.
Child Choice	To a large extent, the parent should follow the child's choice with tasks and activities. However, the parent must always assume control should the child engage in dangerous (e.g.. self-injury) or inappropriate (e.g. destroying property) activities. If child is not showing interest in the current task, parent should attempt to change the activity.
Contingent	Reinforcement must be contingent upon child's behavior. The parent's response (i.e. giving the child a toy) must be dependent upon the child's response (i.e. saying "toy").
Natural Reinforcement	Reinforcement should be natural or directly related to the child verbalization.
Contingent on Attempts	Any goal-directed attempt to respond to questions, instructions, or opportunities should be reinforced. Although an attempt does not necessarily need to be correct, it has to be reasonable.

Appendix B

Online Parent Exit Survey

Please fill out the following form regarding your knowledge of early intervention strategies and your child's current behaviors.

	Your Rating					
	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
My child mostly uses words to communicate	○	○	○	○	○	○
My child seeks me out for social or play activities	○	○	○	○	○	○
Over the last 6 weeks, I have seen my child's language skills improve	○	○	○	○	○	○
Over the last 6 weeks, I have seen my child's social engagement improve (e.g. playing/interacting with others more frequently)	○	○	○	○	○	○
I feel confident advocating for my child and his or her needs	○	○	○	○	○	○
I feel that I have the knowledge and skills to help my child's language and social skills improve	○	○	○	○	○	○
I have a clear understanding of Pivotal Response Treatment	○	○	○	○	○	○
This course was clearly written and well-organized	○	○	○	○	○	○
I would recommend this course to a friend	○	○	○	○	○	○