A COMPARISON OF A GROUP ABA (GABA) VERBAL BEHAVIOR MODEL OF

EARLY INTENSIVE BEHAVIORAL INTERVENTION AND PIVOTAL RESPONSE

TREATMENT FOR CHILDREN WITH AUTISM

by

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ABSTRACT

The autism spectrum disorders (ASDs) are characterized by a triad of impairments in social interaction, communication, and behavior. Once considered untreatable, research has identified comprehensive behavioral intervention as the most well established treatment option. To date, the UCLA method of early intensive behavioral intervention has received the most large-scale research attention and empirical support. However, alternative behavioral methods have also emerged, including the Pivotal Response Treatment (PRT) and the Verbal Behavior (VB) methods. This study compared the outcomes of 14 children with autism participating in a community-based program based on the VB method to the outcomes for 14 children participating in a community-based program based on the PRT method, over a 12-month period. Assessments were conducted to measure cognitive, receptive and expressive language, and adaptive behavior skills, as well as problem behavior and parenting stress. Independent t-tests confirmed the groups were well matched for both baseline cognitive ability and chronological age. A 2 x 2 mixed model analysis of variance showed statistically significant changes over 12 months in IQ scores, receptive and expressive language age equivalents, and problem behavior scores. Significant findings were not found for either adaptive behavior scores or parenting stress scores. Changes in cognitive and adaptive behavior scores were similar to those reported in published UCLA-based studies of similar intensity. Study limitations and recommendations for future research are provided. Although additional research is needed to examine the long-term effectiveness of the programs examined in this study, it appears that they both hold promise as effective autism early intervention approaches that are relatively cost-effective.

PREFACE

This research was approved by UBC Behavioral Research Ethics Board on March 31, 2011, as per certificate H10-02948. Use of data from Nova Scotia was approved by the IWK Research Ethics Board on April 18, 2011, as per certificate 1006921. The research was designed and executed by Richard Stock. The written document was produced by Mr. Stock with input from his supervisory committee and from Dr. Isabel Smith at Dalhousie University. This research has not been published.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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CHAPTER 1: REVIEW OF THE LITERATURE

The term Pervasive Developmental Disorder (PDD) is used to describe a spectrum of disorders of child development. The PDDs include abnormalities in the areas of social skills development, communication abilities, and repetitive behaviors or interests; symptoms can range from very mild to very severe (American Psychiatric Association, 2000). PDD is synonymous with the term Autism Spectrum Disorder (ASD) and includes Autistic Disorder (more commonly referred to simply as "autism"), atypical autism or Pervasive Developmental Disorder Not-Otherwise-Specified (PDD-NOS), Asperger's Syndrome, Childhood Disintegrative Disorder, and Rett's Syndrome. Of these, autism, Asperger's syndrome, and PDD-NOS are the most common. Males are over-represented in the ASDs, with a male:female sex ratio of 4 or 5 to 1 (Stevens et al., 2007). Autism is associated with severe-profound mental retardation in about 40% of cases (Fombonne, 2003); anxiety disorders, obsessive-compulsive disorder, attention deficit hyperactivity disorder, speech and language disorders, and learning disabilities are also common comorbid diagnoses (Schreibman, 2005). The Centers for Disease Control and Prevention (CDC) estimates the prevalence of ASD at 1 in 88 children (CDC, 2012).

The diagnostic criteria for Autistic Disorder are found in the Diagnostic and Statistical Manual (4th edition, text revision) (DSM-IV-TR) of the American Psychiatric Association (2000). In order to meet the diagnostic criteria, an individual must display six or more of the following prior to the age of 3:

1) Qualitative impairment in reciprocal social interaction as manifested by at least two of the following:

   a) Marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye

gaze, facial expression, body postures, and gestures to regulate social interaction;

b) Failure to develop peer relationships appropriate to developmental level;

c) Lack of spontaneous seeking to share enjoyment, interests, or achievements with other people and;

d) Lack of social or emotional reciprocity.

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

a) Delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime);

b) In individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others;

c) Stereotyped and repetitive use of language or idiosyncratic language; and

d) Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.

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

a) Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus;

b) Apparently inflexible adherence to specific, nonfunctional routines or rituals;

c) Stereotyped and repetitive motor mannerisms such as hand or finger flapping or twisting, or complex whole-body movements; and

d) Persistent preoccupation with parts of objects.

In addition to these criteria, a diagnosis of autism requires delayed or abnormal functioning

prior to age three in at least one of the following areas: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.

The DSM-IV-R states that the diagnostic category for PDD-NOS should be used when a child presents with severe and pervasive impairment in the development of reciprocal social interaction, which is also associated with an impairment in either verbal or nonverbal communication skills or with the presence of repetitive behavior, interests, and activities. Children receiving a diagnosis of PDD-NOS are sometimes referred to as having "atypical autism" -- that is, their presentations do not meet the criteria for Autistic Disorder because of late age of onset, atypical symptomatology, sub-threshold symptomatology, or any combination of these.

Asperger's Syndrome (AS) is characterized by severe and sustained impairments in social interaction and includes the development of restricted, repetitive patterns of behavior, interests, and activities (APA, 2000). Unlike autistic disorder, a diagnosis of AS does not involve significant delays or deviances in language development, although the pragmatic aspects of communication may be affected; nor are there any significant delays in cognitive development, the development of age-appropriate self-help skills, or adaptive behaviors. Asperger's Syndrome is usually diagnosed at a later age than either autism or PDD-NOS; it is not uncommon for diagnosis to occur after entry into the school system, and even into adolescence.

The ASDs are more common than Down syndrome, pediatric AIDS, diabetes, and childhood cancers (CDC, 2001) and have a significant negative social, emotional, and financial impact on the quality of life of both children and their families. It is estimated that it costs $3.2 million (USD) to provide care for a person with autism over the course of their

lifetime and that the societal, economic costs of the ASDs are approximately $35 billion USD per year (Ganz, 2006). In large part, the costs are related to the intensity of early intervention that these children receive.

Behavior Analysis

Behavior analysis is a field of psychology that consists of three main branches: behaviorism, the experimental analysis of behavior, and applied behavior analysis (Cooper, Heron, & Heward, 2007). Behaviorism is the philosophy of the science of behavior and views its subject matter as a natural science with an emphasis on observable phenomena. The experimental analysis of behavior originated with B.F. Skinner's book *The Behavior of Organisms* in 1938, which highlighted two types of behavior: respondent behavior and operant behavior. Respondent behavior is reflexive behavior that is elicited by an antecedent stimulus that immediately precedes it (e.g., a bright light elicits pupil constriction). Operant behaviors are not evoked by antecedent stimuli but are influenced (i.e., strengthened or weakened) by their consequences. The experimental analysis of behavior is concerned with basic research demonstrating the functional relations between behavior and environmental events. The primary unit of analysis is called the "three term contingency" consisting of an antecedent, a behavior, and a consequence (Cooper et al., 2007).

Applied behavior analysis (ABA) is defined as "the science in which tactics derived from the principles of behavior are applied systematically to improve socially significant behavior and experimentation is used to identify the variables responsible for behavior change." (Cooper et al., 2007, p. 20). ABA treatment approaches involve the systematic application of interventions based on the principles of learning theory to improve socially significant behaviors (Baer, Wolf & Risley, 1968/1987; Sulzer-Azaroff & Mayer, 1991). One

of the earliest studies in the field of applied behavior analysis demonstrated the effects of

positive reinforcement on the arm-raising behavior of a profoundly developmentally disabled

boy (Fuller, 1949). Since that time, thousands of studies demonstrating the application of

ABA to the socially significant behaviors of people both with and without developmental

disabilities have been published.

ABA methods were first applied to children with ASD beginning in the early 1960s

(Ferster, 1961; Ferster & DeMyer, 1961; Wolf, Risley, Johnston, Harris, & Allen, 1967;

Wolf, Risley, & Mees, 1964). However, ABA-based intervention programs for children with

ASD did not become widely recognized until the late 1980s, when two important events

occurred. The first was the publication of Dr. O. Ivar Lovaas's ground-breaking research

study in which 47% of children with ASD who received 1-to-1 intensive behavioral

intervention for 40 hours per week over 3 years at the University of California-Los Angeles

(UCLA) achieved normal intelligence and regular educational placements (Lovaas, 1987).

The second was the publication of Catherine Maurice's autobiographical account (Maurice,

1993) of her own two children with ASD who were successfully treated with Lovaas's

behavioral intervention method. The publication of Lovaas's study demonstrated for the first

time that children with ASD could achieve significant positive outcomes if they receive early

intensive behavioral intervention. Maurice's book helped to disseminate these findings more

broadly in popular culture, creating a demand for clinical behavior analytic services for these

children. Since that time, a large amount of additional research has been conducted in the

area of ABA and intervention for ASD, and the public demand for services has continued to

increase. Currently, interventions based on the science of ABA are considered to be the only

empirically supported interventions for children with ASD (Howard, Sparkman, Cohen,

Green, & Stanislaw, 2005) and were recommended by the U.S. Surgeon General (1999). However, it should be noted that "Lovaas" and "ABA" are not synonymous. The "Lovaas method" -- referred in this document as the "UCLA method" after the university where Lovaas's original study was conducted -- is only one type of early intensive behavioral intervention program based on the science of applied behavior analysis.

The UCLA Method

Prior to the 1960s, autism was viewed from the perspective of the disease model (i.e., with a psychological etiology) and was therefore seen as an illness that required treatment in a hospital or institutional setting. It was also viewed from a psychoanalytic perspective as a condition caused by poor parenting (Bettelheim, 1967). This viewpoint enjoyed considerable popularity during the 1960s and 1970s and, as a result, led many mothers of children with ASD to experience intense self-blame and guilt for their child's condition (Hall, 2009).

Bernard Rimland, an American research psychologist and the father of a son with ASD, challenged the prevailing psychoanalytic theory in his 1964 book, *Infantile Autism: The Syndrome and Its Implications for a Neural Theory of Behavior*. Rimland's book disputed Bettleheim's (1967) theory and began to move the field away from viewing autism as an emotional illness caused by rejecting mothers to an understanding of it as a neurodevelopmental disorder of biological origin. Viewing autism as a neurodevelopmental disorder has contributed to a wealth of research programs in medicine, genetics, neurophysiology, neuropsychology, immunology, toxicology, and related disciplines (U.K. Department of Health MRC, 2001). While advances in these areas are occurring at an exponential rate, these lines of research have not yet identified a single etiology for autism.

However, it is not necessary to know the exact etiology (or etiologies) of autism in order to develop, deliver, and evaluate interventions.

Behaviorists (i.e., applied behavior analysts) focus on variables in children's current environments, as opposed to other etiological factors (e.g., genetics). Environmental variables are amenable to change; by systematically manipulating these variables, investigators are able to determine the effects of these changes in controlled studies. Additionally, behaviorists view ASD as a syndrome of behavioral excesses (e.g., repetitive behaviors) and deficits (e.g., communication and social skills) that can be influenced, like all human behaviors, through the well-researched principles of learning and operant conditioning (Lovaas & Smith, 2003). Behavioral research in the 1960s and 1970s proved very effective in demonstrating the power of operant conditioning to teach skills to children with ASD, but the gains achieved were frequently limited by poor maintenance and generalization (i.e., skills were not demonstrated outside of training environments). This led researchers, including Lovaas, to implement interventions in more natural environments such as children's homes and community settings.

Early Intensive Behavioral Intervention (EIBI) programs based on the work of Lovaas are characterized as adult-directed, discrete trial-based intervention programs that are started early in life (ages 3-4), provide many hours of intervention per week (usually, 30-40 hrs), last for 2-3 years, and are carried out in children's homes and communities. Lovaas first described his program in a book entitled *Teaching Developmentally Disabled Children: The ME Book* (1981). Lovaas's behavioral intervention program is based on a basic principle of operant psychology: behavior is strengthened or weakened by its consequences. As such, his protocol begins with a discussion of the use of rewards and aversives (i.e., punishers) and

how to deal with challenging behaviors, including problems with attention and self-stimulation (e.g., hand flapping). His manual also includes strategies for teaching the child to "get ready to learn" and stresses the importance of sitting down when directed to do so and giving eye contact when requested by a teacher/parent. The primary program goals include development of the following skills: imitation, matching, following teacher directions (i.e., following receptive commands), verbal imitation, play skills, receptive object identification, expressive object labeling, more complex expressive language (i.e., using verbs, adjectives, prepositions, pronouns, time concepts, emotion labels, and phrase speech), and pretend play skills. *The Me Book* also offers information on generalizing and maintaining skills across time, reducing echolalia and "psychotic speech," and teaching basic self-help skills including dressing, eating, and toileting, and transitioning to school.

The Me Book specifies that the "adult is boss" (p. 236) and recommends 6-8 hours per day of "hard work" with "play" interspersed in a 4:1 ratio (i.e., 80% work and 20% play; p. 238). During the periods of "work," the teacher is urged to deliver instructions at a rate of 1-20 per minute. These instructions are part of teaching units that are called "discrete trials." Discrete trials consist of an antecedent or instruction from the teacher, a response from the student, and a consequence from the teacher, with an inter-trial interval of a few seconds between each teaching unit. An additional feature of the discrete trial is the prompt, which is an extra stimulus that is provided by the teacher after delivering the antecedent instruction to help evoke a correct response from the student. Once a student is responding correctly to prompted instructions and his/her behavior is being reinforced, the prompt is systematically faded until the student's response is solely under the control of the teacher's instruction. The discrete trial is the basic unit of instruction for teaching all target behaviors in the skill

domains listed previously. For this reason, the Lovaas method is sometimes referred to as discrete trial teaching/therapy (DTT). Table 1 summarizes the basic components of a discrete trail.

Table 1. Components of a Discrete Trial

Component	Definition and Example
1. Antecedent	The teacher's instruction; for example, "Touch your head"
2. Prompt	The assistance provide by the teacher to evoke a correct response; for example, the teacher guides the student's hand towards his head
3. Response	The student's response (may be correct, no response, or incorrect); for example, the student touches his head
4. Consequence	Either reinforcement for a correct response or punishment for an incorrect response; for example, the teacher might say, "Nice job touching your head" and/or deliver a conditioned reinforcer such as a preferred food for a correct response
5. Inter-trial interval	A 2-3 second pause between trials

Research on the UCLA Method

In 1987 and 1993, Lovaas and his colleagues published two articles that triggered a paradigm shift in attitudes toward autism treatment (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993). The articles described the "recovery" of nearly 50% of children who received early intensive behavioral intervention (using primarily DTT) for several years. This research demonstrated, for the first time, that significant positive outcomes for children with ASD were possible, fueled demand for ABA-based interventions, and invited scientific criticism.

Criticisms primarily focused on the methodological limitations of the studies, including non-random assignment to groups, non-uniform assessment protocols, and selection bias (Reichow & Wolery, 2009).

Since the 1987 study, several studies have been published, including those associated with the National Institute of Mental Health (NIMH) Multi-Site Young Autism Project (MYAP) as well as independent labs. Reichow and Wolery (2009) provided a comprehensive synthesis of 13 EIBI studies (see Table 2) based on the UCLA method. Two additional UCLA method studies published after the Reichow and Wolery review are also included in Table 2 (Eikeseth, Klintwall, Jahr, & Karlsson, 2012; and Hayward, Eikeseth, Gale, & Morgan, 2009). Reichow and Wolery (2009) included descriptive analyses of the UCLA-based studies, including effect size analyses and meta-analysis. In general, analysis of effect size indicated that children with ASD who received EIBI based on the UCLA method made large gains in multiple domains of behavior and made more progress than children who received less intensive behavioral treatments or other treatments. However, while the effect sizes were large and significant, intervention effects could not be attributed exclusively to the behavioral intervention because none of the studies controlled for maturation and the effect size analyses were limited by the data provided (i.e., individual child data were not reported). Also, no studies comparing the UCLA method to other widely recognized treatment programs have been published. Until such studies are undertaken, it is not possible to determine if behavioral intervention following the UCLA method is more or less effective than other behavioral or non-behavioral options.

Table 2. Summary of UCLA Method Studies (1987-2012)

Authors/Year	N & Sex ratio (M:F)	Mean CA at intake	Exclusion Criteria	Deviation from standard UCLA Method	Mean hr/wk and duration in months	Settings/ Components	Outcome Summary
Lovaas (1987)	19 EIBI 19 ctrl 1 (fewer hrs of EIBI) 21 ctrl 2 (no tmt) no gender data	35 mo	PMA <11 mo	N/A (original EIBI method)	40 hrs/wk for 24+ mo (EIBI) 10 hrs/wk for 24+ mo (ctrl grp 1) No tmt for ctrl grp 2	Home Preschool Parent training	47% of 40 hr/wk group, 0% of the 10 hr/wk group, and 5% of the no treatment group achieved IQs in normal range and regular grade 1 placement ("best outcome")
Anderson, Avery, DiPietro, Edwards, & Christian (1987)	14 EIBI (11:3) no ctrl grp	43 mo (rng 18-64)	Older than 72 mo	Fewer hours; shorter duration; no aversives; older age at intake	15 hrs/wk for 12 mo (8 children); 15 hrs/wk for 24 mo (7 children)	Homes Preschool	0% achieved best outcomes; 86% of EIBI showed improvement; 14% showed no change (baseline mental age, social, and language scores below 12 mo); poorest outcomes for most impaired children
Birnbrauer & Leach (1993)	9 EIBI (5:4) 5 ctrl (no tmt) (5:0)	39 EIBI (rng 32-47) 33 ctrl (rng 22-47)	Sensory or physical impairments	Fewer hours; shorter duration; no aversives	19 hrs/wk for 22 mo (EIBI) no data on ctrl hrs	Homes Parent training	0% of both EIBI and ctrl achieved "best outcomes"; 44% EIBI showed substantial improvement; 56% of EIBI made "modest" gains; children in the ctrl group generally performed lower than the EIBI group
Smith, Eikeseth, Klevstrand, & Lovaas, 1997	11 EIBI (11:0) 10 ctrl (fewer hrs of EIBI & earlier school entry) (8:2)	Mean not provided Age <46 months at intake for both grps	Major medical limitations (e.g., seizures, CP); ratio IQ >35	Archival data; fewer hrs/wk; lower mean IQ	30 hrs/wk for 24 mo (EIBI) 10 hrs/wk for 24 mo (ctrl)	Home Preschool Parent training	0% achieved "best outcomes"; IQ for EIBI group increased from 24 to 36; IQ for ctrl grp decreased from 27 to 24. EIBI grp had more expressive speech at follow up

Table 2. Summary of UCLA Method Studies (1987-2012)

Authors/Year	N & Sex ratio (M:F)	Mean CA at intake	Exclusion Criteria	Deviation from standard UCLA Method	Mean hr/wk and duration in months	Settings/ Components	Outcome Summary
Scheinkopf & Siegel (1998)	11 EIBI 11 ctrl (school-based educational interventions) no gender data	34 EIBI 35 ctrl	n/a	Fewer hrs/wk; shorter duration; not affiliated with a University clinic	27 hrs/wk (range 12-43) for 20 mo (EIBI) 11 hrs/wk for 18 mo (ctrl)	School Home	0% achieved "best outcomes"; 100% of EIBI had post-tmt IQ >65 (mean 89.7 pts) vs. 55% of ctrl (mean 64.3 pts); modest improvements in autism symptomatology for both grps
Smith, Groen, & Wynn (2000)	15 EIBI (12:3) 13 ctrl (parent training) (11:2)	36.7 mo	IQ < 35 or >75; CA <18 mo or >42 mo; major medical conditions or foster care	Fewer hrs/wk; tmt phased out for children progressing slowly after 18 mo; fewer parental requirements; no aversives	24.5 hrs/wk for 12 mo, then gradual reduction (EIBI) Mean EIBI duration 33 mo 5 hrs/wk for 3-9 mo (ctrl)	Home School Parent training	0% achieved "best outcomes"; EIBI gained an average of 16 IQ pts while ctrl lost an average of 1 IQ pt; EIBI also outperformed ctrl on visual-spatial skills, language, and academics; no significant between grp differences for adaptive functioning or behavior problems; PDD-NOS children may have gained more than those with autism
Bibby, Eikeseth, Martin, Mudford, & Reeves (2001)	66 EIBI (55:11) no ctrl	45 mo	Medical conditions	Parent-initiated approximation of UCLA workshop method with quarterly consultation vs. weekly; consultants not UCLA-certified	30 hrs/wk (rng 14-40) for 33 mo	Home Schools	0% achieved "best outcomes"; IQ experienced a non-significant change from mean 50.8 to mean 55.0 (n=22); VABS scores had a significant 8.9 pt (mean) increase after 33.2 mo (n=21); children who started before 43 mo made mean 10.8 IQ pts gain, while those starting after 43 mo had mean 2.4 pt loss; recognizable word speech improved from 38% to 92%

Table 2. Summary of UCLA Method Studies (1987-2012)

Authors/Year	N & Sex ratio (M:F)	Mean CA at intake	Exclusion Criteria	Deviation from standard UCLA Method	Mean hr/wk and duration in months	Settings/ Components	Outcome Summary
Boyd & Corley (2001)	22 EIBI *(19 autism, 3 PDD-NOS)* (16:6)	41 mo (rng 29-48)	Medical condition or chromoso-mal disorder	Shorter EIBI duration, included children with MR; older at intake; slightly fewer hrs/wk	30-40 hrs/wk for 23 mo (rng 9-36)	Home	0% achieved "best outcomes; 32% had IQ in normal range; 100% required aide support in school; parental satisfaction was high
Sallows & Graupner (2005)	23 (10 parent-directed & 13 clinic-directed) EIBI (19:4) no ctrl	33 mo clinic & 34 mo parent EIBI (rng 24-42)	Neurologic normalities; ratio IQ <35	Community based grp had less frequent supervision	38 hrs/wk for clinic-directed for 24 mo 32 hrs/wk for parent-directed for 24 mo	Homes Schools	38% clinic-directed & 60% parent directed achieved "best outcomes"; mean full scale IQ increased from 51-76 (25 pt gain); outcomes predicted by pre-tmt imitation, language, and social responsiveness
Cohen, Amerine-Dickens, & Smith (2006)	21 EIBI (18:3) 21 ctrl (school-based services) (17:4)	<48 mo	Pre tmt IQ <35; major medical issues; >400 hrs EIBI prior to study	No aversives; followed Lovaas for yrs 1 and 2, with addition of social skills training in yr 3	35-40 hrs/wk for 47 wks per yr for 3+ yrs (EIBI) ctrl grp services were eclectic & ranged from 1-25 hrs/wk (mean unavailable)	Home and community (pre-school) Parent training	0% achieved "best outcomes"; EIBI showed statistically significant gain of 25 IQ pts vs. 14 pts ctrl, with similar effects on adaptive behavior; no between grp differences in language comprehension or non-verbal skills; 29% EIBI achieved normal educational placement (unassisted) vs. 5% ctrl
Eldevik, Eikeseth, Jahr, Smith (2006)	13 EIBI (10:3) 15 ctrl (eclectic) (14:1)	53 mo EIBI (rng 36-68) 49 mo ctrl (rng 21-69)	Major medical conditions	Fewer hrs/wk; school setting; mean pre-tmt IQ 41	12.5 hrs/wk for 24 mo (EIBI) 12 hrs/wk for 21 mo (Eclectic)	Classrooms	0% achieved "best outcomes"; EIBI gained mean 8.2 IQ pts vs. mean decline of 2.9 IQ pts ctrl; outcomes predicted by pre-tmt IQ and language abilities

Table 2. Summary of UCLA Method Studies (1987-2012)

Authors/Year	N & Sex ratio (M:F)	Mean CA at intake	Exclusion Criteria	Deviation from standard UCLA Method	Mean hr/wk and duration in months	Settings/ Components	Outcome Summary
Eikeseth, Smith, Jahr, & Eldevik, (2007)	13 EIBI (8:5) 12 ctrl (eclectic) (11:1)	66 mo (rng 48-8)	Major medical conditions; IQ <50	Older students in school settings	28 hrs/wk for 31 mo (EIBI) 29 hrs/wk for 33 mo (ctrl)	Kindergarten and elementary school classrooms	0% achieved "best outcomes"; EIBI gained a mean of 25 IQ pts (vs. 7 pts ctrl) with 54% moving into the normal range (vs. 17% ctrl); EIBI showed net gains in communication, socialization, and daily living skills (vs. net losses for ctrl in the same areas)
Magiati, Charman, & Howlin (2007)	28 EIBI (27:1) 16 ctrl (nursery school) (12:4)	38 mo EIBI (rng 22-54) 42 mo ctrl (rng 33-54)	Major medical conditions	All used 1:1 home discrete trail teaching but 2 added verbal behavior method; fewer hrs/wk	33 hrs/wk for 24 mo (EIBI) 26.5 hrs/wk for 24 mo (ctrl)	Home (EIBI) Specialized nursery school (Ctrl)	0% achieved "best outcomes"; both grps showed improvements in age equivalents in developmental areas but standard scores changed little; no between-group differences in cognitive, language, play, or autism severity
Hayward, Eikeseth, Gale, & Morgan, 2009	23 EIBI clinic-based (19:4) 21 EIBI parent managed (15:6)	36 mo clinic-based 34 mo parent managed	Geography determined group assignment	Clinical supervision model	37 hrs/wk for 12 mo (clinic based) 34 hrs/wk for 12 mo (parent managed)	Home, community, and nursery/school	No differences between groups; significant improvements on all measures; mean gain of 16 IQ pts, 7.2 mo. receptive language, 6.5 mo. expressive language, 6.4 pts VABS composite
Eikeseth, Klintwall, Jahr & Karlsson, 2012	35 EIBI (29:6) 24 ctrl (20:4) (treatment as usual)	47 mo EIBI (rng 25-76) 53 mo ctrl (rng 31-88)	<10 hrs per week	Older students in pre/school settings; school staff as therapists	Mean 23 hrs/week for 12 months (EIBI) rng 15-37 hrs/wk	Preschool	Significant improvement in VABS composite (mean 8.3 pt gain), communication, daily living, socialization and motor scores.

EIBI = Early Intensive Behavioral Intervention (UCLA method); PMA = pro-rated mental age; hrs/wk = hours per week of intervention; ctrl grp= control group; mo = months; rng = range; (M:F) = male-to-female sex ratio; tmt = treatment; MR = mental retardation; MA = mental age.; CA = chronological age; Dx = diagnosis; VABS = Vineland Adaptive Behavior Scales.

Predictors of Outcome

Reichow and Wolery analyzed moderator variables related to outcomes of the UCLA method. They found that the largest changes in IQ scores occurred when supervisory/therapy staff were specifically trained in the UCLA method, when the intervention duration was toward the upper end of the range found across the studies (i.e., 24-36 months), and when the total weekly hours of therapy were in the upper range as well (i.e., 30-39 hrs/wk). Additionally, research has identified several child characteristics that are predictive of outcomes, including pre-treatment IQ, language scores, social skill scores, and imitative repertoires (Sallows & Graupner, 2005) as well as chronological age at intake, adaptive behavior scores, and autism severity (Eikeseth et al., 2012). That is, younger children who have higher IQ scores; more language, social, imitation and adaptive behavior skills; and lower autism severity tend to make greater gains in UCLA method therapy than children without these characteristics, as a group. However, the heterogeneity of outcomes is well established (Eikeseth et al., 2012), so these characteristics do not predict an individual's developmental path in therapy.

Limitations of the UCLA Method

Despite the robust body of research on the UCLA method of EIBI, the method has several limitations. One of the most practical is that it requires many hours of therapy per week for upwards of 2 years for an optimal outcome. This expenditure of time and money may be out of reach for many families of children with ASD, as well as many funding agencies (i.e., state or provincial government Departments or Ministries). Birnbrauer and Leach (1993) suggested that volunteers can be used as interventionists to decrease the costs of intensive home-based EIBI, but also acknowledged the practical limitations of managing a

team of volunteers for an extended length of time (e.g., 2 years or more). Indeed, using volunteer interventionists limited these authors' ability to provide the desired intensity with regard to hours per week – they provided, in the end, a mean of 19 hrs/wk of intervention when their stated goal was 30 hrs/wk. A further limitation of volunteer interventionists is staff attrition; Birnbrauer and Leach reported a mean of 4 months of volunteer commitment in their study. Such high attrition is likely to have negative implications for intervention continuity and consistency as well as for the resources required for frequent staff training.

As noted previously, the estimated lifetime costs for a person with ASD are significant (Ganz, 2006). Jarbrink, Fombonne, and Knapp (2003) collected data from families in the United Kingdom (UK) and found an average of €690 per week in family costs for caring for a child with ASD, including lost wages (Note: one Euro equals approximately 1.3 Canadian dollars). Knapp, Romeo, and Beecham (2009) estimated conservative lifetime costs in the UK, not including informal care by families, at between €796,050 and €1,234,044. Ganz (2006) provided a broader perspective, including the costs associated with health, child, adult, home, respite, and family care; special education; supported employment; non-medical costs; and lost productivity for people with ASD and their parents. She reported lifetime costs of $3,200,000 USD or approximately €2,000,000 (adjusted using GDP purchasing power parity for 2003). Peng, Hatlestad, Klug, Kerbeshian, and Burd (2009) analyzed health care costs in North Dakota (USA) and found that children with ASD had Medicaid costs that were eight times greater than their typically developing peers.

Given the tremendous individual and societal costs associated with supporting people with ASD, it is important to investigate whether or not an initial investment in expensive EIBI treatment might yield future cost savings by altering the developmental trajectories of

children who receive it. Jacobsen, Mulick, and Green (1998) reported annual EIBI costs ranging from $33,000 to $50,000 USD and estimated lifetime cost savings from $656,000 to $1,082,000 (USD) per child from ages 3 to 55 for those who receive EIBI. More recently, Motiwala, Gupta, Lilly, Ungar, and Coyte (2006) reported that annual behavioral intervention costs per child ranged from $40,000 to $75,000 CAD in the province of Ontario, Canada. From these figures, it is clear that EIBI is expensive. What is not known is if the estimated cost savings can be realized by assuming, as these authors did, "best outcome" rates in the range of 30%-50% (Jacobsen et al., 1998; Motiwala et al., 2006). As is evident in Table 2, only 15% of the 13 UCLA method studies reviewed by Reichow and Wolery (2009) were able to achieve best outcomes within this range. Thus, while many parents advocate for EIBI, funding sources must determine whether the outcomes described in the literature justify the costs of the intervention for every child with ASD.

In addition to the high cost of EIBI, several additional barriers further limit its availability to many families. Johnson and Hastings (2002) examined this issue and identified five such barriers (listed in priority order according to parent ratings): (1) obstacles recruiting, training, and maintaining interventionists within a supportive and committed team; (2) concerns over funding; (3) the need for excessive time and energy to organize the intervention program, to the detriment of other family needs (e.g., those of siblings); (4) disruption of family life and invasion of the home by non-family members (i.e., interventionists who were present in the home up to 40 hours per week); and (5) lack of the physical space required for daily intervention. Other barriers noted by parents included a lack of support and understanding from the community and from the educational system for the

EIBI intervention and concerns about the impact of running a home-based EIBI program on other family members.

Despite these expressed concerns, Hastings and Johnson (2001) found that parents implementing home-based EIBI programs experienced no more and no less stress than parents of children with ASD who were not running home programs. However, their stress levels were higher than those reported for the parents of children with other disabilities. Similarly, Hastings (2003) found no negative effects on the social adjustment of siblings of children with ASD in home-based EIBI programs. However, lower autism severity and more social support were both mediator variables that affected the impact of sibling stress, and the children in this study tended to be from families of higher socio-economic status. Finally, Hastings and Symes (2002) examined maternal beliefs about their self-efficacy as interventionists for their children and found that social support from the ABA program team was a significant variable related to self-efficacy, as were the child's autism severity and the general level of maternal stress. Clearly, additional research is needed across many different types of families of children with ASD before general conclusions can be drawn about the impact of this method of intervention on families.

Finally, many gaps exist in the current literature base that provides support for this method. For example, which intervention components are necessary, how long should the intervention be in place, how many hours per week are optimal for specific children, and how important is the therapy setting (e.g., home-based vs. clinic based)?

In summary, the research suggests that there may be significant barriers to implementing home-based EIBI programs. There are currently more families of children with ASD than qualified service providers (e.g., Board Certified Behavior Analysts with training

in autism) who are available to serve them. The combination of securing service providers;

hiring, training, and retaining interventionists; affording the costs involved in running an

intensive EIBI program; and devoting time to manage a program in the home for many hours

per week for several years is daunting. These variables might be exacerbated by factors such

as lower socio-economic status, English as a Second Language (ESL), the presence of more

than one child with ASD in a family, and a lack of family social support, as well as other

factors. Therefore, it seems clear that the UCLA method may not be a "good fit" for all

children with ASD and their families. The "bottom line" is that research is needed to examine

the outcome of alternative interventions both in the field of applied behavior analysis and as

more broadly defined. Pivotal response training is one such alternative.

Pivotal Response Treatment

Pivotal response treatment (PRT) is another ABA intervention methodology that is

used with young children with ASD. The foundation of PRT consists of four main

components: 1) active family involvement in intervention design and implementation, 2)

intervention in natural settings, 3) a focus on "pivotal" areas of development rather than

isolated skills, and 4) applying intervention across home, school, and community settings

(Koegel & Koegel, 2006). PRT proponents argue that, by targeting these critical areas, PRT

results in widespread, collateral improvements in social, communicative, and behavioral

areas that are not specifically targeted (i.e., collateral gains).

With regard to the delivery of instruction, PRT differs from the UCLA method in a

number of important ways. First, rather than focusing on teaching isolated skills through

DTT as in the UCLA method, PRT targets "pivotal" areas of development such as

motivation, responsivity to multiple cues, self-management, and social initiations. The

developers of this method believe that teaching pivotal skills will lead to greater

independence and self-education during a child's waking hours, thus reducing the need for

many hours of structured intervention (Koegel, Koegel, & Brookman, 2003). Second, rather

than relying primarily on highly trained therapists such as those employed in the UCLA

method, PRT teaches both interventionists and parents to provide intervention in natural

contexts throughout the day. Extensive training is provided to teach the basics of behavioral

intervention (e.g., the three-term contingency of antecedent, response, and consequence, as

described previously), the pivotal area of motivation, and learning how to identify "teachable

moments" in the natural environment. In most cases, motivational strategies to improve

responsivity to instructions are the starting points, with a focus on child communication

before moving on to other areas. Initial training includes instruction in the following core

motivational components (Koegel et al. 2003):

- Presentation of clear and uninterrupted instructions (i.e., make sure the child is attending)

- Child choice (i.e., shared control to increase motivation)

- Frequently interspersing maintenance or mastered tasks within instructional trials

- Frequent task variation

- Reinforcing response *attempts*, not just "correct" responses

- Using direct and natural reinforcers (i.e., items selected by the child and/or items that have specific relationships with the desired behavior; for example, if the child says "ball," she receives the ball, not praise or an unrelated item such as food)

- Using multiple exemplars to increase responsivity to multiple cues (e.g., labeling an item as "red pants" rather than simply as "pants")

Research on the PRT Method

The Koegel Autism Centre (University of California-Santa Barbara, UCSB) is the primary research center for PRT. Its activities have resulted in approximately 24 published studies on PRT with children with ASD from 1987 to 2010. In addition, some PRT studies have been published by researchers from other centres in both the United States and Canada. These studies can be divided into three groups: those examining the effectiveness of PRT alone, those comparing PRT and analog-DTT, and those aimed at determining the characteristics of children who are best suited to PRT (i.e., PRT responders).

PRT effectiveness studies. Table 3 (adapted with permission from Koegel, Koegel, Vernon, & Brookman, in Kazdin and Weisz, 2009), summarizes the PRT effectiveness research produced from 1987-2010. As is evident in this Table, PRT studies have demonstrated numerous positive outcomes in five main areas, including:

1. Increased spontaneous child utterances and vocalizations (Bryson, Koegel, Koegel, Openden, Smith, & Nefdt, 2007; Coolican, Smith, & Bryson, 2010; Gillett & LeBlanc, 2007; Koegel, Camarata, Koegel, Bentall, & Smith, 1998; Koegel, O'Dell, & Koegel, 1987; Koegel, Shirotova, & Koegel, 2009; Laski, Charlop, & Schreibman, 1988; Minjarez, Williams, Mercier, & Hardan, 2011);

2. Increased social (e.g., joint attention) and play interactions with peers and others (Harper, Symon, & Frea, 2008; Koegel, Koegel, Shoshan & McNerny, 1999; Koegel, Vernon, & Koegel, 2009; Pierce & Schreibman, 1995, 1997; Stahmer, 1995; Thorp, Stahmer, & Schreibman, 1995; Vismara & Lyons, 2007);

3. Increased parent-child interactions (Koegel, Bimbela, & Schreibman, 1996; Nefdt, Koegel, Singer, & Gerber, 2010; Schreibman, Kaneko, & Koegel, 1991);

4. Increased question asking and verb usage (Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998; Koegel, Carter, & Koegel, 2003);

5. Reduced problem behavior/symptomatology and/or improved cognitive/language/adaptive behaviour scores (Baker, Ericzen, Stahmer, & Burns, 2007; Koegel, Koegel, & Surratt, 1992; Smith et al., 2010).

Table 3. Empirically Supported Pivotal Response Treatment for Autism

Study	Lab	Design	Study Sample	Treatment/ Independent Variable	Dependent Variables	Treatment Outcome
Koegel, O'Dell, & Koegel (1987)	Original Lab	Single subject design – Multiple baseline across participants	n = 2 Ages = 4.5, 5.8	Discrete Trial Teaching (DTT) vs. PRT (called Analogue Treatment* vs. NLP*)	• Imitative child utterances • Spontaneous child utterances • Generalization	Children produced more imitative and spontaneous utterances in PRT; generalization of treatment gains occurred only in PRT
Laski, Charlop, & Schreibman (1988)	Independent	Single subject design – Multiple baseline across participants	n = 8 Ages = 5 - 9.6	Parent training in PRT (called NLP*) at home and in the clinic	• Parent verbalizations • Child vocalizations • Frequency of echolalia	Post-treatment increases in parent requests for vocalizations; increase in children's verbal responsiveness during intervention and generalization
Schreibman, Kaneko, & Koegel (1991)	Independent with original lab collaboration	Group design with random assignment	n = 19 (parents of children with autism)	DTT vs. PRT (called Individual Target Behaviors* vs. PRT)	• Parental affect (scored by naïve observers)	Parents in PRT displayed significantly more positive affect than parents in DTT
Koegel, Koegel, & Surratt (1992)	Original lab	Single subject design – repeated reversal design with counterbalancing	n = 3 Ages = 3.4 -4.6	DTT vs. PRT (called Analogue Treatment* vs. PRT) for teaching of target sounds and words	• Disruptive behavior • Target language responses	Increased responding and less disruptive behaviors occurred PRT condition compared to DTT

Table 3. Empirically Supported Pivotal Response Treatment for Autism

Study	Lab	Design	Study Sample	Treatment/ Independent Variable	Dependent Variables	Treatment Outcome
Pierce & Schreibman (1995)	Independent	Single subject design – Multiple baseline across participants	n = 2 Ages = 10, 10	Peer-implemented PRT to increase social skills	• Intervals with peer interaction • Conversation initiations • Play initiations • Attention behaviors	Children increased interactions, play and conversation initiations. Both children exhibited increases in coordinated and supported joint attention behaviors
Thorp, Stahmer, & Schreibman (1995)	Independent	Single subject design – Multiple baseline across participants	n = 3 Ages = 5.4 – 9.9	PRT teaching of sociodramatic play	• Language assessments • Play behaviors (role playing, make-believe, persistence, social behavior, verbal communication)	All three children increased in all play behavior measures. Play behavior gains maintained during generalization
Stahmer (1995)	Independent	Single subject design – Multiple baseline across participants	n = 7 Ages = 4.3 – 7.2	Modified PRT using symbolic play as a target behavior	• Symbolic play • Complexity of play • Creativity of play • Generalization across toys, settings, play partners	Increase in symbolic play and play complexity after PRT play training; maintenance of gains during generalization.
Koegel, Bimbela, & Schreibman (1996)	Original lab with collaborator	Group design with random assignment	n = 17 Mean age = 6	DTT vs. PRT (called Individual Target Behaviors* vs. PRT)	• Ratings of happiness, interest, stress, communication style during dinnertime probes	DTT resulted in no significant influence on interactions, while PRT resulted in positive parent-child interactions
Pierce & Schreibman (1997)	Independent	Single subject design – Multiple baseline across participants	n = 2 Ages = 7, 8	Peer-implemented PRT to increase social skills	• Intervals with peer interaction • Conversation initiations • Play initiations • Generalization to untrained peers	PRT produced social behavior change across multiple peer-implementers that was maintained during generalization with untrained peers.

Table 3. Empirically Supported Pivotal Response Treatment for Autism

Study	Lab	Design	Study Sample	Treatment/ Independent Variable	Dependent Variables	Treatment Outcome
Koegel, Camarata, Koegel, Ben-tall, & Smith (1998)	Original lab with independent collaborator	Single subject design – ABA with counterbalancing to control for order effects	n = 5 Ages = 4.8 - 6	DTT vs. PRT (called Analogue Treatment* vs. PRT) for teaching target sounds	• Correct production of target sounds in language samples • Intelligibility ratings	Significant gains in the production of target sounds and speech intelligibility during PRT only.
Koegel, Camarata, Valdez-Menchaca, & Koegel (1998)	Original lab with independent collaborator	Single subject design – Multiple baseline across participants	n = 3 Ages = 3.8 – 5.4	Self-initiated question asking ("What's that?") using a PRT framework	• Spontaneous use of target question • Number of stimulus items labeled correctly	Children consistently and spontaneously initiated "What's that?" across treatment and generalization settings; significant increases in vocabulary
Koegel, Koegel, Shoshan, & McNerney (1999a)	Original lab	Retrospective analysis of archival data	n = 6 Ages = 3.1 – 3.10	High vs. low child-initiated social interactions in a PRT treatment	• Language age • Number of initiations • Pragmatic ratings • Social/community functioning • Adaptive behavior scale scores	Children with poor and favorable outcomes had comparable language ages and adaptive behavior scale scores at pre-intervention. Children who exhibited high levels of spontaneous initiations at pre-intervention had more favorable outcomes
Koegel, Koegel, Shoshan, & McNerney (1999b)	Original lab	Clinical replication	n = 4 Ages = 2.7 – 3.11	PRT teaching of child-initiated spontaneous interactions	• Language age • Number of initiations • Pragmatic ratings • Social/community functioning • Adaptive behavior scale scores	Children increased adaptive and pragmatic scores to near chronological level; lost autism diagnosis and special education placements; social/ academic functioning was comparable to typical peers

Table 3. Empirically Supported Pivotal Response Treatment for Autism

Study	Lab	Design	Study Sample	Treatment/ Independent Variable	Dependent Variables	Treatment Outcome
Koegel, Carter, & Koegel (2003)	Original lab	Single subject design – Multiple baseline across participants	n = 2 Ages = 6.3, 4.4	PRT to teach self-initiated queries as a method to access verbs together with a temporal morpheme	• Number of verb productions • Number of queries • Use of correct tense • Mean length of utterance (MLU) • Number/diversity of verbs • generalization	Children were taught "What happened?" or "What's happening?" during intervention; both generalized the use of "-ing" and "-ed" to other verbs and increased their MLU and verb diversity
Sherer & Schreibman (2005)	Independent	Clinical replication	n = 6 Mean age = 3.9	PRT administered to groups with two distinct profiles (predicted responders vs. non-responders)	• Language (echolalia, cued speech, spontaneous speech) • Play (functional, symbolic, and varied play measures) • Social measures (interaction, social initiations)	Children in the responder profile exhibited increases in language, play, and social behavior following PRT intervention
Baker-Ericzen, Stahmer, & Burns (2007)	Independent	Clinical replication	n = 158 Ages = 2.0 – 9.5	12-week PRT parent education program	• Vineland Adaptive Behavior Scales domain scores	All children showed significant improvement in adaptive scale scores regardless of gender, age, and race/ethnicity of the children/families
Vismara & Lyons (2007)	Independent	Single subject design - ABA with counterbalancing and alternating treatments in final phase	n = 3 Ages = 2.2 – 3.2	PRT with child's perseverative interests vs. nonperseverative interests	• Number of joint attention initiations • Contingencies to joint attention initiations • Child affect ratings	Using the child's preservative interests in a PRT method increased joint attention initiations

Table 3. Empirically Supported Pivotal Response Treatment for Autism

Study	Lab	Design	Study Sample	Treatment/ Independent Variable	Dependent Variables	Treatment Outcome
Gillet & LeBlanc (2007)	Independent	Single subject design – Multiple baseline across participants	n = 3 Ages = 5, 4, 4	Parent-implemented PRT (called NLP*) to target language and play skills	• Frequency of vocalizations • Spontaneous vocalizations • Appropriate play • Social validity questionnaire	Increases in overall rate and spontaneity of utterances; increase in appropriate play; parents rated the intervention simple to implement and endorsed continued use of PRT
Bryson, Koegel, Koegel, Openden, Smith, & Nefdt (2007)	Independent with original lab collaboration	Clinical replication	n = 27 Mean age = 4.4	Large scale community training in PRT for interventionist, clinical supervisors, clinical leaders, and parents	• Fidelity of implementation • Intervals with functional verbal utterances	Treatment providers maintained fidelity of implementation across time and increased the functional verbal utterances of the participant children
Harper, Symon, & Frea (2008)	Independent	Single subject design – Multiple baseline across participants	n = 2 Ages = 8.6, 9.1	Peer-implemented PRT to increase social play	• Attempts at gaining peer's attention • Turn-taking interactions • Play initiations	Both children increased initiations and turn-taking initiations; results maintained during generalization
Koegel, Shirotova, & Koegel (2009)	Original lab	Single subject design – Multiple baseline across participants	n = 3 Ages 3.0, 4.1 & 4.8	Addition of an individualized orienting cue with verbal modeling to teach labeling/requesting to non-responders	• Phoneme or word use	All participants showed improvements in word acquisition following the orienting cue intervention
Koegel, Vernon, & Koegel (2009)	Original lab	Single subject design – ABAB design	n = 3 Ages 3.2, 3.3, 3.5	Embedded and non-embedded social conditions	• Self-initiated social engagement during communication • Nonverbal dyadic orienting • General child affect	Embedding social interactions into reinforcers resulted in increased child-initiated social engagement during communication, improved nonverbal dyadic orienting and general affect

Table 3. Empirically Supported Pivotal Response Treatment for Autism

Study	Lab	Design	Study Sample	Treatment/ Independent Variable	Dependent Variables	Treatment Outcome
Nefdt, Koegel Singer, & Gerber (2010)	Independent	Single subject design Non-concurrent multiple-baseline across participants	n = 8 Primary guardians	Self-directed learning program (SDLP) consisting of a CD and manual, for parents of children with ASD (CAs <60 months)	• Fidelity of implementation of PRT procedures • Language opportunities provided to children • Child functional verbal utterances • Observed parent confidence • Social validity	79.4% of parents completed SDLP with fidelity; treatment group provided more language opportunities and demonstrated higher confidence in child interactions than control group; children of treatment group parents emitted more functional utterances than control group; 71.4% reported enjoying doing PRT and 78.6% reported their child was trying to communicate more
Smith et al. (2010)	Independent with original lab collaboration	Clinical replication	n = 45 Mean baseline age = 50 months	Parents and interventionists (up to 15 hrs/wk) implemented PRT in the home and community (e.g., daycare)	• Language and communication • Cognitive ability • Adaptive behavior • Autism symptoms • Behavior problems	Children with baseline IQs >50 had mean gains of 14.9 and 19.5 months on expressive and receptive language; Children with baseline IQs <50 had mean gains of 6.1 and 8.4 months on expressive and receptive language; problem behavior decreased in both groups; autism symptoms decrease for >50 IQ group only

Table 3. Empirically Supported Pivotal Response Treatment for Autism

Study	Lab	Design	Study Sample	Treatment/ Independent Variable	Dependent Variables	Treatment Outcome
Coolican, Smith, & Bryson (2010)	Independent	Single subject design Non-concurrent multiple baseline across participants	n = 8 Mean age =3.10 n=8 Parents	Brief parent training	• Fidelity of parent implementation • Child communication, language, and disruptive behavior	Improvement in parental fidelity of implementation Increase in child utterances
Minjarez, Williams, Mercier, & Hardan (2011)	Independent	Quasi-experimental pretest-posttest	n=17 Mean age =3.11 n=17 Parents	Group parent training	• Fidelity of parent implementation • Child utterances	Improvement in parental fidelity of implementation Increase in child utterances

*Historically, various terms have been used synonymously in these empirical articles. For example, PRT has been called the "Natural Language Paradigm" (NLP) when intervention focuses on language. Similarly, Discrete Trial Training (DTT) has been labeled the "Individual Target Behavior" condition or the "Analogue Treatment" condition in some publications.

Although the body of research in PRT is quite large, most PRT studies have been single-subject research (SSR) studies that included only a few participants and have sought to achieve specific rather than comprehensive behavior change. Thus, evaluation of the effectiveness of PRT requires that appropriate standards of evidence be applied across the existing studies. In the past few years, two groups of researchers have proposed standards for evaluating the quality of SSR studies and establishing a criterion of "evidence-based practice." Horner et al. (2005) proposed five criteria that can be applied to evaluate either individual studies or groups of studies examining the same or closely-related dependent variables: 1) the practice/treatment/intervention is operationally defined; 2) the context and outcomes associated with the practice/treatment/intervention are clearly defined; 3) the practice/treatment/intervention is documented with fidelity; 4) the practice/treatment/ intervention is functionally related to a change in valued outcomes, and 5) experimental control is demonstrated across five or more studies, conducted by researchers in three or more research centres, with 20 or more participants. More recently, the National Autism Center (2009) published the *National Standards Report: Addressing the Need for Evidence-based Practice Guidelines for Autism Spectrum Disorders*, which provides comprehensive information about the level of empirical evidence that exists in support of various treatments for ASD between 1957 and 2007. The NAC report defined an "established treatment" as one for which "sufficient evidence is available to confidently determine that [it] produces beneficial treatment effects for individuals on the autism spectrum. That is, these treatments are established as effective" (p. 32). The NAC expert panel employed a different set of criteria than Horner et al. with regard to the number of SSR studies and the total number of participants required across studies to be considered "established." While Horner et al.

(2005) specified at least 5 SSR studies and 20 participants, the NAC panel required only 4

SSR studies and 12 participants.

Application of these two different sets of criteria results in discrepant assessment of

the extent to which PRT can be considered an "evidence-based practice." PRT meets the

Horner et al. (2005) criteria for two groups of target behaviours only: "increased social and

play interactions with peers and others" and "improved spontaneous child

utterances/vocalizations." On the other hand, the NAC's report identified 11 treatments as

"established," including PRT for children ages 3-9 who are diagnosed with autism and

require intervention in the communication, interpersonal, and play domains.

Despite PRT's endorsement in the 2009 NAC report, the dependent variable(s) of

interest in most PRT studies have been quite narrowly focused, with two exceptions. Baker-

Ericzen, Stahmer, and Burns (2007) measured changes in overall adaptive behavior using the

Vineland Adaptive Behavior Scales (Sparrow, Cicchetti, & Balla, 2005) for 158 children

with autism ranging in age from 2:0 to 9:5. They found improvement in adaptive behaviors

for all participating children. More notably, Smith et al. (2010) conducted the only large-

scale evaluation of the PRT method to date, using measures of cognitive, language,

communication, and adaptive behavior; autism symptomology; and problem behavior. They

found that (a) children with baseline IQs >50 gained more language skills during treatment

than those with IQs <50, (b) problem behaviors decreased regardless of baseline IQ, and (c)

autism symptomology decreased for the >50 IQ group. This study represents an important

step towards validating the PRT method as a comprehensive treatment package. However,

additional large scale PRT studies are needed, especially those that utilize conventional

outcome measures such as those related to cognitive, language, and adaptive functioning (similar to the UCLA data).

  Analog-DTT and PRT comparative studies. In addition to research examining the effectiveness of the PRT method on specific dependent variables, five studies to date have sought to compare the effectiveness of PRT and analog-DTT (i.e., table-based discrete trial teaching as used in the UCLA method) on dependent variables such as child vocalizations, parent-child interactions, and problem behaviors. Koegel et al. (1987, 1998) compared PRT and analog-DTT on the acquisition of spontaneous child utterances and the correct and intelligible production of target sounds. These studies found that: (a) children produced more imitative and spontaneous vocalizations following PRT; and (b) generalization to novel utterances was only observed following PRT. Schreibman et al. (1991) and Koegel et al. (1996) compared the effects of PRT and DTT on parent-child interactions. They found that: (a) parents in the PRT condition displayed significantly more positive affect than parents in the DTT condition (Schreibman et al., 1991); and (b) PRT resulted in improved positive parent-child interactions, while DTT did not (Koegel et al., 1996). Finally, Koegel et al. (1992) found that children displayed increased on-task responding and fewer disruptive behaviors during PRT instruction compared to DTT instruction. Together, these comparative studies suggest that PRT may be superior to DTT in a number of important ways, although additional research is needed to confirm these differences.

  PRT responder studies. As noted by Schreibman (2000), autism early intervention research (within both the UCLA and PRT methods) is characterized by heterogeneous child outcomes. Thus, it is clear that a "one-size-fits-all" treatment does not exist, either for children with autism or their families. Just as some studies based on the UCLA method have

identified predictors of treatment outcomes, several PRT studies have identified profiles of "responders" and "non-responders" to this method, based on pre-treatment differences in child characteristics. The premise is that such knowledge will enable a priori determinations about whether or not PRT is appropriate for a given child. It is important to note the difference between PRT responder profiles and UCLA predictors of outcome. Responder profiles identify specific pre-treatment behaviors (e.g., social avoidant behavior, toy play ability) that appear to be necessary in order for a child to benefit from a treatment method. On the other hand, predictors of outcome are general characteristics related to variables that have been associated with greater or lesser treatment gains over time (e.g., IQ scores, autism severity). However, because heterogeneity of outcomes is still commonplace, children with incomplete responder profiles and/or fewer predictor characteristics may still make large treatment gains.

In the first PRT responder study, Koegel, Koegel, Shoshan, and McNerney (1999a) found that children with both favorable and poor PRT treatment outcomes had comparable language and adaptive behaviors at pre-intervention. However, children who exhibited higher levels of spontaneous social/communicative initiations during pre-intervention had more favorable outcomes than those with lower levels of initiations. Sherer and Schreibman (2005) advanced this avenue of investigation by analyzing archival data from previously published PRT studies and developed individual behavioral profiles and predictors of treatment effectiveness, based on their analysis. Behavioral profiles were selected over profiles including other types of measures (e.g., IQ or standardized language measures), because it is often difficult to obtain accurate test scores from young children with autism prior to treatment. They found five behavioral characteristics that differentiated PRT responders and

non-responders: interest in toys or object manipulation, social approach behaviors, avoidant

behaviors, verbal self-stimulatory behaviors, and non-verbal self-stimulatory behaviors.

Profiles related to these behaviors are summarized in Table 4.

Table 4. PRT Responder and Non-Responder Profiles (Sherer & Schreibman, 2005)

Responder Profile	Non-Responder Profile
Moderate-to-high rate of toy play	Low rate of toy play
High level of social initiation	Low level of social initiation
Very low level of social avoidant behavior	Moderate level of social avoidant behavior
Low rate of non-verbal self-stimulatory behavior	Moderate rate of non-verbal self-stimulatory behavior
Low rate of verbal self-stimulatory behavior	Very low rate of verbal self-stimulatory behavior

In the same study, Sherer and Schreibman (2005) identified three children meeting

each of the responder and non-responder profiles prior to intervention and then implemented

a short-term program of PRT. As expected, the responder children evidenced positive

changes in language, play, and social measures over time, while the non-responders did not.

Schreibman, Stahmer, Barlett, and Dufek (2009) further refined the behavioral profile by

assessing the outcomes of six children who conformed to most of the elements in the PRT

non-responder profile during a pre-treatment screening (three children did not meet the non-

responder toy play criterion and the other three did not meet the social avoidance criterion).

All six children received a course of 18 hours of PRT followed by 18 hours of DTT, which

was included in order to investigate whether the profile also predicted response to this type of

behavioral intervention. They found that the profile was not predictive of the children's

response to DTT. They also found that non-responders with high levels of toy play

performed better than those with low levels. On the other hand, they found that children with

low social avoidance did not fair better than those with high avoidance. In general, all six

children did show some response to PRT and can thus be deemed "minimal responders,"

probably because none met all of the non-responder profile criteria defined by Sherer and

Screibman (2005). These findings are an important step in the refinement of pre-intervention

behavioral profiles that may help clinicians match an intervention method to an individual,

based on intake characteristics.

PRT Summary

The PRT method shows promise as a behavioral intervention for young children with

autism and differs from the UCLA method in a number of important ways. PRT is

implemented solely in the natural environment and thus has the potential to actually be more

intensive than the UCLA method. That is, family members and PRT interventionists can act

as agents of behavior change across many hours of the day (i.e., they can deliver "waking

hours therapy"). This is in contrast to the UCLA method, in which specialized

interventionists conduct intervention during only certain hours of the day. PRT may also

produce more generalized outcomes because it is carried out in daily routines and across all

of a child's natural environments. In addition, this method may be more appealing to some

parents than a home-based UCLA method program, which requires the time and financial

cost of training and maintaining a team of specialized therapists. Additionally, as noted

previously, there is a small body of literature showing that PRT may result in more positive

outcomes than discrete trial instruction with regard to generalized child vocalizations, parent-

child interactions (i.e., parent affect), reduced disruptive behavior, and increased on-task

behavior. There is also a growing literature base in PRT addressing the important issue of heterogeneous outcomes by beginning to define and refine responder and non-responder profiles (e.g., Schreibman at al., 2009).

The promise of the PRT method must be weighed against its current limitations. While there are 20+ published studies (approximately half from the original lab and half from independent labs) demonstrating positive outcomes of PRT on a range of dependent variables, the state of this literature base is ambiguous with regard to the issue of evidence based practice, depending on which set of criteria are applied. In addition, there has been only one published large-scale community-based implementation study to date (Smith et al., 2010). Such demonstrations are essential in order to validate the effectiveness of PRT outside of research settings.

The PRT and UCLA methods represent opposite ends of the continuum of parental expectations and family goodness-of-fit -- the degree to which the intervention framework is a match with the child, family, and environment (Simeonsson, Bailey, Huntington, & Comfort, 1986). Numerous variables are likely to affect which method appeals to an individual family. The fact that PRT involves parents as interventionists in daily routines may be more of a burden than a blessing for some families and may impact negatively on parent/family stress and coping. Families who have multiple children requiring child care may prefer the UCLA method, in which specialists come into their homes and work with their child with ASD while they provide care for their other children. Families who are unable or do not desire to be directly involved as interventionists for their child with ASD may also find the UCLA method to be a better fit for their needs – assuming that they have the financial resources to support this method, and access to UCLA-trained intervention

providers. It may be that families in which both parents work full time or in which multiple generations live in one home with limited space find both methods to be impractical. Just as the severity of autism exists on a spectrum, so too do the needs of families. Thus, the spectrum of families' needs and resources should not be limited to the UCLA or PRT methods of early intensive behavioral intervention. Additional options, such as an out-of-home group verbal behavior method, must also be available.

Verbal Behavior

As described previously, both the UCLA and PRT method of early intensive behavioral intervention (e.g., Lovaas, 1981; Koegel et al., 1987) have exerted considerable influence on behavior analysts for over two decades. Recently, however, an alternative behavioral service delivery method has emerged under various descriptions. Barbera (2007) and Carr and Firth (2005) described this as a "verbal behavior approach" while others have used the term applied verbal behavior (AVB; LeBlanc, Esch, Sidener, & Firth, 2006). In this discussion, I will use the term verbal behavior (VB) method, as it appears to be the term used most widely.

Baer, Wolf, and Risley (1968/1987), described *conceptually systematic* as one of the seven defining dimensions of the science of applied behavior analysis. Because ABA is conceptually systematic, the UCLA, PRT, and VB methods all benefit from the same empirical foundation and are all based on the same conceptual logic. Thus, the VB method shares many similarities with the UCLA and PRT methods. These include teaching procedures based on basic behavioral principles such as pairing, prompting, fading, modeling, chaining, shaping, differential and intermittent reinforcement procedures, discrimination training, procedures to enhance generalization and transfer stimulus control,

errorless learning, task analysis, and others. Additionally, all three methods emphasize the importance of creating carefully organized learning environments, whether in analog or natural environments; utilizing reinforcement for correct performance in order to strengthen desired behaviors; and teaching both expressive/speaker and receptive/listener language behaviors. Finally, all three methods also assert the value of early intensive intervention involving many learning trials on a daily basis. However, the VB method is distinct in a number of ways, the most important of which is its conceptualization and treatment of language and language training, which in turn influences the types of assessment used and curricula followed. The VB method is also different from the UCLA and PRT methods because it incorporates relevant behavioral literature on the role of Motivating Operations (MOs; Laraway, Snycerski, Michael, & Poling, 2003; Michael, 1993; Michael, 2000) as well a combination of table-based DTT and Natural Environment Teaching (NET; Sundberg & Partington, 1999).

Overview of Verbal Behavior

Language interventions in the UCLA method are based on the traditional psycho-linguistic classification system (i.e., expressive and receptive language), which has its roots in cognitive psychology and structural linguistics. The traditional conceptualization is referred to as a "structuralist" approach to language (i.e., an approach that emphasizes the form and structure of language) (Cooper et al., 2007, p. 527). The VB method employs an additional functional conceptualization of language based on Skinner's (1957) analysis of verbal behavior. Skinner's conceptualization of language asserts that language is learned behavior and therefore falls under the functional control of contingencies in the environment. This analysis involves the same operant principles that constitute the analysis of other types

of behavior; thus, no new behavioral principles are required. Skinner defined "verbal behavior" as any behavior that is mediated through a listener's behavior; thus, verbal behavior always involves a social interaction between a speaker and a listener. It is important to note that verbal behavior is **not** synonymous with vocal or speaking behavior (as the term "verbal" implies in other fields such as speech-language pathology) (Cooper et al., 2007). For example, both asking someone to "Please shut the door" and motioning for someone to shut the door (without speaking) would be considered verbal behavior in that they operate through a listener (i.e., the person who shuts the door). The first example would be described as vocal-verbal behavior because the speaker used the vocal musculature to produce the sentence, "Please shut the door," while the second example would be described as non-vocal verbal behavior in that a speaker communicated with a listener through a motor action (i.e., a gesture) rather than speaking.

Verbal Operants

In order to articulate his analysis and distinguish the subject matter from other disciplines, Skinner developed a new set of terms to refer to his newly described verbal operants (Skinner, 1957). A verbal operant is a unit of analysis that includes the inter-play between stimulus control and/or motivating operations and consequences. The elementary verbal operants are independent functional units of language and are described in Table 5. The mand, tact, echoic, and intraverbal operants are all examples of speaker behavior but each is functionally independent of the others.

Table 5. Skinner's Elementary Verbal Operants

Verbal Operant	Conventional description	Example
Echoic	Vocal imitation	Saying "ball" after someone else says "ball"
Mand	Expressive request	Saying "ball" when you want a ball
Tact	Expressive label	Saying "ball" when you see a ball
Intraverbal	Expressive comment or answer to question	Saying "ball" after someone else asks, "Name something you throw"

Echoic. The echoic is a verbal operant in which the speaker repeats the verbal behavior of another speaker. The echoic is under the functional control of a verbal discriminative stimulus and has point-to-point correspondence with the response -- that is, the beginning, middle, and end of the response exactly match the beginning, middle, and end of the stimulus. The echoic produces generalized conditioned or non-specific reinforcement such as praise and attention.

Mand. The mand is a verbal operant in which the response is controlled by motivating operations (described below) and specific reinforcement. In a mand, the speaker asks for what he/she wants, and getting what he/she asked for functions as reinforcement. Skinner selected the term "mand" because it is brief and similar in form to other words such as com**mand** and de**mand**. The mand can be observed in typical child development and begins to establish the speaker and listener roles necessary for further verbal development (Cooper et al., 2007). For instance, a baby may cry for warmth, comfort, food, and so forth. The baby's crying functions as a mand (i.e., request) for a specific form of reinforcement (e.g., touch, a diaper change, food, etc.) and is eventually replaced by word approximations,

words, and sentences. The mand is considered unique in that it is the only verbal operant that directly benefits the speaker (i.e., you get what you ask for).

Tact. The tact is a verbal operant in which the speaker names things/actions with which he/she has direct contact by means of any of the human sense modalities (e.g. sight, touch, smell, etc.). The tact is under the functional control of non-verbal discriminative stimuli and generalized or non-specific reinforcement. For example, when a child sees a tree and says, "tree," he is likely to receive attention from a nearby parent. The actual tree is a non-verbal stimuli that evokes the tact and the behavior is reinforced by adult attention that is non-specific (i.e., praise such as "You're right!" may be provided to a child for correctly labeling a tree but the tree itself is not delivered as the consequence, as occurs for a mand).

Intraverbal. The intraverbal is a verbal operant in which a speaker differentially responds to the verbal behavior of another speaker. For example, saying, "key" when asked, "What do you need to open the door?" would be an intraverbal response. This operant is under the functional control of a verbal discriminative stimulus and generalized (i.e., non-specific) conditioned reinforcement. The response does not have point-to-point correspondence with the verbal stimulus, as is the case with the echoic. An intraverbal repertoire is essential for developing conversational skills and other advanced skills. For example, the conversational give-and-take of posing and answering questions is largely intraverbal behavior.

While each of the four operants described previously is concerned with speaker behavior, Skinner also acknowledged the critical role of listener behavior (i.e., the receptive repertoire); indeed, the very definition of verbal behavior requires listener behavior. The listener plays a role as the mediator of reinforcement for the speaker as well as a

discriminative stimulus for the speaker as the audience for the speaker. It is a misconception

that Skinner's analysis of verbal behavior ignores either receptive/listener behavior or the

role of linguistic structure (Sundberg, in Cooper et. al., 2007). Rather, his analysis refines the

analysis of language and communication, by emphasizing the functional nature of the mand,

tact, and intraverbal aspects of expressive language.

Verbal Behavior Treatment Method

In addition to its treatment of language, the VB method is distinguished from other

ABA intervention methods in at least three important ways: (a) the use of standardized

strategies for assessment, (b) an emphasis on motivating operations, and (c) the use of natural

environment teaching in combination with intensive teaching (i.e., discrete trial teaching).

Assessment. The unique treatment of language in the VB method necessitates a

corresponding assessment system and curriculum for guiding instruction. Sundberg and

Partington (1998) developed the Assessment of Basic Language and Learning Skills

(ABLLS) which identifies 25 curriculum areas across the broad spectrum of child

development, including all of the verbal operants, social and play skills, academic skills,

daily living skills, and motor skills. This tool was revised and updated to become the

ABLLS-Revised (ABLLS-R; Partington, 2006). In a recent survey of 221 behavior analysis

clinicians, 57% reported using the ABLLS as their primary assessment and curriculum guide

and 18% described their approach as the VB method (Love, Carr, Almason, & Petursdottir,

2009). An additional assessment and curriculum guide – the Verbal Behavior Milestones

Assessment and Placement Program or VB-MAPP (Sundberg, 2007-2008) – has recently

been developed to merge the assessment of verbal operants with developmentally appropriate

goals. The VB-MAPP provides a representative sample of a child's verbal and related skills

via 170 measurable learning and language milestones, which are sequenced and balanced across three developmental levels (0-18, 18-30, and 30-48 months). The VB-MAPP assesses skills including the elementary verbal operants described previously as well as motor imitation, independent and social play, match-to-sample ability, visual perception, ability to use a range of linguistic structures, group and classroom skills, and early academic skills. Thus, the VB method is further defined by the use of related assessment and curriculum guides such as the ABLLS-R and VB-MAPP.

Motivating operations (MO). Formal inclusion of the behavioral principle of motivating operations is another distinguishing characteristic of the VB method (Laraway et al., 2003). MOs can be conceptualized as the behavioral analysis of motivation. An MO has two defining effects: value altering and behavior altering. Regarding the value altering effect, if the value of a stimulus, object, or event increases, it is referred to as an establishing operation (EO). If the value decreases, it is referred to as an abolishing operation (AO). If the current frequency of behavior that has been reinforced by some stimulus, object, or event increases, it is referred to as an evocative effect while a decrease in the current frequency of behavior is referred to as an abative effect. For example, if an organism is deprived of water, the value of water will increase (EO) and behavior to obtain water will increase (evocative effect). Once the organism is satiated, the value of water decreases (AO) and behavior to obtain access to water will decrease (abative effect). The VB method incorporates research on MOs into to the clinical approach for intervention, with particular relevance for mand training.

Natural environment teaching (NET) and intensive teaching (IT). In the VB method, teaching in the context of daily activities and routines is called Natural Environment

Teaching (Sundberg & Partington, 1999). As described above, manding occurs in the

presence of an MO/EO; thus, the concept of MO is of primary importance when teaching the

mand operant (i.e., asking for what you want), which occurs primarily in NET versus in

structured instructional sessions. During NET, the goal of intervention is to follow the child's

MO for teaching manding (as well as other verbal operants) in the natural environment. For

example, the goal for a particular child may be to learn the names of colors. While this can

certainly be taught using colored cards or objects during discrete trial instruction while the

child and a teacher are seated at a table, NET involves arranging the environment to include

inherently motivating materials for the same instructional purpose. For example, if the child

likes to play with rubber balls, a variety of balls of different colors might be made available

and, when the child indicates a desire to play with a specific ball, instruction in identifying

the color of that ball might occur prior to giving it to him. In another example, a child may be

learning to follow multiple step instructions. NET might occur during a baking activity that is

highly motivating to the child, in which multi-step instructions would be naturally embedded

(e.g., "Roll the dough and then go get the cookie cutter," "Cut out a cookie and put it on the

plate").

One of the benefits of NET instruction is that it has the potential to lead to more

immediate generalization of skills to "real-world" routines, without the need for post-hoc

generalization programming as is frequently required following discrete trial teaching

(Schreibman, 2000). In fact, most VB programs include both NET-based instruction and

discrete trial teaching (referred to in the VB approach as Intensive Teaching, or IT). NET is

likely to be more effective for teaching manding behavior using the child's current MO and

delivering specific reinforcement, while IT yields many opportunities for receptive and tact

instruction with nonverbal and verbal stimuli using non-specific reinforcement. Because of this, the instructional ratio usually favors NET during the early phases of instruction (when mand training predominates); is more evenly distributed during intermediate instruction; and then switches back to emphasize NET for more advanced learners, especially those working on social skill-building, which can be taught more readily in natural environment settings.

In summary, the primary defining characteristics of the VB method include (a) the use of a functional (i.e., Skinnerian) approach to language assessment (e.g., ABLLS-R, VB-MAPP) and instruction (e.g., early mand training); and (b) a combination of discrete trial instruction (i.e., Intensive Teaching) and Natural Environment Teaching that follows the child's motivation (MO). Secondary defining characteristics include (a) employing transfer of stimulus control procedures across operants as a teaching methodology (for instance, if a child can receptively identify a noun, using that strength to prompt and teach a tact for the same noun or transferring stimulus control from a tact to an intraverbal); (b) the use of mixed verbal operant teaching trials (e.g., altering discriminative stimuli across verbal operants rather than delivering several of the same discriminative stimuli repeatedly), (c) discontinuous measurement (e.g. recording first-trial data only, rather than continuous trial-by-trial data), (d) the use of errorless instruction, and (e) a tendency to employ topography-based (e.g., manual signing) rather than selection-based (picture exchange) alternatives to vocal behavior.

Research on the Verbal Behavior Method

The UCLA method is synonymous with adult-directed discrete-trial instruction in an analog (i.e., artificial) teaching environment. While this methodology has the benefit of allowing for many teaching trials to be delivered in a controlled setting and has yielded

several examples of positive outcomes, it has also been criticized for problems with generalization (Schreibman, 2000). Conditions in analog settings are not representative of the "real world," and teaching materials that are often artificial may not be inherently motivating to a student with autism. It was these criticisms, in part, that led to the development of the PRT method that emphasizes child-directed instruction that is delivered in natural environments. However, a potential problem with the PRT method is the difficulty involved in contriving adequate teaching opportunities solely in the natural environment following the child's natural motivations. The VB method attempts to resolve both of these dilemmas by taking a "middle-of-the-road" approach that integrates **both** NET and IT into individualized programs that are driven by a child's developmental needs.

There are currently no large-scale empirical demonstrations of the effectiveness of the VB method as a whole. Rather, there are numerous empirical demonstrations for the individual components underlying the method. Indeed, the NAC's *National Standards Report* (2009) included research on mand training and other verbal operants in the category of "behavioral packages" that are among the 11 treatments that are considered to be "established." In addition, because the field of applied behavior analysis is conceptually systematic (Baer et al., 1967), research supporting a specific principle or procedure may be extended to different methods that incorporate that principle. Thus, for example, much of the research supporting PRT may be logically extended to support the NET component of the VB method. Similarly, since the VB method is comprised of the same basic behavioral principles and applications used in the UCLA method, the same can be said for the components of IT. Table 6 summarizes research conducted with participants with autism that supports the components that are unique to the VB method.

Table 6. Empirical Support for the Components of the VB Method with Participants with ASD

Study	Operant	Sample Size (N)	Independent Variable	Outcome
Drash, High, & Tudor, 1999	Echoic	3	Mand-model training	Mand training resulted in the development of echoic responding for all participants
Esch, Carr, & Michael, 2005	Echoic	3	Stimulus-stimulus pairing and direct reinforcement	Direct reinforcement following pairing was not effective; pairing did not increase free-operant sounds; shaping increased vowel production for one participant
Carroll & Klatt, 2008	Echoic	2	Stimulus-stimulus pairing and direct reinforcement	Direct reinforcement following stimulus-stimulus pairing resulted in the acquisition of echoic responding for one participant
Richman & Wacker, 2001	Mand	1	Comparison of varying amounts of response effort during functional communication training	Lower response effort was associated with more spontaneous manding
Bourret, Vollmer, & Rapp, 2004	Mand	3	Utility of a novel assessment tool to inform mand training	Individualized mand training strategies were linked to mand assessment for all participants

Table 6. Empirical Support for the Components of the VB Method with Participants with ASD

Study	Operant	Sample Size (N)	Independent Variable	Outcome
Tincani, 2004	Mand	2	Comparison of Picture Exchange Communication System (PECS) and manual signing on the acquisition of mands	Signing produced higher percentage of mands for one participant and PECS for the other; signing produced more vocalizing for both
Mancil, Conroy, Nakao, & Alter, 2006	Mand	1	Functional communication training	Dramatic decrease in aberrant behavior and increase in number of mands
Anderson, Moore, & Bourne, 2007	Mand	1	PECS instruction	PECS training resulted in increased manding, initiations, word counts, and non-targeted behaviors
Gutierrez, Vollmer, Dozier, Borrero, Rapp, Bourret, & Gadaire, 2007	Mand	3	An establishing operation for functional discriminated mands	Three of four participants acquired discriminated manding using topographically similar responses (picture cards). One participant did not acquire a discriminated mand until topographically distinct mands were taught (vocal and picture card)
Pellecchia & Hineline, 2007	Mand	3	Generalization of mands from adults to peers	For all participants, manding generalized from teachers to parents but not to siblings or peers

Table 6. Empirical Support for the Components of the VB Method with Participants with ASD

Study	Operant	Sample Size (N)	Independent Variable	Outcome
Jurgens, Anderson, & Moore, 2009	Mand	1	Concomitant changes in spoken language, social behavior, and play after PECS mand training	Increase in verbal mands and other initiations across settings and increases in spoken vocabulary and length of utterances during play
Wallace, Iwata, & Hanely, 2006	Mand and tact	3	Comparison of preferred and nonpreferred items	All participants learned to tact but only manded for high-preference items
Partington, 1994	Tact	1	Transfer of stimulus control procedure	Procedure 100% effective in teaching all targeted stimuli
Sundberg, Endicott, & Eigenheer, 2000	Tact	2	Comparison of general verbal prompts versus intraverbal prompts for signed tacts	Both participants acquired signed tacts under intraverbal prompt condition but not general condition
Barbera & Kubina, 2005	Tact	1	Stimulus control transfer procedures	Participant did not acquire tacts until exposed to combined stimulus control transfer procedures
Pistoljevic & Greer, 2006	Tact	3	Intensive tact instruction procedure	Increased vocal verbal operants (both tacts and mands) in non-instructional settings
Williams, Carnerero, & Perez-Gonzalez, 2006	Tact	6	Comparison of restricted and free operant presentation of verb tacting	Generalization of verb tacting was more likely under mixed learning history of free and restricted operant training

Table 6. Empirical Support for the Components of the VB Method with Participants with ASD

Study	Operant	Sample Size (N)	Independent Variable	Outcome
Fiorile & Greer, 2007	Tact	4	Multiple exemplar instruction	Tacting emerged for all participants
Perez-Gonzalez, Garcia-Asenjo, Williams, & Carnerero, 2007	Intra-verbal	2	Procedure to evoke emergent intraverbals with reversed stimulus-response functions	Repeated cycles of probing and teaching facilitated emergence of reversed stimulus-response functions
Finkel & Williams, 2001-2002	Intra-verbal	1	Comparison of textual and echoic prompts on the acquisition of intraverbal behavior	Textual prompts were more effective than echoic prompts
Goldsmith, LeBlanc, & Sautter, 2007	Intra-verbal	3	Transfer of stimulus control procedure with errorless learning	Tact-to-intraverbal transfer procedure was effective for teaching naming of items associated with preselected categories, with limited generalization to non-targeted category

With the exception of tacting, none of the VB method components (echoic, mand, tact, or intraverbal) can be considered "evidence-based practice" according to the Horner et al. (2005) criteria described previously, primarily due to insufficient sample size. The Horner et al. (2005) criteria require at least five studies that include at least 20 participants in total. To date, the VB literature summarized in Table 6 includes 3 studies with 9 participants supporting echoic training; 9 studies with 18 participants supporting mand training; 7 studies with 20 participants supporting tact training; and 3 studies with 6 participants supporting intraverbal training. However, it is important to note that Table 6 **only** includes studies that involved participants with autism; many more studies have been published in support of instruction in these verbal operants with other populations. For example, Cihon (2007) completed a review of the VB literature that provided support for seven separate methodologies for teaching intraverbal repertoires; these studies involved either typically developing individuals or participants with disabilities other than autism. It is likely that additional research in these areas will ultimately have the effect of meeting the criteria for "evidence based practice." Nonetheless, although specific components of the VB method (e.g., mand training) were rated as evidence based in the NAC's *National Standards Report* (2009) report, the verbal behavior method as a "package" was not mentioned anywhere in the report. It seems apparent that there is a need for a comprehensive evaluation of the outcomes of the VB method in its entirety (e.g., the combination of NET and IT, the emphasis on MOs for mand training, the use of specific types of assessments, etc.)

Research Problem

Of all childhood developmental disorders, ASD has what is arguably the highest burden of suffering in terms of prevalence, outcome, response to treatment, and economic

cost. ASD is much more common than previously thought and is not necessarily associated with severe cognitive impairment (CDC, 2012). However, ASD is associated with extraordinary levels of family stress, considerably higher than for other disabilities such as Down syndrome (Sanders & Morgan, 1997), non-specific mental retardation (Weiss, 2002), and chronic physical disorders such as cystic fibrosis (Bouma & Schweitzer, 1990). While it remains true that no cure exists for ASD, there are now evidence-based treatments available that can make a substantial difference, at least in the short term (National Autism Centre, 2009; Reichow & Wolery, 2009). However, the economic costs associated with raising a child with autism and providing intervention beginning at the time of diagnosis (usually around age 3-5) are substantial when the expenses for education, social, and medical services in addition to parental income losses are taken into account. In most cases, at least in developed countries, approximately half of these costs fall both directly and indirectly on parents (Jarbrink et al., 2003). Added to this burden is the paucity of well-trained professionals who are able to design, implement, monitor, and modify behavioral interventions that are based on current research and that have empirical support.

Thus, although current research provides the strongest support for early intervention approaches based on the UCLA method, implementation of this methodology – which requires 30-40 hours/week of intensive intervention – is likely beyond the reach of most families, for one or more reasons. This has led to the development of behavioral approaches to early intervention that are less costly and less burdensome for families to monitor. The question that remains, however, is: How do the outcomes achieved by alternative behavioral intervention methods such as PRT and the VB method compare to those reported in the literature on the UCLA method? Hypothetically, all three methods ought to produce

comparable outcomes because they are all based on the same principles, those of applied

behavior analysis. Table 7 provides a summary analysis of the UCLA, PRT, and VB methods

of early intervention for autism.

From this Table, the similarities between and across methods, rather than their

differences, are most apparent. The fundamental conceptual framework underlying each

method is clearly behavior analytic; indeed, each method is rightfully considered an ABA

intervention methodology. However, while the UCLA and PRT methods have been classified

as "established" according to the *National Standards Report,* the VB method has not yet

generated adequate empirical data to be endorsed in this way. Of the three, the UCLA

method clearly enjoys the highest level of evidence. The NAC's 2009 report evaluated 22

studies in order to endorse the UCLA method as an established treatment for children aged 0-

9 with either autism or PDD-NOS, for increasing skills in seven domains and decreasing both

problem behaviors and general symptoms. The report evaluated 14 studies in order to

endorse the PRT method as an established treatment for children ages 3-9 with autism, for

increasing skills in three domains. The VB method received some level of support in the

report, as mand training and studies targeting verbal operants were included in the

established category of "behavioral packages;" however, the VB method does not currently

have the empirical support as a package to be considered on its own.

Table 7. Summary Analysis of the UCLA, PRT, and VB Methods

Parameter	UCLA	Pivotal Response Training	Verbal Behavior
Conceptual framework for non-language instruction	Behavioral	Behavioral	Behavioral
Conceptual framework for language instruction	Behavioral/structural	Behavioral/functional	Skinnerian (functional) analysis of verbal behavior
	Early focus on receptive language	Early focus on requesting (i.e., manding)	Early focus on requesting (i.e., manding)
Teaching episodes	Discrete trial (intensive) teaching	Teaching in natural environments and contexts	A combination of intensive teaching (IT) & natural environment teaching (NET)
Motivation/ Reinforcement	Reinforcers are usually functionally unrelated to target responses and relatively invariant across teaching sessions	Reinforcers are functionally related to target responses and variant across teaching sessions	IT: reinforcers are both functionally related and unrelated NET: reinforcers are functionally related to target responses and variant across teaching sessions

Table 7. Summary Analysis of the UCLA, PRT, and VB Methods (Con't)

Parameter	UCLA	Pivotal Response Training	Verbal Behavior
Target behavior selection	Guided by UCLA-based curricula; no formal assessment process	Individually determined across developmental domains (e.g., language, fine/gross motor, etc.); no formal assessment process	Individually determined across verbal operants and developmental domains; assessment via *Assessment of Basic Language and Learning Skills-Revised (ABLLS-R;* Partington, 2006) or *Verbal Behavior Milestones and Placement Program* (VB-MAPP: Sundberg, 2007-2008)
Curriculum	Primarily curricula by Lovaas, 1981, 2003; and Maurice, Green & Luce, 1996	No manualized curriculum	Primarily Sundberg & Partington, 1998; Partington, 2006; Sundberg, 2007-2008
Directness of instruction & setting	Direct instruction	Indirect instruction	IT: Direct instruction at table
	Child seated at table	Various locations in the presence of a variety of stimuli	NET: Various locations in the presence of a variety of stimuli
	Begin at home and expand to school & community settings	Begin in home, school, and community settings simultaneously	Begin at home and expand to school & community settings
Primary instructors	Specially trained interventionists Some parent instruction	Primarily parent instruction	Specially trained interventionists Some parent instruction
Stimuli preceding response opportunities	Teacher-selected	Child-selected	IT: Mix of teacher- and child-selected NET: Variable presentation of child selected antecedent stimuli
	Multiple stimulus presentations to criteria (massed trials)	Variable stimulus presentation (distributed trials)	

Table 7. Summary Analysis of the UCLA, PRT, and VB Methods (Con't)

Parameter	UCLA	Pivotal Response Training	Verbal Behavior
Targeted response	Same response for several successive teaching episodes (isolated skills)	No particular order of target responses within a session (pivotal skills)	IT: A mix of instructional and maintenance responses (isolated skills) NET: No particular order of target responses (isolated and pivotal skills)
Prompt strategies	Consistent hierarchy for particular target responses	Varies according to child's initiating responses	IT & NET: Antecedent (errorless) prompts using prompt delay procedures
Criteria for presentation of reinforcer	Correct response or successive approximation	Liberal shaping; reinforce successive approximations	Correct response or successive approximation
Data collection methods	Primarily trial-by-trial	Varies, depending on the target behavior and context	Primarily first trial of each teaching session

In addition, while PRT is now considered to be an established treatment (NAC, 2009), it has only recently been evaluated as a comprehensive intervention in a community setting in a single study (see Smith et al., 2010). PRT-based intervention was selected as the provincial method for autism treatment in Nova Scotia, Canada, in light of the variability in research outcomes of community applications of the UCLA method (Reichow & Wolery, 2009), the financial costs associated with long periods of intensive one-to-one teaching required by the UCLA method (Jacobsen et al., 1998), and the human resource challenges (e.g., availability of qualified personnel, ongoing training, supervision, and retention) associated with the implementation of the UCLA method (Perry et al., 2008). Concurrent with the establishment of the Nova Scotia early intensive behavioral intervention (NS EIBI) program was a research study for which data were collected over a 2-year period to evaluate the impact of the PRT-based program on children with autism who received this service. A subset of data from the Nova Scotia project is included in the current study, to examine the effectiveness of the PRT-based NS-EIBI program. It is important to note the NS EIBI program relies primarily on a 1:1 therapist:child component that is not described as part of the typical PRT methodology, which tends to focus more on parents as interventionists.

As previously noted, the VB method also suffers from a lack of empirical support as a comprehensive treatment package. The Group ABA (GABA) Children's Society in Vancouver, British Columbia offers a VB-based intervention program that is delivered in a group setting, similar in structure to a typical preschool. However, unlike a typical preschool, all children in the GABA preschool have a diagnosis of autism or PDD-NOS, and the staff are all trained as behavior interventionists in the VB method. The GABA program was developed in 2004 by parents who were seeking a low-cost program of early intensive

behavioral intervention for their children. Similar to the NS EIBI program, GABA was developed as a feasible and sustainable program in which the operating costs are significantly lower than in a home-based UCLA program. Additionally, the GABA program was designed to appeal to parents who can not or do not want to provide intervention in their homes and assume responsibility for hiring, training, and retaining therapists for their children. The GABA program currently operates 15 hrs per week, 48 weeks per year, and provides both behavior interventionist and professional staffing. Data from the GABA preschool was included in the current study, to examine the effectiveness of the VB-based GABA program.

Research Questions

The purpose of this research study was to compare the outcomes of children participating in the GABA program to the outcomes for a similar group of children participating in the NS EIBI program, over a 12-month period. The study addressed the following experimental and descriptive research questions:

1. At baseline, is there a significant difference between the NS EIBI and GABA groups with regard to IQ and chronological age?

   Hypothesis: There will be no significant difference between groups, confirming that they are well matched.

2. With initial IQ as a covariate (except for problem behavior), are there significant differences either between or within groups over 12 months for children in the NS EIBI and the GABA programs, in the following areas?:

   a. Cognitive ability

   b. Expressive language skills

   c. Receptive language skills

d. Adaptive behavior

e. Problem behavior

Hypothesis: A significant increase in scores will be found for children in both groups across all measures except for problem behavior, for which a significant decrease will be found. There will be no Group x Time interaction effects for any variable.

3. Are there significant differences between baseline (pre-intervention) and 12-month parenting stress scores for parents of children in the NS EIBI and GABA programs? Hypothesis: No hypothesis is possible on the basis of previous research; this question is exploratory in nature.

4. How do the outcomes for children in the NS EIBI and GABA programs compare to the outcomes reported in the research literature for children receiving approximately similar total hours of UCLA intervention? Hypothesis: The results will be comparable across the three interventions.

CHAPTER 2: METHOD

Approval was obtained from the UBC Behavioral Research Ethics Board and from the IWK Research Ethics Board for use of the data in this study.

Participants

The first group of participants was recruited from the Group Applied Behavior Analysis (GABA) preschool in British Columbia, Canada. The GABA program is a specialized preschool program for children with ASD that is based on the VB method and that exists as a collaborative venture between the Group ABA Children's Society (a registered charity) and the ABA Learning Centre (a private agency). The second group of participants was selected from the provincially funded autism intervention program in Nova Scotia, Canada. The provincial Nova Scotia Early Intensive Behavioral Intervention (NS EIBI) program is based on the PRT method and was developed as a partnership between the Dalhousie/IWK researchers and PRT researchers at the University of California Santa Barbara (who had a contract with the province).

Verbal Behavior Group: GABA

Parents of participants at the GABA site signed consent forms for the use of their children's data in this study (see Appendix A). GABA data were available for 14 children (12 boys, 2 girls) with diagnoses of either autistic disorder or PDD-NOS. Participants' mean chronological age at treatment onset was 46.0 months (range = 37-59 months). Two of the 14 GABA children produced no more than one word at baseline (i.e., were functionally nonspeaking). GABA participants were all diagnosed by professionals associated with the British Columbia Autism Assessment Network (BCAAN) or similarly qualified private diagnosticians, using the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter,

DiLavore, & Risi, 2001), the Autism Diagnostic Interview-Revised (ADI-R; LeCouteur, Lord, & Rutter, 2003), and clinical assessment by a multi-disciplinary team. Eligibility for GABA required (a) an ASD diagnosis; (b) a chronological age of less than 6 years at the beginning of intervention; and (c) the absence of serious problem behaviors that required one-to-one dedicated support, as reported by the child's parent and as determined by program staff observations during an initial meeting (no otherwise-eligible children were excluded by this criterion). The GABA participants represent a community sample, since all children whose parents expressed interest in the program were admitted.

PRT Group: NS EIBI

The NS EIBI sample (N = 14) was drawn from a larger data set that was collected from 45 preschool-aged children who enrolled in the program during its first 2 years of operation (see *Research Design/Data Analysis* section for details). These preschool-aged children were diagnosed by a multi-disciplinary team based on clinical judgment using ADOS, ADI-R, and DSM IV-TR criteria. In accordance with Nova Scotia provincial policy, their names were randomly selected from a pool of young children with ASD diagnoses and chronological ages of ≤6 years from across the province. Parents were approached regarding their participation in the Nova Scotia research study after accepting NS EIBI program services. They signed consent forms allowing use of their data for studies related to NS EIBI project outcomes.

Because of the small number of GABA participants (N = 14) compared to eligible NS EIBI participants (N = 45), a matching procedure was employed to select appropriate participants for the current study from the latter group. Specifically, NS EIBI children were drawn from the entire NS EIBI pool to match the 14 GABA participants according to age at

treatment onset and baseline IQ. Matching by sex was attempted, given the tendency for females to present with more severe symptoms (Tsai, Stewart, & August, 1981), but this was abandoned in favor of age and IQ because of the very small number of females available in the participant pool. Matching by age of treatment onset was warranted because previous research suggests a relationship between age and treatment outcomes (Fenske, Zalenski, Krantz, & McClannahan, 1985). Matching by IQ is well established in the autism intervention literature; in a meta-analysis of 133 papers, Mottron (2004) reported that IQ is the most frequently used matching variable in autism studies using comparison groups. Moreover, IQ is an established predictor of outcome (e.g., Sallows & Graupner, 2005).

In order to conduct matching that was blind with regard to the dependent variables in this study (except for IQ), the researcher was provided with a file containing the following baseline information for all 45 NS EIBI children: age at treatment onset, cognitive age equivalents, cognitive standard scores, and cognitive ratio scores for those participants who did not meet standardized scoring rules on the cognitive measure used (the Merrill-Palmer-Revised Scales of Development; Roid & Sampers, 2004). Each GABA participant was then matched to one NS EIBI participant that was closest with regard to both age and IQ. After all matches were completed, baseline and 12-month data related to each of the dependent variables were provided to the researcher for the 14 matched participants by the principal investigator of the NS EIBI study. The matched NS EIBI sample consisted of 12 boys and 2 girls with a mean chronological age at treatment onset of 46.7 months (range = 31-62 months). Three of the 14 NS EIBI children produced no more than one word at baseline (i.e., were functionally nonspeaking).

Dependent Variables (Measures)

A set of common outcome measures was collected for GABA and NS EIBI participants, at baseline and approximately 12 months later. These included measures of language and communication, cognitive ability, adaptive behavior, challenging behavior, and parenting stress.

Language and Communication

The Preschool Language Scale, 4th ed. (PLS-4; Zimmerman, Steiner, & Pond, 2002) was used as a measure of receptive and expressive language. The PLS-4 is an individually administered test that can be used to identify children from birth through 6 years 11 months who have a language disorder or delay. It assesses both receptive language (called auditory comprehension in the PLS) and expressive language (called expressive communication in the PLS) and yields age-based standard scores, percentile ranks, and age equivalents. The PLS-4 is a reliable instrument (r =.82-.95 for subscale scores and .90-.97 for the Total Language Score) with internal consistency (α) coefficients of .81 or above (for most ages) and good clinical validity (sensitivity = .80; specificity = .88 for the Total Language Score).

PLS-4 standard scores for both auditory comprehension and expressive communication were compared when these scores were available for both members of a matched pair. However, age equivalents for both subtests were available for all participants and were used as the main comparison for this reason.

Cognitive Development

The Merrill-Palmer-Revised Scales of Development (M-P-R; Roid & Sampers, 2004) was employed as the primary measure of cognitive development. The M-P-R Developmental Index (DI) is a general index (comparable to an IQ) that is comprised of scales measuring

cognition, fine motor skills, and receptive language. The M-P-R DI is highly correlated with the Bayley Scales of Infant Development and the Brief IQ score from the Leiter International Performance Scale-Revised ($r = .92$ and $.94$ respectively) (Roid & Sampers, 2004).

For most NS EIBI and GABA children, M-P-R standard scores (SS) were used as a measure of cognitive ability unless a child's standard score fell below the lowest obtainable score, in which case a cognitive ratio was calculated using the method employed by Smith et al. (2010). In this method, the age equivalents for the Vineland Adaptive Behavior Scales receptive language subdomain, fine motor subdomain, and daily living skills subdomains were averaged and then divided by a child's chronological age to yield a cognitive ratio. These three subdomains were selected because they most closely reflect the abilities measured using the M-P-R. In a few cases, scores from other assessment measures were used in place of the M-P-R. In the GABA group, two children were assessed using the Stanford Binet Intelligence Scale – 5th Edition (SB5) (Roid, 2003) at baseline; full-scale IQ scores were used for these children. Two other GABA children were assessed with the Mullen Scales of Early Learning (Mullen, 1995) at baseline, and the Early Learning Composite standard score was used in these cases. Finally, one GABA child was assessed with the Wechsler Preschool and Primary Scale of Intelligence – 3rd Edition (WPPSI-III) (Wechsler, 2002) at baseline. The full-scale IQ score was used for this child.

Adaptive Behavior

The Survey Form of the Vineland Adaptive Behavior Scales, 2nd edition (VABS-II; Sparrow et al., 2005) was used as a measure of adaptive behavior, based on parent report. The VABS-II includes communication, socialization, daily living, and motor subscales as well as an overall Adaptive Behavior Composite (ABC) score. The VABS-II yields age

equivalent scores that are sensitive to change over time, have more item density at lower ends, and are generally recommended for assessing change with treatment over time (Matson, 2008). Additionally, the VABS-II has been shown to have good inter-rater and test-retest reliability, subscale inter-correlations, and construct and criterion validity (Matson, 2007). This study employed the use of VABS-II standard scores.

Problem Behavior

Internalizing and externalizing behaviors were assessed using the Child Behavior Checklist, Ages 1½-5 (CBCL; Achenbach & Rescorla, 2000). The CBCL obtains parental ratings of 99 problem items and provides T-scores and percentile ranks for internalizing, externalizing, and total problem behaviors. The CBCL has good psychometric properties, including test-retest values ranging from $r = .95$-1.0, inter-rater reliabilities ranging from $r = .93$-$.96$, internal consistency ranging from $r = .78$-$.97$, and acceptable criterion validity. This study employed the use of CBCL total problem behavior T-scores.

Parenting Stress

Participants' parents completed the Parenting Stress Index – Short Form (PSI-SF; Abidin, 1995) as a measure of parenting stress. The PSI-SF has good psychometric properties including test-retest reliability ranging from $r = .68$-$.85$, internal consistency (α) ranging from $r = .80$ to $.91$, and acceptable content and criterion validity. This study employed the use of PSI total scores.

<div align="center">

Independent Variables

</div>

GABA Program

Participants in the GABA program received intervention based on the Verbal Behavior method (Barbera, 2007) in a specialized preschool (i.e., group) setting. Participants

were enrolled for 3-5 hours per day (either mornings, afternoons or a combination), 5 days per week, for a total of 15-25 hours of intervention/week over 48 weeks per year. Of the total time, participants received approximately 3-5 hours/week of 1:1 intensive teaching; the remainder of the intervention time (12-20 hours per week) occurred in 2:1 (child:therapist) or small group settings.

Upon entry to the program, each child received an ABLLS-R assessment (see Chapter 1), from which an individualized Behavior Intervention Plan (BPI) was developed to identify instructional goals, in collaboration with each child's parents. Typically, two or three target skills were identified in each of the following domains: visual performance skills (e.g., object matching), receptive language, imitation, manding (i.e., requesting), tacting (i.e., labeling), and intraverbals (i.e., conversational skills). Programming also included skills for independence such as toilet training, self-dressing, and feeding (as required), as well as group skills (e.g., sharing, turn taking, etc.).

Intervention occurred in both Intensive Teaching (IT) and Natural Environment Teaching (NET) contexts. Each day was divided into 20-minute blocks, with an average of two to three blocks (40-60 minutes) per day devoted to IT, and the remaining blocks devoted to NET across various routines. During IT sessions, children worked on individualized curriculum goals that were based on the ABLLS-R assessment. One-to-one discrete trial teaching with a behaviour interventionist was the predominant instructional method used in IT sessions. During NET sessions, two children worked together with one behavior interventionist on individual goals related to mutual play, language, social, and other skills, as determined by the ABLLS-R assessment. To the extent possible, children were paired in NET sessions based on similar goals so that these sessions were equally beneficial for both

children. For example, two children learning to identify colours and take turns might do so in the context of a board game that required both of these skills. Finally, one 20-minute NET block per day was devoted to snack time, one to circle time, and one to outside/group games. During these sessions, children worked on goals that were previously taught in IT and other NET sessions, such as manding (i.e., requesting) at snack time, responding to questions during circle time, and playing together during group game time.

GABA professional structure. The GABA program professional structure included a doctoral level Clinical Director, two masters level Program Managers who were also Board Certified Behavior Analysts (BCBAs), a GABA Coordinator, and a number of Behavior Interventionists (BIs). The Clinical Director was a doctoral-level BCBA and registered psychologist who had received approximately 40 days of direct training from recognized experts in the Verbal Behavior method, including the developers of the ABLLS-R and VB-MAPP. The Clinical Director provided initial and ongoing monthly training and supervision to the masters level Program Managers, both of whom had extensive education and training in ABA and autism. In turn, they provided one hour per week of direct consultation to each child's intervention team. The GABA Coordinator also received VB training and was on-site daily. In her supervisory role, she ensured implementation of the schedule, recorded child/staff attendance, and handled all administrative matters. The BIs worked directly with the GABA children and, on average, had early childhood education backgrounds with some but not extensive prior ABA/autism experience. BIs received 15 hrs of initial workshop training on topics that included an introduction to ABA and autism, pairing with reinforcement and manding, Intensive Teaching, Natural Environment Teaching, and positive

behavior support. Monthly professional development workshops occurred throughout the year, with specific topics dependent on staff needs and interests.

Treatment fidelity. Treatment fidelity of clinical skills for each BI was assessed by Program Managers at various time points via in vivo observation and immediate performance feedback, using one of two standardized measures created by the Clinical Director (see Appendix B). These measures included intensive teaching skills using either a 32-item long form (scored out of a possible 160 points) or a 28-item short form (scored out of a possible 112 points). Interventionists typically received one to four evaluations per year depending on their previous experience, skill set and length of service in the program. Skills evaluation focused on 3 broad areas: instructor's use of reinforcement and motivation, instructional control and technique, and organizational skills.

The average fidelity score for BIs across all evaluations was 81%, with a range from 40% to 99%; the average highest score achieved was 89%. Interventionists whose evaluation scores were initially low received additional weekly support and training from Program Managers. For example, the interventionists with the two lowest initial evaluations (40% and 50%) improved to achieve 91% and 92% respectively on their final evaluations. Additionally, each interventionist was monitored by or had access to a Program Manager on a weekly basis for on-going skills training and support.

Parent training and support. In order to address concerns about generalization of skills from the GABA program to the home environment, parents were invited to attend 10 monthly, 90-minute parent meetings each year that were presented by either the Clinical Director and/or the Program Managers. Topics for those meetings are listed in Table 8. The general structure for the meetings included: housekeeping items from the Coordinator, a brief

presentation on the designated intervention topic, viewing of videotaped samples of GABA children working on skills related to the topic, and identification of homework tasks related to topics that each parent self-identified for the following month. For example, following the manding presentation and video review, parents were encouraged to identify their own mand training goals for the following month (e.g., incorporating more mand opportunities into the bath time routine, e.g.). They were also encouraged to review progress on these goals at the next month's parent meeting. The monthly meetings also provided a venue for parents to interact with and gain support from other parents of children with ASD.

Table 8. GABA Monthly Parent Meeting Topics (sample)

Month	Topic
September	Introduction to ABA and Autism
October	Teaching Manding
November	Natural Environment Teaching (NET)
December	Intensive Teaching (IT)
January	Problem Behaviors
February	Teaching Play Skills
March	Adaptive Daily Living: Toilet Training, Feeding, and Dressing Skills
April	Transitioning to Kindergarten
May	Teaching Leisure Skills
June	Visual Supports

NS EIBI Program

Children in the NS EIBI program received intervention based on the PRT method (Koegel, Schreibman, Good, Cerniglia, Murphy, & Koegel, 1989) and positive behavior

support (PBS; Koegel, Koegel, & Dunlap, 1996). The NS EIBI program is unique in that the PRT method is delivered by a combination of interventionists and parents (primarily, the former) in both home and daycare/preschool settings. Children were admitted into the NS EIBI program in two cohorts. Cohort A (n = 25) received 15 hours per week of 1:1 (child:therapist) intervention in their homes, daycare/preschools, and community settings. Cohort B (n = 28) received 15 hours per week of 1:1 PRT instruction in these contexts for 6 months, 10 hrs per week for the next 3 months, and 5 hours per week for a final 3-month period. The amount of 1:1 intervention was reduced from Cohort A to Cohort B, who entered the program in Years 1 and 2 of NS EIBI implementation, during which time elements of the service delivery model were in flux. However, Smith et al.'s (2010) analysis of NS EIBI outcomes revealed no significant differences between participants from Cohorts A and B; thus, participants in this study were drawn from both cohorts.

For both cohorts, each child's individual team developed goals with an emphasis on functional communication and developmentally appropriate skills. Adaptive daily living skills (e.g., toilet training, feeding, etc.) were included on an individual basis but were not considered to be part of the overall programming. All NS EIBI intervention and teaching occurred within the context of play and other functional daily routines. Full-time or part-time daycare or preschool attendance occurred for all but two of the children at some point during the intervention period. NS EIBI staff supported children in these inclusive settings, with an overall goal of facilitating social and communicative interactions with adults and peers. During the course of the study, parents agreed not to enroll their child in other privately funded autism interventions.

NS EIBI professional structure. Each NS EIBI child was assigned an intervention team consisting of their parents, a one-to-one interventionist, a Clinical Supervisor, and a speech-language pathologist. Each of the three geographic regions within the province also had a Clinical Leader, and a Provincial Leader oversaw the entire program. The 45 children whose data were eligible for this study were served by a total of 6 clinical supervisors and 3 clinical leaders. All clinicians had substantial experience with children with ASD and varying levels of expertise in behavioral interventions prior to training in PRT. The one-to-one interventionists tended to be early childhood educators with ASD experience and some had previous experience using ABA techniques.

Treatment teams for Cohort A were trained directly by UCSB trainers during a one-week (30 hr) PRT training session that followed 2-3 days of introductory workshops on ASD by local professionals. PRT training involved group lectures and didactic instruction, including reviews of videotaped practice sessions with feedback. Topics included giving the child choices; using clear instructions; providing immediate, contingent, effective rewards; using direct and natural reinforcers; reinforcing both expressive verbal attempts and correct verbal responses; and interspersing maintenance and acquisition targets (Bryson et al., 2007). Treatment teams for Cohort B received similar initial training, from five NS professionals (three masters-level psychologists, one occupational therapist, and one doctoral psychology student) who received training as trainers from UCSB staff via a 5-day workshop and 12 months of follow-up teleconference consultation. Training of the intervention teams for Cohort B occurred in-vivo in family homes.

Treatment fidelity. Treatment fidelity was monitored via representative video-taped probes of adult-child interactions that were assessed for accuracy of treatment

implementation using continuous 2-minute interval sampling for a total of 10 minutes/session. Coding focused on six key procedures: providing child choice with shared control; providing clear opportunities or instructions; providing immediate and contingent reinforcement; using direct natural reinforcers; providing reinforcement for verbal attempts as well as correct verbal responses; and providing an appropriate balance of maintenance and acquisition tasks (Smith et al., 2010).

The majority of PRT interventionists (86.6%) met the fidelity criteria (>80% accurate performance) within the first four months of working with the first child to whom they were assigned. After achieving initial reliability, each interventionist was monitored by a clinical supervisor and received feedback on his/her fidelity on implementation of PRT on a bi-weekly basis, either in-vivo or via video review. However, no formal follow-up assessments were conducted to assess ongoing treatment fidelity.

Parent training and support. Parents were encouraged but not required to use PRT techniques in their everyday activities with their children. No data were collected on the extent or fidelity of parent involvement.

Research Design

This study employed a quasi-experimental pre-test/post-test design with matched groups and is best conceptualized as an exploratory study for two reasons. First, it is the first known evaluation of the Verbal Behavior method delivered in a group setting (i.e., GABA). Second, it is the first known study to employ a comparative approach with two ABA intervention methods.

In order to address the research questions, the study employed a 2 x 2 mixed model analysis of variance or covariance (ANCOVA/ANOVA) with Time as the within subjects

factor, Group as the between subjects factor, and baseline IQ entered as the covariate. In this design, the participants were grouped by treatment (i.e., NS EIBI vs. GABA), with one repeated measures analysis for each dependent variable.

Data Collection

GABA data were collected at baseline (i.e., prior to attending the program or within 60 days of enrollment) and approximately 12 months later. Data collection occurred in each child's home or at the GABA program by a certified speech-language pathologist, a registered psychologist (at baseline) or by the investigator, who received extensive graduate-level training in cognitive and language assessment as part of his doctoral program and clinical training. Parent measures were collected via mail out, with the investigator providing in-vivo assistance to parents, on request (e.g., if literacy skills in English were a barrier).

NS EIBI data in this study were collected at baseline (i.e., prior to the initiation of early intervention) and approximately 12 months later. Data collection occurred in children's homes or early intervention centres by trained research assistants who were experienced in the assessment of children with ASD. None of the assessors were involved in service provision to the children.

Data Analysis

Data analysis was conducted using SPSS, Version 20. The first research question (i.e., were the two groups well matched?) was addressed using independent samples t-tests. The second and third research questions were addressed via a series of 2 x 2 mixed model ANCOVAs/ANOVAs with Time as the within subjects factor, Group as the between subjects factor, and baseline IQ as the covariate. The fourth research question was addressed via a

descriptive analysis of the outcomes of this study, compared with previously published

UCLA research of similar intensity.

Planned, one-tailed tests were conducted for the main research questions because it

was possible to generate directional hypotheses based on previous research, and a Bonferroni

adjustment was made to minimize the likelihood of a Type I error. The assumption of

sphericity was not evaluated because this assumption is always met for two levels of a

repeated measures analysis (Hinton, Brownlow, & McMurray, 2004). The assumption of

normality was evaluated using both the Shapiro-Wilk and Kolmogorov-Smirnov tests,

because there is considerable disagreement among statisticians about which test is preferred,

especially when examining small samples (Razali & Wah, 2011). According to both tests, the

normality assumption was met for all baseline and 12 month variables for both the GABA

and NS EIBI groups, with the exception of 12 month cognitive scores. For both groups, the

normality assumption was met using the Kolmogorov-Smirnov test but not using the

Shapiro-Wilk test for this variable. Thus, the skewness of 12-month cognitive scores was

further evaluated by calculating Fisher's coefficient, which requires dividing the SPSS-

generated skewness scores by the standard errors for skewness to produce z-scores (Pett,

1997). If a z-score exceeds 1.96 (p>.05), the distribution is asymmetric and significantly

skewed. Results indicated a GABA z-score of 1.88 and a NS EIBI z-score of 1.47, neither of

which were significant. Given this result, combined with the controversy that exists about the

applicability of normality tests for small samples in general (Razali & Wah, 2011), a decision

was made to proceed with parametric analysis using a mixed-model ANOVA, since most

indicators of normality appeared to be met.

CHAPTER 3: RESULTS

The purpose of this research study was to compare the outcomes of children

participating in the GABA program, based on the VB method, to the outcomes for a similar

group of children in the NS EIBI program, based on the PRT method, over a 12-month

period. The results for each research question are provided in this chapter. For each of the

first three questions, the statistical analysis and graphical displays (where appropriate) will be

presented. For the fourth research question, a descriptive analysis will be provided, by

comparing the outcomes of the current study with published UCLA outcomes of similar

intensity.

> **Question 1:** At baseline, is there a significant difference between the NS EIBI and
>
> GABA groups with regard to IQ and chronological age? Hypothesis: There will be no
>
> significant difference between groups, confirming that they are well matched.

Matching

In order to answer this question, an independent samples t-test (two-tailed) was

conducted to compare the baseline cognitive scores for each group. There was no significant

difference between scores for the NS EIBI (M = 42.71, SD = 23.60) and GABA (M = 39.79,

SD = 24.59) groups; $t = .322$, $p = .750$. An independent samples t-test (two-tailed) was also

conducted to compare the baseline chronological ages of participants across groups. There

was no significant difference in age at the start of intervention for the NS EIBI (M = 46.71,

SD = 9.23) and GABA (M = 46.00, SD = 8.12) groups; $t = .218$, $p = .830$. The results

confirm that the groups were appropriately matched with regard to cognitive scores and

chronological age at treatment onset.

Question 2: With IQ as a covariate (except for problem behavior), are there significant differences either between or within groups in the following areas: cognitive ability, receptive language skills, expressive language skills, adaptive behavior, and problem behavior? Hypothesis: A significant increase in scores will be found for children in both groups across all measures except for problem behavior, for which a significant decrease will be found. There will be no interaction effects.

Each of the following five analyses employed a 2 x 2 mixed model ANCOVA or ANOVA with Time as the within subjects factor and Group as the between subjects factor. Additionally, baseline cognitive scores were used as a covariate in the expressive language, receptive language, and adaptive behavior analyses, as IQ has been found to predict outcomes in these areas in previous research (Mottron, 2004). Using a Bonferroni adjustment, the significance level was set at $p = .01$ for each of the five analyses (one-tailed, since directional hypotheses were formulated on the basis of previous research).

Cognitive Ability

Table 9 displays the results of cognitive score changes over a 12-month period for the NS EIBI and GABA groups.

Table 9. Means and Standard Deviations for Cognitive Scores

Group	Mean		SD	
	Baseline	12 months	Baseline	12 months
NS EIBI	42.71	55.86	23.60	37.01
GABA	39.79	48.21	24.60	31.68

Results of a mixed model ANOVA showed no Group X Time interaction, $F(1,26) = .320$, $p = .289$ and no significant difference for Group, $F(1,26) = .257$, $p = .309$ (one-tailed).

However, there was a significant difference for Time, $F(1,26) = 6.69$, $p = .008$ (one-tailed), $\eta^2 = .205$. Figure 1 displays the cognitive score results for the 14 participants in the NS EIBI group and Figure 2 displays the results for the 14 participants in GABA, with group means indicated in bold.

Figure 1. NS EIBI Individual and Mean Cognitive Score Results
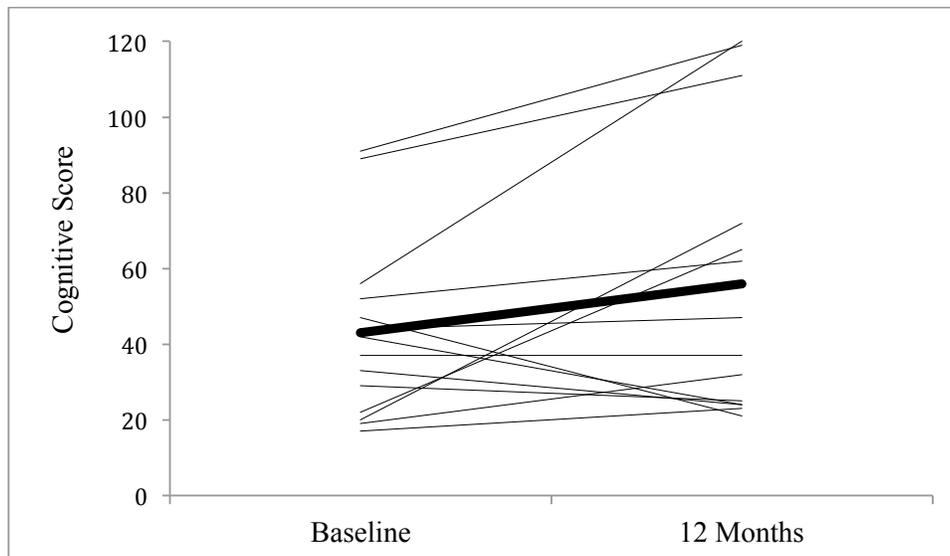
Figure 2. GABA Individual and Mean Cognitive Score Results
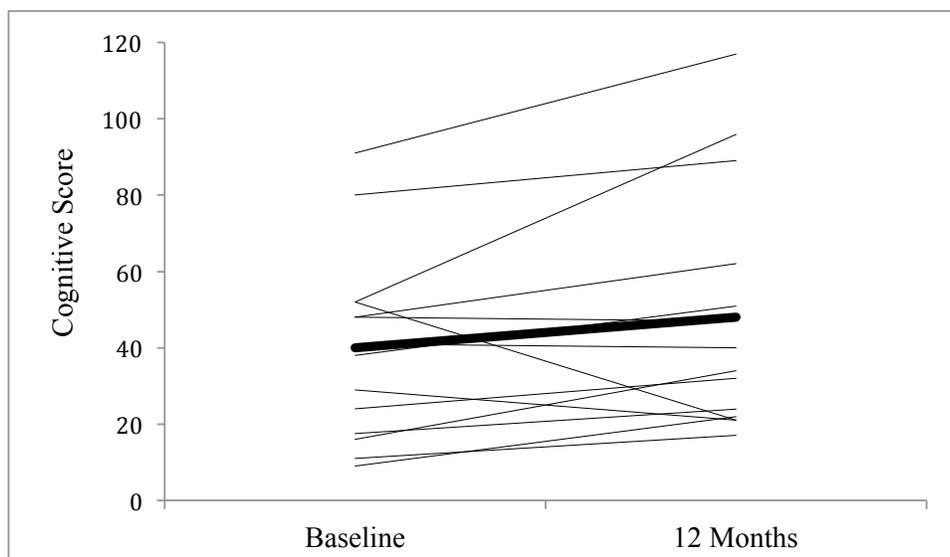
As is evident from Figures 1 and 2, there was wide variability within each group, although the mean change over 12 months was significant. On average, the NS EIBI group gained 13.15 IQ points and the GABA group gained 8.42 points over a 12-month period. Figure 1 shows increased cognitive scores for 10 NS EIBI participants and decreased scores for 4. Figure 2 shows increased cognitive scores for 11 GABA participants and decreased scores for 3.

Baseline and 12 month cognitive score means with 95% confidence intervals are displayed in Figure 3.

Figure 3. Cognitive Score Means and 95% Confidence Intervals
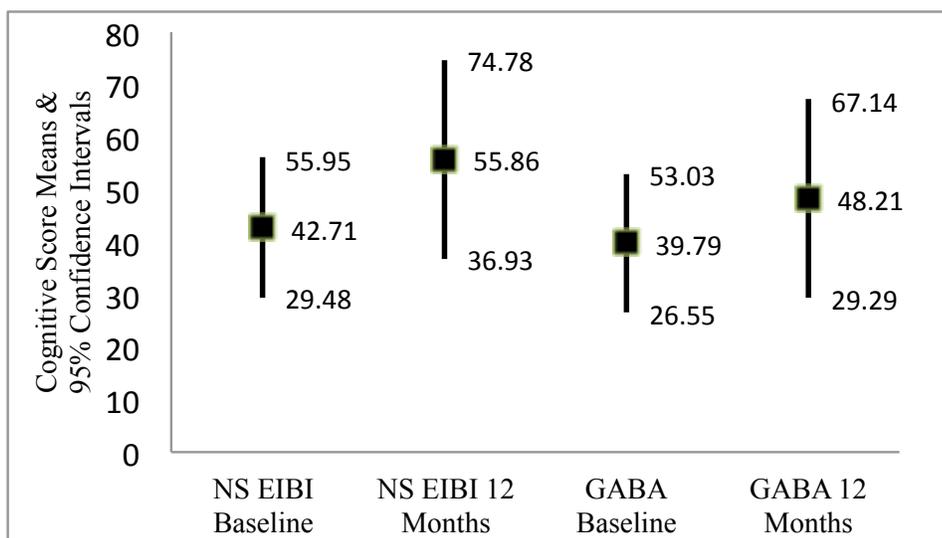
The standard errors were 6.44 for baseline scores and 9.21 for 12-month scores. Both baseline and 12-month confidence intervals for both Groups showed considerable overlap.

Receptive Language

Results of a standard score comparison for the subset of participants for whom these scores were available (n = 16) showed no Group X Time interaction, $F(1,13) = .874$, $p = .367$ and no significant difference for either Group, $F(1,13) = 1.15$, $p = .302$ or Time, $F(1,13) =$

.197, p = 664. Table 10 displays the results of receptive language age equivalent changes

over a 12-month period for the entire NS EIBI and GABA groups.

Table 10. Means and Standard Deviations for Receptive Language Age Equivalents

	Mean		SD	
Group	Baseline	12 months	Baseline	12 months
NS EIBI	24.21	33.43	10.90	18.58
GABA	21.64	32.00	8.63	13.99

Results of a mixed model ANCOVA, controlling for baseline IQ, showed no Group X

Time interaction, $F(1,25)$ = .305, p = .293 and no significant difference for Group, $F(1,25)$ =

. 070, p = .397 (one-tailed). However, there was a significant difference for Time, $F(1,25)$ =

10.07, p = .002 (one-tailed), η^2 = .287. Figure 4 displays the receptive language age

equivalent score results for the 14 participants in the NS EIBI group and Figure 5 displays

the results for the 14 participants in GABA, with group means indicated in bold.

Figure 4. NS EIBI Individual and Mean Receptive Language Age Equivalent Score Results
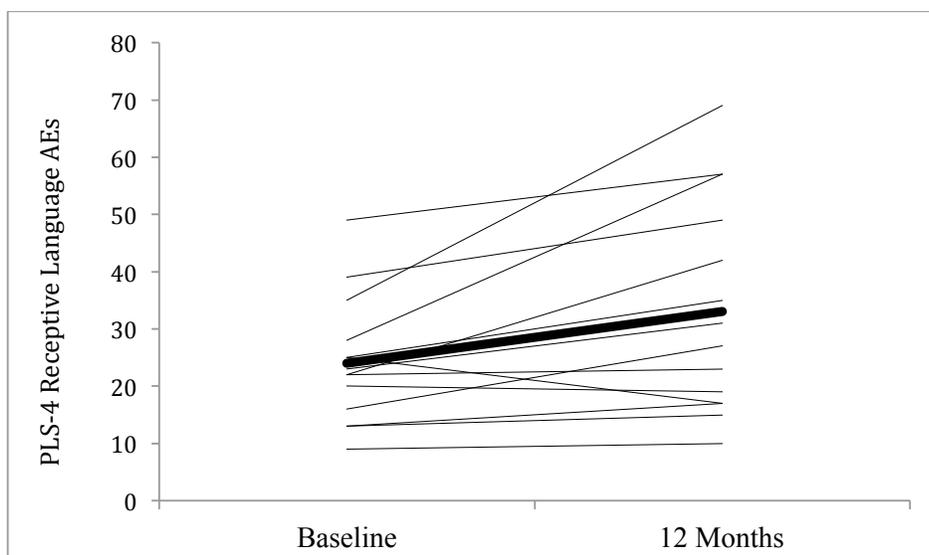
Figure 5. GABA Individual and Mean Receptive Language Age Equivalent Score Results
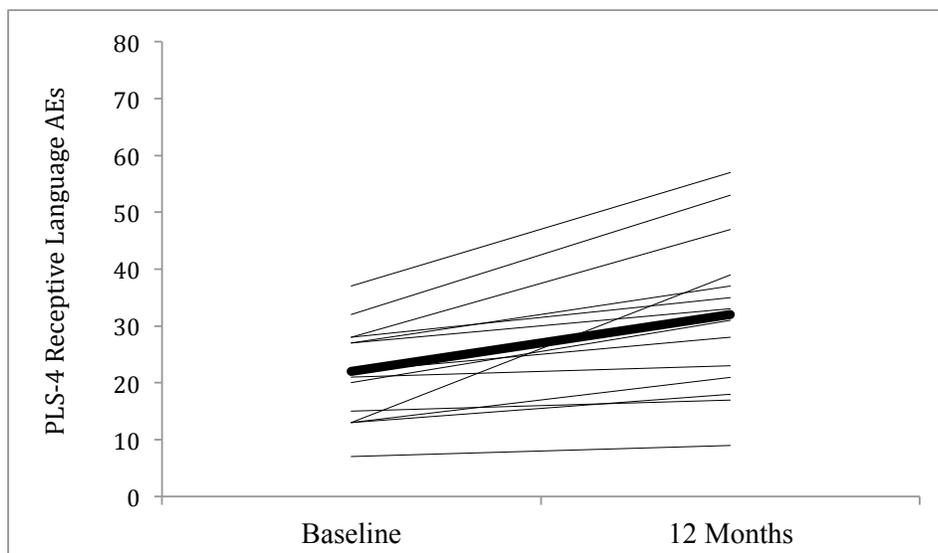
As is evident from Figures 4 and 5, there was wide variability within each group, although the mean change over 12 months was significant. On average, the NS EIBI group gained 9.22 months and the GABA group gained 10.36 months over a 12-month period.

Figure 4 shows score increases for 13 NS EIBI participants and decreased scores for 1.

Figure 5 shows score increases for all 14 GABA participants.

Baseline and 12 month receptive language age equivalent means and 95% confidence

intervals are displayed in Figure 6.

Figure 6. Receptive Language Age Equivalent Means and 95% Confidence Intervals
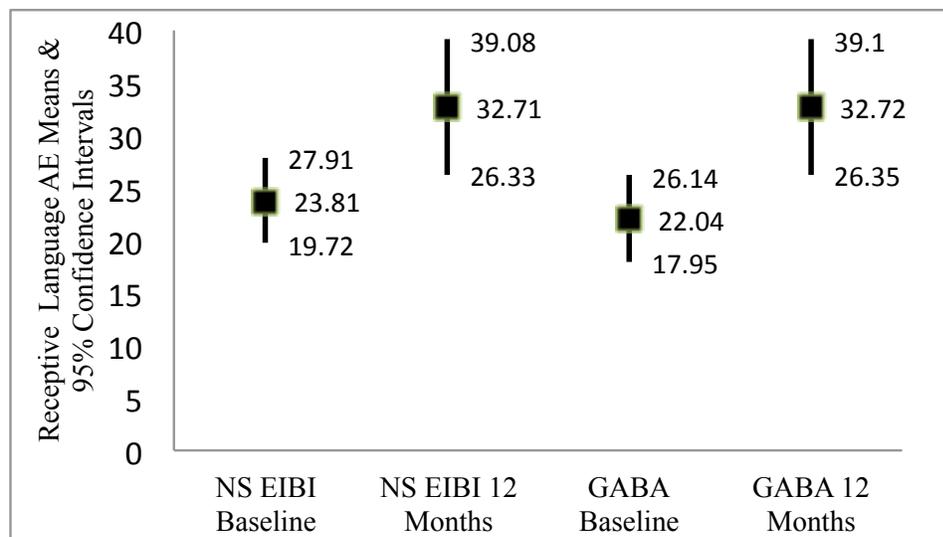
The standard errors were 1.99 for baseline scores and 3.09 for 12-month scores.

Baseline and 12-month confidence intervals for both Groups overlapped slightly.

Expressive Language

Results of a standard score comparison for the subset of participants for whom these

scores were available (n = 18) showed no Group X Time interaction, $F(1,15) = 1.40, p = .255$

and no significant difference for either Group, $F(1,15) = .822, p = .379$ or Time, $F(1,15) =$

$.197, p = .663$. Table 11 displays the results of expressive language age equivalent changes

over a 12-month period for the entire NS EIBI and GABA groups.

Table 11. Means and Standard Deviations for Expressive Language Age Equivalents

|	Mean		SD	
Group	Baseline	12 months	Baseline	12 months
NS EIBI	25.79	36.14	10.21	14.60
GABA	23.93	31.00	7.33	12.63

Results of the mixed model ANCOVA, controlling for baseline cognitive ability, showed no Group X Time interaction, $F(1,2) = 1.36$, $p = .127$ and no significant difference for Group, $F(1,25) = 1.01$, $p = .162$ (one-tailed). However, there was a significant difference for Time, $F(1,25) = 13.52$, $p = .0005$ (one-tailed), $\eta^2 = .351$. Figure 7 displays the receptive language age equivalent score results for the 14 participants in the NS EIBI group and Figure 8 displays the results for the 14 participants in GABA, with group means indicated in bold.

Figure 7. NS EIBI Individual and Mean Expressive Language Age Equivalent Score Results
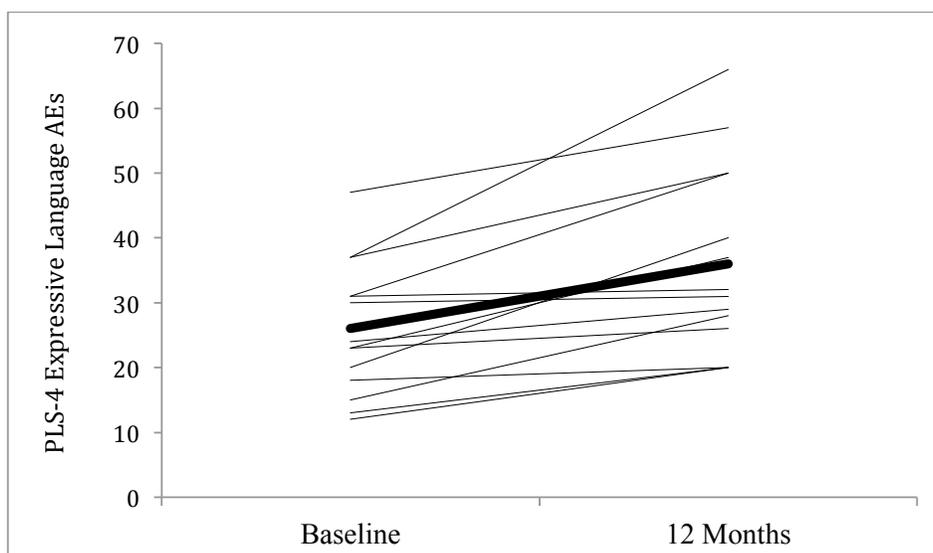
Figure 8. GABA Individual and Mean Expressive Language Age Equivalent Score Results
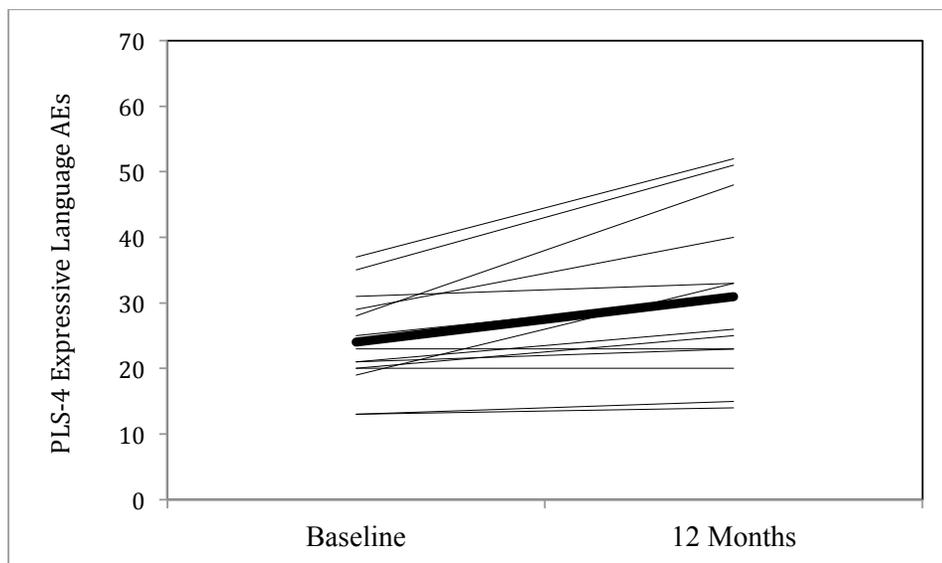

As is evident from Figures 7 and 8, there was wide variability within each group, although the mean change over 12 months was significant. On average, the NS EIBI group gained 10.35 months and the GABA group gained 7.07 months over a 12-month period. Figure 7 shows score increases for all 14 NS EIBI participants. Figure 8 shows score increases for 12 GABA participants and no increases for 2.

Baseline and 12 month expressive language age equivalent means and 95% confidence intervals are displayed in Figure 9.

Figure 9. Expressive Language Age Equivalent Means and 95% Confidence Intervals
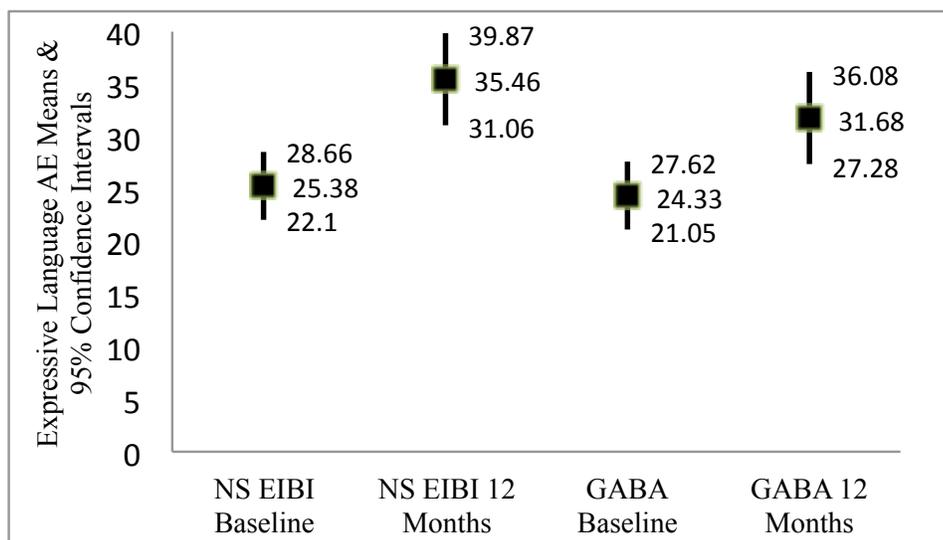
The standard errors were 1.59 for baseline scores and 2.14 for 12-month scores.

Baseline and 12-month confidence intervals for both Groups showed almost no overlap.

Adaptive Behavior Composite

Table 12 displays the results of adaptive behavior composite score changes over a 12-month period for the NS EIBI and GABA groups.

Table 12. Means and Standard Deviations for Adaptive Behavior Composite Scores

	Mean		SD	
Group	Baseline	12 months	Baseline	12 months
NS EIBI	69.21	74.71	9.42	11.52
GABA	63.07	65.79	17.03	13.78

Hurd, Perry, and Flanagan (2009) provided evidence that the VABS-II may result in inflated standard scores relative to the original VABS, making the measure less sensitive to change. In order to address this concern, ANCOVAs (controlling for baseline IQ) were

conducted using both VABS-II standard and VABS-II raw scores. The results of both analyses were identical, so only the standard score analysis (the more conventional of the two) is reported here. Results showed no Group X Time interaction, $F(1,25) = 1.06$, $p = .157$ and no significant difference for either Group, $F(1,25) = 3.83$, $p = .031$ (one-tailed) or Time, $F(1,25) = 0.06$, $p = .404$ (one-tailed). Figure 10 displays the adaptive behavior composite standard score results for the 14 participants in the NS EIBI group and Figure 11 displays the results for the 14 participants in GABA, with group means indicated in bold.

Figure 10. NS EIBI Individual and Mean Adaptive Behavior Composite Score Results
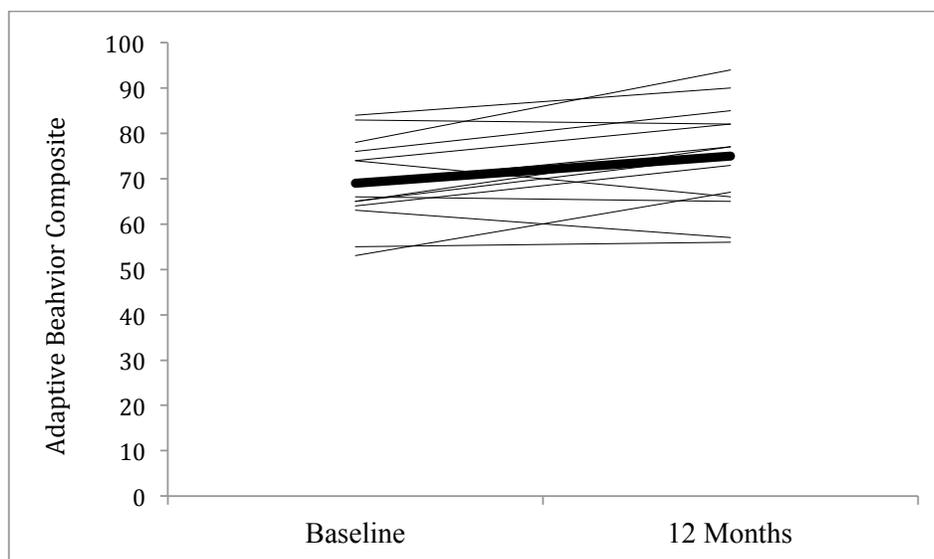
Figure 11. GABA Individual and Mean Adaptive Behavior Composite Score Results
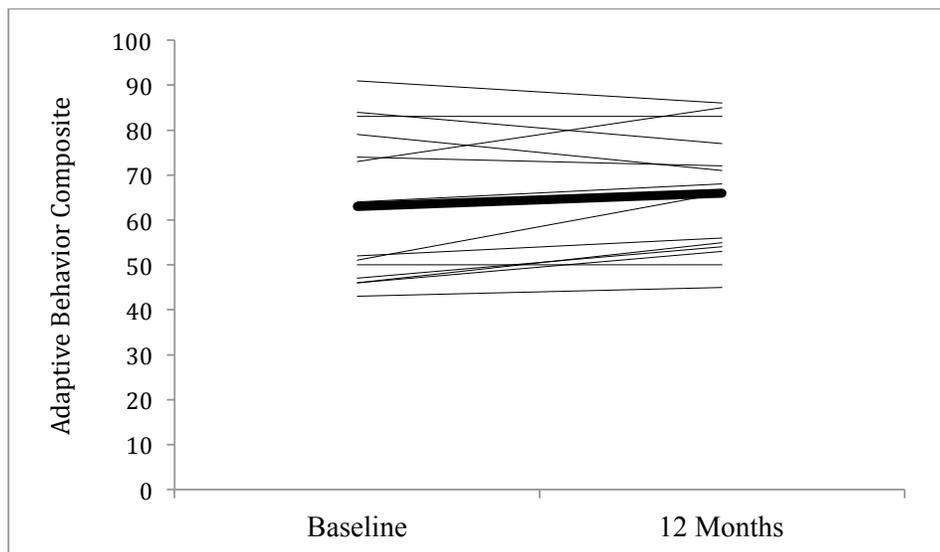
As is evident from Figures 10 and 11, there was wide variability within each group.

However, neither group experienced significant positive changes over Time. This may be

due, in part, to the large standard deviations observed for the GABA group. On average, the

NS EIBI group gained 5.5 points and the GABA group gained 2.72 points over a 12-month

period. Figure 10 shows increasing standard scores for 10 NS EIBI participants and

decreasing scores for 4. Figure 11 shows increasing standard scores for 8 GABA participants,

no change for 2, and decreasing scores for 4. The standard errors were 2.65 for baseline

scores and 2.33 for 12-month scores. Because there was no significant difference for either

Group or Time, confidence intervals are not displayed.

Problem Behavior

Table 13 displays the results of problem behavior (CBCL) score changes over a 12-

month period for the NS EIBI and GABA groups.

Table 13. Means and Standard Deviations for CBCL Total Scores

	Mean		SD	
Group	Baseline	12 months	Baseline	12 months
NS EIBI	60.62	58.00	10.93	10.67
GABA	63.93	59.14	6.93	7.90

Results of the mixed model ANOVA showed no Group X Time interaction, $F(1,25) =$ .841, $p = $ .184 and no significant difference for Group, $F(1,25) = $ .444, $p = $ .256 (one-tailed). However, there was a significant difference for Time, $F(1,25) = 9.78$, $p = $ .002 (one-tailed), $\eta^2 = $ .281. Figure 12 displays the CBCL total score results for 13 participants in the NS EIBI group (the baseline score was missing for one participant) and Figure 13 displays the results for the 14 participants in GABA, with group means indicated in bold.

Figure 12. NS EIBI CBCL Individual and Mean Total Score Results
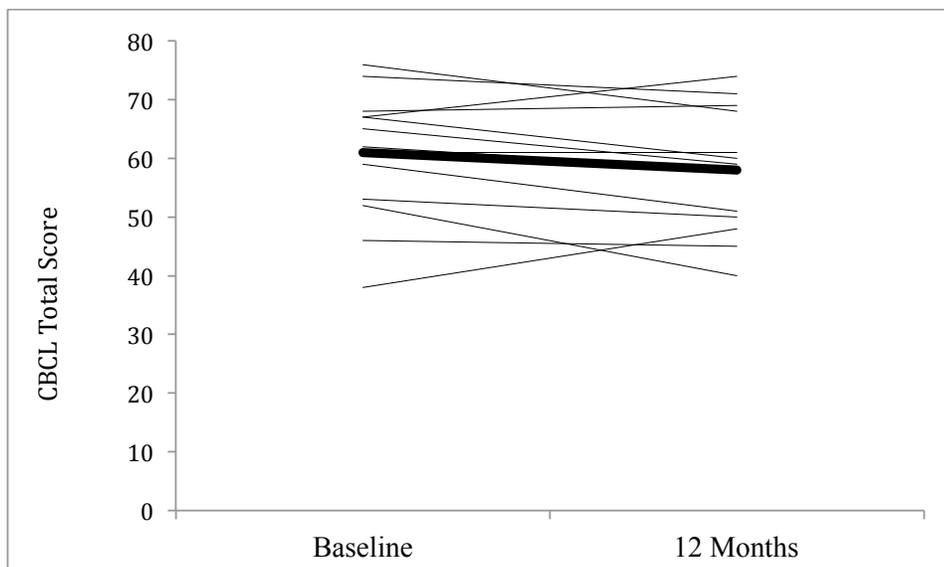
Figure 13. GABA CBCL Individual and Mean Total Score Results
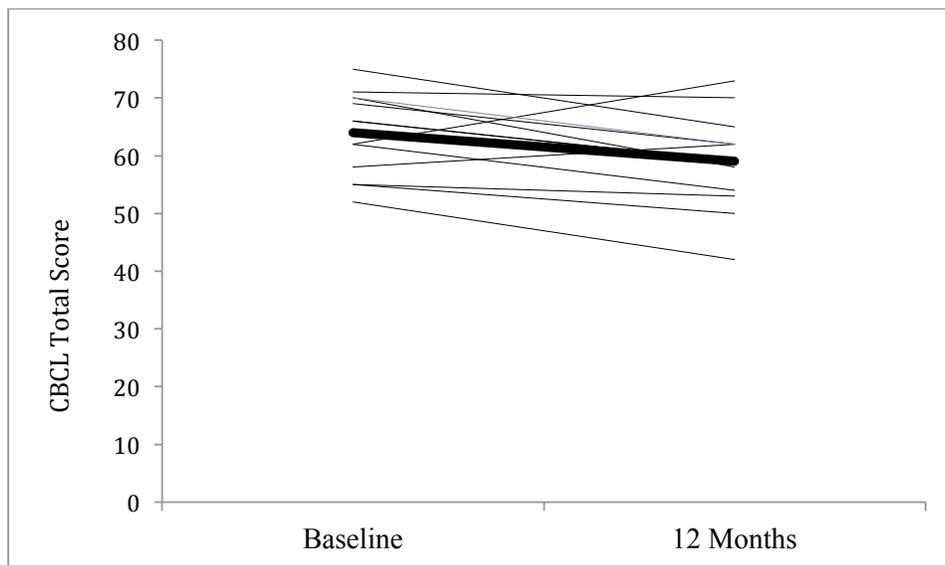
As is evident from Figures 12 and 13 there was variability within each group, although the mean change over 12 months was significant. On average, the mean NS EIBI problem behavior score decreased 2.62 points while the mean GABA score decreased by 4.79 points over a 12-month period. Figure 12 shows decreasing scores for 10 NS EIBI participants, no change for 1 and increasing scores for 3. Figure 13 shows decreasing scores for 12 GABA participants and increasing scores for 2.

Baseline and 12 month CBCL Total Score means and 95% confidence intervals are displayed in Figure 14.

Figure 14. CBCL Total Score Means and 95% Confidence Intervals
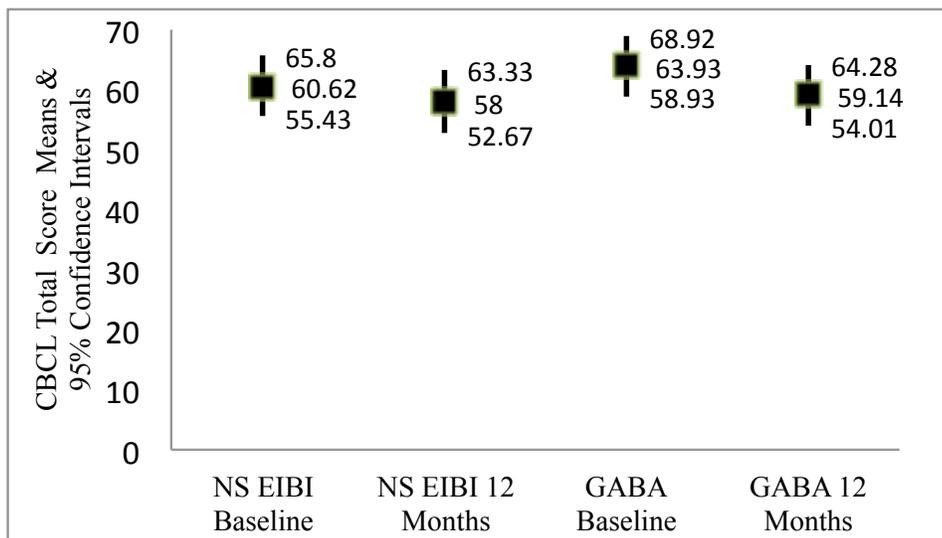
The standard errors were 2.56 for baseline scores and 2.46 for 12-month scores. Baseline and 12-month confidence intervals for both Groups showed considerable overlap.

Question 3: Are there significant differences between baseline (pre-intervention) and 12-month parenting stress scores for parents of children in the NS EIBI and GABA programs? Hypothesis: No hypothesis is possible on the basis of previous research; this question is exploratory in nature.

Parenting Stress

Table 14 displays the results of parenting stress score changes over a 12-month period for the NS EIBI and GABA groups.

Table 14. Means and Standard Deviations for Parenting Stress Scores

	Mean		SD	
Group	Baseline	12 months	Baseline	12 months
NS EIBI	88.46	85.36	17.18	18.72
GABA	95.3	93.5	20.41	20.28

Results of a mixed model ANOVA showed no Group X Time interaction, $F(1,19) =$ .043, $p = .838$ and no significant difference for Group, $F(1,19) = .932$, $p = .347$ (two-tailed) or Time, $F(1,19) = .620$, $p = .441$ (two-tailed). Figure 14 displays the parenting stress score results for 11 participants in the NS EIBI group and Figure 15 displays the results for 10 participants in GABA, with group means indicated in bold.

**Figure 15. NS EIBI Individual and Mean Parenting Stress Score Results**
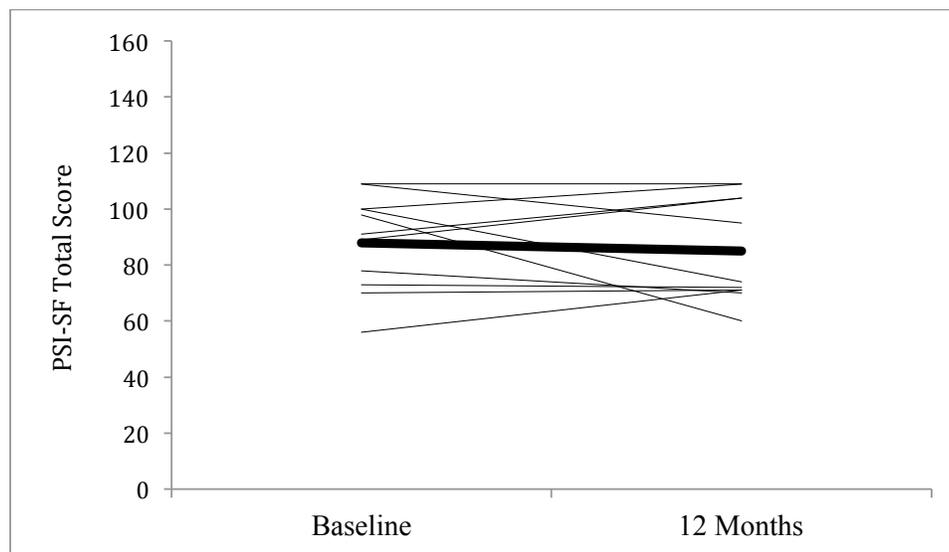
Figure 16. GABA Individual and Mean Parenting Stress Score Results
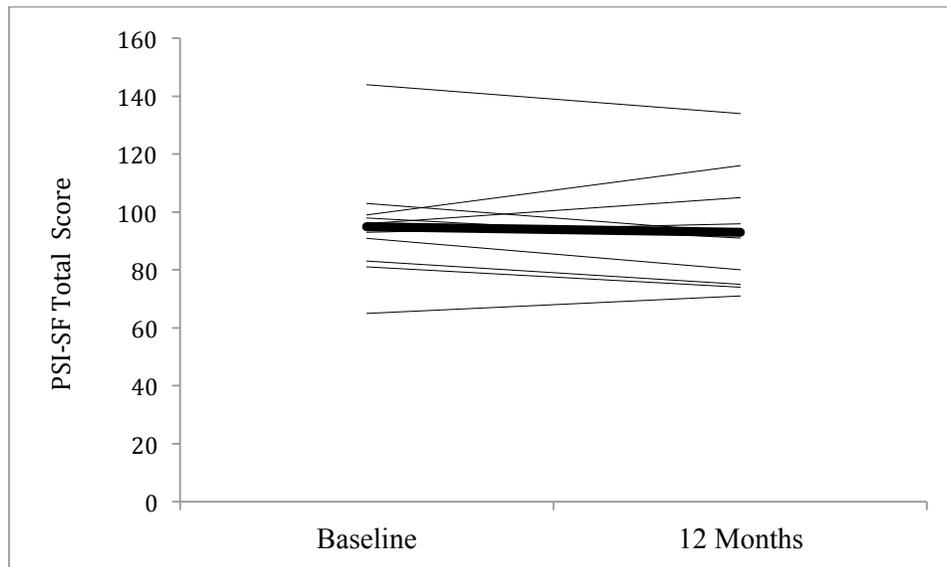
As is evident from Figures 14 and 15, there was variability within each group.

However, neither group experienced significant decreases in overall parent stress over Time.

On average, the PRT parent stress scores decreased 3.1 points while the VB parent stress

scores decreased by 1.8 points over a 12-month period. Figure 15 shows decreasing scores

for 5 NS EIBI participants, 5 increasing scores, and no change for 1. Figure 16 shows

decreasing scores for 6 GABA participants and increasing scores for 4. Because there was

no significant difference for either Group or Time, confidence intervals are not displayed.

Optimal Outcome Participants

Results from even the earliest group evaluations of behavioral interventions for

children with autism (e.g., Lovaas, Koegel, Simmons, & Stevens Long, 1973) have

demonstrated that some children make more progress than others who receive the same

treatment. Historically, different terms and different criteria have been used to describe the

children who make the most significant gains. Lovaas (1987) employed the term "normal

functioning" to refer to children who received UCLA intervention and subsequently passed

grade one in school without requiring special assistance and attained "average or above average scores on IQ tests" (p. 6). Subsequently, Sallows and Graupner (2005) used the term "rapid learners" to describe children who met criteria that were similar to those described by Lovaas. Perry et al. (2008) used the term "average functioning" to refer to children who received intensive ABA-based treatment, achieved post-intervention cognitive and/or adaptive behavior scores in the low average range or better (e.g., IQ scores >85), and did not meet criteria for ASD on the Childhood Autism Rating Scale (CARS) (Schopler, Reichler, & Renner, 1988). Most recently, Kelley, Naigles, and Fein (2010) used the term "optimal outcome" to refer to children who, after receiving intensive ABA-based treatment, were placed in regular education classrooms without assistance, achieved full-scale IQ scores >70, and no longer met criteria for an ASD diagnosis using the ADOS.

Similar to previous research (e.g., Eikeseth et al., 2012; Reichow & Wolery, 2009), participants in the current study achieved a range of outcomes after 12 months of behavioral treatment. For the purpose of a post-hoc descriptive analysis of children who achieved the greatest gains, we adopted the "optimal outcome" criterion of post-treatment IQ scores >70, as per Kelley et al. (2010). Unfortunately, neither school placement nor post-treatment diagnostic information were available to the researcher for children in either the VB or the PRT groups. A total of 7 children met the >70 IQ criterion; 4 were from the NS EIBI program and 3 were from the GABA program. Their scores are reported in Table 15.

Table 15. Scores for Optimal Outcome Children

	Cognitive standard score		PLS-AC (receptive language) standard score		PLS-EC (expressive language) standard score		VABS-II ABC scores		CBCL Total score		PSI Total score	
	BL	12 Mo	BL	12 Mo	BL	12 Mo	BL	12 Mo	BL	12 Mo	BL	12 Mo
NS EIBI 1	89	111 (+22)	94	120 (+26)	97	111 (+14)	84	90 (+6)	n/a	37	98	60 (-38)
NS EIBI 2	91	119 (+28)	107	101 (-6)	104	100 (-4)	74	82 (+8)	76	68 (-8)	109	109 (0)
NS EIBI 3	56	120 (+64)	71	99 (+28)	78	87 (+9)	78	94 (+16)	53	50 (-3)	78	70 (-8)
NS EIBI 4	20	72 (+52)	50	56 (+6)	68	53 (-15)	65	75 (+10)	61	61 (0)	109	95 (-14)
GABA 1	80	89 (+9)	80	85 (+5)	86	84 (-2)	91	86 (-5)	70	58 (-12)	n/a	n/a
GABA 2	91	117 (+26)	89	95 (+10)	102	101 (-1)	73	85 (+12)	69	62 (-7)	81	74 (-7)
GABA 3	52	96 (+44)	96	99 (+3)	77	84 (+7)	83	83 (0)	62	54 (-8)	93	96 (+3)

As is evident in Table 15, 7 of 28 participants met the criteria for optimal outcomes (i.e., 12 month IQ scores >70). Four of the 7 participants entered the study with IQ scores >70, and 3 entered the study with IQ scores <70. Changes in IQ scores ranged from +9 for one GABA participant to +64 for one NS EIBI participant, with an overall mean of +35. As measured by the PLS-4, the change in auditory comprehension standard scores ranged from -6 to +28 and the change in expressive communication standard scores ranged from -15 to +14. Similarly, the change in adaptive behavior composite scores on the VABS-II ranged from -5 to +16; the change in problem behavior scores as measured by the CBCL ranged from 0 to -12; and the change in parenting stress total scores on the PSI-SF ranged from +3 to -38. Two of the 7 participants (NS EIBI 1 and 3 in Table 15) showed evidence of score changes (±1 pt.) in the desired direction across all measures.

> **Question 4:** How do the outcomes for children in the GABA and NS EIBI programs compare to the outcomes reported in the research literature for children receiving approximately similar total hours of UCLA intervention? Hypothesis: The results will be comparable across the three interventions.

UCLA Comparison

In order to compare the outcomes of the current study with existing published data on the UCLA method, the approximate total hours of intervention were calculated for the current study and for the studies listed in Table 3. For the current study, the GABA group's average hours per week (20 hours) was combined with the NS EIBI group's average hours per week (15 hours) to yield 17.5 hours/week for the combined groups. This weekly intensity was multiplied by 4 weeks per month and then multiplied by 12 to estimate the total number of hours across the 12-month intervention period. The method yielded approximately 805

hours of intervention for the current study. Using a parallel set of calculations, three UCLA

studies from Table 2 were identified, with total intervention hours of approximately 1,100

hours (range 1,080-1,200). The comparison studies are summarized in Table 16.

Table 16. UCLA-Based and Current Studies with Total Hours

Study	Total Hours
Anderson, Avery, DiPietro, Edwards, & Christian (1987)	1,080
Eldevik, Eikeseth, Jahr, Smith (2006)	1,200
Eikeseth, Klintwall, Jahr & Karlsson (2012)	1,100
Current study	805

Across the three UCLA-based studies and the current study, the only measures that

allow for a comparison of changes over time are those related to cognitive ability and

adaptive behaviour. These comparisons are summarized in Table 17.

Table 17. Comparison of Current Study with UCLA-Based Studies of Similar Intensity

Study	N	CA (mo) @ intake	Duration/Intensity	Settings	Outcomes
Anderson, Avery, DiPietro, Edwards, & Christian (1987)	14	43 (18-64)	Mean 15 hrs/wk for 18 month Approx. 1080 total hours	Homes preschools	Mean IQ pts +5.6 pts Mean VABS ABC +10.0 pts
Eldevik, Eikeseth, Jahr, Smith (2006)	13	53 (36-68)	Mean 12.5 hrs/wk for 24 months Approx. 1200 total hours	classrooms	Mean IQ pts + 8.2 pts Mean VABS ABC -0.1 pts
Eikeseth, Klintwall, Jahr, & Karlsson, (2012)	35	47 (25-76)	Mean 23 hrs/week for 12 months (range 15-37) Approx. 1100 total hours	Preschool	Mean VABS-II ABC +8.3 pts
Current study	28	46 (31-62)	Mean 17.5 hrs/wk for 12 months(range 15-25) Approx. 805 total hours	Homes and Preschools	Mean IQ pts + 10.8 pts Mean VABS-II ABC +4.11 pts

The VABS-II Composite (total) mean score gain in the current study (+4.11 points) reflects the mean gain for the NS EIBI group (+5.5 points) and the GABA group (+2.72 points) combined, since no significant difference was found between the two groups. The change from baseline to 12 months in the current study was not significant, in contrast to the results reported by Anderson et al. (1987) and Eikeseth et al. (2012). However, the gain of +4.11 points in the current study was higher than that reported by Eldevik et al. (2006), who reported a loss of -0.1 points.

Similarly, the mean IQ score gain for the current study (+10.79 points) reflects the mean gain for the NS EIBI group (+13.15 points) and GABA group (+8.42) combined. The change in IQ scores was similar to and slightly higher than Anderson et al. (1987) and Eldevik et al. (2006). Eikeseth et al. (2012) did not report cognitive measures.

Unfortunately, the published data do not allow for a comparison of language scores due to discrepancies between measures used and the types of scores reported. For example, Eikeseth et al. (2012) reported Vineland Communication standard scores as a measure of language, while Eldevik et al. (2006) reported ratio scores derived from the Reynell Developmental Language Scales (Reynell, 1990) for some participants and ratio scores derived from the Psychoeducational Profile-Revised (Schopler, Reichler, Bashford, Lansing, & Marcus, 1990) for others.

Summary

No significant differences were found between the NS EIBI and GABA groups for any of the dependent variables. However, as predicted, positive and significant changes in the desired direction were observed across the two groups for cognitive ability, expressive language, receptive language, and problem behavior scores. Unexpectedly, significant

changes were not observed for adaptive behavior. Additionally, parenting stress scores did

not change significantly over a 12-month period. Also, changes in cognitive scores and

adaptive functioning, were similar to those reported in UCLA studies of comparable

intensity. Finally, the four participants who began their respective interventions (NS EIBI or

GABA) with higher IQ scores achieved the best outcomes, which is consistent with previous

research (Kelley et al., 2010; Sallows & Graupner, 2005). Only three participants with lower

baseline IQ scores achieved 12-month IQ scores >70.

CHAPTER 4: DISCUSSION

This study was the first to employ a comparative examination of the 12-month

outcomes of two types of early behavioral intervention programs: Verbal Behavior-based

GABA delivered in a specialized preschool group setting (n = 14) and Pivotal Response

Treatment-based NS EIBI delivered by interventionists in home, daycare/preschool and

community settings (n = 14). In addition to employing a comparative approach, it is also the

first study to report outcomes of the VB method as a "package" over an extended period of

time. The results for each of the research questions will be discussed in the sections that

follow.

Matched Groups

The first research question pertained to the extent to which the NS EIBI and GABA

groups were appropriately matched. An independent samples t-test indicated no significant

difference between the groups at baseline for cognitive scores (p=.750) or chronological age

(p=.830). In particular, the results exceed the p = .50 alpha value recommended by Mervis

and Robinson (2003) and Mervis and Klein-Tasman (2004) for assessing differences between

matching variables, thus the two groups were well matched on these variables.

Dependent Variables

The primary research questions pertained to differences over a 12-month period in

scores related to cognitive ability, receptive language, expressive language, adaptive

behavior, problem behavior, and parenting stress.

Cognitive Ability

Results of a mixed model ANOVA with Time as the within subjects factor and Group

as the between subjects factor indicated a significant change in IQ scores over a 12-month

period for both the NS EIBI and GABA groups (mean = +10.79 pts). Confidence intervals

for IQ scores showed considerable overlap. While non-overlapping confidence intervals

always accompany significant differences, the converse is not necessarily true (Payton,

Greenstone, & Schenker, 2003; Wolfe & Hanley, 2002). Schenker and Gentleman (2001)

criticized the overlap method of determining significance "… as a quick and relatively rough

method for exploratory data analysis… The overlap method should not be used for formal

significance testing unless…the information needed to carry out a more appropriate

procedure is unavailable" (p. 186). Furthermore, Cumming and Fidler (2005) noted that the

impact of experimental design is often overlooked when employing the overlap method.

Specifically, they argued that rules for interpreting overlapping CIs only apply to

comparisons of independent groups and are not appropriate for examining repeated measures

because of issues related to autocorrelation. Thus, the amount of CI overlap in the present

study, which utilized a repeated measures design, is irrelevant for assessing the difference

between the means for each group at baseline and 12 months. In this case, results of the

statistical analyses provide the best measure of the significance of change over time.

The effectiveness of the UCLA method for increasing IQ scores is well established in

the literature (Reichow & Wolery, 2009). Thus, it is not surprising that significant gains were

observed in IQ scores for the current study, as the NS EIBI and GABA programs are both

based on the same applied behavior analytic principles as the UCLA method, including

prompting, fading, discrimination training, positive reinforcement for correct responses, and

so forth (Sundberg, 2006). However, it is difficult to compare the current study directly with

the majority of UCLA studies for several reasons, including differences in treatment intensity

and duration. UCLA studies tend to report outcomes for interventions that are more intense

in terms of both hours of therapy per week and duration of therapy in months or years. For those that are comparable to the current study (see Table 17), the results for changes in IQ scores were similar. In general, these results support the suggestion by Reichow and Wolery (2009) that the greatest changes in IQ scores are likely to occur when the duration of therapy is long and the total hours of therapy per week are high. For example, Sallows and Graupner (2005) reported a 25-point IQ gain following 24 months of intervention at 38 hours per week. By comparison, the current study reflects more modest outcomes for less intensive interventions over a shorter period of time. A final issue is the wide variability in both the tests that have been used to measure cognitive ability and the types of scores that have been used (e.g., ratio IQ scores, standard scores) across studies. These issues add to the difficulty in comparing outcomes across studies.

Despite statistically significant gains in mean IQ scores for both groups, only 7 of 28 participants in the current study achieved IQ scores >70 after 12 months of treatment. All four children who began their respective interventions (NS EIBI or GABA) with the highest IQ scores (range 80-91) achieved the best outcomes (range 89-119), which is consistent with previous research (e.g., Kelley et al., 2010; Sallows & Graupner, 2005). Surprisingly, three children who began with lower IQ scores (range 20-56) also achieved 12 month scores >70 (range 72-120). This might reflect, at least in part, Sheinkopf and Siegel's (1998) observation that behavioral interventions tend to emphasize behaviors that are conducive to test-taking situations (e.g., attending to tasks, complying with adult instructions). Thus, some participants' increased IQ scores, such as the NS EIBI child who showed a +64 point gain (from 56 to 120) over a 12-month period, likely reflect both an increase in their overall rate

of development as well as generalized improvements in test-taking behaviors, which is also

desirable and reflects skill acquisition.

Receptive and Expressive Language

Results of a mixed model ANCOVA with Time as the within subjects factor and

Group as the between subjects factor indicated a significant change for both receptive and

expressive language age equivalents over a 12 month period for both the NS EIBI and the

GABA groups (mean +9.79 and +8.71 months respectively). Confidence intervals for

receptive language overlapped slightly for the NS EIBI group and not at all for the GABA

group. Confidence intervals for expressive language overlapped slightly for the GABA group

and not at all for the NS EIBI group. Gains in language scores were expected, as a primary

focus of both treatment programs was on language and communication development (Carr &

Firth, 2005; Koegel & Koegel, 2006), with language gains reported in previous research for

both methods (see Tables 4 and 7). Consistent with the findings of Smith et al. (2010) in their

large-scale community-based evaluation of the PRT method, receptive language AEs (mean

= +9.8 months) improved slightly more than expressive language AEs (mean = +8.7 months)

over a 12-month period. It is somewhat curious that expressive language did not show more

evidence of change, given the focus on teaching requesting/manding behaviors that exists in

both the NS EIBI and GABA programs. However, standardized language assessment tools,

including the PLS-4, are not known for their sensitivity to measuring requesting/manding

behavior. Rather, they tend to be more sensitive to changes in expressive labeling/tacting

(Esch, LaLonde, & Esch, 2010). Therefore, it is possible that certain topographies of

expressive language, namely requesting/manding, did improve for participants in both

treatment programs but that the language measure employed was not adequately sensitive to

this change. A more sensitive, albeit non-standardized, method of assessment would involve tracking and reporting the acquisition rate of specific curricular targets taught to each participant over time (e.g., tacts/labels, mands/requests, intraverbals/answering wh-questions, etc.), as suggested by Lechago and Carr (2008).

Adaptive Behavior

In the current study, Vineland Composite (ABC) standard scores did not improve significantly over time. Large baseline standard deviations for the GABA group (Table 13) likely contributed to this result, which is similar to some UCLA studies of both similar (e.g., Eldevik et al., 2006) and greater intensity (e.g., Smith et al., 2000). On the other hand, significant changes in VABS ABC scores have been associated with and attributed to UCLA interventions that are both more intensive (e.g., Lovaas, 1987; Bibby et al., 2001), and similar in intensity to the current study (Anderson et al., 1987; Eikeseth et al., 2012). In addition, Smith et al. (2010) also reported moderate gains in adaptive behavior for a community-based PRT sample. It is also important to note that, while VABS-II composite scores did not increase significantly over 12 months, neither did they decrease. Such a decrease has been reported in other studies; for example, VABS composite scores decreased significantly over 12-33 months in the "assess and monitor" no-treatment control group employed by Dawson et al. (2010) and the eclectic control group employed by Eikeseth et al. (2007). In the present study, both GABA and NS participants maintained a steady rate of development over 12 months, as reflected in the stability of the VABS-II composite scores.

The most likely explanation for the wide variability in adaptive behavior outcomes in past research is that some treatment programs (and the studies related to them) emphasize adaptive behaviors less than others and thus report lesser gains. For example, GABA

participants in the current study, who as a group gained +2.7 points on the VABS-II over a 12-month period, spent most of their time in a specialized preschool therapy setting where adaptive skills (especially daily living and motor skills) were prioritized less than basic language and communication skills. In addition, most previous research in which adaptive behavior was measured used the original VABS (Sparrow, Cicchetti, & Balla, 1984), which some have suggested provides more conservative standard scores that are more sensitive to change (Hurd et al., 2009). If this is the case, comparisons between the VABS and the VABS-II (which was used in the present study) may be misleading.

Problem Behavior

Results of a mixed model ANOVA with Time as the within subjects factor and Group as the between subjects factor indicated a statistically significant change (i.e., reduction) in problem behavior scores over a 12-month period for both the NS EIBI and the GABA groups (mean -3.71). Because the mean difference was quite small, the CBCL confidence intervals (CIs) were examined in detail to estimate the clinical significance of the change. The CBCL provides three ranges in which total behaviour T-scores may fall: <60 is considered the normal range, 60-65 is considered the borderline clinical range, and >65 is considered the clinically elevated range (Achenbach & Rescorla, 2000).

CIs for the NS EIBI group ranged from 55.43-65.8 at baseline and from 52.67-63.33 at follow-up. This means that the lower CI limits at both time points fell within the normal range, while the upper limits moved from the clinically elevated to the borderline range 12 months later. CIs for the GABA group ranged from 58.9-68.9 at baseline and from 54.0-64.28 at follow-up. As was the case for the NS EIBI group, the lower limits at both time points were in the normal range and the upper limits moved from the clinically elevated to

the borderline range 12 months later. Thus, although there was a significant change in the mean scores across the two groups, it does not appear that this change was large enough to be clinically significant.

It is interesting to note that only 2 of 15 UCLA studies have reported on changes in problem behavior. Smith et al. (2000) did not find between group differences for problem behavior in UCLA method and control groups, despite a 16-point increase in IQ scores for the former group. Sallows and Graupner (2005) employed the CBCL but only at post-test as a partial assessment of "residual symptoms in rapidly learning children" (p. 427). Hence, it is not possible to evaluate the extent to which the results of the present study are typical of ABA-based early intervention programs.

Parenting Stress

The research question related to parenting stress was exploratory in nature, as a directional hypothesis could not be formed based on existing literature. Results indicated that parenting stress scores neither increased nor decreased significantly over the course of intervention and there were no differences between the GABA and NS EIBI groups. Large standard deviations (Table 15) combined with a small sample size make the results difficult to interpret. Nonetheless, the results are consistent with previous findings that families whose children with ASD participate in home-based intensive behavioral interventions are not at higher risk for stress (Hastings & Johnson, 2001; Remington et al., 2007). Of course, it is likely that variables other than those examined in this study also need to be considered when examining parenting stress. For example, child characteristics such as low cognitive ability (Boyd, 2002) as well as problem behavior and adaptive behavior have been associated with maternal stress (Tomanik, Harris, & Hawkins, 2004).

Similarity of Outcomes

The similarity of outcomes between the NS EIBI and GABA programs is noteworthy in light of the differences between the models and the characteristics of each program. While NS EIBI delivered fewer therapy hours on average, those intervention hours were delivered entirely on a one-to-one basis across home and regular daycare settings. Parents were able to observe therapy sessions at home and were invited to follow through with therapeutic interventions throughout the day. In contrast, GABA delivered only 3-5 hours per week of one-to-one therapy, with the majority of time spent in two-to-one and group settings in a segregated preschool that did not include active or frequent parent participation or observation. Despite these differences in the independent variable, no between group differences were observed. This is likely due to the fact that, despite the structural differences noted, the two programs are fundamentally more similar than dissimilar (see Table 7). For example, they are both based on a behavior analytic conceptual framework for language instruction, with an early focus on manding (i.e., requesting) in the natural environment. In addition, both programs rely heavily on contingent positive reinforcement (both tangible and social) for desired behaviors; both programs are delivered by trained interventionists; and both seek to embed instruction in activities that are highly motivating to participants. The question of which program is "best" is an empirical one that can be explored in future research.

Limitations

Research Design

The lack of both a no-treatment control group and random assignment to treatment groups are limitations of this study, which is best conceptualized as an exploratory study that

employed a quasi-experimental pretest-posttest comparison design (Campbell & Stanley, 1963). Although a more rigorous design (e.g., a randomized control trial, RCT) is desirable when comparing treatments, Rogers and Vismara (2008) suggested that the RCT is a late-stage design that may best be used for answering questions about the comparative effects of well-established interventions. In this regard, the comprehensive community-based PRT method is supported by one large-scale study (Smith et al., 2010) while the VB method is not currently supported by any large-scale studies. Therefore, neither method can be considered "well established" as a comprehensive behavioral intervention package at the present time. A quasi-experimental approach was deemed appropriate in order to use data from the two community-based samples examined herein. Participants from the two programs were matched by baseline IQ scores and chronological age, in order to achieve maximum equivalence and partially compensate for lack of random assignment.

Sample Size

The current study is also limited by its sample size, which affects statistical power and the conclusions that can be drawn from the statistical analyses. The study included 14 participants from each of two programs for a total 28 participants. This sample size is not unusually small for studies of this type; for example, UCLA studies to date have ranged in sample sizes from N = 9 (Birnbrauer & Leach, 1993) to N = 66 (Bibby et al., 2001), with a mean N = 21. While a larger sample size would have been desirable, using a community-based sample requires flexibility regarding the participants who are available.

Participant Characteristics

Another limitation related to the use of small community-based samples pertains to the characteristics of the available participants. Ten of the 14 GABA participants had

baseline IQ scores <50. Thus, in order to achieve chronological age and IQ matching with

participants from the larger NS EIBI pool, the final combined group was made up of 20/28

participants with baseline IQ scores <50. In addition, 2 GABA and 3 NS EIBI participants

were functionally nonverbal at baseline (i.e., produced no more than two words using

speech). In the existing literature examining the impact of early behavioral intervention for

children with ASD, this represents a unique group of children with regard to low cognitive

ability. In the original UCLA study, Lovaas (1987) excluded children with "pro-rated mental

ages of <11 months" (p. 4). Schopler, Short, and Mesibov (1989) noted that the pro-rated

mental age (PMA) "can easily be translated to the ratio IQ by dividing the PMA by 30 and

multiplying by 100" (p. 163). When they applied this translation to Lovaas' criterion,

Schopler et al. reported a ratio IQ ≤37 for subject exclusion. Similarly, Sallows and Graupner

(2005) excluded children with ratio IQ scores <35, Smith et al. (2000) and Cohen et al.

(2006) excluded children with IQ standard scores <35, and Eikeseth et al. (2007) excluded

children with IQ scores <50. Had the current study employed an exclusion criteria of baseline

IQ <35, six children would have been excluded; hence, the GABA sample would have been

reduced to n = 8 and the total sample to N = 16. Using an exclusion criterion of baseline IQ

<50 would have reduced the total sample size to N = 8 participants across the two programs.

Out of all of the UCLA studies summarized in Table 2, only Smith et al. (1997)

reported outcomes for a group of participants with IQ scores similar to those in the current

study. Smith et al.'s inclusion criteria specifically required IQ scores <35 and they reported a

+12-point mean increase in IQ after 24 months of intervention at 30 hours per week. Because

the intensity of their intervention was much greater than that in the current study, it is not

possible to compare the results directly; nonetheless, the IQ gains of Smith et al.'s group of

children with severe cognitive impairments is similar to that in the present study (mean = +10.79).

Given the unusually low cognitive ability of most of the children in the present study, the results must be interpreted with caution and cannot be generalized to children with autism who participate in other VB- or PRT-based programs. Additionally, the current results support previous findings that children with higher IQ scores at baseline generally achieve greater gains than those with lower scores (Anderson et al., 1987; Eldevik et al., 2009; Magiati et al., 2007; Sallows & Graupner, 2005).

Measurement

A number of measurement challenges were encountered during the course of the current study, especially with regard to cognitive and language scores. Several children in both groups (n = 11) were unable to obtain a valid standard score on the M-P-R, primarily at baseline. In those cases, a ratio IQ score was computed according to the method employed by Smith et al. (2010) (described previously) and substituted for a cognitive standard score. Six of the 11 children who received a ratio IQ score at intake were able to obtain a valid standard IQ score at 12 months. This situation is not unique and has been reported in other behavioral intervention studies (e.g., Bibby et al., 2001; Birnbrauer & Leach, 1993; Eikeseth, Smith, Jahr, & Eldevik, 2002; Eldevik et al., 2006; Lovaas, 1987; Magiati et al., 2007). While use of ratio IQs is not ideal, it allows for maximal use of existing data and is the clinical reality of community-based research that does not exclude participants based on baseline cognitive scores.

In addition, the current study employed age equivalents (AEs) for measures of receptive and expressive language, in order to make maximal use of the existing data and to

avoid further reducing the sample size in the analysis. The need for use of AEs occurred

because 6 NS EIBI participants were unable to obtain valid baseline standard scores on the

PLS-4, for a variety of reasons (e.g., problem behavior that interfered with assessment). A

number of limitations are inherent with the use of AEs: AEs are not measured on an equal

interval scale; they do not reflect a participant's relative standing among same-aged peers;

and they may falsely imply that abilities increase at a constant rate over time and thus be un-

evenly distributed and skewed (Maloney & Larrivee, 2007; Mervis & Klein-Tasman, 2004).

Nonetheless, their use is not without precedent in the early intervention research literature

(e.g., Anderson et al., 2007; Magiati et al., 2007; Smith et al., 2010). In defense of AEs,

Luyster, Qiu, Lopez and Lord (2007) noted that an AE is the most transparent score when

standard scores cannot be obtained and that they allow maximum use of available data.

Treatment Fidelity

A lack of frequent, ongoing treatment fidelity measures is also a limitation of the

current study. Treatment fidelity in the GABA program was assessed via a checklist

(Appendix B) during in-vivo evaluations with immediate performance feedback 1-4 times

per year (depending on interventionist experience and skill level), with weekly clinical

supervision. Interventionists with lower fidelity scores received additional support and

training. Fidelity of parents' implementation of VB techniques did not occur, as this was not

a primary focus of the GABA program. In contrast, the NS EIBI program employed video

evaluations until fidelity (>80% correct on key skills) was achieved. This criterion was met

by 87% of NS EIBI interventionists within the first 4 months of treatment; however, fidelity

was not formally assessed thereafter, although clinical supervision continued on a bi-weekly

basis throughout treatment. Assessment of fidelity of parents' implementation of PRT

techniques did not occur, although parents were encouraged to use PRT in their everyday activities with their children. Thus, while treatment fidelity measures were more rigorous in the GABA program, both programs would have benefited from more frequent and standardized measures of treatment fidelity. Additionally, measurement of the fidelity of parental implementation would have added to the current findings. On the other hand, it is notable that this is one of only a few autism behavioral intervention studies to include any measures of treatment fidelity at all, a concern that has been raised by a number of researchers (e.g., Charman & Howlin, 2003; Matson, 2007).

Experimenter Bias

Experimenter bias exists as a limitation and potential confound. All NS EIBI data were collected by third-party research assistants who were not involved in service delivery (Smith et al., 2010). For the GABA group, approximately 25% of all assessments were administered/scored by third-party clinicians. The remaining assessments were conducted and scored by the researcher, who was also involved in service delivery to some of the children. However, the researcher did not access the baseline data of any of the children prior to conducting the 12-month assessments. Third party administration of all assessment measures would have been ideal, had available resources allowed for it.

Long-Term Follow-Up

A final limitation is that the current study did not provide long-term follow-up data to evaluate the extent to which gains made over the 12-month period of intervention continued post-treatment, as has been demonstrated in UCLA method research (McEachin et al., 1993). Follow-up data are needed to examine whether intervention gains continue, reach a plateau, or are lost once intervention ceases and the children moves into elementary school.

Future Research

A number of areas for future research are evident, based on the results and limitations of this study. These include a need for additional comparative studies of similar intensity, more rigorous experimental designs, broader matching criteria, larger sample sizes with increased homogeneity, inclusion of additional dependent variables, third-party evaluation, more rigorous measurement of treatment integrity, and use of manualized curricula.

Treatment Intensity

It is important to reiterate that both the NS EIBI and GABA programs were of relatively low intensity, compared to the programs in most UCLA-based studies. For both the NS EIBI and GABA groups, total treatment intensity -- as defined by hours per week of intervention -- was similar; however, the structure of the total intervention hours varied significantly. NS EIBI children received all of their intervention hours that were delivered by therapists (at a maximum, 15 hours/week) in a 1:1 therapist-to-child arrangement, while GABA children received 3-5 hours per week of 1:1 therapy and 12-20 hours in 2:1 or small group arrangements. Differences in the outcomes between the two treatments might have occurred if the GABA program was delivered entirely with 1:1 intervention, if the NS EIBI program was delivered primarily in a group preschool-like setting, or if both programs received many more hours per week (e.g., 30-40 hrs/wk). Future research is needed to examine the outcomes of both programs when treatment occurs at higher levels of intensity, using similar child: therapist ratios.

Experimental Design

Kasari (2002) reviewed research related to comprehensive interventions for young children with ASD and offered a number of suggestions for improving future studies,

beginning with the research design. It is widely acknowledged that rigorously designed comparative studies are needed in order to determine if one treatment approach is more effective than another (Kasari, 2002; Matson, 2007; Matson & Smith, 2008). Future research should seek to "raise the bar" and employ true experimental designs with random assignment to treatment and control groups (Matson & Smith, 2008). Using the current study as a model, it would have been desirable to employ random assignment to a NS EIBI group, a GABA group, and a control group (e.g., eclectic treatment control), and to match all participants on key variables (Kasari, 2002). Random assignment prevents the results from being confounded by experimenter bias in assignment to groups; and including a randomly assigned control group significantly increases the scientific rigor of the experiment by isolating the effects of the independent variable (treatment) in order to help rule out alternate explanations of the experimental results. However, it is important to acknowledge that, in early autism intervention, random assignment to a no-treatment control group presents a number of ethical challenges, as children who are in need of (and are likely to benefit from) such intervention cannot be denied access to it (Kasari, 2002). However, at least two alternatives might be considered (Matson & Smith, 2008). The first is to employ a wait-list control group wherein children access intervention in a staggered fashion; for example, control group children might access services 6 months after the experimental children. The "down side" of this approach is that treatment is delayed for the control group children, despite evidence of the importance of early intervention that begins as soon as possible after diagnosis (Matson & Smith, 2008). A second option is to assign a group of children to an eclectic or community services control group wherein they receive treatment of some sort, but not the treatment delivered to the experimental group. Upon completion of the study, all

children (both control and experimental) are then offered the intervention shown to be most effective, if it is not the one they have already received. This method insures that all children receive some treatment for the duration of the study and is usually preferable for ethical reasons.

Matching Criteria

The current study matched participants by baseline chronological age and IQ scores. Future research would be strengthened by including additional matching variables, such as autism severity (Matson, 2007), which has been shown to predict early intervention outcomes in some studies. For example, Zachor and Ben-Itzchak (2010) reported that less severe autism at baseline was associated with greater cognitive and adaptive behavior gains after 12 months of intervention. Additionally, measurement of severity over time would enable a direct assessment of the impact of the treatment(s) of interest on the core symptoms associated with autism (Matson, 2007). Established measures such as the ADOS (Lord et al., 2001) or the CARS (Schopler et al., 1988) might be employed for this purpose (Weiss, 1999).

Sample Size and Homogeneity

Kasari (2002) recommended a minimum of 30 participants per treatment group, in order to allow for optimum statistical power when conducting. In addition, she recommended recruiting participants who are relatively homogenous with regard to variables such as cognitive ability, problem behavior, and co-morbid psychopathology, in order to enhance the generalizability of findings. These recommendations will be discussed in more detail in the sections that follow.

Cognitive ability. One of the reasons for the disparate outcomes in the behavioral research is the fact that many studies, including the current study, are quite heterogeneous with regard to baseline IQ scores (Kelley et al., 2010). Some researchers have attempted to address this issue by splitting a large and diverse sample into low and high IQ groups, using a cut-off score of ±50 (e.g., Smith et al., 2010), in order to examine outcomes for the two groups separately. However, additional research is needed with children whose entry-level cognitive and/or language abilities are severely impaired. For example, in a UCLA study, Smith et al. (1997) recruited participants with baseline ratio IQ scores <35 and reported a mean increase of +12 points for the experimental group after 30 hours/week for 24 months. Additional research on the effectiveness of a variety of comprehensive intervention approaches is sorely needed for this very challenged group of children with ASD.

Unusual or "problem" behavior. Future research should also assess the presence and severity of unusual or "problem" behaviors in participants. Such behaviors include serious problem behavior (e.g., aggression, self-injurious behavior, etc.) as well as those related to autism "core symptoms" such as repetitive and stereotypic behaviors, which are the most frequently reported and may be even more common that previously suspected (Matson, Wilkins, & Macken, 2009). High rates of unusual or problem behaviors may interfere with the delivery of early intervention programs because of the time required to address them instead of teaching new skills; this, in turn, may account for some of the variability observed in individual outcomes (Jang, Dixon, Tarbox, & Granpeesheh, 2011). Future research is needed in which unusual or problem behaviors are measured for inclusion as a covariate in the analysis and/or in which experimental groups that are more homogenous with regard to such behaviors are recruited.

Co-morbid psychopathology. Matson (2007) noted the failure of autism early intervention studies to recognize and address the potential for comorbid psychopathology including depression and anxiety, which may affect a child's response to treatment. Future research should employ appropriate childhood measures to screen for psychopathology at both pre-test and post-test and create experimental groups accordingly.

Additional Dependent Variables

Magiati et al. (2007) recommended the use of a combination of cognitive measures at baseline and follow-up vs. reliance on a single IQ measure. They argued that the combination approach may provide a more reliable picture of a child's abilities and enhance test-retest consistency. This recommendation is consistent with the practice of Cross Battery Assessment (XBA), which is rooted in contemporary Cattell-Horn-Carroll theory of cognitive abilities and is considered psychometrically and theoretically defensible (Flanagan, Ortiz, & Alfonso, 2007). This approach puts more emphasis on measurement of a range of broad abilities versus a single overall IQ score. The XBA assessment approach guards against invalidity and unreliability in assessment and is consistent with best practices in assessment. However, XBA requires a higher degree of examiner competency and may require additional testing to obtain a global ability score. Therefore, the limitations of XBA may make it an impractical addition to research that is already effortful in terms of time and resources.

Future research should also seek to expand the range of dependent variables that are examined, especially with regard to social language and imitation skills. Ben-Itzchak and Zachor (2007) reported that children with greater social and language deficits at baseline made fewer gains during treatment in terms of language and play skills. They suggested that

the ADOS (Module I) might be used to assess language, communication, and reciprocal social interaction skills. Alternatively, the Social Responsiveness Scale (Constantino & Gruber, 2005) could be employed for this purpose, as per Smith et al. (2010). Additionally, the importance of imitation skills in children with ASD is recognized as a core deficit (Ben-Itzchak & Zachor, 2007). Rapid acquisition of imitation ability is a strong predictor of treatment outcomes (Sallows & Graupner, 2005; Stone & Yoder, 2001), and improvements in imitation skills are a meaningful and valid outcome of behavioral interventions (Kasari, 2002). Therefore, future research should seek to measure imitation ability as a dependent variable.

Experimenter Impartiality and Treatment Integrity

Ideally, assessors should be impartial and independent from the research team as well as un-involved in service/treatment delivery (Kasari, 2002). Independence of assessors strengthens research results by reducing the possibility for bias. In addition, Matson (2007) identified therapist drift from accurate treatment implementation as a real concern, especially given the nature of behavioral interventions that typically take place over one or more years and may change in focus and intensity during that time. A host of factors, including both initial training and ongoing clinical supervision, may impact treatment fidelity over time. Matson (2007) recommended ongoing (i.e., repeated measures) video analysis by blind raters with subsequent therapist feedback to protect against the likelihood of therapist drift. As an example, Sallows and Graupner (2005) required interventionists to first pass a written test on training procedures that were based on Lovaas's *Teaching Developmentally Disabled Children: The Me Book* (1981). Therapists' use of instructional techniques was also assessed using videotaped treatment sessions that were rated before treatment began. In addition,

weekly clinical supervision was provided to each therapist by a senior investigator. Future research would also benefit from the use of manualized interventions that require rigorous, clinically-oriented certification prior to beginning treatment, as is currently the case with the Early Start Denver Model (UC Davis MIND Institute, 2012).

Curriculum Based Assessment

A comprehensive, developmentally appropriate, individualized curriculum that targets skill deficits across all developmental domains is likely to achieve the most meaningful treatment outcomes. However, most early intervention research to date has focused on the measurement of broad outcomes (e.g., IQ, language, autism severity) that do not directly assess an individual's progression through an individualized curriculum and are not clinically useful for curricular modification (Gould, Dixon, Najdowski, Smith, & Tarbox, 2011). Gould et al. (2011) advocated for the use of an assessment approach that lends itself to tracking an individual's progress over time through the use of domain-specific measures (e.g., developmental/educational, social skills, motor functioning, speech and language/communication, daily living skills, play skills, academics/achievement, and intelligence) that directly link assessment items to specific curricular targets. This approach would enable direct measurement that can provide a reliable and valid picture of a child's progress at any given point in time. While comprehensive and psychometrically-sound measurement tools of this type do not exist at the present time (Gould et al., 2011), the development of such tools would be consistent with Kasari's (2002) recommendation that an outcome measure should reflect the focus of treatment and provide multiple data points. This is not to say that broad outcome measures such as IQ and adaptive behavior scores are without merit (they clearly are not). Rather, a curriculum-based approach would further

enrich existing outcome measures and provide additional information on important independent variables.

In addition, future research should seek to provide sufficient treatment details to enable clear interpretation and replication of the results (Lechago & Carr, 2008). While potentially cumbersome, it would be desirable for researchers to report (a) specific curricular targets (given the fact that these will change over the course of a multi-month or multi-year intervention), as well as a child's performance within each program area; (b) the education, training and therapeutic involvement of the main caregiver, therapist(s) and supervisor; (c) the specific instructional procedures used during treatment; (d) the teaching format employed (e.g., primarily discrete trial, primarily natural environment teaching, or a combination); (e) strategies used to facilitate skill maintenance and generalization; (f) mastery criteria and data collection procedures; (g) treatment duration and intensity; and (h) procedures for reducing or managing problem behaviors (Lechago & Carr, 2008).

Clinical Implications and Conclusion

It is important to acknowledge that the current research base on early autism intervention provides the most extensive support for the effectiveness of an intensive, UCLA-based behavioral treatment method (Rogers & Vismara, 2008). However, some families desire an alternative model for one or more reasons, including goodness-of-fit (Simeonsson et al., 1986) for their child and family, amount of parent involvement, and location of the intervention. In this regard, Smith et al. (2010) reported the outcomes for children with autism who received a community-based PRT-based intervention (i.e., NS EIBI) in home, daycare/preschool and community settings. The current study reported the outcomes for 14 children with ASD who received intervention in the GABA program and

who were matched by age and baseline IQ to children with ASD who received intervention in the NS EIBI program. No differences were found across the NS EIBI and GABA groups on any measure. Children in both treatment programs made significant gains in IQ and both receptive and expressive language over a 12-month period. There was also a statistically significant reduction in problem behaviors for the two groups. Statistically significant improvements in adaptive behavior and reductions in parenting stress were not evident. The IQ and adaptive behavior results are similar to published UCLA studies of comparable intensity. It is important to note that both the NS EIBI and GABA programs -- keeping pace with science and research in the fields of applied behavior analysis, VB, PRT, and autism more broadly -- have evolved and developed since these data were collected. Therefore, different outcomes may be produced by either program, either individually or comparatively, in their current and future forms.

An additional consideration, of great importance to many families, insurance providers, and government policy-makers, is the annual cost of intervention. Early intensive behavioral intervention may cost $40,000-$75,000 (Canadian) per year (Motiwala et al., 2006). In contrast, the estimated annual cost per child for the GABA program at the time of data collection was $24,000-$28,000 (Canadian); currently, the costs are approximately $30,000/year for the same service, due to increased staff and overhead costs. Unfortunately, a cost estimate is not available for the NS EIBI program; however, Smith et al. (2010) described it as a "far less costly community-based model" (p. 517), when compared to the intensive UCLA method.

Given the results of this study, and within the limitations noted previously, both the GABA VB-based and NS EIBI PRT-based programs appear to be feasible options for parents

of children seeking an alternative early intervention treatment for a child with autism. NS EIBI may provide the flexibility of an intervention that is conducted by both interventionists and parents in both home and community settings, while the GABA program may be more attractive to families seeking a specialized preschool intervention setting outside of the home. Although additional research is needed to examine the impact of both programs and PRT and VB methods more broadly, they both appear to offer promising early intervention approaches that are also relatively cost-effective.

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Appendix A: GABA Parent Consent Form

Consent Form
A Comparison of the Group ABA (GABA) Verbal Behavior Method of Early Intensive Behavioral Intervention and Pivotal Response Training (PRT) for Children with Autism

Principal Investigator: Pat Mirenda, Ph.D., BCBA-D, Professor, Dept. of Educational & Counselling Psychology and Special Education; 604-822-6296

Co-Investigator: Richard Stock, M.S., BCBA, Doctoral Candidate, Dept. of Educational & Counselling Psychology and Special Education
Research for the fulfillment of degree requirements for the Doctoral degree.

Funded by: The Canadian Institutes for Health Research (CIHR)

Purpose: The purpose of this study is to compare the outcomes of children who received behavioural intervention for autism based on a group applied behavior analysis (GABA) method, and those who received Pivotal Response Treatment (PRT) over a 12 month period. You and your child are invited to participate because your child previously attended the GABA preschool program in Vancouver, BC.

Study Procedures and Time Commitment: The study involves the use of test results that were collected by GABA staff to evaluate your child's skill development before and after 12 months of enrolment in GABA. We ask your permission to use the results of assessments that measured your child's language skills, cognitive development, adaptive behavior, and challenging behavior. We also ask permission to use the results of measures of parenting stress and parent satisfaction that were collected while your child was at GABA. The study will not require any time commitment from you or your child, and no additional tests will be administered.

Risks and Benefits: There are no foreseeable risks to you or your child if you participate in this study.

Confidentiality: Children and families will not be identified by name or place of residence in any reports that arise from the project. Number codes will be used to refer to all children and families in the computer database. All original data records will be maintained in a locked file cabinet at the University of British Columbia. Coded data on computer disks will be maintained on password-protected hard drives at the University of British Columbia. Data

from this project will be preserved for analysis for 5 years after the results are published and will then be destroyed by shredding all paper copies of the assessments and securely erasing all computer copies.

Contact: If you have any questions or would like more information about this project, you may contact Dr. Pat Mirenda at (604) 822-6296 or Richard Stock at ###-###-####. If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent: Your participation and that of your child in this study is entirely voluntary. You may refuse to participate or withdraw from the study at any time without jeopardy to your future relationship with the University of British Columbia, ABA Learning Centre or GABA Preschool.

Your signature below indicates that you have received a copy of this consent form for your own records and that you consent to participation in the study.

_____
Parent/Guardian Signature   Date

_____
Printed Name of the Parent or Guardian signing above

_____
Printed Name of the Child with Autism

Appendix B: GABA Treatment Fidelity Measures (Long Form/Short Form)

BEHAVIOUR INTERVENTION ASSESSMENT III: INTENSIVE TEACHING
LONG FORM

Interventionist:_____

Program Manager/Supervisor:_____

Learner:_____

Date:_____

Reinforcement

1	Instructor builds an EO for a particular reinforcer before engaging in intensive teaching	1 2 3 4 5
2	Instructor uses a variety of reinforcers to motivate the child	1 2 3 4 5
3	Instructor pairs him/herself with reinforcement	1 2 3 4 5
4	Instructor pairs primary reinforcers with social reinforcers	1 2 3 4 5
5	Instructor uses differential reinforcement (e.g., degree of reinforcement matches the child's response effort)	1 2 3 4 5
6	Instructor delivers reinforcement contingent upon target behaviour	1 2 3 4 5
7	Instructor utilizes reinforcement efficiently (e.g., reinforcing compliance and not poor behaviours)	1 2 3 4 5
8	Instructor follows the set VR schedule	1 2 3 4 5

1 = Needs Improvement; 2 = Emerging; 3 = Adequate; 4 = Good; 5 = Exceptional

Instructional Control

1	Instructor easily controls the session and gains child's compliance (instructional control)	1 2 3 4 5
2	Instructor uses redirection procedure appropriately	1 2 3 4 5
3	Instructor handles undesirable behaviours appropriately following the behaviour plan designed by the consultant	1 2 3 4 5

1 = Needs Improvement; 2 = Emerging; 3 = Adequate; 4 = Good; 5 = Exceptional

Instruction

1	Instructor follows the procedure for how to implement each trial	1 2 3 4 5
2	Instructor gains child's engagement and attention prior to giving instruction	1 2 3 4 5
3	Instructor demonstrates appropriate delivery of SDs (tone of voice, variety, etc.)	1 2 3 4 5
4	Instructor uses appropriate pace of instruction throughout the session (short ITI)	1 2 3 4 5

5	Instructor uses both question and fill in the blank formats when teaching	1 2 3 4 5
6	Instructor mixes varies tasks across the verbal operants (mand, receptive, tact, etc.)	1 2 3 4 5

1 = Needs Improvement; 2 = Emerging; 3 = Adequate; 4 = Good; 5 = Exceptional

Prompting

1	Instructor allows the child 2-3 seconds to respond (short response latencies) before delivering feedback	1 2 3 4 5
2	Instructor delivers effective prompts and knows when to prompt the child	1 2 3 4 5
3	Instructor uses 0-second delay when shaping a novel target behaviour	1 2 3 4 5
4	Instructor understands and demonstrates effective fading of prompts (most-to-least prompting procedure)	1 2 3 4 5
5	Instructor follows each prompted trial with transfer trial	1 2 3 4 5
6	Instructor is aware of inadvertent prompts	1 2 3 4 5

1 = Needs Improvement; 2 = Emerging; 3 = Adequate; 4 = Good; 5 = Exceptional

Motivation

1	Instructor utilizes task interspersal throughout the session to keep the child motivated (e.g., does easy trials within a difficult task)	1 2 3 4 5
2	Instructor demonstrates an appropriate balance between NET teaching (child directed / focus on initiations) and Intensive Teaching (adult directed / focus on responding)	1 2 3 4 5
3	Instructor keeps the child engaged throughout the session	1 2 3 4 5

1 = Needs Improvement; 2 = Emerging; 3 = Adequate; 4 = Good; 5 = Exceptional

Organization

1	Instructor keeps materials organized and easy to access	1 2 3 4 5
2	Instructor has a clear idea of current targets and knows what to teach	1 2 3 4 5
3	Instructor has control over reinforcers	1 2 3 4 5
4	Instructor accurately records data (frequency of manding, probe data sheets, etc.)	1 2 3 4 5
5	Instructor is able to plot data on graph	1 2 3 4 5
6	Instructor contributes ideas/observations during the team meeting	1 2 3 4 5

1 = Needs Improvement; 2 = Emerging; 3 = Adequate; 4 = Good; 5 = Exceptional

INTENSIVE TEACHING SKILLS EVALUATION

SHORT FORM

1 = Needs Improvement   2 = Emerging   3 = Good   4 = Exceptional

Reinforcement and Instructional Control				
BI builds an MO for a particular reinforcer before engaging in teaching	1	2	3	4
BI uses a variety of reinforcers and conducts frequent preference assessments	1	2	3	4
BI pairs self with reinforcers	1	2	3	4
BI maintains control over reinforcers	1	2	3	4
BI utilizes differential reinforcement (magnitude of SR+ matches quality of response)	1	2	3	4
BI delivers reinforcement contingent on desired/target behaviours	1	2	3	4
BI can accurately state the current VR	YES		NO	
BI delivers reinforcement according to the current VR	1	2	3	4
BI uses the "ready" response effectively (gain attention before issuing SDs)	1	2	3	4
Teaching Technique				
BI correctly implements each program according to procedure	1	2	3	4
BI uses appropriate SDs and tone of voice	1	2	3	4
BI uses effective pace of instruction	1	2	3	4
BI uses both direct question and fill-in-the-blank question formats	1	2	3	4
BI mixes and varies across the verbal operants	1	2	3	4
BI utilizes task interspersal (easy and difficult tasks)	1	2	3	4
BI allows 2-3 second response latency (does not exceed)	1	2	3	4
BI does not prompt/teach during probes	1	2	3	4
BI completes probes within recommended time (i.e. 20 minutes)	1	2	3	4
BI delivers effective prompts (correct prompt level)	1	2	3	4
BI uses zero second delay when shaping new behaviours	1	2	3	4
BI follows prompted trials with transfer trials	1	2	3	4
BI remembers to include probe trials (several responses after transfer trials)	1	2	3	4
BI is aware of and avoids inadvertent prompts	1	2	3	4
Organization				
BI keeps materials organized and easy to access	1	2	3	4
BI has a clear idea of current targets and knows what to teach	1	2	3	4
BI accurately records data	1	2	3	4
BI effectively uses cue cards	1	2	3	4
BI is able to plot/graph data	1	2	3	4
BI contributes ideas and is prepared with questions	1	2	3	4
Comments:				