

EXAMINING FACTORS RELATED TO OUTCOME IN AUTISM SPECTRUM
DISORDER

by

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This dissertation is dedicated to my daughter,
Ruby Twigg.

“The good life is one inspired by love and guided by knowledge.”
- Bertrand Russell (1925).

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ABSTRACT

Early, comprehensive, behavioural treatments substantially improve outcomes in up to 50% of children with autism spectrum disorders (ASD) while the remainder respond less optimally (Howlin et al., 2009). Understanding this variable treatment response is a priority. Attempts to understand this variability have examined global factors (e.g., IQ, language, age and symptom severity) and their relationship to particular outcomes (e.g., IQ changes; Howlin et al., 2009). The current dissertation adds to a growing body of literature (e.g., Sherer & Schreibman, 2005) moving beyond these immutable factors to examine empirically- and theoretically-determined child characteristics (i.e., toy contact, approach, avoidance, stereotyped and repetitive vocalizations and non-verbal behaviours and affect) hypothesized to predict intervention outcomes for children with ASD.

The objective of the current dissertation is to examine the relationship between the six child characteristics at the start of intervention and 12-month language/communication changes for children with ASD enrolled in the Nova Scotia Early Intensive Behavioural Intervention (NS EIBI) program (Bryson et al., 2007). The program is based on Pivotal Response Treatment (Koegel & Koegel, 2006).

Study 1 examined 27 children with ASD [mean age = 51.26 months ($SD = 9.63$); mean cognitive age equivalent = 26.89 months ($SD = 9.66$)]. Child characteristics were coded from baseline video of the children and therapists during home play interactions. Results indicated that younger baseline age and positive child affect at the start of intervention were related to greater 12-month changes in expressive language.

Study 2 examined 39 children with ASD [mean age = 46.95 months ($SD = 8.10$); mean cognitive age equivalent = 25.03 months ($SD = 10.30$)]. Child characteristics were coded from baseline video of a standard play task administered by trained research assistants. Results indicated that lower levels of baseline appropriate toy contact and avoidance were related to greater 12-month changes in expressive language. A non-significant trend for positive child affect to be related to greater 12-month changes in expressive language was also found.

Results are interpreted in the context of the differences across the two studies and in relation to previous ASD intervention research examining predictors of outcome.

LIST OF ABBREVIATIONS USED

ABA	Applied Behavioural Analysis
ADI-R	Autism Diagnostic Interview - Revised
ADOS	Autism Diagnostic Observation Schedule
AE	Age Equivalent
APA	American Psychiatric Association
ASD	Autism Spectrum Disorder
ATC	Appropriate Toy Contact
CA	Chronological Age
CBQ	Children's Behaviour Questionnaire
CDC	Centres For Disease Control
CELF-IV	Clinical Evaluation of Language Fundamentals – Fourth Edition
DEG	Disengagement
DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition – Text Revision
DSM-5	Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition
DTT	Discrete Trial Teaching
EG	Engagement
EIBI	Early Intensive Behavioural Intervention
EL	Expressive Language
ESCS	Early Social Communication Scales
FP	Free Play
IBI	Intensive Behavioural Intervention
ICC	Intraclass Correlation Coefficients
IJA	Initiated Joint Attention
IQ	Intelligence Quotient
JA	Joint Attention
M-P-R	Merrill-Palmer-Revised Scales of Development
MTW	More Than Words

NS EIBI	Nova Scotia Early Intensive Behavioural Intervention
PDD-NOS	Pervasive Developmental Disorder – Not Otherwise Specified
PECS	Picture Exchange Communication System
PLS-IV	Preschool Language Scales – Fourth Edition
PPVT-III	Peabody Picture Vocabulary Test – Third Edition
PRT	Pivotal Response Treatment
RA	Research Assistant
RJA	Responses to Joint Attention
RL	Receptive Language
RPMT	Responsive Pre-linguistic Milieu teaching
RSI	Responses to Social Interaction
SRNVB	Stereotyped and Repetitive Non-Verbal Behaviours
SRS	Social Responsiveness Scale
SRV	Stereotyped and Repetitive Vocalizations
VABS	Vineland Adaptive Behaviour Scales
VABS ABC	Vineland Adaptive Behaviour Scales – Adaptive Behaviour Composite

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CHAPTER 1: INTRODUCTION

Autism Spectrum Disorders (ASD) are a class of neuro-developmental disorders characterized by varying degrees of impairment in two main areas. Specifically, children diagnosed with ASD show impairment in social interaction and communication, and display restricted and repetitive behaviours and interests [American Psychiatric Association (APA), 2013]. The degree to which each child with ASD displays deficits in each of these areas is extremely variable, truly making it a spectrum of disorders. The most recent version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013), captures the variability across the spectrum through its criteria for the diagnosis of ASD along with specifiers (i.e., intellectual and language abilities, medical/genetic conditions, and severity) for other characteristics that may or may not be present to varying degrees in each individual. This is in contrast to the previous edition, the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition – Text Revision (DSM-IV-TR; APA, 2000) in which five separate ASD diagnoses were captured under the umbrella term Pervasive Developmental Disorders [PDD; i.e., Autistic Disorder, Rett’s Disorder, Childhood Disintegrative Disorder, Asperger’s Disorder and Pervasive Developmental Disorder – Not otherwise specified (PDD-NOS)]. In order to reflect the most recent diagnostic classification system, the term ASD will be used throughout the current dissertation unless a paper distinctly refers to a previous DSM-IV-TR diagnosis and it is relevant to the particular topic area being discussed.

In addition to the wide spectrum of symptom presentations, ASD is characterized by an early onset and children display deficits in very early socio-communicative skills (Lord, Wagner, Rogers, Szatmari, Aman, Charman et al., 2005). The pervasive nature of

ASD impacts all areas of both the child and family's lives (Perry, Harris & Minnes, 2004) and results in exorbitant costs because of the treatment intensity required to adequately address these deficits (Jarbrink, Fombonne & Knapp, 2003). The need for research to address these issues is further demonstrated by the rising prevalence reported over last decade (CDC, 2014). Current estimates suggest that at least 1 in every 150 children is diagnosed with an ASD (Fombonne, 2009), making it among the most common developmental disorders affecting children today. Due to the widespread, severe impact of the disorder and the prevalence, considerable research has gone into determining what constitutes successful intervention for these children.

Research has identified that comprehensive, intensive, early interventions, based on the principles of Applied Behavioural Analysis (ABA), are necessary to treat ASD (Lord et al., 2005; Lovaas, 1987; National Autism Centre, 2009). Over the last few decades a number of different types of interventions based on ABA have been developed for use with children with ASD (National Research Council, 2001). As mentioned earlier there is considerable phenotypic variability in ASD. Therefore, it seems that multiple interventions may be necessary in order to successfully treat *all* children on the spectrum. Two extensively researched and empirically supported intervention techniques are Discrete Trial Teaching (DTT; Lovaas, 1987) and Pivotal Response Treatment (PRT; Koegel & Koegel, 2006). Across the ASD early intervention literature, remarkable gains are consistently demonstrated in up to 50% of children, while the remainder respond less optimally (Howlin, Magiati & Charman, 2009; Smith, Koegel, Koegel, Openden, Fossum & Bryson, 2010). The reasons for this variability in treatment outcomes remain unclear; to advance the field, research is needed to examine the specific factors (e.g., child,

family) responsible (Lord et al., 2005; Rogers & Vismara, 2008). This variability, coupled with the availability of multiple forms of intervention and their very high costs, makes treatment individualization a primary research focus in order to ensure efficient and effective treatment for *all* children with ASD.

The current dissertation seeks to address this variability in treatment outcome by examining empirically and theoretically determined child characteristics that are hypothesized to predict intervention outcomes for children with ASD. In Chapter Two, background research on intervention outcomes and the variable responses observed in treatments for children with ASD is reviewed. Also reviewed is research examining factors related to outcome for children with ASD in treatment; specifically, research looking at predicting growth while in treatment and research looking at predicting treatment response. Chapter Two also outlines how these predictor variables may be related to another well-known construct in the child development literature, namely temperament. Using data from two groups of children enrolled in the Nova Scotia Early Intensive Behavioural Intervention (NS EIBI) program (Bryson, Koegel, Koegel, Openden, Smith & Nefdt, 2007), Chapters Three and Four examine the predictive utility of pre-determined baseline child characteristics. In Chapter Three, video-recorded behaviour from a sample of children is utilized to investigate the study's hypotheses. In Chapter Four, behaviour recorded during a standard play task administered to a sample of children with ASD is used to examine the study's hypotheses. Finally, Chapter Five summarizes and discusses the research findings of the two studies. The implications of these results for clinical practice and future research are also highlighted. This research

sheds light on factors important for treatment individualization and thereby, on how best to allocate services to provide effective and efficient treatment for children with ASD.

CHAPTER 2: BACKGROUND

2.1 OUTCOMES IN ASD INTERVENTION

A considerable body of research has emerged over the last 20 years suggesting that interventions based on ABA are effective for children with ASD. ABA is the science of applying behavioural principles (derived from years of experimental research) to promote change in socially significant behaviours, through analyzing the environmental factors influencing them (Baer, Wolf & Risley, 1968; 1987). A number of treatment models that are based on the principles of ABA have been developed for use with children with ASD (see Rogers & Vismara, 2008; National Autism Center, 2009, for reviews).

A number of comprehensive early intensive behavioural intervention programs for children with ASD utilize DTT as their core teaching strategy. These comprehensive programs have been shown to produce considerable gains (e.g., increases in IQ and language) for some children with ASD (Howlin, Magiati & Charman, 2009; Reichow & Wolery, 2009). DTT is a specific method of intervention that is based on the principles of ABA and involves teaching many specific skills individually by reinforcing appropriate responses over multiple massed trials (National Research Council, 2001). In his landmark study examining the outcomes of children with ASD enrolled in a university clinic-based early intervention program, Lovaas (1987) reported that almost 50% of children (i.e., 9 of 19) had achieved “normal functioning”. Although his methodology and findings have spurred considerable controversy (Gresham & MacMillan, 1998; Schopler, Short & Mesibov, 1989), the finding that up to half of the children achieve very good outcomes (e.g., significant increases in IQ, placement in regular classroom) has been replicated in a

number of other studies (e.g., Flanagan, Perry & Freeman, 2012; Luiselli et al., 2000; McEachin et al., 1993). Earlier claims of “normal functioning” have been tempered by findings that although children make significant gains in a number of areas, children continue to meet diagnostic criteria for ASD in virtually all cases (National Research Council, 2001). As a result, “normal functioning” as a description of outcome may be inappropriate and misleading.

Sallows and Graupner (2005) attempted to replicate Lovaas’ (1987) findings in a non-clinic based intervention program. They randomly assigned 24 children with autism to either clinic-directed early intensive therapy or to a parent-directed treatment group. Children in the parent-directed group received the same intensity (i.e., 30-40 hours/week) and type (i.e., Lovaas-style DTT-based intervention) of treatment, but less in-home supervision of therapy than those in the clinic-directed group (i.e., 6 hours per month versus 6-10 hours per week, respectively). After four years of treatment, the two groups did not differ significantly on multiple measures of performance. The combined results showed significant increases in IQ, communication, and adaptive skills. In addition, Sallows and Graupner (2005) found that 48% achieved average post-treatment IQs and were “succeeding in regular education classrooms” at four-year follow-up, replicating earlier DTT research studies.

More recently, Flanagan et al. (2012) examined the effectiveness of a community-based Intensive Behavioural Intervention (IBI) program for 61 children with ASD compared to an age-matched waitlist control group. In addition, group comparisons at baseline indicated that children in the control group did not differ from children in the treatment group on measures of autism severity or adaptive functioning (no measure of

cognitive functioning at baseline was available). Children in the intervention group received 20 to 35 hours of IBI per week. The authors describe the IBI program as being based on the principles of ABA, with frequent data collection to facilitate data-based decision making. It combines DTT with naturalistic procedures (though the authors do not elaborate on the types of naturalistic strategies employed) and follows a comprehensive curriculum that focuses on teaching many individual discrete skills following a developmental sequence (Perry, Cummings, Dunn Geier, Freeman, Hughes, LaRose et al., 2008). Children in the waitlist group received a variety of interventions (e.g., low-intensity behavioural intervention, speech-language therapy, occupational therapy). Examination of outcomes revealed that children in the treatment group displayed lower levels of symptom severity and higher levels of cognitive ability and adaptive functioning at time 2 (i.e., on average 28 months after time 1 measurement) compared to the waitlist control group. Eighteen percent of the intervention group achieved IQs in the average range (>85), compared to only 3% in the control group. Similarly, 15% of children in the intervention group experienced gains in adaptive functioning of 15 standard score points or more, while only 2% of children in the waitlist group displayed gains of that magnitude. Taken together with the studies described earlier, these findings are encouraging and highlight the effectiveness of early intensive treatment for children with ASD. However, they also point out the need for further research investigating the level and kind of resources necessary to promote gains [e.g., whether programs require intensive, day-to-day therapist supervision or higher parental involvement with less direct supervision, as in Sallows and Graupner (2005)]. In addition, given the fact that a number of children across the literature on EIBI for ASD

respond less optimally (Howlin, Magiati & Charman, 2009), this research points to the possible need to establish multiple treatments in order to provide effective intervention for *all* children on the spectrum.

Another ABA-based model that has received considerable research attention is PRT, a naturalistic intervention. The term naturalistic refers to the natural elements that are included in the intervention, namely that it occurs in the child's everyday environments (e.g., home and preschool), during their regular routines (e.g., play, activities of daily living) and includes reinforcement that directly relates to the specific intervention targets (Koegel & Koegel, 2006). The goal of including these elements is to have the child's responding come under the control of natural environmental stimuli and thus promote generalization and maintenance of skills (Koegel & Koegel, 2006). Within these naturalistic elements PRT utilizes a number of key treatment strategies to promote gains in children with ASD.

First PRT involves following the child's lead (e.g., inserting learning/language opportunities into activities the child is clearly interested in) to ensure that the child is optimally motivated to participate. Next it involves gaining shared control (i.e., having some control over a particular aspect of the activity such as acquiring pieces of the toy) so that the child needs to attend to the interactive partner and is motivated to respond in order to obtain the items/activity in the interventionist's control. Another key strategy in PRT involves balancing maintenance (i.e., tasks already learned/mastered) and acquisition (i.e., tasks not yet learned/mastered) tasks to, again, ensure the child's motivation to participate stays high (i.e., they continually receive a high rate of reinforcement for correct responding). As mentioned previously, PRT also focuses on

providing reinforcement that is naturally contingent on the child's response or attempt to respond (i.e., when the child appropriately responds to a prompt to say the word "ball" in the context of playing with the ball, (s)he is then given the ball and the activity continues). In this way the child's responding is tied naturally to items/activities in the natural environment that increases the likelihood of maintaining and generalizing the skills learned. Finally, strategies used within PRT also target the child's own initiation of skills/language learned. Interactive partners begin by providing a model for, and subsequently reinforcing, an appropriate response from the child. After the child is consistently responding to the model, opportunities are then set up in which no model is provided but it is clear to the child that a response is required. In this way children's own spontaneous and initiated language is shaped by the intervention strategies. All of the strategies discussed above are used throughout treatment to promote gains in children with ASD.

Through its use of the abovementioned strategies, PRT targets pivotal developmental areas (e.g., motivation, initiations, self-management, and responsivity to multiple cues) that are important for improving outcomes for children with ASD (Koegel & Koegel, 2006; Koegel, Koegel, Harrower & Carter, 1999). By targeting these pivotal developmental areas, PRT aims to help the child make widespread, generalized gains in other areas (communication, socialization, behaviour). These collateral gains are particularly noteworthy given that the initial explicit goal of PRT is to increase expressive language abilities. Research on PRT has demonstrated strong evidence of improvements in communication, language, play skills, affect and maladaptive

behaviours of children with ASD (see Humphries, 2003; Koegel, Koegel and Brookman, 2003; Verschuur, Didden, Lang, Sigafoos & Huskens, 2013, for reviews).

For example, Koegel, Symon & Koegel (2002) used a multiple-baseline design to examine the effects of parent training in PRT on the communication skills of five children with ASD. Parent training consisted of five consecutive, five-hour sessions with a parent educator (i.e., a senior doctoral student in special education or clinical psychology with experience in ABA and training parents of children with ASD). In these sessions, in vivo demonstration and on-going coaching of parents in how to target the pivotal area of children's motivation was given. After the initial training week, on-going consultation with families via telephone or email was given as needed. The duration of consultation ranged from 3 to 12 months across children. All five children showed improvements in the use of functional verbal communication during intervention, and continued improvements were demonstrated at follow-up and were evident in multiple settings. These results replicated previous research demonstrating that targeting pivotal developmental areas can lead to improvements in communication (e.g., Koegel, Camarata, Valdez-Menchaca & Koegel, 1998; Koegel, Koegel & Surratt, 1992; Koegel, O'Dell & Koegel, 1987).

Similarly, Koegel, Koegel, Shoshan & McNerney (1999) conducted an exploratory (as opposed to experimental), pre/post design study in which they prospectively examined outcomes for four children enrolled in a PRT-based program targeting self-initiations. All four children were enrolled in regular education preschools with special education assistants in their classes. The PRT-based treatment consisted of two, one-hour sessions per week. Sessions were coordinated with parents to increase the

likelihood that follow-through would occur at home. They found that children with ASD enrolled in PRT demonstrated improvements in a number of areas. Specifically, participants showed better school performance and increases in their adaptive functioning as measured by the Adaptive Behaviour Composite (ABC) of the Vineland Adaptive Behaviours Scale (VABS; Sparrow, Balla & Cicchetti, 1984). The VABS ABC measures an individual's daily functioning in the areas of communication, daily living, socialization, motor skills and maladaptive behavior. In addition to these improvements, individuals in the Koegel et al. (1999) study were enrolled in regular education classrooms and had social circles that included more typically developing peers. These results and those presented by Koegel et al. (2002), although conducted with smaller samples using single-subject design methodology, are similar to those reported from studies using group designs with children enrolled in DTT interventions (e.g., both demonstrate increases in academic, adaptive and language functioning, and enrollment in regular educational settings). Importantly, the research on PRT interventions extends those findings by demonstrating real-world gains in social functioning (e.g., parental report post-intervention indicated social circles that include typically developing children outside of the school setting and participation in extra-curricular and leisure activities with no additional support required). The use of anecdotal parental reports of children's social functioning (rather than those of unbiased observers), while perhaps highlighting the importance and functional nature of these skills for the children and their families, is a limitation of this research. Further research is required to determine whether these gains represent clinically and statistically significant gains from baseline and whether they reflect increases in social skills due to the intervention itself.

Finally, PRT has been shown to produce collateral benefits in other areas of development not directly targeted. For example, using a multiple baseline design, Koegel, Koegel, Green-Hopkins and Barnes (2010) taught three children to initiate interactions by asking “where” questions. This led to increased use of the particular initiations targeted, generalized use of “where” questions, and improvements in the children’s use of language structures typically represented in answers to “where” questions. Baseline data demonstrated that none of the three children used “where” questions spontaneously. During intervention children were prompted to use “where” questions to obtain desired objects (“Say: where is the red car?”). Verbal prompts were faded as the child’s spontaneous use increased. All three children demonstrated increased spontaneous use of “where” questions during intervention and also demonstrated generalized use of “where” questions at home with parents. Finally, periodic probe data indicated that all three children also displayed increased, correct use of various language structures (i.e., in, on, under, in front of, etc.) corresponding to the questions they had asked. Importantly these language structures were not directly targeted but rather were part of the interventionist’s natural response to the child’s questions and all three children began incorporating these structures into their own language repertoire.

More recent research has examined the impact of implementing PRT in community-based settings. Baker-Ericzen, Stahmer and Burns (2007), examined the outcomes for 158 children with ASD enrolled in a community-based parent training intervention utilizing PRT strategies. Children ranged in age from two to nine years ($M = 49.36$ mos.) with the majority (90%) being under the age of six. Parents participated in a 12-week parent training program during which they met with a trained clinician once per

week for one hour. During the weekly sessions, parents were trained in PRT strategies and then given homework to practice implementing the strategies with their children at home. Significant increases in communication, daily living and social skills and in the overall VABS ABC were demonstrated.

A second examination of the impact of a community-based PRT intervention model for children with ASD (Bryson et al., 2007) was conducted in the province of Nova Scotia (Smith et al., 2010). Approximately half of the children enrolled in the study received up to 15 hours per week of therapist-implemented intervention for the first six months with hours tapered to 10 and then 5 hours in the subsequent six months. The other half (the initial cohort of children) received up to 15 hours of intervention per week for the year of intervention. All parents also received approximately eight hours of coaching in PRT strategies at the start of their children's intervention programs followed by monthly, two-hour coaching sessions. Significant mean gains in cognitive ability, receptive and expressive language, as well as decreases in challenging behaviour and autism symptom severity were demonstrated for children enrolled in the program. Similar to previous ASD early intervention research, a significant proportion (40%) of children enrolled in the program made large gains (i.e., attaining ratio IQ's > 85), while others gained relatively less in all areas (Smith et al., 2010).

More recently, Minjarez, Williams, Mercier and Hardan (2011) have added to this growing body of group research supporting PRT. Minjarez et al. (2011) demonstrated that PRT can be implemented with fidelity in a community sample using a group format as the context for teaching the strategies to parents of children with ASD. Significant increases in functional verbal utterances (i.e., a measure of expressive language abilities

coded from video samples) were demonstrated in 17 children (ages 29 to 79 months). Critically, these data and those published by Smith et al. (2010) and Baker-Ericzen et al., (2007) contribute to the PRT literature by adding group-design results to the body of single-subject design studies supporting PRT. In addition, this research demonstrates that PRT-based models can be effectively and feasibly implemented in a community setting.

2.2 VARIABILITY IN OUTCOMES

While tremendous advances have been made in intervention research for ASD, there is much left to be done. As alluded to previously, and perhaps most importantly, this research has shown that while significant mean gains can be made in numerous developmental areas, there is huge variability in individual outcomes (Ospina, Seida, Clark, Karkhaneh, Hartling, Tjosvold et al., 2008; Reichow & Wolery, 2009). Research has yet to uncover whether this outcome variability may be resolved by prescribing different treatments for children with specific profiles, whether distinct treatment models may be best used at particular developmental periods, or whether both will be necessary (Howlin et al., 2009). Understanding this variability is vital to ensuring that all children with ASD optimally benefit from intervention and that intervention resources are allocated most effectively and efficiently. Research has attempted to examine this variability in outcome in two related, but separate ways; the first through predicting overall growth in treatment and the second through predicting treatment response, a component of overall growth (Yoder & Compton, 2004).

2.3 PREDICTING GROWTH

Various studies have looked at predicting growth while in intervention based on characteristics of the child with ASD at the start of intervention. These studies identify baseline factors that are related to growth in particular outcomes for children enrolled in an intervention. In their systematic review, Howlin et al. (2009) stated that the majority of these studies in the ASD intervention literature had examined predictors of IQ as their primary outcome measure. Few studies have looked at predictors of other important outcome variables (e.g., language, social functioning). In much of the literature, four baseline child variables seem to be most consistently examined as predictors of outcome; IQ, language, chronological age (CA) and severity of ASD symptoms.

Howlin et al. (2009) found that results of studies examining age and severity of autism symptoms at the start of treatment have been mixed in terms of their prediction of child outcome. For example, initial CA did not predict outcome in any of the studies reviewed by Howlin et al. (2009); however, the authors noted that the age range across the studies reviewed was narrow, ranging from 3 to 5.5 years. In Lovaas' (1987) original study, CA at the start of treatment was not related to outcome (as measured by IQ and educational placement) in either the experimental or control group. However, children enrolled in the treatment and control groups were, on average, only 35 and 41 months of age, respectively. In fact, all participants were less than 46 months of age. Thus, the restricted age range in these studies may contribute to the lack of significant findings/null effects when examining CA as a predictor of outcome.

In contrast, in a more recent study with a wider age range (i.e., 2-7 years), Perry, Cummings, Dunn Geier, Freeman, Hughes, Managhan et al. (2011) found that younger

initial CA predicted higher IQ at outcome when controlling for initial IQ. The Perry et al. (2011) study examined the Ontario Intensive Behavioural Intervention (IBI) program, which is similar to that in the original Lovaas (1987) study in terms of treatment intensity and use of DTT methods as the core strategy. The Ontario IBI program differed in its lack of aversive strategies (i.e., punishment) for undesirable behaviours, and in its use of naturalistic strategies designed to increase skill generalization. In addition to prediction of outcome IQ, Perry et al. (2011) found that younger CA at the start of intervention was related to better outcomes on a number of measures (i.e., VABS ABC, as well as Communication, Daily Living, Socialization and Motor standard scores). Flanagan et al. (2012) extended these findings when they examined a subgroup of children enrolled in the Ontario IBI program (27% of whom were included in the original Perry et al., 2011, study). They similarly determined that younger initial CA predicted higher IQ at outcome in the treatment group, but not in a waitlist control group.

With regard to severity of autism symptoms, studies have again been mixed in terms of relationship to outcome in intervention. Smith, Groen and Wynn (2000) examined outcome differences in children with ASD ages 18 to 42 months enrolled in either an intensive treatment group (i.e., 30 hours of therapist-implemented intervention per week plus 5 hours of parent-implemented intervention per week) or a parent training group (5 hours per week of parent training from a trained supervisor plus 5 additional hours per week of parent-implemented intervention). In each of the two groups, children were diagnosed with either autism or PDD-NOS. When examining outcome differences between the two diagnostic groups, the authors found no statistically significant differences but noted that within the intensive treatment group, children with PDD-NOS

tended to have higher outcome scores across a variety of areas (e.g., IQ, receptive and expressive language), despite having intake scores on these measures that were not significantly different than the children diagnosed with autism. The authors attribute their lack of statistically significant differences at outcome to the small sample size, high variability across the sample and therefore inadequate statistical power to detect differences.

Remington, Hastings, Kovshoff, Espinosa, Jahr, Brown, et al. (2007) closely examined the baseline differences between two subsets of children with ASD who were deemed responders and non-responders to an ABA-based EIBI program delivered in the children's homes. Using "reliable change index" scores, the authors identified (from the larger group) the six children whose IQs changed positively to a reliable extent and the six children whose IQs decreased over the course of the 24-month intervention. The larger group of children enrolled in the study ranged in age from 30 to 42 months of age at the start of intervention. Mean scores on baseline variables for the six responders and the six non-responders were compared using Cohen's *d* statistic and revealed that, among other differences, responders displayed more autism symptoms on the Developmental Behaviour Checklist (DBC; Einfeld & Tonge, 1995) Autism Algorithm as rated by their parents, compared to non-responders. Interestingly, these results suggest that children who responded better to treatment had higher levels of autism severity at baseline than children who did not respond as well to treatment.

Further complicating the findings related to autism severity and its relationship to outcome in intervention for ASD are the Perry et al. (2011) results described earlier. In that study, more severe autism symptoms as rated on the Childhood Autism Rating Scale

(CARS; Schopler, Reichler, Renner, 1988) Total score predicted lower scores on only one of their outcome measures, namely estimated IQ. Autism severity did not predict the VABS ABC or any of the VABS domain scores. These findings and the aforementioned results pertaining to CA and autism symptom severity illustrate the complex nature of examining the relationships between these variables and the outcomes investigated in studies of children with ASD enrolled in behavioural intervention programs (i.e., difficulties in measurement, relationships may differ for children with ASD with dissimilar characteristics, relationships may differ depending on the intervention).

Unlike the findings surrounding CA and symptom severity, Howlin et al. (2009) highlighted the relative reliability of both baseline IQ and language abilities in the prediction of outcomes for children with ASD in intervention. In fact, in the studies reviewed by Howlin et al. (2009), all but one (i.e., Sallows & Graupner, 2005) found that baseline IQ predicted growth within intervention. This finding has been replicated in recent studies examining predictors of outcome for children with ASD in early intervention. Perry et al. (2011) found that initial IQ accounted for a significant amount of the variance in each of the outcome variables examined (and discussed above) when controlling for baseline levels of each variable, and that higher initial IQ predicted higher scores on each of the variables at outcome. The Howlin et al. (2009) review also emphasized that baseline language abilities predicted intervention outcome in a majority of studies (four of seven). For example, Sallows and Graupner (2005) found that, for children with autism between the ages of 24 and 42 months, initial language abilities as measured by both the Reynell Developmental Language Scales (Reynell & Gruber, 1990)

Expressive Language score and the VABS Communication scale were related to IQ outcome one year after treatment started.

As noted, baseline age, severity of autism symptoms, IQ, and language have been the most frequently examined outcome predictors. A small number of other potential predictors have been examined in a few studies. For example, children's relatively better baseline imitation abilities, daily living, social and motor skills, and fewer behaviour problems have all been found to predict improved outcome within intervention (Perry et al., 2011; Remington et al., 2007). At this point, the vast majority of the literature has focused on IQ, language, age and severity of symptoms. While important for understanding factors related to improved outcomes, this literature illustrates little more than the fact that those children who start off with higher skill levels at baseline, display improved overall growth as assessed by outcome measures after treatment (i.e., the Matthew Effect; Walberg & Tsai, 1983).

The research into predictors of growth within interventions represents an important start to understanding the factors related to children's outcome. However, these studies are restricted in terms of how much they can inform us about children's outcomes in treatment and about treatment individualization. First, the vast majority of the literature in this area has examined predictors of growth within intervention in the context of interventions relying heavily on DTT strategies. Research into predictors of growth in the context of other interventions, such as PRT, is very limited, as outlined later in this dissertation. Second, research into predictors of growth has not examined other potentially important developmental constructs (e.g., temperament) and whether individual differences in such constructs may contribute to the variability in outcomes

seen in children with ASD while in intervention. One final limitation of the research in predictors of growth in the ASD intervention literature has been a failure of studies to utilize particular research methodologies and statistical techniques designed to identify that the growth made in a particular treatment groups varies as a function of a particular pre-treatment variable and group assignment.

More specifically, as discussed above, some of the studies examining outcome predictors have looked at outcomes and their predictors in a single treatment group. Others have compared a treatment group to a comparison group (e.g., treatment as usual, waitlist control group, other treatment group) to establish whether a difference in outcomes existed between the two groups and to then examine predictors of outcome within each of the two groups separately. Of the studies reviewed previously, Flanagan et al. (2012) is the only exception to this method of examining predictors of outcome. While the inclusion of a comparison group supports the hypothesis that some of the change is due to the treatment itself (assuming significant differences between the two groups are found and that groups are randomly assigned so that baseline variables do not significantly differ between the two groups), change is often also influenced by many other factors (e.g., maturation, other therapies, family factors; Yoder & Compton, 2004) and these are not accounted for when examining predictors within each group separately. In order to determine that these factors truly represent predictors of response to intervention, specific statistical strategies (discussed in the next section) need to be utilized (Yoder & Compton, 2004). Given these limitations, the literature examining predictors of treatment outcome in ASD gives only a limited sense of *some* of the factors that may influence overall growth while in intervention; growth that, as mentioned

previously, may be influenced by many factors other than treatment. To individualize treatments for children with ASD, research needs to take prediction of outcomes a step further to understand how and why a given variable might influence a particular outcome in the context of a specific intervention (Lord et al., 2005).

2.4 PREDICTING TREATMENT RESPONSE

As mentioned previously, treatment response represents only one constituent of the overall growth made within treatment (Yoder & Compton, 2004), yet its prediction is very important in terms of most efficiently and effectively allocating treatment services. Treatment response studies define whether or not a positive response to treatment was evidenced. In group design research, this is established by examining between-group differences in randomized groups who are initially equivalent (Yoder & Compton, 2004). In single-subject design research this is done by individually identifying treatment responders and non-responders based on the magnitude and immediacy of their treatment response when appropriate research designs are utilized (e.g., multiple baseline, followed by treatment phase, and ending with removal of treatment; Yoder & Compton, 2004). Once the ability of a given intervention to produce a treatment response has been established using either group or single-subject design methodology, research can then examine which factors predict a favourable response to intervention. Yoder and Compton (2004) outlined a number of factors important for consideration in this type of research. Specifically, three factors are important for the effective identification of predictors of treatment response: namely, the use of appropriate research methodologies; the selection of theoretically informed predictors (as opposed to conducting exploratory analyses); and replication of previously examined predictors of treatment response.

2.4.1 Research Methodologies Appropriate for Predicting Treatment Response

First, predicting treatment response requires attention to the research methodology being used (Lord et al., 2005; Yoder & Compton, 2004). In particular, two research designs are commonly accepted as appropriate for identifying predictors of treatment response. The first is the randomized control trial (RCT), including examination of the statistical interaction between the hypothesized pre-treatment predictor and group assignment (Lord et al., 2005). As discussed previously, in this case growth within the treatment group is assumed to be due to the treatment itself when the control group does not make similar gains. When this growth varies as a function of some hypothesized predictor, one can assume that the pre-treatment variable moderates the treatment effect, and is therefore characterized as a predictor of treatment response (Yoder & Compton, 2004). When the two groups compared are given different treatments (as opposed to comparing one treatment to a treatment as usual or no treatment group), one can determine whether the hypothesized pre-treatment characteristics predict outcome in one (i.e., are specific to one treatment) or both (i.e., are more general predictors of outcome in more than one treatment) groups.

It is important to note that while RCTs that include statistical interaction terms can be used to establish predictors of treatment response, the use of this research design in the field of ASD is difficult, if not impossible (Rosenbaum, 2010) and may not always answer the important questions (McCall & Green, 2004). Parents may believe more in the effectiveness of one treatment versus another, which may influence their motivation to participate in the treatment or the likelihood that they will agree to be randomized, subsequently influencing the results. For example, the widespread implementation of

DTT programs and a public perception that these programs represent the *only* effective treatment make it less likely that parents will agree to have their child randomly assigned to an alternative, as yet unproven, treatment. Thus true random assignment becomes difficult, and, even where possible, may result in biased samples. An example that illustrates these difficulties comes from Cohen, Amerine-Dickens and Smith (2006) in which the authors used a quasi-experimental design with children assigned to groups based on parent preference. The results demonstrated that the parents in each group represented different demographics (i.e., parents in the experimental treatment group had attended/attained a significantly greater number of years of education than parents in the treatment as usual group; Cohen et al., 2006). In addition, research utilizing RCT designs often results in methodological considerations that render findings inapplicable to the real world. For example, in many cases, RCTs rely on circumscribed samples (e.g., those meeting strict research diagnostic criteria for autism, without co-morbid conditions) that do not reflect the characteristics of real-world samples or that produce samples representative of only a portion of the overall population under study (e.g., a specific age group; Rosenbaum, 2010). For all of these reasons, RCTs may not only be difficult, but may not always result in the findings most applicable to intervention for individuals with ASD (i.e., biased findings). Furthermore, as noted in Keenan and Dillenburger (2011), over-reliance on RCTs as the gold standard for decision- and policy-making may lead to negative outcomes (e.g., lack of funding for interventions widely accepted as being supported by the best current research) for some children with ASD.

The second research design accepted as appropriate for investigating predictors of treatment response is a single-subject design (Yoder & Compton, 2004). As mentioned

previously, individual participants are identified as treatment responders or non-responders based on specific single-subject methodology and by evaluating the immediacy and the magnitude of change in a target outcome. Assuming that the responders' data meet the design requirements, change is attributed to the treatment rather than to other factors. When a large enough sample of individual responders and non-responders has accrued, these studies can then be followed up by a group comparison to examine the differences in putatively important pre-treatment characteristics. This group follow-up represents the critical element for identifying the predictors of response to treatment. Yoder and Compton (2004) indicated that identifying treatment response predictors that are specific to a particular type of intervention is less feasible using single-subject designs compared to doing so in randomized group designs. However, one attempt to establish specific predictors of response to PRT using single-subject designs (Schreibman, Stahmer, Barlett & Dufek, 2009) is reviewed later in this chapter.

Similar to the use of RCTs to identify predictors of treatment response, using a series of single-subject designs has its own set of limitations. First, single-subject design research relies, by definition, on very small samples (i.e., often three or four participants). Given the extreme variability in the expression of ASD as well as in the response to treatment, findings from these small-sample studies may not be applicable to the wider population of individuals with ASD. For this reason the use of a group comparison to follow up the single-case studies is critical. However, the time and resources necessary to accumulate a large enough, representative group make it less feasible to conduct research using this method and may explain why very little ASD intervention research thus far has used this methodology to identify treatment response predictors.

2.4.2 Theory-driven Selection of Predictors of Treatment Response

A second factor important for the identification of predictors of response to treatment is the use of theory to select potential predictor variables (Yoder & Compton, 2004). This requires that researchers specify, a priori, why certain child characteristics might predict treatment response. Fully understanding why some variables might be expected to promote gains for some children while in intervention and not others requires thinking about the predictors within the context of both child development and the specific intervention under study (Lord et al., 2005). This type of analysis narrows the number of potential predictors in a theoretically and empirically informed way. This stands in contrast to conducting exploratory analyses in which differences between responders and non-responders are examined post hoc. This second type of analysis may result in spurious findings due to the number of predictors potentially responsible for the differences between the groups. Indeed, the lack of theoretically informed predictors in the current ASD intervention literature has been criticized. Lord et al. (2005) identified the need for examining predictors that take into account developmental (i.e., both typical and atypical) and treatment (i.e., critical treatment processes) theory.

2.4.3 Replication of Treatment Response Research

Finally, in order to be confident, replication of previous findings is important (Yoder & Compton, 2004). Replication of well-conducted studies with representative samples will afford more confidence in research findings and will allow clinicians to individualize treatment programs for children with ASD. This is a critical application of research in ASD intervention, given the resources required for effective treatment. At present, very few studies in the ASD intervention literature have examined predictors of treatment response, and existing findings have yet to be replicated. In addition, the lack of

theoretically informed, a priori hypotheses about predictors of treatment response is a major gap.

The preceding discussion illustrates that predicting treatment response differs from predicting overall growth within intervention as it involves accounting for an *a priori* specified portion of that overall growth. When predictors of treatment response are established, they can then provide valuable information regarding how best to individualize treatments. In particular this research can inform how to decide which individual children may optimally respond to treatment (i.e., if they possess characteristics deemed to be important predictors of response). In addition, this research helps us to identify potential alternative treatment targets for child initially deemed to be non-responders. That is, if specific variables are found to predict positive response to treatment, those variables can be targeted and taught in modified treatments for children who do not, at baseline, exhibit those characteristics. After those precursor skills are taught, the child may then benefit from the original intervention. For example, the child who has less well-developed play skills may first need to be taught to engage with objects before moving on to target language skills in a program in which teaching occurs in the context of play with objects.

Furthermore, if treatment response research is able to identify predictors of response to *specific* interventions (i.e., through the inclusion of a randomly assigned alternative treatment group with appropriate statistical analyses) then children can be matched to particular interventions based on the pre-treatment characteristics they possess. Gathering this type of information through treatment response research will allow clinicians and researchers to more efficiently and effectively allocate crucial treatment services.

2.4.4 Previously Identified Treatment Response Predictors in the ASD Literature

One of the first studies to examine predictors of treatment response was by Koegel et al. (1999). The authors retrospectively examined three children who responded well to one form of ABA-based intervention, namely PRT, and three who responded less optimally. They found that the two groups were distinguished by the number of spontaneous social initiations prior to treatment (i.e., responders were characterized by higher levels of social initiations). The authors later went on to teach initiations to 10 additional children with ASD and found that their language abilities increased.

Subsequent research by Sherer and Schreibman (2005) has more thoroughly examined child predictors of response in the context of PRT. The authors retrospectively examined data from children characterized as responders and non-responders, to identify baseline characteristics that might explain their response status. The authors examined the outcomes for a group of 28 children with ASD enrolled in a PRT-based intervention. They selected the six children identified as extreme responders on the basis of individually administered tests (i.e., increases in language raw scores) and behavioural measures (i.e., increases in appropriate language use and toy play) taken both before and after a six-month intervention. The five non-responders displayed little to no gain on these measures. Exploratory examination of intake video data from these 11 children revealed that appropriate toy contact, approach, avoidance, verbal and non-verbal self-stimulatory behaviours were variables that distinguished the two groups. Specifically, children who, at baseline, appropriately engaged more with toys, used more verbalizations, and avoided people less responded better than did children without this

“responder” profile. The non-responders tended to engage less with toys, and exhibited fewer social approach and verbal self-stimulatory behaviours.

Having identified these profiles, the authors then prospectively identified three children who met the responder criteria and three who met the non-responder criteria and administered a period of PRT. Responders underwent six months of PRT, while the treatment of non-responders was discontinued after five weeks due to lack of change in any of the outcomes examined (the authors indicated that it would have been unethical to continue treating these children and referred them to other services). Children identified as responders displayed better outcomes (i.e., higher scores on IQ, language, adaptive and social measures) than non-responders, both post-treatment (i.e., after six months for responders and five weeks for non-responders) and at follow-up (i.e., six to nine months after treatment ended, no follow-up data available for one non-responder). These results are consistent with previous research in which similar child variables were found to impact child outcome post- intervention with PRT (Ingersoll, Schreibman & Stahmer, 2001).

The research conducted by Sherer and Schreibman (2005) represents one of the first attempts to look at predictors of treatment response for children with ASD enrolled in a PRT-based intervention. However, it is important to note that this research does not address some of the factors key to accurately identifying treatment response predictors. Specifically, because of the retrospective way in which treatment response predictors were identified, Sherer and Schreibman (2005) were not able to take into account the theory behind why the predictors identified might be important to treatment response. In addition, given the methodology used, the authors were not able to identify that the

predictors were specific to PRT or whether they were more general predictors of treatment response. As mentioned previously, examining theoretically derived predictors of treatment response (selected a priori) that take into account both developmental theory and the processes theoretically involved in the particular treatment under study, has been identified as a critical next step in the ASD intervention literature (Lord et al., 2005; Yoder & Compton, 2004).

In a subsequent study, Schreibman et al., (2009) attempted to further refine this responder profile. They examined response to both PRT and DTT in children characterized by their previously established non-responder profile in all but one variable (i.e., high toy contact or low avoidance). That is, children who displayed low levels of approach and verbal stereotypy, along with high levels of avoidance and non-verbal stereotypy, but who displayed high levels of toy contact (similar to the original responders) formed one group. The other group was made up of children who displayed low levels of toy contact, approach and verbal stereotypy along with high levels of non-verbal stereotypy, but who had lower levels of avoidance (similar to the original responders). All six children were administered 18 hours of PRT intervention after baseline was taken and were then subsequently offered 18-36 hours of DTT (two children received 18 hours of DTT but the authors noted concerns that this might not be enough time to observe treatment effects and so the subsequent children received 36 hours of DTT). Three children were then administered an additional 36 hours of PRT (one whose profile had shifted to a “responder” profile over the course of PRT and DTT, and two whose profiles did not change). The three children characterized as non-responders except for their high toy contact responded better to PRT than the three non-responders

characterized by low levels of avoidance. According to the study authors, in neither case did the profiles predict response to the alternative intervention, namely DTT. Compared to the responders in the original Sherer and Schreibman (2005) study, children in the Schreibman et al. (2009) study made some gains in both spontaneous and cued vocalizations (more so for children with high toy contact than for children with low social avoidance). The authors noted, however, that children's gains were smaller than those of children in the original study who exhibited the full responder profile. The authors concluded that when isolating two of the original responder variables (i.e., toy contact and social avoidance) it appeared that for non-responders, higher levels of toy contact was a better indicator of response to PRT than low levels of social avoidance. They also noted that given children's moderate outcomes relative to responders in the original study, the full responder profile may be necessary for a child to optimally benefit from PRT.

Other child variables not examined in the work discussed above may also predict treatment response for children with ASD. For example, children with ASD display early behavioural profiles characterized by lower levels of positive affect (Kasari, Sigman, Mundy & Yirmiya, 1990) and higher levels of negative affect (Garon, Bryson, Zwaigenbaum, Smith, Brian, Roberts et al., 2009). Given the link between early expressions of affect and later communication abilities (i.e., through interactions involving shared attention) in typically developing children (Hohenberger, 2011), the findings regarding affect may have important implications for the development of communication skills in children with ASD. This theoretical link between early affect and the development of language abilities is explored more fully in a later section on the

theoretical rationale for the selection of predictor variables. First, research within the PRT literature is explored that suggests that child affect may be useful as an indicator of a child's level of interest in and motivation for an activity.

In children with ASD, positive affect (i.e., as measured by expressed interest, enthusiasm and happiness/smiling) may also be an important indicator of their level of interest or motivation to learn. Early in the evolution of PRT, Koegel and Mentis (1985) argued that, due to their communication difficulties, children with ASD develop learning histories characterized by significant failure in various tasks which can result in lower motivation (as indexed by expressed affect) to complete or even attempt future tasks. They described this process as a kind of "learned helplessness" (Seligman & Maier, 1967) resulting from the children's experience that their attempts to respond are not often paired with the reinforcement necessary to motivate continued responding. Given that many children with ASD are undiagnosed until they are 3 or 4 years of age (Mandell, Morales, Xie, Lawer, Stahmer & Marcus, 2010), despite the fact that many parents notice signs much earlier (De Giacomo & Fombonne, 1998), they likely have already experienced many of the communication and learning failures that Koegel and Mentis (1985) described. Therefore, children with ASD may come to treatment with varying levels of motivation to learn. Children who have experienced a lot of previous failure may display low motivation indexed by low affect, while others may display higher motivation and corresponding affect. The child with more positive affect may be more likely to engage in the intervention activities and therefore may be more likely to respond to the intervention.

Furthermore, Koegel, O'Dell & Dunlap (1988) conducted a single-subject design study in which four children were engaged in two learning conditions. In one condition, children's natural motivation to learn was targeted by reinforcing their spontaneous attempts to vocalize. In the second condition, children were reinforced for correct motor speech attempts prompted by an adult. While engaged in the first condition targeting the child's motivation, children consistently displayed more positive affect and higher levels of correct speech than in the second condition. Therefore, it appears as though child affect may provide an indication that a child is more motivated and engaged in a learning situation. It is worth noting that the sensitive way in which the adults in this study responded to the natural motivations and interests of the children with ASD in the first condition is similar to research indicating the importance of sensitive/responsive parenting in language learning in typically developing children (Tamis-Lamonda, Bornstein & Baumwell, 2001). This contingent responding to the child's interests and motivations and the use of child affect as an indicator of interest and motivation for learning may explain why some children respond better to treatment than others. This research illustrates the potential utility of child affect as a predictor of treatment response and supports its examination as such, along with the other variables outlined by Sherer and Schreibman (2005).

The research conducted by Sherer and Schreibman (2005) and Schreibman et al. (2009) represents important steps in examining the characteristics of children with ASD that predict response to treatment. However, it is worth noting that the children in these studies were very impaired as evidenced by little-to-no functional verbal language, low IQ and severe autism symptoms. Given that these characteristics have been examined

using only a few single-case design studies it is not clear whether the same findings will emerge when examining larger, more representative samples of children with ASD. Group designs are needed to replicate and extend these findings (Yoder & Compton, 2004). Moreover, research has yet to be conducted that includes other potentially important predictors of treatment response, such as child affect. Similarly, research into individual child treatment response predictors has not yet considered whether other developmental constructs may be useful in predicting treatment response. Temperament represents one such construct with potential links to some of the previously identified treatment response predictors (and to affect) and therefore may warrant further examination as a treatment response predictor itself. Furthermore, some discrepancies exist in the literature around the operational definitions of predictor variables. For example, in the studies described previously, only toy contact that was judged to be appropriate to the function of the toy was examined as a treatment response predictor. Stahmer (1999) has argued that even inappropriate toy contact should predict response to treatment, provided the toy is highly reinforcing for the child.

In addition to the limitation mentioned above, the theoretical reasons one might expect the other variables identified by Schreibman and colleagues to predict response to treatment (e.g., why might decreased avoidance be linked to better outcomes in an intervention whose primary target is increased verbal communication?) have not been clearly outlined. As mentioned previously, these theoretical links are important for understanding the interaction between child characteristics and treatment variables and therefore understanding why a certain variable may predict response to a given treatment for an individual child. Finally, having sound, a priori, theoretical rationales for the

selection of predictors affords more confidence in significant findings, thus making replication more likely. This will allow researchers and clinicians to more confidently use the results for the subsequent individualization of treatment programs.

2.5 THEORETICAL RATIONALE FOR THE SELECTION OF POTENTIAL PREDICTORS

The previous literature examining predictors of treatment response for children with ASD has neglected to offer theoretical reasons why one might expect certain variables to be predictive. This is an important task for two reasons: first, for uncovering which variables are consistent predictors, and second, for understanding why certain children achieve better outcomes than others and therefore how to modify treatment for those who respond less optimally. The following section provides a rationale for why the variables previously examined by Schreibman and colleagues (2005, 2009; i.e., toy play, approach, avoidance, verbal and non-verbal self-stimulatory behaviour), and affect, might predict treatment response in children with ASD.

Importantly, the discussion takes into account relationships between the hypothesized predictors and language outcomes in typically developing children and children with ASD. In addition, although previous research has not definitively determined that these predictors are specific to PRT, to date the child variables have only been examined in that treatment context. Thus, the current discussion considers the interaction of the child predictors with key PRT treatment mechanisms. This allows for a more thorough discussion of the theoretical rationale for the examination of these particular treatment response variables. This discussion does not preclude the potential that the child variables may also be predictive in other intervention contexts.

Finally, discussing why the child predictors may interact with PRT strategies is particularly relevant for the current research as it utilizes data from the Nova Scotia EIBI program in which the primary intervention model is PRT. Similarly, outlining research in which the child predictors are examined in relation to language outcomes is also particularly important given that the primary initial intervention target in PRT expressive language.

2.5.1 Appropriate and Inappropriate Toy Contact

Appropriate toy contact, or object engagement, represents one variable with links to language development in both typically developing children and in children with ASD. In a number of studies of typically developing children, functional play (i.e., appropriate play with an object according to its obvious function) and symbolic play with objects (i.e., play in which toys are used to represent something other than what their original function designates) are related to language development (see Lewis, 2003, for a review). Longitudinal research suggests that early toy play, both functional and symbolic, is related to long-term gains in both receptive and expressive language abilities (McCune, 1995; Ungerer & Sigman, 1984). The child's ability to form mental representations is hypothesized to underlie the relationship between play and language (McCune, 1995). Specifically, children's representational play skills become increasingly complex over time; at the same time, language skills requiring the same level of representation develop (McCune, 1995). Given this relationship between early toy play and later language development in typically developing children, one might hypothesize that children with ASD who engage in more appropriate toy play may also attain higher levels of language development.

Indeed, some research has found a significant relationship between toy play and later language abilities in children with ASD. However, the relationship is somewhat less clear than with typically developing children, perhaps due to the variable language outcomes seen in children with ASD (see Lewis, 2003, for a review). Specifically, many children with ASD display relatively better developed expressive versus receptive language abilities; a pattern that is the reverse of that seen in typically developing children (Hudry, Leadbitter, Temple, Slonims, McConnachie, Aldred et al., 2010; Maljaars, Noens, Scholte & van Berckelaer-Onnes, 2012). However, a recent study by Volden, Smith, Szatmari, Bryson, Fombonne, Miranda et al. (2011) found that the language patterns in children with ASD may be more complex than originally thought and that developmental level may have an impact. In their study of 294 newly diagnosed preschool children with ASD, scores on the Preschool Language Scales –Fourth Edition (Zimmerman, Steiner & Pond, 2002), indicated that for children at the youngest cognitive developmental level [as measured by the Merrill-Palmer-Revised (Roid & Sampers, 2004) Cognitive domain score] this original pattern held true (i.e., expressive greater than receptive language scores); however, for children at older developmental levels the reverse (typical) pattern was observed. Taking these findings into consideration, the relationship between play and language skills in children with ASD may also depend in part, on their developmental level.

When examining the relationship between play and language in ASD, Sigman and Ruskin (1999) demonstrated that functional play, specifically the number of different functional acts (while engaged in solitary play), was not related to language abilities at one year of age, but did predict long-term gains in expressive (but not receptive)

language abilities. Similarly, Toth, Munson, Meltzoff and Dawson (2006) found that a combined measure of solitary functional and symbolic toy play predicted communication gains over two years, measured using the Vineland Adaptive Behaviour Scales – Communication Domain score (i.e., combined receptive, expressive and written language abilities), in preschool-aged children with ASD. Taking this research a step further, some authors have hypothesized that a third variable (i.e., parent’s ability to synchronize their behaviour with that of their child) may mediate the relationship between toy play and later language development in children with ASD (Lewis, 2003). Siller and Sigman (2002), for example, found that parents’ ability to synchronize their behaviour and language with the toy play of their four-year-old children with ASD was positively related to the children’s language gains, measured 10 and 16 years later. Parents whose behaviour was categorized as synchronized with their children’s play demonstrated more undemanding (i.e., the caregiver’s vocalizations maintains the child’s ongoing play activity, through reinforcement or comments consistent with the child’s play) than demanding (i.e., vocalizations that demand a change in the child’s ongoing play activity) verbal utterances. Coupled with the variable toy play skills of children with ASD (Sherer & Schreibman, 2005; Sigman & Ruskin, 1999), this latter finding may have important implications for the relationship between toy play, as a treatment response predictor, and language gains made by children with ASD in intervention.

Related to the parent synchrony measure examined by Siller and Sigman (2002), one of the most important aspects of PRT is that it is child-led (Koegel & Koegel, 2006). That is, interventionists are trained to observe the child’s interest or choice (e.g., of toys), to gain some shared control over the child’s interest (e.g., maintain control over some parts

of the activity or toy) and to then insert learning opportunities (e.g., elicit verbal requests for desired objects) into ongoing interactions related to the child's immediate interest. Thus, the interventionist's behaviour is intimately tied, or "synchronized" with that of the child. As a result, a child with ASD who engages in more toy play allows more opportunities for the interventionist to follow his lead and thus to create additional learning opportunities. Furthermore, as the interventionist provides more learning opportunities, more reinforcement is given that is both naturally related to (e.g., the child is given the ball after verbally requesting "ball"), and contingent on, the child's behaviour, another important technique used to promote learning in PRT. This increased reinforcement helps to maintain the child's interest and motivation in learning (Koegel, O'Dell & Dunlap, 1988). The strong relationships between play and language in typically developing children and children with ASD, as well as the hypothesized interaction between play and treatment techniques, provides a solid rationale for examining the impact of baseline toy play on treatment response in PRT. However, it is important to note that two recent studies are contrary to the current proposal regarding the relationship between toy play and language gains while in intervention.

First, Yoder and Stone (2006) examined the effects of two interventions [i.e., Picture Exchange Communication System (PECS) versus Responsive Pre-linguistic Milieu Teaching (RPMT)] on the non-imitative spoken language of 36 preschoolers with ASD randomly assigned to treatment groups. RPMT is similar to PRT in that it focuses on building language opportunities (e.g., prompts for imitative language and questions to encourage language) around objects of interest to the child. PECS is an augmentative and alternative communication (AAC) system that teaches a child to use pictures to

communicate. Yoder and Stone (2006) reported that children with ASD who began treatment with higher rates of object exploration (i.e., number of different toys touched) displayed faster rates of growth in non-imitative words when in the PECS treatment group. However, for children in the RPMT treatment group, lower rates of object exploration were related to faster rates of non-imitative word use.

Similarly, Carter, Messinger, Stone, Celimli, Nahmias & Yoder (2011) compared the results for 62 children with ASD randomly assigned to either the Hanen “More than Words” (MTW) program or a “business as usual” control group. MTW is also similar to PRT, in that it focuses on child-led interactions in which the parent reinforces the child’s attempts to communicate intentionally. Although no main effect of the intervention on communication was found, children within the MTW group who played appropriately with fewer toys at baseline made greater gains in intentional communication (i.e., a variable that included both non-verbal and verbal communicative acts). This was in contrast to children who played appropriately with more toys at baseline who displayed attenuated growth in intentional communication.

Both Yoder and Stone (2006) and Carter et al. (2011) attributed their findings regarding object manipulation/play to the fact that in responsivity-based interventions (e.g., RPMT, MTW and PRT) learning opportunities are often centered on objects or toys of interest. When a child is not interested in toys initially, treatment often begins with teaching the child to play appropriately with objects. In doing so, opportunities for promoting language development also occur. As a result, children with lower toy contact may have benefitted more from teaching centered on increasing both appropriate toy contact and expressive language. While the findings by Yoder and Stone (2006) and

Carter et al., (2011) suggest a possible negative relationship between toy play and language development in the context of responsivity-based interventions, the general literature base regarding toy play and language development support a positive relationship. Further clarification of this relationship in the context of intervention is needed.

Finally, as mentioned earlier, Stahmer (1999) has argued that inappropriate toy contact may also be related to a child's response to PRT. She argues that children with ASD who play with toys in a very stereotyped and repetitive manner often respond well to PRT because those items are available as strong reinforcers of child behaviour. Stahmer (1999) describes unpublished research in which children who displayed high levels of stereotyped play with objects were taught to incorporate those interests into other, more appropriate play themes (e.g., intense interest in stacking toy plates was redirected to include placing them in a toy truck to "ship" them). Similar to *appropriate* toy contact, the presence of strong reinforcers such as those described by Stahmer makes it easier to use critical PRT techniques (e.g., following the child's lead, using natural reinforcement contingent on the child's behaviour). Thus, even inappropriate toy contact may be theoretically linked to better treatment response.

Research has demonstrated a link between inappropriate object manipulation and later language functioning in children with ASD; however, the relationship appeared to be in opposite direction to that proposed by Stahmer (1999). Ozonoff, Macari, Young, Goldring, Thompson and Rogers (2008) reported that, at 12 months, children who later received a diagnosis of ASD (at 36 months) displayed significantly more inappropriate object manipulation (i.e., frequency of spinning objects and duration of both rotating and

visually inspecting objects) when compared to typically developing controls. Increased spinning, rotating and visual inspection by 12-month-olds were all related to more severe ASD symptoms at 36 months, while rotating and visual inspection were also significantly negatively related to various aspects of cognitive development (i.e., visual reception, fine motor skills) including receptive and expressive language as measured by the Mullen Scales of Early Learning at 36 months. Contrary to the hypothesis proposed by Stahmer (1999), this research demonstrates a negative relationship between inappropriate object manipulation and later language functioning in ASD. What is yet to be determined is whether this relationship can be altered when intervention is implemented that incorporates this object play and whether an intense interest in inappropriate aspects of objects can be redirected to positively influence a child's response to treatment. To the author's knowledge, no published research has examined inappropriate toy contact as a treatment response predictor. However, given the presence of these behaviours in many children with ASD and the importance of strong motivators in behavioural intervention, it may be important to determine whether inappropriate toy contact is related to treatment response in ASD intervention.

2.5.2 Approach and Avoidance

As suggested by the work of Schreibman and colleagues, social approach and avoidance behaviours may also be key treatment response predictors for children with ASD. Relationships between various aspects of social interest/motivation and language have been demonstrated in both typically developing children (Evans, 1993) and in children with ASD (Ingersoll et al., 2001; Koegel et al., 1999). In typically developing children, numerous studies have examined the link between three main types of social

withdrawal (i.e., shyness, social disinterest and social avoidance) and later cognitive, academic and psychosocial outcomes (see Coplan & Armer, 2007, for a review).

In terms of the impact of social withdrawal on language outcomes in typical development, by far the majority of the research has focused on shyness and its impact on language development. Research has found that preschool-aged children who display high levels of social withdrawal, as evidenced by shyness, display poorer receptive and expressive language abilities (Spere & Evans, 2009). In fact, even infants described as “inhibited” demonstrate fewer spontaneous vocalizations, and go on to display less spontaneous language (i.e., speak less) as toddlers (Rezendes, Snidman, Kagan & Gibbons, 1993). Although the mechanism responsible for the link between shyness and language is still debated, four potential explanations have been explored (see Coplan & Evans, 2010, for a review). The first is that shy children experience performance anxiety that hinders their performance on language tests. The second potential explanation is that shy children are more hesitant to take risks and therefore will not take a chance as often as their non-shy counterparts when they do not know the answer on language tests or in social situations. Third, some authors note that studies of the link between shyness and language often compare the extremes of most to least shy (i.e., outgoing) children. As a result, it may not be that shy children are behind in language development but that outgoing children have an advantage. The final potential explanation is that because of shyness, some children have less opportunity to practice and develop language skills. Indeed the possibility that social withdrawal, regardless of how it manifests (i.e., shyness vs. avoidance), may impact a child’s opportunity to practice language is worthy of investigation in children with ASD. Although the mechanism through which shyness

impacts language development in typically developing children is not clearly understood (as discussed above) and may differ from the social withdrawal seen in children with ASD, similar links between aspects of social withdrawal and language development in ASD have been demonstrated.

For example, in their single-subject design study, Ingersoll et al. (2001) examined the impact of a child's level of peer avoidance on language gains in the context of intervention. They found that children ($n = 3$) who were categorized as low peer-avoiders made greater language gains in six months of a naturalistic treatment (i.e., a combination of incidental teaching methods and PRT) than children characterized as high peer-avoiders. Work by Sigman and Ruskin (1999) lends further support to the importance of social interaction to language development in ASD. The authors used the Early Social Communication Scales (ESCS; Mundy, Delgado, Block, Venezia, Hogan & Seibert, 2003), a measure of early non-verbal communication and social-communicative behaviours, to examine the relationship between responding to a communicative partner and language abilities. In a group of children with ASD they found that responses to social interaction (RSI) and to joint attention (RJA) bids by others, as measured by the ESCS, were related to language age not only concurrently but also to one-year gains in language ability (Sigman & Ruskin, 1999). Thus it seems that responding to the social advances of others (and possibly the language opportunities so afforded) is related to language growth. While responding to social advances is not the converse of avoiding them, this research may inform further examination of avoidance as a treatment response predictor. If not responding to the social advances of another negatively affects language gains, then one might reasonably expect that avoidance of social partners would also

negatively impact language gains, perhaps by limiting communication/language opportunities as previously suggested. Furthermore, in the treatment context, avoidance may impede the therapist's ability to intervene. Thus avoidance behaviours represent a potential *negative* predictor of treatment response.

Finally, behaviours that result in a child approaching a social partner (e.g., initiating either verbally or non-verbally in the context of play) have also been linked to language development in children with ASD (Koegel, Carter & Koegel, 2003; Koegel et al., 1999). As mentioned previously, Koegel et al. (1999) retrospectively compared children who responded either well or less optimally to PRT and found that a higher frequency of spontaneous social initiations prior to treatment distinguished the responders from the non-responders. These authors also demonstrated that by first teaching children with ASD to initiate, their language abilities increased. The previously mentioned research by Sigman and Ruskin (1999), which demonstrated that early social *responses* (RSI and RJA) are related to concurrent and later language abilities, also examined the impact of social approach behaviours on language abilities. In that study, children with ASD who displayed higher levels of initiating joint attention (IJA), as measured by the ESCS, had higher concurrent language abilities, as well as greater gains in language ability one year later. Therefore, similar to avoidance, it appears that the level of approach behaviours in children with ASD is related to their language development.

As with the toy play variable it is apparent, from research both on children who are developing typically as well as those with ASD, that social approach and avoidance represent variables in need of further exploration as treatment response predictors. The variability in both social avoidance and approach behaviours in children with ASD has

been well documented (Buitelaar, 1995; Freitag, 1970; Ingersoll et al., 2001; Richler, 1976). This variability may partially explain why some children respond well to treatment. Similar to toy play, within PRT, social approach and avoidance may have important implications for the ease with which interventionists use critical treatment techniques. For example, following the activities and interests of a child who is highly socially avoidant would be harder than following the interests of a child who is more tolerant of the social advances of others. In the case of the child who avoids people, the interventionist would have fewer opportunities to set up learning situations and subsequently fewer opportunities to reinforce the child's responses. It would also be harder to use other techniques designed to increase child motivation (i.e., interspersing tasks more likely to lead to success for the child) with children who avoid the social advances of others. Thus a child who demonstrates higher levels of avoidance may be less motivated to continue with treatment activities than a child who avoids people less. The latter child may then have more opportunities to engage in and be reinforced by intervention activities and techniques.

Similarly, the child who demonstrates more social approach behaviours would also naturally allow for a greater number of teaching opportunities. These children would not only benefit from the interventionists' ability to create learning opportunities, but their approach behaviours would also allow the interventionist to insert learning opportunities into the child-initiated interactions. It would again be easier for interventionists to use PRT techniques (i.e., following child's lead, providing natural reinforcement contingent on the child's responses, reinforcing attempts) with a child who was more likely to approach them, than with a child who displayed fewer approach behaviours. Given the

links between approach/avoidance and language development in children with ASD and in typically developing children, as well as the potential interaction of these variables with treatment techniques, they warrant further investigation to determine whether they have a role to play in predicting treatment response.

2.5.3 Stereotyped and Repetitive Vocalizations and Non-Verbal Behaviours

Sherer and Schreibman (2005) identified both verbal and non-verbal self-stimulatory behaviours as playing a role in the response status of children enrolled in their intervention research. Within these categories they included a number of stereotyped and repetitive behaviours. The use of the term ‘self-stimulatory’ implies that the function of the behaviours is sensory reinforcement that is intrinsic to the child. Current research suggests that sensory reinforcement represents only one potential function of stereotyped and repetitive behaviours (Cunningham & Schreibman, 2008). Therefore, the current study uses the neutral descriptive terms ‘stereotyped and repetitive vocalizations’ and ‘stereotyped and repetitive non-verbal behaviours (SRV and SRNVB, respectively). This terminology more accurately reflects the nature of behaviours defined by Sherer and Schreibman (2005).

It is important to note that neither SRV nor SRNVB distinguished treatment responders and non-responders as clearly as did other variables (toy play, avoidance behaviours) in the original study of PRT response predictors (Sherer & Schreibman, 2005). Similarly, the theoretical links between these variables and treatment response are less clear, but previous research may suggest some potential pathways through which SRV and SRNVB impact treatment response. Regarding the predictive ability of SRV, it

is useful to look at the literature on echolalia (i.e., immediate or delayed repetition of language spoken by another; Prizant, 1984) in children with ASD. Previous research has suggested that some echolalia may have a communicative purpose (Prizant & Duchan, 1981). That is to say, the echolalic verbalizations of children with ASD may sometimes represent attempts to communicate meaning. Furthermore, Schuler and Prizant (1985) suggested that as many as 85% of children with ASD who go on to develop speech have demonstrated immediate or delayed echolalia, further supporting the belief that some echolalia may be viewed as an effort to communicate rather than as meaningless or purposeless utterances (Prizant & Rydell, 1984). It may also be that the ability to vocalize, whether echolalia or SRV, makes it more likely that a child will develop spoken language.

Indeed research examining pre-linguistic vocalizations in both typically developing children and children with developmental delay, has found that infants with higher early rates of vocalizations have better-developed expressive language abilities later. Camp, Burgess, Morgan and Zerbe (1987), studied the early vocalizations of 141 typically developing infants during 5-minute observations of mothers interacting with their babies. The authors found that higher rates of vocalizations between 4-6 months correlated with higher word use, as measured by the Verbalization factor of the Bayley Scales of Infant Development (Bayley, 1969) at 11-15 months. McCathren, Yoder and Warren (1999) examined 58 toddlers, 17-34 months of age, with mild to moderate developmental delays. The authors found that higher total rates of vocalizations, rates of vocalizations with consonants, and rates of vocalizations used interactively during a baseline interaction with a familiar adult were positively correlated with expressive vocabulary one year later.

These findings that early vocalizations in infancy are associated with better expressive language abilities, combined with the literature regarding echolalia, may shed some light on the relationship between SRV and later language abilities in children with ASD. However, it should be noted that both SRV and echolalia are different from early vocalizations in typical infants and therefore these data only provide a potential framework for understanding the relationship between SRV and language outcomes in children with ASD. Examining this potential link in the context of PRT treatment strategies (e.g., reinforcing word approximations/attempts) may provide further context for the relationship between SRV and better language outcomes in children with ASD.

Similar to the rationale provided earlier regarding inappropriate toy contact, it may be that a therapist can use a child's SRV as opportunities for learning. As mentioned previously, one important technique within PRT involves taking advantage of incidental teaching opportunities (Koegel & Koegel, 2006). If a child engages in more frequent SRV, the therapist has more opportunities to pair these vocal behaviours with appropriate reinforcement, setting the stage for the development of intentional communication. For example, if a child's SRV involves repeating the "d" sound, the skilled therapist can begin to pair the child's vocalizations with reinforcing items beginning with "d" (e.g., dog, drink), thus establishing meaning through association. This may encourage future more intentional use of the vocalizations. A second PRT technique critical for language development involves reinforcing children's attempts at responding (versus only complete, accurate responses; Koegel et al., 1988). A child who engages in more SRV presents the therapist with more opportunities to reinforce vocal attempts and maintain the child's motivation for continued learning opportunities. In this way, SRV may lead to

better responses to PRT than a child with very few vocalizations. It is worth reiterating here, that the links between SRV and language in both typical and atypical (i.e., ASD) development are much less clear than those of the other child predictor variables discussed. In addition, the way in which this variable interacts with key PRT treatment strategies is less clearly understood.

Similar to the SRV category, SRNVB did not distinguish responders from non-responders as clearly as other variables in the retrospective Sherer & Schreibman (2005) analysis. That is, responders demonstrated “low to moderate rates” of SRNVB, while non-responders demonstrated “modest” rates of this behaviour (the terms low, moderate and modest were not explicitly defined) with the ranges for this variable in each of the two groups overlapping. From a treatment perspective, however, it is plausible that this behaviour may distinguish children with ASD who respond to treatment versus those who do not. As mentioned previously, some important PRT techniques involve following the child’s lead, using natural reinforcement contingent on the child’s behaviour, and reinforcing attempts (Koegel & Koegel, 2006; Koegel et al., 1988). It is more challenging to follow the lead of a child who demonstrates high rates of SRNVB, given that it is harder for the therapist to participate in the child’s activities, particularly with no object around with which to interact. In addition, it is also harder for the therapist to share control of the activity with the child (another technique within PRT) and therefore to provide reinforcement contingent on the child’s behaviour. Finally, the use of all of these treatment techniques is dependent on having the child’s attention in order to set up, follow through on and reinforce a learning opportunity. In the case of a child who displays higher rates of SRNVB, it may be more difficult to get and maintain their

attention. Anecdotal accounts also suggest that children who display high rates of SRNVB do not respond as well to PRT intervention (e.g., Stahmer, 1999). Therefore, high rates of SRNVB may predict poorer treatment response.

2.5.4 Affect

Last, the theoretical link between affect and language in typical development has been outlined by a number of researchers in the field. In their study involving 18 typically developing 22-month-olds, Kasari et al. (1990) examined links between child affect ratings and joint attention. The authors found that typically developing toddlers, displayed positive affect more frequently when engaging in joint attention, as opposed to requesting, interactions with adults. More recently, Messinger, Fogel and Dickson (2001) examined the expression of positive affect (as indexed by smiling) in various contexts in 13 typically developing infants aged one to six months. The authors found that the infants were more likely to smile, than not smile, when engaged in interactions with their mothers. Furthermore, the types of smiles infants engaged in (i.e., smiles involving cheek raises or open mouths) were different depending on the type of mother-child interaction (i.e., when their mother was also smiling or when visually engaged with their mother's face). Taken together, this research suggests that very early on infants and young children are more likely to display positive affect during periods of shared engagement. As discussed next, the way in which child affect may be linked with later language development may be through its connection with these early parent-child interactions involving shared engagement.

Early dyadic interactions between an infant and his/her caregiver are highly emotional and involve the regulation of arousal between the two partners; such

interactions set the stage for future learning (Moore, 2006). In addition, these early interactions introduce important components of future communication exchanges (e.g., turn-taking) and have been called proto-conversations (Bateson, 1975). Caregivers who are sensitive to their infants' affective states during such interactions and who act contingently upon the babies' behaviour effectively scaffold a communicative context (Hohenberger, 2011). These exchanges closely resemble future conversational exchanges between communicative partners. Thus the beginnings of communication stem from early interactions involving the parent carefully attending to the infant's emotional cues.

It is also during these early interactions that infants begin to learn about their own impact on the world (including other people) around them. For example, they learn that their actions, facial expressions and vocalizations are often followed by responses from their caregivers (Moore, 2006). Furthermore they may learn that their early affective communicative behaviours (e.g., crying) have positive consequences, thus motivating future occurrences of such behaviours (Hohenberger, 2011). With each of these experiences, the infant is primed for later interactions involving self, the caregiver, and an object of shared interest (i.e., triadic interactions; Moore, 2006). These increasingly complex interactions involving joint attention provide opportunities for the further development of language and communication. During these triadic interactions, which entail the same early affective behaviours (i.e., actions, facial expressions and vocalizations) used during dyadic interactions, the infant is able to cue the caregiver to objects of interest (i.e., referents). From these foundations, the adult is able to build communicative exchanges (e.g., commenting, labelling) around objects by which the infant is motivated. Eventually the infant starts to imitate the vocalizations the caregiver

pairs with the objects of interest (Moore, 2006) and begins building his/her vocal/verbal communication repertoire. Research involving typically developing children has indeed found that joint attention abilities are linked to later language abilities. In their longitudinal study of 95 typically developing infants, Mundy, Block, Delgado and Pomares (2007) found that responding to joint attention bids from another at 9 months of age and initiating joint attention at 18 months of age were related to language abilities measured at 24 months.

In ASD, the link between child affect and language development is less clear. It is well known that the use of shared attention (e.g., joint attention) is impaired in children with ASD (Sigman & Ruskin, 1999). Furthermore, children with ASD appear to show lower levels of positive affect during interactions involving joint attention, compared to typically developing controls (Kasari et al., 1990). However, Whalen, Schreibman and Ingersoll (2006) showed that an intervention targeting joint attention can increase positive affect directed towards a social partner in children with ASD. In their study, Whalen et al. (2006) taught four children with ASD - using both DTT and PRT methods - to respond to (e.g., follow gaze and point, look when partner taps or shows an object) and initiate (e.g., coordinated gaze shifting and proto-declarative pointing) joint attention. At post-treatment, all four children showed increases in positive affect directed towards the experimenter, as well as in the targeted JA behaviours. The authors also included comparison data with six typically developing control children. In addition to increased directed positive affect seen in the children with ASD, the authors found that three of the children with ASD displayed levels of positive affect similar to those of the typically developing children. This research demonstrates that, as in typically developing children,

affect and joint attention appear to be related in children with ASD. However, how affect is related to language and communication development in autism is less clear from this literature. This link may be more clearly understood when examining child affect in the context of early intervention.

In contrast to its study as an outcome of intervention, child affect has not yet been examined as a treatment response predictor. It may be that child affect acts as an indicator of the child's interest in and motivation for learning opportunities, as described previously (Koegel et al., 1988). Variations in the level of motivation to participate in new activities may lead some children with ASD to respond more to intervention than others. When considered in the context of PRT, the child's baseline level of positive affect may influence treatment response through its interaction with key treatment strategies. The child's level of expressed affect may serve as an overt indication of the child's interest in a toy or task. The child who displays more positive affect makes it easier for the therapist to understand the object or activity of interest and therefore to follow the child's lead. Furthermore, the therapist who is aware of the toys and/or activities that motivate the child can build language opportunities around those items and activities. As in typical development, interactions built around a shared referent allow the therapist to comment on and label the object or event. The therapist can then also use the strategy of gaining shared control to encourage the child to vocalize, a task that is more likely when the child is highly motivated. Finally, knowing the child's interest makes it easier to provide reinforcement that is natural and contingent.

Considering the treatment strategies used in PRT, it appears that greater expressed positive affect may make it easier for the therapist to apply the intervention techniques in

a way that mimics the process of language learning demonstrated in typical development. The way this process unfolds in children with ASD participating in intervention, however, is much more exaggerated and deliberate. It is possible that this process is the mechanism through which affect leads to better treatment response for some children with ASD than others. Thus, for the present purposes, affect represents a final child variable in need of further examination as a potential treatment response predictor.

2.6 TEMPERAMENT

Until now, research examining predictors of growth in treatment and treatment response has studied individual child variables without consideration for their potential links with broader developmental constructs. Most research into predicting growth while in treatment has failed to consider individual differences in constructs other than IQ, language skills or symptom severity as potential explanations for the variability in outcome. In addition, the links between some of the treatment response variables (e.g., toy contact, approach, avoidance and affect) examined and these developmental constructs have not been explored. Temperament is one such construct which captures individual differences seen in children with ASD, as in typically developing children, however with characteristic profile differences. Therefore, temperament may have important information to add to the literature on predicting individual growth. In addition, it may provide a parallel framework within which to conceptualize the other predictors of treatment response. Recent work has described differential early temperament profiles for children with emerging ASD, their non-ASD siblings and typically developing children (see Garon et al., 2009). Temperament profiles have yet to be examined as a

potential predictor of outcome in the ASD intervention literature but represent an area in which further study may help to explain some of the variability in outcome.

Temperament is most commonly defined as biologically-based, individual differences in both reactivity and regulation (Rothbart & Bates, 1998). Research has consistently found that the various dimensions of temperament can be best represented by three reliable and valid, higher-order factors: Extraversion/Surgency, Negative Affectivity and Effortful Control (Rothbart, Ahadi, Hershey & Fisher, 2001). Included in the Extraversion/Surgency factor are an individual's level of impulsivity, motor activity, shyness, and pleasure resulting from intensely stimulating situations. The Negative Affectivity factor is characterized by one's level of discomfort, fear, sadness, anger, and ability to be easily soothed. Finally, Effortful Control is made up of an individual's inhibitory and attentional control, perceptual sensitivity, and the amount of pleasure and excitement obtained from less stimulating situations. Affect may be one treatment response variable of particular interest in relation to temperament, given that there are affective components within each of the dimensions that make up this larger developmental construct. To varying degrees one's affective reactions and ability to regulate affect in response to various stimuli are represented in the three temperament dimensions. Research into temperament in ASD has suggested different temperament profiles for children with ASD compared to controls.

2.6.1 Temperament and ASD

The most consistent finding in the literature concerning temperament in ASD has been that of differences on the Effortful Control factor. Konstantareas and Stewart (2006) found that only the Effortful Control factor, and not the Negative Affectivity and

Extraversion/Surgency factors, distinguished a group of 19 children with ASD, ages 3-10 years, from their typically developing peers. More specifically, the children with ASD were rated lower by their parents on the attention focusing and inhibitory control subscales of the Children's Behaviour Questionnaire (CBQ; Goldsmith & Rothbart, 1991). Similarly, 10- to 15-year-old boys with ASD were distinguished from their typically developing peers by lower levels of Effortful Control in a recent study by Samyn, Roeyers and Bijttebier (2011).

Garon et al. (2009) found that high-risk toddlers (i.e., those with an older sibling with ASD) who later developed ASD were distinguished not only from typical controls, but also from non-ASD high-risk toddlers on a number of subscales of the parent-completed Toddler Behaviour Assessment Questionnaire - Revised (TBAQ-R; Rothbart, Ellis, Rueda & Posner, 2003). Specifically, they found that toddlers with emerging ASD displayed lower positive anticipation and attention shifting, as well as higher activity levels. In addition, toddlers who later developed ASD and the non-ASD high-risk group were together distinguished from typically developing controls by decreased levels of positive affect, increased negative affect and difficulties controlling attention and behaviour. These findings support previous research suggesting differences in aspects of effortful control, but also suggest differences in other temperament factors. Similarly, De Pauw, Mervielde, Van Leeuwen and Clercq (2011) found that children with ASD (mean age of 10 years) were rated by their parents as higher on Negative Affectivity, and lower on both Surgency and Effortful Control when compared to typical controls. Furthermore, children with more marked ASD symptoms as measured by the Social Communication Questionnaire (SCQ; Rutter, Bailey, Lord & Berument, 2003) showed higher Negative

Affect and lower Surgency and Effortful Control than children with fewer symptoms. These differences have also been demonstrated using other temperament measures. For example, using the Behavioural Style Questionnaire (BSQ; McDevitt & Carey, 1978), Bailey, Hatton, Mesibov, Ament & Skinner (2000) found differences on scales related to the 3 over-arching temperament factors assessed by the CBQ. Children with ASD displayed lower scores on scales related to Effortful Control and showed differences on aspects of Surgency (e.g., increased activity levels and withdrawal behaviours) and Negative Affectivity (e.g., decreased rhythmicity) when compared to typical controls (as well as to children with Fragile X syndrome).

2.6.2 Temperament and Treatment Response

Previous research has demonstrated that children at high risk for ASD display an atypical early temperament profile (Garon et al., 2009). However, previous research has also demonstrated that older children with ASD display variable temperament profiles (Hepburn & Stone, 2006). In their study using the Behavioural Style Questionnaire (BSQ) of the Carey Temperament Scales (CTS; McDevitt & Carey, 1996), Hepburn and Stone (2006) examined the temperament profiles of 110 children with ASD ages, 3-8 years. The authors found that the variability within each of the nine temperament dimensions measured on the BSQ (SDs ranging from .7 to .9 for their sample) was consistent with that of other similarly aged children in the original normative samples (McDevitt and Carey, 1978). Given these findings, one might consider the potential for variability in temperament profiles to influence response to treatment in individuals with ASD. It is plausible that an individual's temperament profile might predispose them to respond more or less optimally to behavioural treatment. This may be particularly true

when one considers the potential relationships among the three main temperament factors and the behavioural variables previously associated with differential response to PRT. The current research study seeks to explore these relationships in an effort to better understand the potential relationships between the treatment response predictors and outcome. For example, toy contact involves the child's ability to attend to toys and to engage with those objects (in either appropriate or inappropriate ways). This behaviour may reflect Effortful Control through its attentional and inhibitory control aspects. Approach and avoidance reflect a child's propensity to engage a social partner or not. These variables may be related to some of the attributes typically captured by the Extraversion/Surgency factor (e.g., activity level, impulsivity or shyness). Finally, positive affect, as a proposed predictor of treatment response, may also reflect some qualities of behaviour typically captured by the Extraversion/Surgency and Negative Affectivity factors. Given that these links have not been previously examined, the hypothesized relationships between temperament and the child treatment response predictors are exploratory in nature when compared to the other hypotheses examined in the current dissertation.

2.7 THE CURRENT STUDY

The current studies were designed in light of the need outlined above for enhanced evidence regarding prediction of individual treatment responses within early intervention for ASD. Data were collected regarding the progress of children receiving services from the NS EIBI program (for a detailed description of the model, see Bryson et al., 2007). As mentioned previously, the Nova Scotia program is based on the principles of PRT. PRT was designed with the goal of encouraging parents and others regularly in

contact with the child to implement these strategies in all environments, thus increasing the opportunity for children to generalize skills. Research has demonstrated that PRT improves the communication and other adaptive abilities of children with ASD (Koegel, Koegel & McNerney, 2001; Koegel, Symon & Koegel, 2002; Sherer & Schreibman, 2005, Smith et al., 2010). In addition to a strong research base supporting its effectiveness, PRT shares features with other ABA intervention methods, including DTT that have previously been demonstrated to be effective for use with children with ASD (National Autism Centre, 2009).

In the Nova Scotia EIBI model (NS EIBI), treatment is delivered by parents and therapists in the home and/or preschool/daycare settings (Bryson et al., 2007). This aspect of the NS EIBI program increases the intensity (i.e., in hours per week) of the therapy and promotes generalization across persons and settings. Families receive training in implementing PRT by trained clinical interventionists; each child's clinical team is responsible for developing and implementing an individual program plan.

The current research has two main objectives. The overall aim was to build on previous single-subject research by examining both the treatment response variables identified in that research, and affect, in two representative groups of children with ASD enrolled in the NS EIBI program. Specifically, we sought to determine whether these variables predicted changes in children's communication skills over 12 months of intervention using PRT. Furthermore, we examined the predictive ability of these variables when taking other established outcome predictors (i.e., CA, cognitive abilities and ASD severity) into consideration. The second, more exploratory aim was to

determine whether the putative treatment response variables could be linked to measures of children's temperament.

CHAPTER 3: STUDY 1

The first objective of Study 1 involved evaluating whether the treatment response variables described by Sherer and Schreibman (2005; i.e., ATC, avoidance, approach, SRV and SRNVB), as well as inappropriate toy contact and affect, could be reliably coded from video. Specifically, video records taken of the behaviours of a sample of children enrolled in the NS EIBI program. The second objective involved examining whether those variables predicted change over 12 months of intervention.

3.1 METHOD

3.1.1 Participants

Data for Study 1 were gathered from a subset of children enrolled in a larger study evaluating the NS EIBI program, specifically those for whom video data were available. Fifty-three children were enrolled in the larger project and of those, baseline videos (obtained from the clinical program) were available for 27 (see the procedures section for a full description of the video context). Group differences were examined for children for whom video data were available (“Video”) compared to those for whom video data were not available (“No Video”). A one-way multivariate analysis of variance (MANOVA) was conducted to determine whether the “Video” group differed from the “No Video” group in terms of age, cognitive abilities, receptive and expressive language, and ASD symptom severity at the start of intervention. No significant group differences were found on the measures, *Wilk’s A* = .91, $F(5, 42) = .82, p = .54$. Means, standard deviations (SD) and ANOVA results for each dependent variable are presented in Table 1.

Table 1

Means, SDs and ANOVA Results Comparing “Video” and “No Video” Groups

Variable	Video		No Video		<i>F</i>	<i>P</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Age (mos.)	51.26	9.63	48.84	10.76	.24	.63
Cognitive Age Equivalent (AE)	26.89	9.66	25.96	10.74	.44	.51
ASD Severity (T score)	78.88	10.84	76.44	10.30	.43	.52
Receptive Language AE	32.33	14.60	27.23	14.21	2.48	.12
Expressive Language AE	31.56	12.10	27.81	10.54	1.82	.18

Data were collected for the 27 children with ASD following 12 months of participation in the NS EIBI program. These children came from three areas in Nova Scotia, representing both urban and rural regions. Because this is a community-based program, and one whose only eligibility criteria is a diagnosis of ASD, it is expected that the children were representative of the demographics (e.g., socio-economic status) of children with ASD in Nova Scotia. The mean chronological age for the total sample of children was 51.26 months (*SD* = 9.63) at the start of intervention. The mean cognitive age equivalent (AE) of the children, as measured primarily by the Merrill-Palmer-Revised Scales of Development (M-P-R; Roid & Sampers, 2004), was 26.89 months (*SD*

= 9.66), indicating that the sample was representative of the range of abilities typically seen in children with ASD. The sample also displayed variability in the severity of autistic symptoms as measured by the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) Total score ($M = 78.88$, $SD = 10.84$).

Eligibility criteria for the NS EIBI program include a DSM-IV-TR (APA, 2000) diagnosis of an ASD, based on standardized measures [i.e., Autism Diagnostic Observation Schedule (ADOS; Lord, Risi, Lambrecht, Cook, Leventhal, DiLavore et al., 2000), Autism Diagnostic Interview – Revised (ADI-R; Lord, Rutter & Le Couteur, 1994)] and clinical judgment. In addition, to be eligible children had to be under the age of six years and without severe sensory, motor or neurological impairment. No children were excluded from participation in the clinical program on this latter basis. In addition, in this first cohort of children enrolled in the NS EIBI program, children were selected by the clinical program to represent the range of language abilities demonstrated across the spectrum (i.e., from nonverbal to well-developed verbal abilities reflected in average performance on standardized language tests). This selection was made because it was important to give staff in this new program experience with children with a range of language abilities as part of their in vivo training in PRT techniques, given that verbal language is the primary target of the NS EIBI program. Thus children in both the below-four (range in the current sample was 36-47 months) and four-to-six age ranges were selected to represent a range of language abilities.

3.1.2 Measures

The primary intervention target of the NS EIBI program is verbal communication. Outcome measures were selected with consideration of the extreme variability in

communication skills of preschool-age children with ASD and the necessity to measure skills at multiple time points.

Language/communication. The primary language measure was the Preschool Language Scale – Fourth edition (PLS-IV; Zimmerman, Steiner & Pond, 2002). The PLS-IV taps both receptive [Auditory Comprehension Index (AC)] and expressive [Expressive Communication Index (EC)] language abilities and is useful for estimating early communication and language abilities in children from birth to 6 years, 11 months. The psychometric properties of the PLS-IV have been demonstrated in previous research (see Zimmerman et al., 2002). In addition, the PLS-IV appears to be a sound measure for examining the receptive and expressive language abilities of children with ASD of varying developmental levels (Volden, et al., 2011). Correlations between the PLS-IV and its predecessor, the PLS-III, were .65 and .79 for the AC and EC indices, respectively (Zimmerman et al., 2002). In addition, in a study examining the validity of the PLS-IV, Zimmerman et al. (2002) demonstrated substantially lower standard scores on the AC and EC, as well as the Total Language Scale for 44 children with ASD (67, 66 and 64, respectively) when compared to 44 of their typically developing peers (103, 102 and 103, respectively) matched on age, gender, parental education and race/ethnicity.

Where appropriate, the Peabody Picture Vocabulary Test – Third edition (PPVT-III; Dunn & Dunn, 1997) was used as a supplemental measure of receptive language abilities for children who were able to point. The PPVT-III is used with individuals aged two years and older. It also demonstrates strong psychometric properties. For example, correlations between the PPVT-III and the Wechsler Intelligence Scale for Children –

Third Edition (WISC-III; Wechsler, 1991), verbal, performance and full-scale IQ scores ranged from .82 to .92 (Dunn & Dunn, 1997).

The Concepts and Following Directions (C&FD) subscale of the Clinical Evaluation of Language Fundamentals – Fourth edition (CELF-IV; Semel, Wiig & Secord, 2003) was used as a supplementary measure of receptive language abilities for children who reached a ceiling on the PLS-IV. The CELF-IV is designed for use with individuals aged 5 to 21 years, 11 months and also demonstrates strong psychometric properties. In particular, a correlation of .81 was demonstrated when examining the relationship between the C&FD subscale of the CELF-IV and the Concepts and Directions subscale of its predecessor the CELF-III (Semel, Wiig & Secord, 2003).

The primary measure of communication abilities was the Vineland Adaptive Behaviour Scales – Second edition (VABS - II; Sparrow, Cicchetti & Balla, 2005). The VABS-II is a measure of adaptive functioning in four domains: Communication, Daily Living, Socialization, and Motor skills. This measure is normed for use with individuals from birth through to 90 years of age and is administered via a standardized semi-structured interview with a parent or caregiver. In their study involving 60 children ages 1-5 years, Harrison and Oakland (2003) reported a correlation of .70 between the VABS-II Adaptive Behaviour Composite (ABC) and the Adaptive Behaviour Assessment System – second edition (ABAS-II; Harrison & Oakland, 2003) General Adaptive Composite score. The VABS-II is an appropriate measure for use with children with ASD because it captures the child's skill levels as shown in daily activities. This is important as children with ASD may have difficulty completing individually administered formal tests or alternatively, may show competencies during formal assessment that they do not

display in unstructured settings. Scores from the Communication domain, assessing both receptive and expressive language abilities, were used in the current study. For all language and communication measures, age equivalents (AE) are presented.

Finally, the main goal of the current study was to examine what factors are associated with degree of language gain for children with ASD while in intervention. As mentioned previously, understanding the variable outcomes of children with ASD while in intervention is of utmost importance to the future of treatment individualization and effectiveness for children with ASD (Lord et al., 2005). The main dependent variable used in the current study is a change score (i.e., the change in both receptive and expressive language AE from baseline to 12 months after the start of intervention). Thus the study examines factors hypothesized to be related to why some children with ASD achieve better outcomes than others while in a PRT-based intervention.

Cognitive Abilities. The M-P-R is an individually administered measure of intellectual development for children aged one month to six years, six months. The M-P-R uses brightly coloured, motivating toys and activities to assess a variety of abilities, making it an especially appropriate measure for use with children with ASD. In addition, the wide age range allows for the opportunity to assess the skills of participants who are in the developmentally earlier range. The Developmental Index (DI) AE was used in the current study as a measure of baseline cognitive abilities. This score represents performance on a number of aspects of intellectual abilities, including non-verbal cognition, receptive language and fine motor skills. The M-P-R demonstrates strong psychometric properties. Correlations between the M-P-R DI and both the Mental Score from the Bayley Scales of Infant Development, Second Edition (Bayley, 1993) and the

Brief IQ from the Leiter International Performance Scale – Revised (Roid & Miller, 1997) were strong (i.e., .92 and .94, respectively; Roid & Sampers, 2004).

In order to make the most of the data available for each child, we used hierarchies of both language and cognitive measures (Smith et al., 2010). Previous research has utilized similar methods in order to maximize participant data (Anderson, Lord, Risi, DiLavore, Schulman, Thurm et al., 2007; Magiati, Charman & Howlin, 2007). For both receptive and expressive language scores, whenever possible PLS-IV scores from the Auditory Comprehension (AC) and Expressive Language (EL) subscales were used. If a child reached a ceiling on the PLS-IV AC and was instead given the CELF-IV, the AE from the Concepts and Following Directions subscale was used for the measure of RL. Similarly, if a child reached a ceiling on the PLS-IV EL subscale, the AE from the Expressive Communication domain of the VABS-II was used. If a child was unable to obtain a score on the PLS-IV, RL was estimated from the average of the PPVT-III AE and the AE from the Receptive Communication subdomain of the VABS-II and EL was estimated in the same manner described above.

Wherever possible the cognitive measure was the M-P-R Developmental Index (M-P-R DI) AE. For those children unable to obtain a valid baseline on the M-P-R, the cognitive AE was estimated from the average of the following VABS-II subscales: Receptive Language, Personal, Domestic and Community Daily Living and Fine Motor. These scales were selected as best reflecting the skills measured by the M-P-R DI AE.

Autism Severity. The Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) is a parent-report measure of the severity of autism symptoms for children 4 to 18 years of age. The SRS includes 65 items that assess five areas of functioning implicated

in ASD: Social Awareness, Social Cognition, Social Communication, Social Motivation and Autistic Mannerisms. The SRS uses a severity rating rather than a yes/no format indicating the presence or absence of symptoms, consistent with current thinking in the field of ASD that the severity of symptoms falls on a spectrum. The SRS Total T score was used as a baseline measure of the severity of autistic symptoms. While the SRS is intended for use with older children and adolescents, research by Pine, Luby, Abbacchi and Constantino (2006) suggests it shows promise as a measure of symptoms in preschool-aged children with ASD.

Video data coding. All treatment response variables were coded from 10-minute video samples of trained therapists interacting with the children at baseline (i.e., prior to starting intervention). Definitions for appropriate toy contact, avoidance, approach and SRV and SRNVB were taken from Sherer and Schreibman (2005), with minor clarifications / modifications as necessary to achieve inter-rater reliability. The definition of inappropriate toy contact was taken from Stahmer (1999). Based on the scoring protocol used by Sherer and Schreibman (2005), appropriate and inappropriate toy contact, avoidance, approach, and SRNVB were coded in 30-second intervals for a total of 20 intervals per video. SRV was also coded in 30-second intervals for a total of 20 intervals per video. However, unlike the other child predictors, SRV was coded as a proportion of the child's total language (i.e., SRV, verbal utterances, and immediate imitation/echolalia). That is, the number of intervals in which SRV occurred was divided by the total number of intervals in which any verbalizations occurred to obtain the SRV score.

The definition of affect was adapted from those of Baker, Koegel and Koegel (1998), Brookman-Frazee (2004) and Kochanska and Aksan (1995). There was no clear indication from these previous studies regarding the appropriate length of intervals for affect coding. The decision was made to code child affect in one-minute intervals for a total of 10 intervals per video. The total score was an average of the scores for each interval. It is important to note that in some cases, technical difficulties (e.g., poor sound or video quality) resulted in the videos being cut shorter than the intended 10-minutes. This resulted in some of the intervals not being “scoreable”. The percentage of total scoreable intervals during which a child engaged in each of the treatment response behaviours was taken as the total score for each variable.

Appendix A provides the coding scheme and definitions for each treatment response variable. Toy contact was coded as having occurred when the child interacted with a toy in one of two appropriate ways, or in an inappropriate way, for 5 seconds or more. Appropriate uses included the child using the toy according to its function (e.g., roll train along the floor) or using the toy to represent another object in play (e.g., use toy banana as a phone). Inappropriate uses included the child playing with a toy in a way other than for its intended function, in a non-functional manner (e.g., repeatedly picking up banana and dropping it, waving string). Avoidance was coded when the child physically moved or turned his head or gaze away in response to an adult’s touch, gaze, words, or attempt to join in play. Approach was coded when the child physically moved (including reaching) or turned his head or gaze towards the adult or when he approached to take the adult’s toy. SRV were coded when the child made seemingly meaningless sounds or utterances, high-pitched screams that were not associated with a tantrum, and

repetitive sounds. SRNVB were coded when the child displayed any number of behaviours (without objects) that appeared to be stimulating in nature. Behaviours varied from child to child but included such behaviours as hand flapping, rocking, facial grimacing, head shaking, jumping up and down, and body posturing. Affect was coded along a continuum ranging from highly negative (“Child does not appear to be enjoying himself. There are clear signs of distress, anger, fear, sadness or frustration”) to highly positive (“Child appears to be enjoying himself- may smile, laugh happily out loud, or jump with joy).

Video data were coded by trained raters. Raters were trained via multiple methods. Initially raters engaged in didactic training with the author including discussions regarding the variable definitions with video examples. Raters then coded practice videos until they reached an acceptable level of reliability [i.e., Intraclass Correlation Coefficient (ICC) > .75]. During the practice coding all variables, with the exception of SRNVB achieved excellent reliability (ATC = .99, Avoidance = .76, Approach = .77, SRV = .91, SRNVB = .56, affect = .91). It appeared that the behaviour of one practice child significantly affected the reliability for SRNVB; when this child’s data were removed the ICC increased to .90. Discrepancies for this child were discussed until consensus was reached, and raters were allowed to begin coding the study videos. In Study 1, 100% of the baseline child videos were coded by a second trained rater to assess reliability continuously.

3.1.3 Procedure

Assessment visits. Assessment measures for Study 1 were selected from those used in a larger NS EIBI evaluation study. Assessments occurred primarily in a clinical

laboratory. Children and their parents were brought to a testing room where trained research assistants (RA) administered the measures. Occasionally assessments took place in other settings (e.g., daycare) when travel to the lab was not possible for families.

Video Data. Video samples for Study 1 were gathered through the NS EIBI program for clinical purposes and not specifically for research (although informed consent was obtained for research use). Interventionists recorded videos for each child prior to beginning formal intervention. The videos were taken in the child's home with other family members and NS EIBI staff in the room. Occasionally, videos were recorded in the child's preschool when taking them at home was not possible. In either case, the toys included as part of the interaction in the video were familiar to the child; they were not standardized across children. As part of facilitating the program's goal of targeting language growth, the purpose of the initial videos was to obtain a sample of the child's language abilities prior to starting intervention. Interventionists were instructed to engage the child and to encourage language production.

Hypotheses. Study 1 seeks to examine the predictors within a sample of children with ASD who were previously enrolled in the NS EIBI. A primary objective of Study 1 was to examine the reliability with which the child variables could be coded. A second objective was to examine the predictive validity of the previously identified child treatment response variables, as well as affect, for a sample of children with ASD. Based on the previous literature, and a general consensus within the ASD research community that increased cognitive ability, older chronological age (CA) and lower ASD symptom severity predict better outcomes for children with ASD, those relationships were hypothesized to hold in the current study. Additionally, as was previously discussed,

there appear to be relatively strong relationships between increased levels of appropriate toy contact (ATC), approach and affect, decreased levels of avoidance and communication abilities in both typically and atypically developing children.

Furthermore, there appear to be clear ways in which these relationships may interact with key treatment strategies utilized in PRT. As a result the current research puts forth clear directional hypotheses about the predictive ability of these variables in the current sample. However, for inappropriate toy contact, SRV and SRNVB, given that both the empirical (i.e., Scherer & Schreibman, 2005) and theoretical (i.e., links between these variables and communication in research on both typical and atypically developing children) links appear less clear no specific hypotheses were made. With respect to the primary objectives, the following specific results are hypothesized:

1. Higher cognitive ability, younger chronological age (CA) and lower ASD symptom severity will predict greater change (indexed by changes in both expressive and receptive communication composite scores from baseline to 12 months).
2. Higher levels of baseline appropriate toy contact, approach and positive affect, as well as lower avoidance (indexed by the percentage of intervals in which the child engaged in those behaviours) will predict greater change (indexed by changes in both expressive and receptive communication composite scores from baseline to 12 months).
3. No directional hypotheses were made regarding the predictive validity of inappropriate toy contact, SRV or SRNVB, given inconsistent findings in the literature and lack of strong theoretical rationale

3.2 STATISTICAL ANALYSES

The reliability with which the child variables could be coded was evaluated using ICC. Consistent with Landis and Koch's (1977) conventions, any variables that achieved at least a "substantial" level of agreement (i.e., .61 to .81) were included in the main analyses.

To assess the predictive validity of the previously established predictors (i.e., start cognitive ability, age and autism symptom severity), the child predictors (i.e., appropriate and inappropriate toy contact, approach and avoidance and finally, SRV and SRNVB) and affect, first the correlations between the predictor and dependent variables were examined. Subsequently, hierarchical multiple regressions were conducted for each of the two dependent variables (i.e., 12-month receptive and expressive communication changes). Given the small sample size, predictor variables were entered into the regression equation only if they showed significant bivariate correlations with the dependent variables, and in the case of the child predictors, only if they met the reliability of coding criteria. The previously established predictors (i.e., CA, cognitive ability and ASD symptoms) were entered first, in step one. To assess their predictive ability over and above the previously established predictors, putative child predictors and affect were entered in step two.

3.3 RESULTS

3.3.1 Reliability

Means and standard deviations for the baseline and 12-month outcome variables are presented in Table 2. Inappropriate toy contact occurred in only 11% of individuals in

Table 2

Means (Standard Deviations) for Baseline and 12-month Follow-up Variables for the Study 1 Sample

Time-point	Variable	<i>M</i>	<i>SD</i>	Minimum	Maximum
Baseline	Cognitive AE	26.89	9.66	8	44
	Chronological Age (mos.)	51.26	9.63	36	66
	ASD Severity (T score)	78.88	10.84	60	90
	App. Toy Contact (%)	91.65	12.86	45	100
	Avoidance (%)	11.87	14.35	0	50
	SRV ^a	7.30	12.13	0	45
	Affect ^b	3.25	.50	2	4.3
	Rec. Language AE Start	32.33	14.60	8	69
12-months	Exp. Language AE Start	31.56	12.10	14	63
	Rec. Language AE 12-mos	46.08	19.34	13	86
	Exp. Language AE 12-mos	44.27	17.18	17	79
	Rec. Lang. Change	13.54	11.71	-7	37
	Exp. Lang. Change	12.27	8.58	-1	32

Note: ^aSRV was scored as a proportion of the child's total language, ^bAffect was scored as an average of the ratings for each interval

the sample and therefore was not included in further analyses. Using Landis and Koch's (1977) criteria, ATC (.75), avoidance (.63), SRV (.71) and affect (.71) all achieved "substantial" reliability. Approach (.51) and SRNVB (.31) did not achieve acceptable levels of reliability and therefore were not included in further analyses.

3.3.2 Receptive Communication

Bivariate correlations between the previously established predictors, child predictors, affect, and RL AE change scores were examined. Based on those results, variables were entered into the hierarchical multiple regression as described above to assess their predictive validity.

Inter-correlations among the predictor variables. Table 3 displays the correlations among the previously established predictors, child predictor variables and affect and the dependent variables. As expected, cognitive AE at start was significantly negatively correlated with SRV and was moderately negatively correlated with Avoidance, although this latter correlation did not reach statistical significance. Finally Avoidance was also significantly negatively correlated with Affect. No other predictor variables were significantly correlated.

Correlations between the predictors and change in RL AE from baseline to 12 months. Table 3 also displays the correlations between the previously established predictors, child treatment response predictors, affect, and the change in RL AE from baseline to 12 months. Although not significantly correlated, SRV showed a moderate, negative relationship with RL AE change. Consistent with the current study's hypotheses, CA was significantly negatively correlated with RL AE change. No other predictor

Table 3

Correlations Between Baseline and 12-month Follow-up Variables for the Study 1 Sample

Variable	CA	Cog AE	SRS Total	ATC	Avoidance	SRV	Affect	Baseline RL	Baseline EL	12-mos RL	12-mos EL	RL Change	EL Change
CA	1	.02	.12	.01	.21	.29	-.13	-.19	-.29	-.48*	-.40*	-.57**	-.42*
Cog AE		1	.09	.08	-.37 ^a	-.42*	.07	.75**	.65**	.68**	.68**	.16	.41*
SRS Total			1	-.06	-.19	-.11	-.22	-.12	-.04	-.07	-.14	.06	-.17
ATC				1	-.16	.04	.22	-.02	-.05	-.04	.00	-.04	.09
Avoidance					1	.28	-.47*	-.56**	-.29	-.34 ^a	-.42*	.16	-.43*
SRV						1	-.09	-.42*	-.58**	-.55**	-.62**	-.36 ^a	-.45*
Affect							1	.42*	.24	.33 ^a	.46*	.01	.58**
Baseline RL								1	.82**	.80**	.86**	.05	.55**
Baseline EL									1	.84**	.89**	-.34 ^a	-.36 ^a
12-mos RL										1	.93**	.64**	.68**
12-mos EL											1	.45*	.75**
RL Change												1	.43*
EL Change													1

Note. *p < .05; **p < .01; ^ap < .10

variables were significantly related to the change in RL AE from baseline to 12 months. However, cognitive AE at start was significantly positively correlated with both start and 12-month RL AE scores (Table 3). In addition, both avoidance and affect were significantly correlated with RL AE at start and showed a strong trend towards significance when correlated with 12-month RL AE scores. All of these correlations were in the expected directions (i.e., negative correlations for avoidance and positive correlations for affect). For this reason, cognitive AE at start, avoidance and affect were included in the regression analysis that follows.

A hierarchical multiple regression analysis was conducted to determine predictors of overall change in RL AE from baseline to 12 months (Table 4). In step one, CA and cognitive AE at start were entered. This step accounted for 35% ($p = .007$) of the variability in RL AE change scores; however, only CA was a significant predictor and, as hypothesized was negatively related to RL AE change. In step two, avoidance, SRV and affect were added into the regression. The addition of these variables did not significantly predict change as measured by the RL AE change scores ($p = .076$).

3.3.3 Expressive Communication

Bivariate correlations were examined between the previously established predictors, child treatment response predictors, affect and EL AE change scores. Based on those results, variables were entered into the hierarchical multiple regression to assess their predictive validity.

Table 4

Hierarchical Regression for Receptive Language Change from Baseline to 12-month Follow-up for the Study 1 Sample

Step	Variable	<i>B</i>	<i>B SE</i>	<i>B</i>	<i>T</i>	<i>P</i>	R^2	ΔR^2	<i>F</i> Δ	<i>p</i>
1	CA	-.69	.21	-.57	-3.37	.003	.35	.35	6.12	.007
	Cog AE	.19	.20	.16	.95	.351				
2	CA	-.72	.20	-.60	-3.68	.001	.53	.19	2.66	.076
	Cog AE	.26	.22	.22	1.16	.260				
	Avoidance	.39	.15	.49	2.54	.019				
	SRV	-.25	.19	-.24	-1.31	.205				
	Affect	2.97	3.98	.13	.13	.464				

Correlations between the predictors and change in EL AE from baseline to 12 months.

Table 3 also displays the correlations between the previously established predictors, child treatment response predictors, affect, and the change in EL AE from baseline to 12 months. Consistent with the hypotheses, cognitive AE at start, and affect were significantly positively correlated with the change in EL AE. Also consistent with hypotheses, avoidance and CA were significantly negatively correlated with the change in EL AE. No specific directional hypotheses related to SRV were made. Table 3 shows that SRV was significantly negatively correlated with EL AE change. Finally, neither ASD symptom severity nor ATC was significantly related to the change in expressive language AE from baseline to 12 months.

A hierarchical multiple regression analysis was conducted to predict overall change in EL AE from baseline to 12 months (Table 5). In step one, CA and cognitive AE at start were entered. This step accounted for 35% ($p = .008$) of the variability in EL AE change scores. Both CA and cognitive AE were significant predictors, with CA negatively and cognitive AE positively related to the dependent variable. In step two, avoidance, SRV and affect were added into the regression. This step accounted for an additional 28% ($p = .01$) of the variance in EL AE change scores. CA at start remained a significant predictor of EL AE change, while cognitive AE was reduced to a non-significant trend. Of the three child treatment predictors entered, only affect was a significant predictor of EL AE change from baseline to 12 months and was positively related to the outcome. Overall, the predictor variables entered accounted for more than half (i.e., 63%) of the variance in EL AE change scores.

Table 5

Hierarchical Regression for Expressive Language Change from Baseline to 12-month Follow-up for the Study 1 Sample

Step	Variable	<i>B</i>	<i>B SE</i>	<i>B</i>	<i>T</i>	<i>P</i>	R^2	ΔR^2	<i>F</i> Δ	<i>p</i>
1	CA	-.37	.15	-.42	-2.49	.021	.35	.35	6.01	.008
	Cog AE	.36	.15	.42	2.45	.022				
2	CA	-.29	.13	-.32	-2.21	.039	.63	.28	4.97	.01
	Cog AE	.26	.15	.30	1.80	.087				
	Avoid	.03	.10	.05	.28	.781				
	SRV	-.14	.12	-.19	-1.15	.263				
	Affect	8.76	2.62	.53	3.35	.003				

3.4 DISCUSSION

The current study sought to examine the relationship between child variables previously linked to either growth while in treatment (i.e., CA, cognitive AE and ASD symptom severity) or treatment response (i.e., ATC, avoidance, SRV) as well as affect, and changes in receptive and expressive language made over 12 months in a PRT-based intervention. The results indicate that younger CA predicted greater change in both receptive and expressive language, while more positive baseline child affect predicted greater change in expressive but not receptive language. Baseline cognitive abilities no longer predicted expressive language changes once the child treatment response predictors were accounted for and did not predict receptive language changes. Finally, none of ASD severity, ATC, avoidance or SRV was predictive of either type of language change over the 12 months of intervention.

The finding that more positive affect was related to greater expressive language change over the 12 months of intervention was consistent with the study's hypothesis. This relationship held, even when controlling for previously established predictors (i.e., baseline CA and cognitive abilities). To the best of the current writer's knowledge, baseline child affect has not been examined as a predictor of outcome while in intervention. This finding is consistent with previous research linking positive affect to joint attention and language development (Hohenberger, 2011). As previously indicated, positive affect may serve as an indicator of the child's interest in and motivation for the object or activity or more generally, their interest in learning/achievement. If true, this would allow the interaction partner (e.g., interventionist) to utilize important intervention techniques that mimic the parental responsiveness that has been found to be critical for children's language learning.

Specifically, in a responsivity-based intervention like PRT the therapist creates opportunities for language learning that are centered on the object or activity that is most motivating to the child at any given moment. This increases the likelihood that the child will persist in using language to gain and maintain access to said toy. In contrast, it may be more difficult for therapists to create meaningful language opportunities centered on motivating objects or activities with a child whose motivation is less obviously expressed. Thus, the techniques used in PRT (i.e., following the child's lead, gaining shared control and then creating language opportunities around the child's interest) can be seen as an exaggerated, deliberate process that resembles the naturally occurring process that leads to typical language learning (i.e., triadic interactions between child, responsive caregiver and object that precede first words; Moore, 2006; Tamis-Lamonda et al., 2001). This process may be the mechanism through which increased positive affect leads to greater expressive communication gains in PRT. This is an exciting area of research that is worthy of further investigation and has implications for treatment individualization (e.g., affect may be an important initial target in children who display low levels of positive affect prior to starting treatment). This issue is explored further in Chapter Five (General Discussion) in conjunction with the results of Study 2.

The current results regarding cognitive abilities were not consistent with the study hypotheses. Specifically, baseline cognitive abilities were not related to 12-month changes in receptive or expressive language once the child treatment response predictors were accounted for. This was unexpected given that cognitive abilities have been a relatively consistent predictor of outcome in the literature on early intervention in ASD. However, upon closer inspection these results may be less surprising. In much of the previous

literature, IQ (e.g., Lovaas, 1987; McEachin et al., 1993; Remington et al., 2007) or “total progress” across developmental domains (Magiati et al., 2007), rather than communication, has been the most frequently examined outcome. In these cases, it is perhaps not surprising that IQ has predicted outcome given that these studies examined outcome prediction in the context of DTT. As mentioned previously, DTT targets specific, discrete skills which are often closely related to the tasks included in IQ measures. An additional consideration for the current study’s findings is that most of the literature has looked at predicting outcome on a particular variable versus predicting a change in that variable, as in the current study. The relatively few studies that have examined the relationship between pre-treatment variables and language outcome or change have shown mixed findings when examining IQ as a predictor of outcome; moreover, statistical issues (e.g., use of unprotected correlations to examine relationships) make interpretation difficult. Finally, it is also important to note that the language content and requirements across different measures of IQ vary widely. For example, the language components involved in completing the Wechsler Preschool and Primary Scale of Intelligence – Fourth Edition (WPPSI-IV; Wechsler, 2012) are very different than those required when completing the M-P-R. More specifically, in order to complete the Wechsler tests, a child would need to have higher language comprehension abilities than would be required for other, less verbally demanding IQ tests. These differences between IQ tests could result in different means across an ASD sample. As a result, the lack of significant findings regarding the predictive contribution of initial cognitive abilities in the current study may have resulted from the use of a measure with lower expressive language demands than was used in some previous studies. Three studies discussed below illustrate some of the challenges (e.g., lack of examination of predictors of

language as the outcome, statistical issues and use of different IQ measures) in establishing consistent predictors of intervention outcome in ASD research.

Two studies looking at factors related to outcome for children with ASD found that initial IQ was correlated with both receptive and expressive language outcome in both intervention and control groups (Eikeseth et al., 2002; Eldevik et al., 2006). Eikeseth et al. (2002) also found that initial IQ (as measured by the Wechsler scales) was related to receptive and expressive language change in their behavioural treatment group but not their control group. Finally, in a follow-up to their original study, Eikeseth et al. (2007) found that initial IQ was correlated with the VABS Communication domain score at three-year follow-up for their behavioural treatment group, but not the control group. However, it is important to note that in all of these studies, the relationships between pre-treatment IQ and language outcome and change scores were examined using unprotected correlations. As a result, these findings may reflect Type 1 error (i.e., spurious correlations). That is, although these findings suggest that baseline IQ may be related to language outcome and even language change, further research is needed to determine whether IQ is a consistent predictor of language outcome when both test content and statistical considerations are taken into account.

One previously mentioned study by Sallows and Graupner (2005) also examined factors related to language outcome after intervention. In contrast to the studies discussed above, Sallows and Graupner (2005) found that although baseline IQ (as measured by the Bayley Scales of Infant Development – Second Edition; Bayley, 1993) was related to IQ at one and three years post-treatment, it was not related to language three years post-treatment (they did not measure language outcome after one year). This is similar to the current findings that baseline cognitive ability was not related to the language outcome variable. Furthermore,

although they did not look at predictors of language change, Sallows and Graupner (2005) did examine predictors of IQ change from baseline to 12 months. Despite the fact that baseline IQ predicted the IQ outcome variable at 12 months post-treatment, it was not related to *change* in IQ over 12 months. This study, along with those discussed above, demonstrates that the prediction of *language* outcomes from baseline IQ is not as straightforward as it might appear. Thus the fact that baseline cognitive abilities did not predict outcomes in the current study may result from language being the outcome under study, as well as the use of a change versus outcome variable.

Finally, in the current study, neither ASD severity, ATC, avoidance nor SRV were related to 12-month changes in receptive or expressive language. As reviewed previously, ASD severity has been an inconsistent predictor of outcome in the literature (Howlin et al., 2009). The fact that ATC, Avoidance and SRV did not predict 12-month changes in language abilities may be a result of differences in the setting in which these variables were measured compared to that in the study by Sherer and Schreibman (2005). Specifically, in the current study these variables were coded from video of the child interacting in a familiar environment (i.e., home or preschool) with toys that were also familiar (i.e., their own or their preschool's) and not standardized across children. This is in contrast to the study by Sherer and Schreibman (2005), in which the variables were coded from video taken of the children interacting with a parent in an unfamiliar environment (i.e., lab assessment room) with a standard, unfamiliar set of toys. These contextual differences may have played a role in the current results regarding ATC, Avoidance and SRV (e.g., children may be less avoidant overall in a familiar environment thereby reducing the variability, and therefore the

predictive power, in the sample). Findings regarding these variables are discussed further in Chapter 5 (General Discussion) with the findings from Study 2.

In conclusion, the results of Study 1 indicate that more positive baseline child affect predicted greater changes in expressive (but not receptive) language, a novel finding. Consistent with previous research, younger CA predicted greater change in both receptive and expressive language. Baseline cognitive abilities, ASD severity, ATC, avoidance and SRV did not predict language changes over the 12 months of intervention. The context in which children's behaviour was assessed may exert an important influence on such findings.

CHAPTER 4: STUDY 2

The main objective of Study 2 was to assess whether the variables identified by Sherer and Schreibman (2005), as well as affect, predict change while in treatment (measured by change in language scores over 12 months of treatment) in a sample of children enrolled in the NS EIBI program. The secondary objective was to determine whether the treatment response variables are related to various aspects of temperament.

4.1 METHOD

4.1.1 Participants

Data were collected for a new sample of 39 children with ASD, again following 12 months of participation in the NS EIBI program. As in Study 1, these children come from both urban and rural regions in Nova Scotia, but Study 2 participants were from two of the three original areas. The mean age for the total sample was 46.95 months ($SD = 8.10$) at the start of intervention. The mean cognitive AE of the children, in months, was 25.03 ($SD = 10.30$). The sample had a mean SRS Total score of 75.14 ($SD = 11.62$). A one-way multivariate analysis of variance (MANOVA) was conducted to determine whether the Study 2 group differed significantly from the Study 1 group in terms of age, cognitive abilities, receptive and expressive language, and ASD symptom severity at the start of intervention. Significant group differences were found on the dependent measures, $Wilk's \Lambda = .72$, $F(5, 47) = 3.64$, $p = .007$. As shown in Table 6, these differences were only significant for receptive and expressive language scores at start. The groups did not significantly differ in terms of their cognitive AE, ASD symptom severity (i.e., SRS Total score) or CA. The NS EIBI program eligibility criteria for

children in Study 2 were the same as those in Study 1 (i.e., diagnosis of ASD, age under 6 years); however, Study 2 participants were not selected to represent a range of language abilities.

Table 6

Means, SDs and MANOVA Results Comparing Study 1 and Study 2 Groups

Variable	Study 1		Study 2		<i>F</i>	<i>P</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Age in mos.	51.26	9.63	46.95	8.10	2.69	.15
Cognitive AE	26.89	9.66	25.03	10.30	.04	.85
ASD severity (T score)	78.88	10.84	75.14	11.62	1.44	.24
Receptive Language AE	32.33	14.60	21.87	11.83	6.34	.02
Expressive Language AE	31.56	12.10	24.13	9.71	4.19	.05

4.1.2 Measures

Language, Communication, Cognitive Abilities, ASD Symptom Severity. Measures of language / communication, cognitive abilities and ASD symptom severity were the same as in Study 1.

Temperament. To assess temperament parents were given the Children’s Behaviour Questionnaire (CBQ; Goldsmith & Rothbart, 1991). The CBQ was designed to measure various aspects of temperament in children ages 3 to 7 years. Items are rated from 1 (extremely untrue of your child) to 7 (extremely true of your child). The various dimensions of temperament rated on the CBQ fall under three overarching factors, namely, Extraversion/Surgency, Effortful Control and Negative Affectivity. The CBQ

demonstrates good internal consistency (average alpha = .73; Rothbart, Ahadi, Hershey & Fisher, 2001).

Video data coding. Definitions for the treatment response variables in Study 2 were the same as those included in Study 1 (Appendix A). However, in Study 2 these variables were coded from a 15-minute video-recorded Play Task designed to provide a more structured standardized activity from which a wider range of children's behaviour could be coded. In addition, the interactions were with a trained RA as opposed to a trained interventionist as in Study 1. The Play Task was added to the battery of tests after the Study 1 sample had concluded participation. The task (described in detail in the Procedures section) was broken down into three intervals: the free-play phase (FP; five minutes), the engagement phase (EG; seven minutes) and the disengagement phase (DEG; three minutes). With the exception of avoidance, all child predictor variables were coded during all three phases of the play task. Avoidance was coded only during the engagement period, given that RAs were instructed not to attempt to engage the child during the other two phases. Therefore, both appropriate and inappropriate toy contact, approach, as well as SRV and SRNVB, were coded during 30 30-second intervals per video. Avoidance was coded during 14 30-second intervals per video. Affect was coded during 15 one-minute intervals per video. As was the case in Study 1, the percentage of total scoreable intervals in which a child engaged in a particular behaviour was taken as the total score for each variable, with the exception of SRV and affect. SRV was once again coded as a proportion of the child's total language and the total score for affect was an average of the scores for each scoreable interval.

The same two raters as in Study 1 coded the video data from Study 2. A refresher training session was conducted prior to coding. At that time, definitions were reviewed and the new coding intervals were explained. Raters again coded practice videos until they reached an acceptable level of reliability (i.e., ICC > .75). All variables, with the exceptions of approach and affect, achieved excellent reliability during practice coding (ATC = .99, IATC = .80, avoidance = .78, approach = .60, SRV = .96, SRNVB = .99 and affect = .49). Again, it appeared that the video of one participant used in practice coding was significantly reducing reliability for coding of both approach and affect. Again, the coding discrepancies were discussed until consensus was reached and then raters were allowed to begin coding the study videos. One primary rater coded all of the videos while a second coded 50% of the videos to assess reliability.

4.1.3 Procedure

Assessment visits. Assessments were conducted by trained research staff in the same manner as for Study 1.

Video Data. Video samples for Study 2 were taken by trained research staff. The Play Task involved the child and a female research assistant engaging with a standard set of toys in each of the three intervals mentioned previously. During FP the RA was instructed to allow the child to play with the toys and not to engage the child in play. If the child initiated interaction with the RA during this time, she was to respond naturally, but briefly, and to return to her own play. During the EG phase, the RA was to try actively to engage the child in interaction with the toys, but not to encourage language explicitly. Finally, similar to FP, during the DEG phase the RA was instructed not to

engage the child actively in play. Again if the child initiated interaction the RA was to respond naturally and then return to her own play.

Hypotheses. The primary objective of Study 2 was to examine the previously established predictors, the child treatment response predictors, and affect within a sample of children with ASD enrolled in the NS EIBI. A secondary objective was to examine the relationships between the treatment response predictors and temperament. With respect to the primary objective, the following results were hypothesized:

1. Higher cognitive AE at start, younger CA and lower ASD symptom severity will predict better response to treatment (indexed by changes in language/communication composite scores).
2. Higher levels of baseline ATC, approach and affect, as well as lower avoidance (indexed by the percentage of intervals engaged in those behaviours) will predict better response to treatment (indexed by changes in language/communication composite scores).
3. No directional hypotheses were made regarding the predictive validity of inappropriate toy contact, SRV or SRNVB given the inconsistencies in the literature and lack of strong theoretical arguments one way or another.

Regarding the secondary objective, the following results were hypothesized:

4. (a) At baseline, children showing more video-coded approach and positive affect, and lower levels of avoidance, will display temperaments characterized by higher scores on CBQ Extraversion; (b) Higher video-coded baseline appropriate toy contact will be related to higher scores on CBQ Effortful Control.

4.2 STATISTICAL ANALYSES

As with Study 1, the reliability with which the child variables could be coded was evaluated using ICCs. Again, any variables that achieved a “substantial” level of agreement (i.e., .61 to .81) or higher according to Landis and Koch’s (1977) conventions were included in the main analyses.

As with Study 1, to assess the predictive validity of the previously established predictors (i.e., start cognitive AE, CA and ASD symptom severity), child treatment response variables (i.e., ATC, approach, avoidance SRNVB and SRV) and affect, bivariate correlations between the predictor and dependent variables were examined. Again, similar to Study 1, two main analyses were subsequently conducted. For each of the two dependent variables (i.e., 12-month receptive and expressive language/communication change), a hierarchical multiple regression was conducted. Given the small sample size, predictor variables were entered into the regression equation only if they were significantly correlated with the dependent variables in the bivariate correlations. The previously established predictors (i.e., start cognitive ability, chronological age and ASD severity) were entered first, in step one. To assess their predictive ability over and above the previously established predictors, the child treatment response predictors (i.e., ATC, approach, avoidance, SRNVB and SRV) and affect were entered in step two.

Partial correlations were conducted to evaluate the relationships between the baseline child treatment response variables and temperament.

4.3 RESULTS

4.3.1 Reliability

Table 7 provides the means and standard deviations for the child treatment response predictors and affect. As with Study 1, inappropriate toy contact occurred in a very small number of individual cases (23% of videos) and at a very low rate; it was therefore not included in further analyses. Using Landis and Koch's (1977) criteria, ATC (.82), SRV (.61) and affect (.75) all achieved "substantial" reliability. Avoidance (.50), approach (.44) and SRNVB (.60) did not achieve acceptable levels of reliability. Inspection of the data indicated that the two raters were quite discrepant in their coding of one participant's avoidance and SRV behaviours. Removal of this participant's data increased the reliability of the coding for avoidance and SRV to .65 and .70, respectively, and thus both variables were retained in further analyses. Because of their continued lower levels of reliability, approach and SRNVB were not included in further analyses.

4.3.2 Receptive Communication

Bivariate correlations between the previously established predictors, child predictors, affect, and RL AE change scores were examined. Based on those results, variables were entered into the hierarchical multiple regression as described above to assess their predictive validity.

Inter-correlations among the predictor variables. Table 8 displays the correlations among the previously established predictors, the child treatment response variables and affect. CA was significantly positively correlated with cognitive AE at start. Cognitive AE at start was significantly positively correlated with ATC and affect and

Table 7

Means (Standard Deviations) for Baseline and 12-month Follow-up Variables for the Study 2 Sample

Time-point	Variable	<i>M</i>	<i>SD</i>	Minimum	Maximum
Baseline	Cognitive AE	25.03	10.30	8	51
	Chronological Age (mos.)	46.95	8.10	30	60
	ASD Severity (T score)	75.14	11.62	42	91
	App. Toy Contact (%)	85.33	25.59	0	100
	Avoidance (%)	24.31	28.82	0	100
	SRV ^a	30.10	36.50	0	100
	Affect ^b	3.29	.73	1.5	4.13
	Rec. Language	21.87	11.83	9	60
12 month Follow-up	Exp. Language	24.13	9.71	10	53
	Rec. Language	33.84	17.34	10	63
	Exp. Language	33.71	14.15	12	70
	Rec. Lang. Change	10.87	9.86	0	36
	Exp. Lang. Change	8.45	6.97	-3	24

Note: ^aSRV was scored as a proportion of the child's total language, ^bAffect was scored as an average of the ratings for each interval

Table 8

Correlations Between Baseline and 12-month Follow-up Variables for the Study 2 Sample

Variable	CA	Cog AE	SRS Total	ATC	Avoidance	SRV	Affect	Baseline RL	Baseline EL	12-mos RL	12-mos EL	RL Change	EL Change
CA	1	.42**	.06	.15	-.01	-.05	.18	.34*	.32*	.19	.18	-.09	-.13
Cog AE		1	.20	.51**	-.53**	-.46**	.65**	.76**	.75**	.84**	.82**	.43*	.46**
SRS Total			1	-.11	-.07	.22	-.14	.14	.12	.23	.11	-.01	-.07
ATC				1	-.65**	-.31 ^a	.64**	.39*	.45**	.46**	.48**	.37*	.36*
Avoidance					1	.19	-.68**	-.39*	-.42**	-.61**	-.61**	-.49**	-.57**
SRV						1	-.48**	-.50**	-.57**	-.55**	-.60**	-.28	-.37*
Affect							1	.55**	.59**	.68**	.72**	.49**	.58**
Baseline RL								1	.92**	.83**	.88**	.19	.44*
Baseline EL									1	.81**	.89**	.23	.37*
12-mos RL										1	.94**	.70**	.75**
12-mos EL											1	.54**	.75**
RL Change												1	.76**
EL Change													1

Note. *p < .05; **p < .01; ^ap < .10

significantly negatively correlated with both avoidance and SRV. ATC was significantly negatively correlated with avoidance and significantly positively correlated with affect. In addition, ATC displayed a trend towards a negative correlation with SRV. Both avoidance and SRV were significantly negatively correlated with affect. No other baseline variables were significantly correlated.

Given the high degree of multicollinearity among the predictor variables, grand mean centering was conducted prior to analyzing the data (Field, 2009). Individual scores on each of the predictors were subtracted from the group mean for that variable.

Correlations between the predictors and change in RL AE from baseline to 12 months. Table 8 also displays the correlations between the previously established predictors, child treatment response predictors, affect, and change in RL AE from baseline to 12 months. Cognitive AE at start was significantly positively correlated with the change in RL AE from baseline to 12 months. Likewise, ATC and affect were both significantly positively correlated with change in RL AE scores, while avoidance was significantly negatively correlated. No other predictor variables were significantly related to the change in RL AE from baseline to 12 months. However, SRV was significantly negatively correlated with both start and 12-month RL AE scores (Table 8). In addition, CA was significantly positively correlated with RL AE at start. For this reason, SRV and CA were included in the regression analysis that follows.

A hierarchical multiple regression analysis was conducted to determine predictors of overall change in RL AE from baseline to 12 months (Table 9). In step one, CA and cognitive AE at start were entered. This step accounted for 25% ($p = .017$) of the variability in RL AE change scores; however, only cognitive AE at start was a significant

Table 9

Hierarchical Regression for Receptive Language Change from Baseline to 12-month Follow-up for the Study 2 Sample

Step	Variable	<i>B</i>	<i>B SE</i>	<i>B</i>	<i>T</i>	<i>P</i>	<i>R</i> ²	ΔR^2	<i>F</i> Δ	<i>p</i>
1	CA	-.33	.21	-.27	-1.57	.129	.25	.25	4.72	.017
	Cog AE	.49	.16	.53	3.02	.005				
2	CA	-.23	.23	-.19	-1.01	.325	.34	.08	.76	.561
	Cog AE	.20	.26	.21	.77	.449				
	ATC	-.102	.15	-.24	-.70	.492				
	Avoidance	-.113	.12	-.34	-.94	.356				
	SRV	.00	.06	.01	.06	.955				
	Affect	4.06	4.19	.31	.97	.342				

predictor. In step two, ATC, Avoidance, SRV and Affect were added into the regression. Similar to the findings on RL in Study 1, the addition of these variables did not result in a significant increase in the amount of variance accounted for ($p = .56$).

4.3.3 Expressive Communication

Bivariate correlations were examined between the previously established predictors, child treatment response predictors, affect, and EL AE change scores. Based on those results, variables were entered into the hierarchical multiple regression to assess their predictive validity.

Correlations between the predictors and change in EL AE from baseline to 12 months. Table 8 also displays the correlations between the previously established predictors, the child treatment response predictors, affect, and change in EL AE from baseline to 12 months. Consistent with the hypotheses, cognitive AE at start, ATC and affect were significantly positively correlated with the change in EL AE scores. Also consistent with hypotheses, avoidance was significantly negatively correlated with the change in EL AE. SRV was significantly negatively correlated with EL AE change scores. Finally, neither autistic symptom severity nor CA was significantly related to the change in EL AE from baseline to 12 months. However, CA was significantly positively correlated with baseline EL AE, and was related to language change in Study 1; therefore it was included in the subsequent regression analysis.

A hierarchical multiple regression was conducted to predict overall change in EL AE from baseline to 12 months (Table 10). In step one, CA and cognitive AE at start were entered. This step accounted for 31% ($p = .006$) of the variability in EL AE change

Table 10

Hierarchical Regression for Expressive Language Change from Baseline to 12-month Follow-up for the Study 2 Sample

Step	Variable	<i>B</i>	<i>B SE</i>	<i>B</i>	<i>T</i>	<i>P</i>	<i>R</i> ²	ΔR^2	<i>F</i> Δ	<i>p</i>
1	CA	-.28	.14	-.33	-1.94	.062	.31	.31	6.23	.006
	Cog AE	.38	.11	.58	3.44	.002				
2	CA	-.14	.14	-.17	-1.06	.298	.53	.22	2.80	.049
	Cog AE	.04	.15	.06	.26	.801				
	ATC	-.19	.09	-.62	-2.15	.041				
	Avoid	-.16	.07	-.69	-2.25	.034				
	SRV	-.02	.04	-.08	-.45	.658				
	Affect	4.43	2.49	.49	1.78	.088				

scores. Only cognitive AE was a significant predictor; however, CA showed a trend towards significance. In step two, ATC, avoidance, SRV and affect were added into the regression. This step accounted for an additional 22% ($p = .05$) of the variance in EL AE change scores. After entering the child treatment response variables, only ATC and avoidance were significant predictors of the change in EL AE scores. Affect displayed a trend towards significance. Overall, the predictor variables entered accounted for more than half (i.e., 53%) of the variance in EL AE change scores.

It is important to note that, despite its positive correlation with EL AE change in the bivariate correlations, ATC was negatively related to the change in EL AE in the regression analysis. Further investigation of this finding revealed a net suppression effect. According to Tabachnick and Fidell (2000), a net suppression effect occurs when one variable enhances the importance of another variable by virtue of suppressing irrelevant variance in its relationship with the dependent variable. When multiple predictor variables are entered in the regression, the authors suggest removing all of the congruent variables (i.e., predictor variables whose relationship with the dependent variable maintains the same direction of relationship as demonstrated in the bivariate correlations) one at a time. Examination of the regression coefficient of the suppressed variable (i.e., ATC) after each congruent variable is removed allows confirmation that a suppressor effect is present and identification of the specific variable producing the suppressor effect. The suppressor is identified when its removal results in the biggest change in the regression coefficients for the suppressed variable. In this analysis, removal of avoidance resulted in the biggest change in the regression coefficients for ATC, identifying it as the suppressor. Therefore, although ATC was positively correlated with EL AE change in the

bivariate correlations, Tabachnick and Fidell (2000) suggest that its relationship as identified in the regression analysis represents its true relationship with EL AE change. The negative relationship between ATC and EL AE change from baseline to 12 months is contrary to the current study's hypotheses.

4.3.4 Temperament

In the present study, initial cognitive abilities were significantly correlated with all of the child treatment response predictors and affect (Table 8). As a result, partial correlations controlling for baseline cognitive AE were examined to assess conceptual links between the child treatment predictors and affect, and the CBQ temperament domains. Examination of these data indicated that none of the child treatment predictors or affect were related to any of the CBQ temperament domains when controlling for baseline cognitive AE (Table 11).

Table 11

Partial Correlations between Child Treatment Predictors, Affect and CBQ Temperament

Domains

Variable	CBQ Effortful Control	CBQ Extraversion / Surgency	CBQ Negative Affectivity
ATC	.23	-.23	.11
Avoidance	-.06	.25	-.24
SRV	-.33 ^a	-.30 ^a	.01
Affect	.23	.12	.11

Note. ^a $p < .10$

4.4 DISCUSSION

Study 2 also sought to examine the relationship between child variables previously linked to either growth while in treatment (e.g., CA, cognitive abilities and ASD symptom severity) or treatment response (i.e., ATC, avoidance and SRV), as well as affect, and changes in receptive and expressive language over 12 months. Children in Study 2 were enrolled for 12 months in the same PRT-based intervention as children in Study 1. In Study 2, the child predictor variables were coded from a video-recorded play task in which the child interacted with a trained research assistant in a lab with a standard set of toys. The results for Study 2 indicate that lower levels of avoidance and ATC predicted larger changes in expressive but not receptive language. Importantly, these relationships held even while controlling for other previously established predictors of treatment outcome (i.e., baseline CA and cognitive abilities). In addition, higher baseline cognitive abilities predicted larger receptive but not expressive language change. There was a non-significant trend towards increased positive affect predicting increased expressive but not receptive language change, while CA, ASD severity and SRV were not related to either type of language change over the 12 months of intervention. Finally, exploratory examination of conceptual links between the child treatment response predictors and temperament domain scores did not result in any significant relationships when baseline cognitive abilities were taken into account. The current discussion focuses on interpretation of the results specific to Study 2. Differences in findings between Study 1 and 2 will be considered in the General Discussion (Chapter Five).

As hypothesized decreased avoidance was related to larger changes in expressive language. This finding is also consistent with work by Ingersoll et al. (2001), in which

children categorized as high peer avoiders displayed less language gain over 6 months of intervention than children who were deemed low peer avoiders. Two, possibly complementary, explanations for these results are proposed here. First, it may be that children who are more avoidant on the play task measure or children who are more avoidant with their peers are simply more socially avoidant in general. If so, this would lead to fewer experiences with language overall, including fewer opportunities to practice language and fewer opportunities to be reinforced for using it. This account is consistent with one of the proposed theories explaining the link between social withdrawal (as evidenced by shyness) and decreased language abilities in typically developing children (Coplan & Evans, 2010).

Secondly, it is also possible that a child who demonstrates greater avoidance is not as likely to benefit from the treatment strategies utilized in an intervention like PRT. For example, with a child who displays higher levels of social avoidance, it would be more difficult to gain shared control of a toy or activity of interest and insert language opportunities. With fewer language opportunities overall, it would also be more difficult to intersperse tasks more likely to lead to success (i.e., reinforcement) for the child. These strategies not only increase a child's exposure to meaningful language opportunities but also increase a child's motivation to continue to learn and attempt to use language. As a result, the child who displays higher levels of social avoidance may benefit less from treatments such as PRT, that rely heavily on the therapist/child interaction, than the child who is more tolerant of the social advances of others.

The current study also found that increased ATC predicted decreased expressive language change. Although contrary to the current study's hypothesis, similar findings

have been demonstrated in two other studies reviewed previously (Carter et al., 2011; Yoder & Stone, 2006). In both cases the authors attributed their findings to the fact that in responsivity-based interventions (similar to PRT) learning opportunities are often centered on objects or toys of interest. If a child is not interested in toys initially treatment may begin with teaching toy play and, in doing so, opportunities for promoting language development may also occur. Children with lower toy contact may then benefit more from teaching centered on increasing both appropriate toy contact and expressive language.

The current results, although differing from those of Sherer and Schreibman (2005), are consistent with the above-mentioned studies. This is important for two reasons: 1) as discussed previously, the intervention techniques used in PRT and the interventions discussed above are similar, and 2) the context in which ATC was measured in the current study resembled that in the above-mentioned studies more than that in Sherer and Schreibman (2005). Specifically, in addition to using a standard set of toys in an unfamiliar environment, the interactions during which object manipulation/play was coded by Yoder and Stone (2006) and Carter et al. (2011) were with an unfamiliar research assistant who was given instructions not to try to elicit language (as in the current study). Furthermore the current findings, as with those of Yoder and Stone (2006) and Carter et al. (2011), are based on group, rather than single-subject methodology as in Sherer and Schreibman (2005). Given these factors, the claim that toy play is facilitated alongside language development for children who begin intervention with lower interest in objects may be a plausible explanation for the current findings.

Supporting the hypotheses of Study 2, higher cognitive abilities at baseline predicted increased receptive language change. However, baseline cognitive abilities did not remain a significant predictor of expressive language change when child treatment response predictors were added. As discussed in Chapter Three, the relationship between baseline cognitive abilities and language change is mixed in previous studies and methodological limitations make interpretation of the findings difficult. The current finding that baseline cognitive abilities predicted 12-month changes in receptive language abilities is consistent with those of Eikeseth et al. (2002), who found a similar relationship in their behavioural treatment group. As mentioned previously, those earlier data were based on unprotected bivariate correlations and therefore may have been the result of Type 1 error. However, the current results provide further support for the relationship between initial cognitive abilities and 12-month receptive language change at the group level and highlight the inconsistency in the findings in this area.

Unlike in Study 1, the hypothesis that baseline child positive affect would predict expressive language change was not supported, although a non-significant trend was in the expected direction. Potential explanations for this discrepancy are discussed in Chapter Five (General Discussion). Also inconsistent with the hypothesis was the finding that baseline CA was not related to either receptive or expressive language changes as it was in Study 1. Also as in Study 1, baseline child affect was not related to changes in receptive language, and neither ASD severity nor SRV were related to either receptive or expressive language changes. ASD severity has been a less consistent predictor in the literature and the current results join those of a number of other studies that found that it was not linked to treatment outcome. No hypotheses were made regarding SRV given

that there did not appear to be a strong rationale regarding why or how it might predict outcome in PRT.

Given the growing body of literature suggesting that children with ASD display characteristic temperament profiles (e.g., Garon et al., 2009), and the conceptual links between the baseline child variables and the three over-arching temperament domains, exploratory analyses were conducted to examine these relationships. However, when baseline cognitive abilities were taken into account, none of the hypothesized relationships were significant. These findings do not preclude the possibility of a relationship between temperament and treatment outcome in ASD intervention. Future research may examine this relationship more directly through other research methodologies.

To summarize, the Study 2 results support recent research suggesting that ATC may be negatively related to language and communication change while in responsivity-based interventions, such as PRT. In addition, the current results are consistent with the Sherer and Schreibman (2005) finding that higher levels of social avoidance predict poorer treatment outcomes, namely decreased expressive language change. Results from Study 2 also support previous research suggesting that higher baseline cognitive abilities are related to increased receptive language change over 12 months of intervention. However, a link between baseline cognitive abilities and expressive language change was not found. The current results add to a growing body of literature highlighting the potential importance of key child variables (e.g., ATC and avoidance) that may play a role in understanding treatment response and individualization. Although baseline child affect did not predict expressive language change, a non-significant trend was consistent

with results from Study 1. This suggests that continued research examining the potential role of child affect in predicting outcome and treatment response in ASD intervention is warranted. Similar to Study 1, baseline ASD severity and SRV did not predict language changes over 12 months of intervention.

CHAPTER 5: GENERAL DISCUSSION

This dissertation sought to address the outcome variability demonstrated in children with ASD enrolled in intervention. A strength of the current research was its examination of theoretically and empirically informed child characteristics and their relationship to an important outcome (i.e., language change), while considering how key treatment strategies may impact those relationships. Taking into consideration previously established predictors of growth while in treatment (i.e., cognitive abilities and CA), a number of child treatment response variables (i.e., ATC, avoidance and affect) predicted expressive language change in children with ASD enrolled in the NS EIBI program.

The finding that child affect at baseline was related to expressive language change for children with ASD enrolled in a PRT-based intervention is particularly noteworthy. Preliminary evidence for this relationship was demonstrated across both studies. This novel finding suggests a need to explore further the role of child affect in predicting outcomes for children with ASD in intervention. In addition, the current research found that baseline ATC and avoidance predicted expressive language changes when coded within the context of a standard play task. These results lend further support to existing ASD intervention research suggesting these variables may play an important role in predicting language changes over the course of treatment (Carter et al., 2011; Yoder & Stone, 2006). They also highlight the complex nature of the links between these variables and outcomes when considered in the context of specific treatment approaches. Together, these findings add to the growing body of literature examining factors related to the extreme outcome variability demonstrated by children with ASD in intervention.

Furthermore they suggest key child characteristics that may be important considerations for future treatment individualization research.

The discussion that follows delves further into the current findings by discussing a number of factors that may have influenced the results. Specifically, this section considers key contextual issues that may explain the differences in results across Studies 1 and 2. In addition, critical differences between the current research and the original Sherer and Schreibman (2005) study are considered. Finally, limitations of the current research, as well as implications for future research are discussed.

5.1 MAKING SENSE OF THE DIFFERENCES IN FINDINGS

The following section focuses on discussing the differences between findings in Studies 1 and 2 regarding the child treatment response predictors. In particular, differences have been identified in the study contexts and in the baseline language abilities of the two samples. Either or both of these differences, along with the small sample sizes, may have impacted the results. First, there were key differences between the contexts in which the data were obtained. Specifically, the video data were taken in different environments (i.e., familiar in Study 1 versus unfamiliar in Study 2), with different adult interaction partners (i.e., familiar therapists being trained in ASD intervention in Study 1, versus unfamiliar research assistants trained in the research protocol in Study 2). In addition, the adults in each study were given different instructions pertaining to the child's use of language (i.e., in Study 1, to elicit as much language as possible from the child; in Study 2, to not attempt to elicit language but rather to respond briefly but naturally to the child's language). These contextual

differences and their potential effects on the findings for each of the child treatment response variables are discussed here.

5.1.1 Affect

In the current pair of studies, more positive baseline child affect predicted greater changes in expressive language over the 12 months of intervention (significantly in Study 1, and a non-significant trend in Study 2). Two potential explanations for the discrepancy in these results are explored. First, it is important to consider the potential impact on the expression of positive child affect of the contexts in which these variables were measured.

In Study 1, baseline child affect was coded from videos of the children interacting with interventionists in a familiar environment (i.e., home or preschool) with familiar toys. In contrast, in Study 2, baseline child affect was measured with a standard set of unfamiliar toys in an unfamiliar lab environment with a research assistant. In the Study 1 context, children may have been more likely to demonstrate positive affect because of their familiarity with the toys and the interventionists' explicit attempts to engage the child in toy play. In the current studies, while baseline mean levels of child affect did not differ between the Study 1 and 2 samples, the range of scores in the Study 2 sample (i.e., affect ratings of 1.5 to 4.13) did reflect slightly more negative affect than the range in the Study 1 sample (i.e., affect ratings of 2 to 4.3). Furthermore, children also may be more likely to persist in the language learning opportunities set up by the therapist when the interaction involves toys/objects with which they are already familiar. Likewise, they may also be more likely to persist in language learning opportunities when engaging with a therapist with whom they are developing a relationship (i.e., someone who is generally

responsive to their needs, requests, etc.). As noted previously, this responsive interaction style has been deemed a critical feature of language learning in typically developing children (Tamis-Lamonde et al., 2001) and has also been linked to better language outcomes in children with ASD (Siller and Sigman, 2002). As a result, affect measured in a context with these more responsive and familiar elements may be more closely linked to language learning than affect measured in an environment with many novel elements.

A second potential explanation for the discrepancy between the Study 1 and 2 findings may simply have been limited power to detect significant results in Study 2. Although a larger sample contributed to Study 2, the number of children with all necessary data available was still relatively modest overall ($n = 39$). Furthermore, an additional variable (i.e., ATC) was included in the regression analyses in Study 2. As a result, the relatively small sample size combined with the addition of the ATC variable may have contributed to the fact that affect was a non-significant trend in the second study.

5.1.2 Appropriate Toy Contact (ATC)

There were also differences in the prediction of communication outcome by ATC across the two studies. Specifically, higher levels of ATC predicted less change in expressive language over the 12 months of intervention in Study 2, but was unrelated to language change in Study 1. Similar to the findings regarding affect, this difference may be due to the differing contexts from which the data were coded. The video-recorded play task in Study 2 more closely resembled the context from which the child predictors were measured in other studies (Carter et al., 2011; Yoder & Stone, 2006) demonstrating similar findings. Specifically, the authors of those studies indicated that, in addition to

using a standard set of toys in an unfamiliar environment, the interactions also involved an unfamiliar research assistant who was given instructions not to try to elicit language. This similarity may partially explain why ATC was a significant predictor in Study 2 but not Study 1. In addition to this issue, the differences in contexts between the two studies may have had an impact on the expression of ATC across the two groups.

As mentioned previously, the toys used in Study 1 would not only have been familiar to the children but were matched to their developmental level and play capabilities. In contrast, some of the toys (e.g., tea set, play food) utilized in Study 2 may have ‘pulled’ for higher level play (e.g., pretend/imaginative play), an absent or emerging skill for some children included in Study 2. This difference may have contributed to the different profile of ATC observed in Study 2 when compared to Study 1. Specifically, the Study 2 group displayed less toy contact overall. In contrast, in Study 1 the familiarity of the toys and environment may explain why the sample displayed more toy contact overall and may have contributed to the reduced variability of ATC in the Study 1 sample. This reduced variability may have made it more difficult to detect prediction of changes in language abilities. Examination of the ranges of ATC in each study supports this hypothesis; the range for ATC was much wider in the Study 2 sample (0-100%) than in Study 1 (45-100%). Combined with the similarity of the Study 2 context to that in the Sherer and Schreibman (2005) study, this supports the idea that the context in which ATC is coded may influence both its expression as well as its relationship with language outcomes.

5.1.3 Avoidance

The final child predictor that was differentially related to 12-month changes in expressive language across the two studies was baseline avoidance. Avoidance did not predict changes in expressive language in Study 1 but did in Study 2. Again, it appears as though the context from which the variables were coded could have played a role. Specifically, children may have been more inclined to avoid the novel adult in an unfamiliar context, such as in Study 2. In contrast, in Study 1, in a familiar environment with familiar toys, children might be less likely to avoid the adult. This may be particularly true when the interventionist's social advances take place when the child is most motivated to engage with the toy, as would be the case in PRT. Examination of the avoidance scores appears to provide some preliminary support for this interpretation; the Study 1 group engaged in less avoidance overall than the Study 2 sample. In addition, it appears that the range of avoidance displayed in Study 1 (0-50%) was smaller than that in Study 2 (0-100%). Thus, the context within which avoidance is coded may also play a role in determining its utility as a predictor of changes in language ability while in intervention.

While these differences in context may have affected the findings across the two studies, two additional previously mentioned factors may have also impacted the variability - baseline differences in language and the power to detect significant findings. First, baseline receptive and expressive language abilities differed between the Study 1 and 2 samples. Given that the dependent variables under examination in both studies were changes in receptive and expressive language, different findings might be linked to the initial language differences between the two groups. As discussed previously, these

differences may be the result of the decision by the clinical team to select children who represented a wide range of language abilities across the preschool age range. While this selection process for the children in Study 1 may have led to differences between the participant groups in the two studies, the two groups did not differ significantly on any of the other baseline variables examined.

Second, it is also important to note that the lack of significant findings for some of the variables examined in both Studies 1 and 2 may be the result of insufficient power to detect significant results. In both studies the sample sizes were relatively small and those samples were used to examine a number of potential predictors. The lack of significant findings for avoidance in Study 1 and SRV in Studies 1 and 2 may have resulted from insufficient power. Similarly, in Study 2 there may not have been enough statistical power to detect the contribution of affect. As noted earlier, a relatively small sample and an additional variable in the regression analyses in Study 2 may have contributed to reduced power to detect potential relationships.

Thus, contextual differences, baseline differences in language and lack of statistical power may have affected the present findings. Of these, contextual differences are a critical focus for future research examining these variables in treatment individualization for children with ASD. The finding that variables predicted outcome differentially across contexts adds important information to the existing literature on predicting outcomes or treatment response for children with ASD in intervention. Further within-subjects research is needed to test the predictive ability of these variables when measured in multiple contexts for each child. Understanding the impact of context when examining these child variables will have important implications for their use in guiding

appropriate interventions for individual children with ASD. In addition to suggesting that context may play an important role in the assessment of these child characteristics the current research also adds more globally to the growing body of research aimed at understanding the variability in response to treatment in children with ASD.

5.2 REVISITING SHERER AND SCHREIBMAN (2005)

In addition to the previously discussed contextual differences between Study 1 and 3, consideration of differences between the characteristics of the original Sherer and Schreibman (2005) sample, and participants in the current studies may help us to understand the differences in findings. Direct comparisons of some characteristics are difficult due to differing measures. However, the age equivalents reported on the various measures suggest that the Sherer and Schreibman (2005) sample may be lower functioning overall than the current samples. Despite the fact that Sherer and Schreibman's participants were similar to those in Studies 1 and 2 in terms of chronological age (i.e., mean of 45 months versus 51 and 47 for Study 1 and 2 samples, respectively), reported baseline cognitive and language abilities were much lower. In the Sherer and Schreibman (2005) sample, the average baseline Bayley Scales AE score for two of the three responders and two of the three non-responders was 11 months (one responder and one non-responder obtained IQ scores on the DAS and their Bayley Scale AEs were not reported). This is in contrast to the 27- and 25-month age-equivalent scores (assessed by the M-P-R) for the Study 1 and 2 samples, respectively. To further illustrate these differences, ratio IQs [i.e., $(AE / CA) \times 100$] were calculated for all three samples. The mean ratio IQ for the four children from Sherer and Schreibman (2005) was 29 (this

rose to a mean of 44 when the scores from the two children who obtained IQ estimates on the DAS were included). The mean ratio IQs for the Study 1 and 2 samples from the present research were 54 and 53, respectively. Thus, these estimates further illustrate that the sample in the Sherer and Schreibman (2005) study is relatively lower functioning than both samples in the current research when comparing the children's mental ages to their CA and when examining this relationship through ratio IQs.

These baseline differences in functioning, which highlight the extreme phenotypic variability seen in children with ASD, may explain why the findings from the current research differed from those of Sherer and Schreibman (2005). Two potential implications of these baseline differences are explored. First, it is possible that what predicts outcome for children on the spectrum with certain characteristics (e.g., lower cognitive and language abilities) may not predict outcome for others. The current research suggests that when exploring the relationships between the child treatment response predictors and language gains in a larger, more representative sample of children with ASD, the results may differ. Thus while the treatment response variables explored by Sherer and Schreibman (2005) may predict outcome for some non-verbal or relatively more cognitively impaired children with ASD, these findings may not generalize to the larger ASD population.

Second, it is important to note that visual inspection of the present data indicated that none of the children displayed Sherer and Schreibman's (2005) full responder profile (i.e., higher levels of ATC, approach and SRV with lower levels of avoidance and SRNVB). This further supports the baseline differences between the current samples and

those in the original work. In addition, it raises the possibility that the full responder profile is necessary for best distinguishing those who respond optimally from those who do not. Indeed, when isolating individual treatment response predictors in their follow-up study, Schreibman et al. (2009) reported that children did not respond to PRT to the same extent as did children in the original study who displayed the full responder profile. Both the current research and the Schreibman et al. (2009) follow-up study examined the treatment response predictors in isolation. It is possible that a child's behaviour on any one of the individual predictors does not sufficiently distinguish those who respond most optimally from those who do not. The treatment response predictors may interact to impact response status. For example, it could be that high levels of avoidance are only associated with poorer treatment response when paired with low levels of toy contact and/or SRV. In the absence of the full profile of behaviours, the influence on response status may be less clear. Thus, these baseline differences between the children in the current research and those in Sherer and Schreibman (2005) may have implications for both the generalizability of the findings to the larger ASD population and the ability to detect significant differences in response status in the absence of the full profile of behaviours.

Finally, it is important to highlight how the profiles were determined for the Sherer and Schreibman (2005) sample. Prior to conducting the prospective study, Sherer and Schreibman (2005) described retrospectively selecting the best and worst responders to a PRT intervention. The authors then reported examining differences noted in video-recorded play episodes to determine which characteristics separated the two groups. This type of analysis ignores the intermediate responder group. It may be that when all

children are included, as in a group design study, the predictive ability of some treatment response variables is washed out. Alternatively, it may be that the treatment response variables are more easily or clearly measured when examined at their extremes, as opposed to as continuous variables. The differences noted between the original Sherer and Schreibman (2005) group and the samples included in this research may in part explain the different findings between studies. Indeed, the children's levels of functioning and profile variability may influence which child variables predict language outcomes for a given group of children.

5.3 IMPLICATIONS OF THE CURRENT RESEARCH

The field of ASD intervention research has called for further examination of factors related to the significant outcome variability demonstrated within this population (Lord et al., 2005; Rogers & Vismara, 2008). Part of the impetus for understanding this variability is the fact that multiple forms of treatment have been developed and very high costs (e.g., financial and time) are associated with ASD intervention. As a result, understanding why children respond differently to particular interventions and using that information to individualize treatment programs is necessary to ensure efficient and effective treatment for *all* children with ASD. The current research attempted to address this call by examining a number of factors related to treatment outcome for children with ASD enrolled in a particular ABA-based intervention (i.e., PRT). The two studies outlined in this dissertation went beyond examining the global – and immutable – factors related to treatment outcomes (e.g., cognitive abilities and CA) and extended this research to specific child factors potentially impacting the variability.

A number of child factors hypothesized to be related to the variability in treatment outcomes were examined. Through examination of both the theoretical and empirical links between various child variables and language development in typical and atypical development, a number of hypotheses were derived. These hypotheses also took into account the particular treatment strategies involved in PRT and how they might interact with the proposed relationships. A major strength of the current dissertation was the thorough examination of these theoretical links and their potential interaction with the treatment strategies when deciding, a priori, which hypotheses would be tested. These issues have been deemed important components of research examining factors related to individual treatment outcomes (Yoder & Warren, 2004).

The current findings indicated that ATC, avoidance and affect are child variables that may have important implications for understanding the variability in response to treatments for children with ASD. Specifically, this research suggested that children who display higher levels of positive affect and who are less avoidant of social advances from others respond most optimally to PRT-based intervention. These factors may be particularly important in a child-led intervention such as PRT where the interventionist relies on cues from the child to guide where they insert their learning opportunities. This is in contrast to other forms of ABA-based interventions that primarily utilize adult-led strategies (e.g., DTT). In those types of interventions variables such as initial child affect and level of social avoidance may not be expected to predict intervention outcomes. However, future research is needed to examine whether these child variables are in fact specific to child-led interventions such as PRT, or whether they may play a more general role in predicting outcomes across a number of interventions. Finally, it may also be that

children who enter a PRT-based intervention without these characteristics may benefit from first targeting these variables prior to targeting typical initial treatment areas (e.g., expressive language).

The current findings also suggest that children who display lower levels of appropriate toy contact may be expected to make better progress in a PRT-based intervention that simultaneously targets the development of appropriate play. Once again, appropriate play may be particularly important in child-led interventions, such as PRT, due to the fact that learning opportunities are centered on the child's object or activity of interest. Similar to the affect and avoidance variables, this may be less important in adult-led interventions where learning opportunities focus on individual skill areas. The current research represents an important step in understanding the complex relationships between child characteristics, treatment strategies and development in critical skill areas (i.e., expressive and receptive language/communication).

5.4 LIMITATIONS

It is important to acknowledge a number of limitations of the current research. First, although this dissertation provides a priori, theoretical and empirical rationales for its hypotheses regarding the child predictors, the methodology (e.g., lack of a control group, lack of single-subject multiple baseline design) did not allow for confirmation that the child predictors were treatment response predictors rather than predictors of overall growth. Further examination of these hypotheses utilizing both single-subject and group design research will be necessary to determine whether the child predictors truly predict response to PRT in a representative sample of children with ASD. Multiple-baseline

single-subject research designs would be useful for determining whether each of the child predictors (i.e., affect, avoidance and appropriate toy contact) predict response to PRT-based interventions for individual children with ASD. In addition, future group research designs might focus on examining the predictor variables in samples of children enrolled in PRT-based interventions and in a control or comparison group (e.g., treatment as usual, wait-list control or another well-specified intervention). Appropriate statistical techniques (i.e., interaction terms) can then be used to determine whether ATC, avoidance and affect interact with group assignment to predict outcome. This type of group research would also allow researchers to determine whether the current studies' findings apply to the diverse population of children with ASD. Thus, both single-subject and group research designs would afford more confidence in the current findings.

A second limitation of the current research was the absence of a measure of joint attention. As mentioned previously, typically developing children display positive affect during periods of joint attention (Kasari et al., 1990; Messinger et al., 2001), while children with ASD (Kasari et al., 1999) and children at high risk for developing ASD (Gangi, Ibanez & Messinger, 2014) display less positive affect during similar interactions. However, research has also shown that teaching children with ASD to engage in joint attention (Whalen et al., 2006), or targeting positive affective sharing in caregivers (Brian et al., 2009) may lead to collateral improvements in positive affect for children with ASD. Along with these links between positive affect and joint attention, research has also demonstrated that better joint attention abilities are related to improved expressive language gains in both typically developing children (Mundy et al., 2007) and children with ASD (Sigman & Ruskin, 1999). Thus, researchers have hypothesized that

early expressions of positive affect in children are related to later language development through these types of affect-laden joint attention interactions (Hohenberger, 2011).

In the current study, the video footage from which the child characteristics were coded did not permit adequate coding of joint attention (i.e., coders could not always see the direction of both interaction partners' gaze to determine whether the object of their attention was shared). Similarly, the coding of positive affect in the children was based solely on the child's expression of affect and did not differentiate positive affect that was shared, from that which was not shared. As a result, it was not possible to determine whether the predictive relationship between positive affect and expressive language gains in the current research was due to joint attention interactions involving shared positive affect or simply the child's positive affect (i.e., shared or not). It will be important for future research to separate the two to determine whether one is more important than the other for predicting expressive language gains in intervention. This will have important implications for understanding which children with ASD achieve better outcomes while in intervention than others. It will also be critical for understanding how to adapt treatment targets for initial non-responders. Specifically, it will be necessary to understand whether targeting positive affect more generally will be sufficient for promoting improved expressive language gains or whether it will be necessary to target shared positive affect specifically.

A third limitation of the current research was the significant differences in baseline receptive and expressive language abilities between the samples in Study 1 and 2. These differences made interpretation of the discrepant findings across the two studies difficult and limit generalizability of the results. Although contextual differences between the

studies and their implications for understanding the results were reviewed, one cannot rule out that the differences in the findings regarding predictors could be linked to the initial differences in language between the two groups. If contextual differences, and subsequently the way in which the child characteristics were displayed in each context, affected the predictive ability of the variables, then future research will need to identify the circumstances under which it is possible to reliably assess child treatment response predictors. Alternatively, if initial baseline group differences influenced the outcomes, then further research will be needed to determine whether there is a subset of children with ASD for whom ATC, avoidance and affect predict outcomes.

A fourth potential limitation of the current research was the use of only one time-point for the collection of video data for each child. Previous research in this area (Carter et al., 2011; Sherer & Schreibman, 2005; Yoder & Stone, 2006) has also relied on a single time-point for the collection of video data. However, measurement of the child treatment response predictors under study might be influenced by various factors (e.g., illness, poor sleep) on any given day. Therefore, using scores averaged across multiple time-points on these variables may result in more representative sampling of the child's typical behaviour. In turn, using these averaged scores to examine predictors of outcome may reduce extraneous variability and would afford more confidence in the findings.

Finally, as mentioned previously, the current study builds on the work by Schreibman and her colleagues (2005, 2009) by examining treatment response predictors using a group design, as opposed to single-subject design methodology. However, despite the larger samples of children with ASD afforded by the current research design, both samples are still relatively small. Given the number of predictors examined in both

studies, it is possible that there was simply not enough power to detect all of the significant relationships between the baseline and outcome variables. Furthermore, given the phenotypic variability displayed by children with ASD, larger samples would provide extra assurance that the findings would generalize to the larger ASD population. As mentioned previously, further support for this variability was found through visual inspection of the data from the present studies which indicated that none of the children displayed the full responder profile reported by Sherer & Schreibman (2005). Thus larger samples would ensure that heterogeneity is represented and afford more confidence in the study findings.

5.5 FUTURE DIRECTIONS

This research moves beyond previous studies of immutable predictors of outcome (e.g., IQ, severity of ASD symptoms) that have essentially found that, while in intervention, “the rich get richer” (i.e., the ‘Matthew Effect’; Walberg & Tsai, 1983). Instead, this dissertation outlines why certain variables might be expected to be related to outcomes, in the context of the intervention strategies utilized in one form of ABA-based intervention (i.e., PRT). As mentioned previously, further examination of the relationships between the predictors (i.e., ATC, avoidance and affect) and outcomes (e.g., language) utilizing both single-subject and group design research will be necessary to determine whether the predictor variables are truly predictors of response to treatment. In addition, replication and extension of the current findings is important prior to translating such findings into clinical practice. Specifically, further confidence in the findings would provide a rationale for future studies aimed at determining whether the child predictor

variables should be initial treatment targets for children who enter treatment with non-responder profiles.

Along these lines, preliminary research on an early parent-mediated intervention (the *Social ABCs*) targeting positive emotion sharing and early communication development in very young children (i.e., aged 12-24 months) at risk for a diagnosis of ASD, has evidenced reduced atypicality in communication and increases in receptive and expressive language (Brian, Smith, McCormick, Dowds, Sauve, Smith et al., 2009). These findings provide further evidence for the importance of targeting affect to improve language development in children who show reduced levels of positive affect. Further research could help to determine whether the children enrolled in the Social ABCs intervention program who go on to receive a diagnosis of ASD and enter the NS EIBI program, respond better to EIBI than those children who do not receive the Social ABCs.

Further research into predictors of outcome in ASD intervention will also need to consider that the current dissertation only examined the child variables in the context of a PRT-based intervention. As a result, it is not yet clear whether these predictors are specific to PRT or whether they would predict intervention outcome more broadly. Preliminary work by Schreibman et al. (2009) found that the child variables were predictive of PRT but not DTT intervention. Furthermore, given the theoretical and empirical links outlined between the predictors and outcome variables in the context of PRT strategies, one would not necessarily expect that the child variables examined here would predict outcome in other types of interventions. If, for example, child affect is an indicator of a child's interest in or motivation for the task at hand, then this would be expected to be an important predictor in a child-led intervention such as PRT. In an adult-

led intervention such as those based in DTT, child affect may not play a role in predicting response to treatment since the adult does not need to rely on cues from the child to guide their teaching. Research using the Early Learning Measure (ELM; Smith, Buch & Gamby, 2000), has begun to examine other factors potentially related to outcome in DTT-based interventions. Sallows and Graupner (2005) found that pre-treatment non-verbal and verbal imitation as measured by the ELM was related to IQ, social skill acquisition and language outcomes in a primarily DTT-based intervention. Thus pre-treatment ability to imitate may be an important outcome predictor in DTT-based interventions. Given the small samples used to examine treatment response predictors previously (Schreibman et al., 2009; Sherer & Schreibman, 2005) and the lack of an alternative treatment group in the current study, further research is needed. These findings along with those of the current dissertation provide a rationale for future research examining whether there may be differential outcome predictors for specific interventions.

Despite the fact that the current dissertation and the above research utilizing the ELM suggest the potential for differential outcome predictors for separate interventions, there is much work to be done in this area. The current dissertation has suggested *potential* mechanisms through which child affect, avoidance and appropriate toy contact may be related to outcome in the context of PRT. However, no definitive conclusions can be drawn at the present time. Further research, utilizing other treatment comparison groups would allow one to determine whether the variables under study are specific to a particular intervention or are more generally predictive of outcome across treatments. This research would help to guide treatment individualization for children with ASD, as it

would allow researchers and clinicians to examine pre-treatment child characteristics and match them to the appropriate interventions.

Finally, it will be important for future research to examine whether the child treatment response predictors are related to other outcome variables (e.g., IQ) in addition to language. For example, the importance of play for cognitive development has been outlined in previous research (see Lifter, Foster-Sanda, Arzamarski, Briesch & McClure, 2011, for a review). Children learn about their world and develop important cognitive skills (e.g., meta-cognition and problem-solving) through play (Lifter et al., 2011). As a result, related baseline child characteristics (e.g., appropriate toy contact) may also be related to changes in cognitive abilities over the course of treatment. For example, a child who demonstrates less appropriate toy contact and/or who tends to play with toys in more restricted ways, may have fewer opportunities to learn about object properties and develop related cognitive skills through play. In addition, as previously suggested, the mechanism through which child affect and avoidance influence the development of language may be the way in which those variables allow others to create learning opportunities that mimic the process demonstrated in typical language learning. In the same way these processes may lead to the child learning more about the object and how to manipulate it and therefore develop important cognitive processes. In a child who displays low rates of positive affect and greater avoidance, it may be more difficult to set up these opportunities that could lead to further development of their cognitive abilities through play. Thus, further research is needed to determine which of these or other predictors may be involved in other important developmental outcomes.

5.6 CONCLUSION

In conclusion, variability in treatment outcomes has been well documented in the field of ASD intervention. This dissertation sought to address this variability in treatment outcomes by examining empirically and theoretically derived child characteristics that were hypothesized to predict intervention outcomes for children with ASD. The results suggested that a novel variable, namely child affect, is related to changes in expressive language. These findings may help to explain why some children achieve greater changes in language abilities than do others while engaged in a naturalistic behavioural intervention. In addition, further support was found for previous research (Sherer & Schreibman, 2005) demonstrating that skills in toy play and children's levels of social avoidance are related to expressive language outcomes. These findings, along with the results for child affect may help to explain why some children with ASD achieve greater changes in language abilities than others while in a PRT-based intervention. Furthermore, results from the current dissertation suggest that researchers should give careful consideration to contexts within which these child variables are measured, as context may partly determine the relationships between predictor and outcome variables. These data represent important additions to the growing body of literature seeking to examine specific child factors related to treatment outcomes. Further research is needed to replicate these findings with larger, representative samples of children with ASD, in the context of multiple forms of intervention and in relation to other outcome variables.

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APPENDIX A Variable Coding Form and Definitions

Toy Contact Coding Sheet

Child Code: Tape Code: Observer: Date Coded:

Interval (in seconds)	Code (A1, A2, I1 or -)	# new toys played with	Solitary (√)	Joint (√)	Interval (in seconds)	Code (A1, A2, I1 or -)	# new toys played with	Solitary (√)	Joint (√)
00:00-00:30					05:01-05:30				
00:31-01:00					05:31-06:00				
01:01-01:30					06:01-06:30				
01:31-02:00					06:31-07:00				
02:01-02:30					07:01-07:30				
02:31-03:00					07:31-08:00				
03:01-03:30					08:01-08:30				
03:31-04:00					08:31-09:00				
04:01-04:30					09:01-09:30				
04:31-05:00					09:31-10:00				

Feedback/Notes:

Operational Definition of Toy Contact:

Child interacts with a toy in one of two appropriate ways, or in an inappropriate way, for 5 seconds or more.

Appropriate uses include the child: (A1) using toy according to its function (e.g., roll train along the floor) or (A2) using the toy to represent another object in play (e.g., use toy banana as a phone).

Inappropriate uses include: (I1) the child playing with a toy in a way other than for its intended function, in a non-functional manner (e.g., repeatedly pick up banana and drop it, waving string).

Coding will also keep track of the number of different (new) toys the child plays with across each interval (i.e., only toys not previously played with get coded in subsequent intervals). In addition, coding will keep track of whether the toy play was solitary (i.e., involved only the child acting on the toy) or whether it was joint [i.e., involved both the child and the adult acting together on the same toy or same set of toys (does not include situations where the child and adult are playing **separately** with identical sets of toys)]. Only one (either solitary or joint play) should be coded for each 30 second interval, where both occur in one interval the highest level behaviour should be coded (i.e., joint). Solitary and joint play are only coded during the engagement period. If the child is not playing with any toys in an interval, a code of – is given for the toy contact “code” as well as for all remaining categories (i.e., # new toys, solitary and joint play).

*definition adapted from Scherer & Schreibman, 2005; Schreibman, Stahmer, Barlett, & Dufek, 2009; Stahmer, 1999

Toy Contact Scoring Sheet

*Scores refer only to the highest level of behaviour that occurred in each interval. In intervals in which both appropriate and inappropriate toy contact occur the only highest level behaviour (i.e., A1 or A2) gets included in the score. For example, if both A1 and I1 occur in the same interval the interval is scored as A1 (i.e., the higher level behaviour) and is subsequently what is counted in the scores calculated below.

Category	Score
Total # of intervals in which appropriate (i.e., A1 and A2) behaviour occurred:	
Proportion of Total Intervals in which appropriate behaviours occurred (A1's+A2's/total codeable intervals):	
Total # of intervals in which inappropriate (i.e., I1) behaviour occurred:	
Proportion of Total Intervals in which inappropriate behaviours occurred (I1's/total codeable intervals):	
Total # of intervals in which toy contact (i.e., A1, A2, I1) behaviour occurred:	
Proportion of Total Intervals in which toy contact behaviours occurred (A1+A2+I1's/total codeable intervals):	
Total # new toys played with across all intervals:	
Total # of intervals in which solitary play occurred:	
Proportion of Total Intervals in which solitary play occurred (#solitary intervals/total codeable intervals):	
Total # of intervals in which joint play occurred:	
Proportion of Total Intervals in which joint play occurred (#joint intervals/total codeable intervals):	

Avoidance Behaviour* Coding Sheet

Child Code:

Tape Code:

Observer:

Date Coded:

Interval (in seconds)	Code (+ or -)	Interval (in seconds)	Code (+ or -)
00:00-00:30		05:01-05:30	
00:31-01:00		05:31-06:00	
01:01-01:30		06:01-06:30	
01:31-02:00		06:31-07:00	
02:01-02:30		07:01-07:30	
02:31-03:00		07:31-08:00	
03:01-03:30		08:01-08:30	
03:31-04:00		08:31-09:00	
04:01-04:30		09:01-09:30	
04:31-05:00		09:31-10:00	

Total # of intervals in which behaviour occurred (+’s):

Proportion of Total Intervals (+’s/total codeable intervals):

Feedback/Notes:

Operational Definition:

The child physically moves or turns their head or gaze away in response to an adult’s touch, gaze, words or attempt to join play.

*definition adapted from Scherer & Schreibman, 2005; Schreibman, Stahmer, Barlett, & Dufek, 2009

Approach Behaviour* Coding Sheet

Child Code:

Tape Code:

Observer:

Date Coded:

Interval (in seconds)	Code (+ or -)	In response to adult's initiation (Y/N)?	Interval (in seconds)	Code (+ or -)	In response to adult's initiation (Y/N)?
00:00-00:30			05:01-05:30		
00:31-01:00			05:31-06:00		
01:01-01:30			06:01-06:30		
01:31-02:00			06:31-07:00		
02:01-02:30			07:01-07:30		
02:31-03:00			07:31-08:00		
03:01-03:30			08:01-08:30		
03:31-04:00			08:31-09:00		
04:01-04:30			09:01-09:30		
04:31-05:00			09:31-10:00		

Total # of intervals in which behaviour occurred (+'s):

Proportion of Total Intervals (+'s/total codeable intervals):

Feedback/Notes:

Operational Definition:

The child physically moves (including reaching) or turns their head or gaze towards the adult or approaches to take the adult's toy.

*definition adapted from Scherer & Schreibman, 2005; Schreibman, Stahmer, Barlett, & Dufek, 2009

Stereotyped and repetitive vocalizations* Coding Sheet

Child Code:

Tape Code:

Observer:

Date Coded:

Interval (in seconds)	Code (VU, SRV, II, IE, DE, OV)	Interval (in seconds)	Code (VU, SRV, II, IE, DE, OV)
00:00-00:30		05:01-05:30	
00:31-01:00		05:31-06:00	
01:01-01:30		06:01-06:30	
01:31-02:00		06:31-07:00	
02:01-02:30		07:01-07:30	
02:31-03:00		07:31-08:00	
03:01-03:30		08:01-08:30	
03:31-04:00		08:31-09:00	
04:01-04:30		09:01-09:30	
04:31-05:00		09:31-10:00	

Feedback/Notes:

Operational Definition of Language Codes:

Verbal Utterances (VU): The child uses verbal utterances for a variety of communicative functions (e.g., requesting, question asking, commenting, responding, initiating, refusing). Examples of VU may include consonant and/or vowels sounds, consonant-vowel combinations, single words, and word combinations. In addition, vocalizations that serve a *communicative* function and add to the interaction are also included here (e.g., animal sounds, making the sound that a mustard bottle makes while squeezing it during play with the food toys). Instances of immediate imitation of another’s language or of echolalia are scored in a separate category below.

*definition adapted from Tager-Flusberg, Rogers, Cooper, Landa, Lord, Paul, et al., (2009)

Stereotyped and Repetitive Vocalizations (SRV): The child makes *nonsensical, non-communicative* utterances; these may include long and short utterances, high-pitched screams that are not associated with a tantrum, repetitive sounds. These behaviours vary from child to child.

* definition adapted from Scherer & Schreibman, 2005; Schreibman, Stahmer, Barlett, & Dufek, 2009

Immediate imitation (II) / Echolalia [immediate (IE) or delayed (DE)]: Exact repetition of a word or word group spoken by another person (Faye, 1969). Can be immediate (imitating the word or word group just spoken by a person) or delayed (repeating the word or word group spoken by a person longer ago). Delayed echolalia is often inappropriate for the context in which is it used.

Other vocalizations (OV): Any other vocalization that does not fit into one of the above categories (please specify what form the vocalization takes (e.g., singing to oneself, that does not meet criteria for VU).

Stereotyped and repetitive non-verbal behaviours* Coding Sheet

Child Code:

Tape Code:

Observer:

Date Coded:

Interval (in seconds)	Code (+ or -)	Interval (in seconds)	Code (+ or -)
00:00-00:30		05:01-05:30	
00:31-01:00		05:31-06:00	
01:01-01:30		06:01-06:30	
01:31-02:00		06:31-07:00	
02:01-02:30		07:01-07:30	
02:31-03:00		07:31-08:00	
03:01-03:30		08:01-08:30	
03:31-04:00		08:31-09:00	
04:01-04:30		09:01-09:30	
04:31-05:00		09:31-10:00	

Total # of intervals in which behaviour occurred (+’s):

Proportion of Total Intervals (+’s/total codeable intervals):

Feedback/Notes:

Operational Definition:

Include behaviours performed by the child (without objects) that appear to have stimulating effect. Behaviours vary from child to child but may include hand flapping, rocking, facial grimacing, head shaking, jumping up and down, and body posturing.

* definition adapted from Scherer & Schreibman, 2005; Schreibman, Stahmer, Barlett, & Dufek, 2009

Child Affect* Coding Sheet

Child Code:

Tape Code:

Observer:

Date Coded:

Interval (in seconds)	Code (1, 2, 3, 4 or 5)	Interval (in seconds)	Code (1, 2, 3, 4 or 5)
00:00-01:00		05:01-06:00	
01:01-02:00		06:01-07:00	
02:01-03:00		07:01-08:00	
03:01-04:00		08:01-09:00	
04:01-05:00		09:01-10:00	

Sum of interval scores (i.e., interval 1 + interval 2 + ... + interval 10):

Average of interval scores (sum of interval scores/total number of scoreable intervals):

Feedback/Notes:

Operational Definition:

Highly negative affect (1): Child does not appear to be enjoying himself. There are clear signs of distress, anger, fear, sadness or frustration.

Mildly negative affect (2): No clear signs of negative affect, but some indication of irritation, impatience, boredom, apprehension. An impression that “he or she would rather be elsewhere,” in the overall neutral aura.

Neutral (3): Child does not display overall signs of positive or negative affect, displays an overall neutral aura.

Mildly positive (4): No clear “full-blown” joy, but the mood is nevertheless pleasant.

Highly positive (5): Child enjoys himself- may smile, laugh happily out loud, or jump with joy. Must be jumping with the purpose of expressing joy, and not to display repetitive behaviour or to express discontent.

* definition adapted from adapted from Baker, Koegel and Koegel (1998); Brookman-Frazee, 2004; Kochanska & Aksan, 1995