Evaluating the Impact of Service Setting on Early Intensive Behavioural Intervention Outcomes for Children with Autism Spectrum Disorder

by

Karli Pedreira

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Abstract

Early Intensive Behavioural Intervention (EIBI) is well established as an effective intervention for children with Autism Spectrum Disorder (ASD). Common settings where EIBI programs are delivered include homes, centres, mainstream schools, and integrated child care centres (i.e., daycare and preschool). Each of these settings encompasses a unique combination of service characteristics, yet few studies have directly compared the effectiveness of EIBI programs in different settings. Therefore, the current project evaluated outcomes in children with ASD who have received EIBI in either a home, centre, or integrated child care setting. Archival data from 2006-2014 was obtained from St.Amant Autism Program consisting of 188 children in the Early Learning Program (ELP). A multivariate regression was used to examine whether the setting of service delivery was predictive of scores on 5 outcome measures including standardized scales assessing autism severity, cognitive functioning, language, and adaptive behaviour, and a criterion-referenced assessment to measure skill mastery. The results suggest that on measures of language, scores are comparable across settings. However, differences may exist across settings in other domains (i.e., cognitive functioning, autism severity, adaptive behaviour, and skill acquisition). Overall, the results suggest that (1) a larger number of service hours delivered at home may predict gains in cognitive functioning and adaptive behaviour, (2) a larger number of service hours in integrated child care settings may predict reduced autism severity, and (3) a larger number of service hours delivered at a centre such as a classroom within Minnetonka School may predict lower scores in adaptive behaviour, an increase in autism severity, and a lower proportion of skill gains. While the comparison of outcomes across settings of EIBI service delivery remains as a research need, the current study provides an important foundation for understanding more about treatment setting and how it may impact child outcomes.

Keywords: autism spectrum disorder, early intensive behavioural intervention, service setting

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Introduction

Autism Spectrum Disorder (ASD) is a severe early-onset neuro-developmental disability characterized by impairments in social interactions, verbal and non-verbal communication, and a restricted repertoire of interests (American Psychiatric Association, 2013). The effectiveness of applied behaviour analysis (ABA) used in early-intensive behavioural intervention (EIBI) programs has been widely studied and has also demonstrated to reliably produce substantial gains in children with ASD (Department of Health, 1999; Peters-Scheffer, Didden, Korzilius & Sturmey, 2011). The prevalence of ASD has increased in recent years, as has the availability of government funded EIBI programs (Fombonne, 2003; Jacobson & Mulick, 2000; Thomson, Martin, Arnal, Fazzio & Yu, 2009). EIBI has a number of essential characteristics, although some aspects vary from program to program, including the service delivery setting. It is of particular concern of how characteristics of program delivery may vary across different settings. The purpose of this paper is to evaluate and compare outcomes in children with ASD who have received EIBI in either a home, centre, or integrated child care setting (i.e., daycare and preschool).

Autism Spectrum Disorder

According to the *Diagnostic and Statistical Manual of Mental Disorders, 5th edition,* a child diagnosed with ASD must meet the following criteria: (a) persistent deficits in social communication and social interaction, (b) restricted, repetitive patterns of behaviour, interests or activities, (c) symptoms must be present in the child's early years, (d) symptoms must cause clinically significant impairment in social, occupational, or other critical areas of functioning, and (e) the disturbances cannot be better explained by intellectual disability or global developmental

delay (American Psychiatric Association, 2013). Previously, all autism spectrum disorders were recognized as five distinct subtypes of pervasive developmental disorders, including autistic disorder, child disintegrative disorder, Rett disorder, pervasive developmental disorder-not otherwise specified (PDD-NOS), and Asperger syndrome. Today, all of these distinct subtypes have been merged under one umbrella diagnosis of ASD. The term "spectrum" refers to a continuum of severity or developmental impairment. Individuals with ASD can vary widely across this continuum, with individual differences primarily in symptoms, severity, age of onset, levels of functioning, and challenges with social interactions. While the causes of ASD are currently unknown, there is a significant amount of research that supports the role of genetics in ASD (Rutter, 2000).

In Canada, there is currently no federal government monitoring system that provides accurate statistics on the prevalence of ASD. Research on prevalence rates of ASD in Canada can be challenging, partly due to provincial and territorial differences in how ASD is diagnosed and recorded. The National Epidemiologic Database for the Study of Autism in Canada (NEDSAC; www.nedsac.ca) currently provides the best prevalence estimate in Canada. Since 2003, NEDSAC has been recording the prevalence of ASD in Newfoundland and Labrador, Prince Edward Island, and Southeastern Ontario. As of 2010, the reported statistics by NEDSAC estimate that in Canada 1 in 94 children have been diagnosed with ASD, an estimated average annual percent increase in prevalence of ASD from 9.7% to 14.6% (Ouellette-Kuntz et al., 2014). Though the reported statistics support the rise in prevalence of ASD, it is important to consider other factors that might have influenced these results. Some of these factors include a decrease in age of diagnoses, an increase in awareness of ASD, and changes in diagnostic criteria (Ouellette-Kuntz et al., 2014).

Early Intensive Behavioural Intervention

EIBI is based on principles of ABA and is carried out in the early years of children with ASD and children with developmental delays. Typically, it involves discrete-trials teaching (DTT) delivered through intensive programing (i.e., 40 hrs of 1:1 training per week), for two or more years (Lovaas, 1987). The DTT method of teaching involves the instructor providing an instruction with a prompt for the child to respond, and then following the response with an immediate consequence. If the child makes an error, an error correction trial is implemented in order to increase the likelihood of a correct response. Major components of DTT include reinforcement procedures, prompt fading, breaking tasks into smaller parts, and requiring mastery of each task (Fazzio & Martin, 2011).

More specifically, Green, Brennan, and Fein (2002) have described the following common features across EIBI programs: (a) treatment is both individualized and comprehensive, addressing all appropriate skill domains; (b) many behaviour analytic procedures are used to develop novel repertoires and to reduce interfering behaviour (e.g., differential reinforcement, prompting, discrete-trial teaching, incidental teaching, activity-embedded trials, task analysis, and others); (c) one or more individuals with advanced training in ABA and experience with young children with autism were involved and directed the treatment; (d) normal developmental sequences guide the selection of intervention goals and short-term objectives; (e) parents assist as active co-therapists throughout their child's intervention; (f) intervention is generally delivered in a 1:1 ratio, then gradual transitions to small-group and large-group formats when warranted; (g) intervention typically begins in the home and is progressively carried over into other environments (e.g., community settings) with gradual, systematic transitions to preschool, kindergarten, and elementary school classrooms once children develop the skills required to learn in those settings; (h) programming is year round and intensive, this includes 20 to 30 hrs of

structured sessions per week in addition to informal instruction and practice throughout most of the children's other waking hours; (i) in the majority of cases, the duration of intervention is 2 or more years; and (j) most children initiated treatment in the preschool years, 3 to 4 years of age.

The efficacy of EIBI programs has been well established through several systematic reviews and meta-analyses (Eldevik et al., 2009; Kuppens & Onghena, 2012; Makrygianni & Reed, 2010; Peter-Scheffer et al., 2011) of studies that compared EIBI with a control group (e.g., eclectic treatment, no treatment). Many of these studies have identified specific child factors that may impact outcomes, including age, adaptive behaviours, cognitive ability, and autism severity at treatment intake. There is evidence demonstrating that the earlier the age of intake and the higher initial adaptive behaviour scores, the more positive the outcomes (Perry et al., 2011; Remington et al., 2007; Sallows & Graupner, 2005). Furthermore, research suggests a relationship between autism severity and "rapid responders" to treatment (Harris & Handleman, 2000; Perry et al., 2011; Remington et al., 2007; Sallows & Graupner, 2005). "Rapid responders" are children who rapidly learn new skills in response to treatment, and as a result make significant gains in mental age (average 15 month gain) and IQ (1.5-2 *SD* increase) in the first year of treatment (McEachlin, Smith, & Lovaas, 1993; Lovaas, 1987; Sallows & Graupner, 2005). The research also demonstrates a moderate relation between cognitive ability at intake and outcomes (Eikeseth et al., 2002, 2007; Hayward, Gale, & Eikeseth, 2009; Sallows & Graupner, 2005).

EIBI program features that may influence outcomes are less well-studied. Compounding the problem is that many outcome studies do not always clearly describe their independent variable (i.e., specification of treatment curriculum and procedures) (Lechago & Carr, 2008), and in some reports relatively little is known about the basic program characteristics (Carr, 2006). Lechago and Carr identified several treatment specifications that are often loosely described in

EIBI outcome studies. Some of these specifications include full descriptions of curriculum targets, level of parental involvement, staff training and education, prompt and fading procedures, mastery criteria, data collection procedures, and average number of trials presented per hour. Another variable that is often lacking detail is the description of program characteristics specific to the treatment setting. Given that the quality of EIBI intervention may seriously impact its effectiveness (Green, 1996; Perry, Prichard, & Penn, 2006; Jacobson, 2000), it is important to consider how different service settings encompassing different program characteristics may affect intervention quality, and may thereby influence child outcomes.

Service Setting

Setting can be defined as the place or type of surroundings where something is positioned or where an event takes place. For the purpose of this paper, I will describe service setting with the understanding that it encompasses both where therapy happens and how the program is typically structured in that location. The most common settings where EIBI programs are delivered include homes, treatment centres, mainstream schools, and integrated child care settings such as daycares and preschools. Typically, the majority of a child's initial instruction is delivered at home with gradual systematic transition to other environments (e.g., classroom, or daycare). However, some children are enrolled in full time centre-based or school programs, where the majority of their intervention hours are not delivered in the home (Grindle et al., 2012). With the increasing number of children with ASD receiving EIBI treatment, EIBI services are being delivered in a larger variety of settings and as a result an increasing number of children and families do not receive the typical home-based therapy.

There are no strict definitions of, for example, "centre-based", "home-based", or "integrated child care" EIBI programs. The term "-based" denotes that the large majority of the intervention hours are delivered in that setting, though in some cases intervention hours may

occur in other locations (i.e., playground, fieldtrips, etc.). There are, however, characteristics that are typically included in the description of each setting in published studies; I will summarize these in the next section.

For the purpose of this paper, daycares and preschools are both categorized as an integrated child care setting. All daycares and preschools in Manitoba are required to meet the same licensing and accreditation requirements (The Community Child Care Standards Act, 2016), they generally do not have any major educational differences, and children receiving intervention in either setting will likely encounter comparable surroundings.

Some differences, however, exist between daycares and preschools. In a preschool setting, children are usually within 3 to 5 years of age. Typically, preschools offer a comparable schedule to kindergarten where child care is offered for half-days or full-days, and schools are closed for holidays and summer. Most teachers will have some training in early childhood education, though it is not a requirement. In a daycare setting, the age range of children is much larger; some daycares will accept children as early as a few months of age. A daycare will typically offer a more flexible schedule that includes full time care for extended hours and throughout summer. In some cases, the daycare providers will have some training in early childhood education. While the majority of preschools offer learning activities based off of a curriculum, many daycares have also adopted similar educational curricula; although more focus is placed on play compared to preschool. While daycares and preschools must follow the same licensing and accreditation requirements, the quality of care and education may vary across each integrated child care setting.

EIBI program characteristics across settings. Typical characteristics of a home-based program include 1:1 instruction, trained ABA tutors and therapists, parental supervision (i.e., parents are present in the home but are not involved in treatment delivery), parental involvement

in program implementation outside of treatment hours, and high intensity (i.e., more than 25 hrs per week). In some home-based programs, activities with other typically developing peers are included (Sallows & Graupner, 2005), and instruction can be delivered either by trained therapists or parents (Sheinkoph & Siegel, 1998). Given that the home is already a familiar environment, and that there are limits to a therapist's ability to bring items and people to therapy sessions, home-based programs may also be characterized by fewer novel stimuli, as compared to programs in other settings.

The term "centre-based" implies that an EIBI program is delivered outside the home, at a dedicated treatment facility or institution. Centre-based programs typically have many of the same characteristics as home-based programs, such as 1:1 instruction, parental involvement in program implementation outside of treatment hours, trained ABA tutors or therapists, and high intensity. Three defining features of a centre-based program include: (1) service delivery in a location outside of the home, without parental supervision, (2) behavioural intervention programming, including the child's daily routine and learning schedules, that is planned and supervised by ABA trained individuals, and (3) treatment delivered within a classroom model. Other distinctive characteristics of centre-based programs may include more access to novel stimuli and naturalistic teaching opportunities, and a high degree of therapist control over the environment. Some centre-based programs may include smaller instructor-to-child ratios where treatment is integrated with other peers diagnosed with ASD or other developmental disabilities, and typically developing children (Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991; Harris & Handleman, 2000).

The characteristics of EIBI programs in integrated child care settings (i.e., daycares and preschools) may deviate most from a typical home-based EIBI program. These characteristics include a combination of smaller instructor-to-child ratios in a mainstream integrated child care

centre and 1:1 treatment, many inclusion opportunities with access to novel stimuli, teachers with and without ABA training, minimal control over the environment, and children (both clients and peers) of a wide range of ages. Other characteristics such as intensity and level of parent participation at home can vary considerably across different daycare and preschool programs.

The differences in program characteristics across settings raise the question – how might the different settings affect child outcomes? For example, children receiving treatment at home or in a centre may benefit from a program that is entirely focused around the child's intervention. In integrated child care settings, it can be more difficult to prioritize the child's intervention program around the schedule determined by the daycare and preschool providers, who usually do not have ABA training. On the other hand, children receiving EIBI in centres and integrated child care settings have more opportunities to interact with other peers and more access to novel stimuli that would not be available in the home on a regular basis.

The ease of achieving control over the environment can also vary considerably across settings. Integrated child care settings are the most difficult environments to achieve control; they have been described as "less than ideal treatment conditions" (Perry et al. 2008). At home, the level of control can also vary depending of the structure of family and home (e.g., siblings, pets, availability of private space in the home). Whereas, when programs are delivered in centres, the physical space and daily schedule can be focused on ABA programming allowing for more control.

Settings also vary in terms of convenience and cost-effectiveness. Depending on the needs and schedules of the family, a larger selection of settings in which their child can receive treatment is more convenient. Some families, for example, may benefit from treatment given at home when there is limited access to integrated child care facilities (e.g., rural families), or in some cases families who are unable to provide supervision at home during treatment hours may

benefit from treatment that is delivered in a site-based program. Furthermore, settings that include lower instructor-to-child ratios are presumably more cost-effective and allow for more children to have access to EIBI programs. Another advantage is that diverse settings allow programs to be more tailored to each individual child. For example, some children might benefit from a setting that allows for more inclusion opportunities (e.g., centre-based, daycare), while others may benefit from a more individualized instruction in a familiar environment with limited inclusion opportunities (e.g., home-based).

EIBI effectiveness across settings. The effects of setting on EIBI outcomes have not been extensively studied. The majority of EIBI outcome studies have focused on services that have been delivered in home-based programs. Given that each different setting encompasses a unique combination of characteristics in program delivery, it is important to consider whether these differences in characteristics across settings will impact outcomes for children receiving EIBI treatment.

Many studies have established the effectiveness of EIBI delivered at home (McEachlin, Smith, & Lovaas, 1993; Lovaas, 1987; Reed, Osborne, & Corness, 2007(a); Remington et al. 2007), and in centre-based programs (Ben-Itzchak & Zachor, 2007; Harris et al., 1991; Harris & Handleman, 2000; Roberts et al., 2001; Zachor, Ben-Itzchak, Rabinovich, & Lahat, 2007). The effectiveness of EIBI delivery in daycare and preschool settings is less well studied, but encouraging (Eikeseth, Klintwall, Jahr, & Karlsson, 2011; Eldevik, Hastings, Jahr, Huges, 2012; Rivard, Terroux, & Mercier, 2014). However, there is little research that directly compares the effectiveness of EIBI in different settings.

Only one study to date has directly examined setting as a treatment variable in an early intervention program. Roberts et al. (2011) compared the effectiveness of two early behavioural intervention programs: an individualized home-based and a small group centre-based program.

The home and centre-based treatments were both non-intensive and their program characteristics both varied considerably from what was previously described as typical. The centre-based treatment consisted of weekly 2-hr sessions for a period of 40 weeks. Each session consisted of six playgroups of 4 to 6 children diagnosed with ASD, and six parent support and training groups. The playgroup training focused on the development of social play skills, functional communication, and small group activities. The parent support and training group was run concurrently with the child program. The parent training consisted of mainly group discussions with staff and other parents that emphasized a variety of topics including: communication, self-help issues, school options, and positive behaviour support.

The home-based program consisted of biweekly 2-hr sessions for a period of 40 weeks. Staff worked directly with each child to teach social skills, functional communication, attending and play skills, sensory processing issues, self-help skills, visual communication, fine and gross motor skills, and the development of pre-academic skills. Parents were trained to work with their child using techniques such as direct modeling, constructive feedback, and discussion addressing the needs of the family.

Despite randomization between groups, a larger proportion of children in the home-based program were previously diagnosed with autistic disorder compared to children in the centre-based program. Children in both groups did not differ significantly in age, or in the number of ABA and educational interventions previously obtained. After controlling for baseline differences, results demonstrated that while both groups made gains over the intervention period, overall outcomes favoured the centre-based group. Most notably, children in the centre-based group improved significantly more on social and communication scales of the Vineland Adaptive Behavior Scales II (Sparrow, Balla, & Cicchetti, 2005), and on the comprehension scale of the Reynell Developmental Language Scales III (RDLS-III) (Edwards et al., 1997). Parent outcomes

also favored the centre-based group with parents making significantly more gains in perception of competence and quality of life.

Statement of the Problem

While EIBI has been largely established as an effective treatment for children with ASD (Kuppens & Onghena, 2012; Makrygianni & Reed, 2010; Peter-Scheffer et al., 2011), there remains a scarcity of research that directly examines service setting as an independent variable. As ASD prevalence and demand for EIBI services increase, more children are receiving those services in a variety of settings. Therefore it is important to learn more about the potential effects of various settings on child outcomes. The current project has several important implications. First, the findings may guide service providers to allocate resources to the setting(s) where EIBI provides superior outcomes. If outcomes are equivalent across the settings, resources may be allocated according to other considerations (e.g. cost-effectiveness, social validity). Second, a difference in outcomes between settings will naturally raise the question of why and how various settings impact outcomes. This project will thereby lead to productive research with important and generalizable implications for service, and expands our understanding for improving the quality of intervention for all individuals affected by these challenges. The Psychology/Sociology Research Ethics Board of the University of Manitoba and the St.Amant Research Access Review Committee approved this research prior to conducting the project.

Method

Participants and Service Program

I retrospectively analyzed archived service data spanning from November 2006 to December 2014 obtained from St.Amant Autism Program. St.Amant Autism Program staff removed any identifying information from the databases before providing them to me. This database included a total of 260 children who participated in the St.Amant Early Learning

program (ELP). From the 260 children, there were 72 who were excluded from the project database due to missing data that described either their outcome scores, or their location of service delivery. This resulted in a final data set that described 188 children (36 females, 152 males) residing in the province of Manitoba who have been diagnosed with ASD.

To calculate age at intake, intake date was defined at the treatment start date (i.e., first treatment session), if available, otherwise the date of the first intake assessment was used to calculate age. The treatment start date and date of first intake assessment typically fell within a few months of each other. Age at intake was not calculated for 54 children due to missing data at both time points. For the remaining 134 children age at intake ranged from 24.9 months to 69.4 months with an average of 47.3 months (SD = 9.33). The total sample included only children who partook in the St.Amant Early Learning Program (ELP) for at least one year (i.e., 188 children). The large majority of children did not exceed three years of service in the ELP; any data that was collected after a child's third year of service in ELP was excluded from the database.

The data provided by the St.Amant Autism Program consisted of four different databases that detailed, respectively: scores on standardized measures, scores on the ABLLS-R, total service hours, and the location of service hours. Date of birth, client number, and gender, were also provided in each database, and served as linking information to consolidate all of the data into the research project database.

Records detailing child characteristics, and standardized scores were directly transposed from the original database into the project database. For the database containing ABLLS-R scores, the proportion of skills gained were calculated for each year (i.e., total number of skills mastered divided by the total number of attainable skills), then these scores were then transposed into the project database. The database detailing total service hours originally broke down the total number of service hours that each child received for each month. The monthly service hours

were merged using Excel functions to compute the total number of service hours that each child received for each year that were enrolled in the program. The total service hours received each year for each child were then transposed into the project database. Two research assistants entered records detailing the location of service hours into a database from original hard copies. To ensure data entry reliability, an independent research assistant randomly selected 40% of all records entered for a reliability check. Interobserver agreement was reported at 100%. This database detailed the number of hours each child received in various settings throughout their enrollment in the program. The numbers of service hours received in each setting were separated for each year that they were enrolled in the program, then transposed into the project database. The final project database consisted of child characteristics (i.e., client number, date of birth, gender, and intake date), scores on each outcome measure at 4 assessment points (intake, end of year 1, 2, and 3), the total number of service hours received in each year, and the total number of service hours received in each setting for each year.

In the ELP, each client works with a treatment team that consists of an autism consultant, senior tutor, and tutor. The autism consultants are professionals that must have either completed or are working towards a Master's or Doctoral degree in Applied Behavioural Analysis. The consultants are responsible for assessing each client in different skill domains and developing individualized behavioural programs based on their skill deficits. The initial assessments are conducted using the Assessment of Basic Language and Learning Skills – Revised (ABLLS-R) (Partington, 2008) curriculum. This curriculum involves the assessment of four skill domains: (a) basic learner skills (b) academic skills, (c) self-help skills, and (d) motor skills. The senior tutors' responsibilities include assisting the consultants by completing data entry, graphing, supervising tutors, and training new team members and parents on program implementation. They must have at least 1000 hrs of experience working with children with ASD and have completed at least two

courses on principles and applications of behaviour analysis. The tutors are responsible for providing the clients with one-to-one behavioural intervention based on the programs developed by the consultants. They must hold a high school degree and are provided with *"Discrete-trial Teaching with Children with Autism – A self-instructional Manual"* (Fazzio & Martin, 2011) upon being hired. The senior tutors and consultants are responsible for training the tutors on behavioural program implementation. Parents are required to spend a minimum of 5 hrs per week working with their child on behaviour programs outside of treatment hours. On a monthly basis, the consultant holds a clinic meeting with the tutor, senior tutor, parents, and the client. The main objectives of the clinic meeting are to assess the client's progress, address any problem behaviours, develop new goals, and providing on-going training to tutors and parents. The structure of the treatment team is independent of the clients setting of service delivery; it is the characteristics within these settings that vary in program implementation.

Independent Variables

The St.Amant ELP offers services in a variety of different settings. The independent variables in this study were the number of service hours delivered in each of the three service settings. The three settings of service delivery include: home-based programs, a centre-based program delivered at Minnetonka School, and integrated child care programs delivered in a variety of different daycares and preschools. A clinical manger in the St.Amant Autism Program has verified the following descriptions of each service setting to ensure their accuracy.

Home. Treatment hours are delivered in the client's home with a parent or guardian present; all children receive individualized one-on-one instruction with an ABA trained tutor. At home, there are more options in terms of the physical space around the home that the treatment can be delivered (e.g., backyard, living room, kitchen, etc.) The level of privacy and control over the environment can vary (e.g., the number of siblings, family members, or pets present). Another

discriminable feature of the home setting includes the parents' access to programs, data, and progress notes. All treatment materials are kept in the home throughout treatment services, such that parents may review their child's progress at any time. Materials kept at home also include new stimuli that are introduced for treatment purposes. While these stimuli are initially novel, the child has access to the stimuli outside of treatment hours. Monthly clinic meetings with the treatment team and parents are held in the home. Children in the home-based program can be enrolled in either the comprehensive or focused model of service (i.e., 31 hr vs. 15.5 hr, respectively).

Centre-Based Location. Minnetonka School is a mainstream (K-8) public school where St.Amant has offered a centre-based EIBI program in a classroom model within the school that is focused around ABA programming and intervention since 2012. Clients receive one-to-one instruction with their ABA trained tutor in a controlled setting; one senior tutor is present in the classroom at all times and one consultant is responsible for the program development of every client in the classroom (approximately 8 children with ASD). All treatment materials are kept in a secure space in the Minnetonka classroom. Children in the centre-based program have access to stimuli during treatment hours that are initially novel, though may become increasingly familiar over the course of treatment. Throughout the day there are many inclusion opportunities to interact with other children with ASD (e.g., recess, lunch). Monthly clinic meetings with the treatment team and parents are held at Minnetonka. The program provides 31 hrs of treatment per week to each child.

Integrated Child Care. Treatment hours are delivered in a daycare or preschool setting of the parent's choice. Clients receive one-to-one instruction with their ABA trained tutor amongst other typically developing peers; in some cases the consultant and senior tutor train the child's inclusion support worker in lieu of a tutor. The client follows the same routine as their

peers deemed by the daycare or preschool providers, such that it can be difficult to control the environment and other external influences. It is the responsibility of the treatment team, in consultation with the child care facility, to ensure that the child's programming is prioritized in the child care facility. In most cases, individuals who are not trained in ABA also provide supervision. All treatment materials are kept in a secure space at the daycare or preschool. During child care hours there is access to stimuli that are initially novel, and many inclusion opportunities are accessible. Monthly clinic meetings with the treatment team and parents are held in the home. Children in the daycare or preschool program can be enrolled in either the comprehensive or focused model (i.e., 31 vs. 15.5 hrs, respectively).

Dependent Variables

Child outcomes were assessed by five continuous variables evaluating (1) skill acquisition based on the ABLLS-R curriculum, and (2) standardized scores on four different domains. For each year that a child was enrolled in the ELP program, they were scored on ABLLS-R (i.e., number of skills mastered), and on each of the four standardized domains.

ABLLS-R. The ABLLS-R is a criterion-referenced assessment tool that serves as a curriculum guide and skills-tracking system developed for children with ASD or other developmental disabilities (Partington, 2008). This assessment includes 25 skill areas that are broken down into four classifications (i.e., basic learner, academic skills, self-help skill, and motor skills), with a total of 544 skills across the categories. The autism consultant for each child developed training programs that were based on the ABLLS-R manual; the autism consultant throughout treatment continuously updated the mastery of each ABLLS-R skill.

Standardized Assessments. These standardized assessments target four critical domains: cognitive, measures of autism severity, adaptive behaviour, and language. Certified psychologists

who hold a doctoral degree in Psychology administered the standardized assessments to each client.

Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (WPPSI-IV). The WPPSI-IV is a comprehensive tool administered by trained examiners for children aged 2 years and 6 months through to 7 years and 7 months. It provides scores that represent intellectual functioning in verbal and performance cognitive domains, as well as providing score representing a child's general intellectual ability (Wechsler, 2012a, 2012b). Standard scores range from below 70 (i.e., extremely low) to above 130 (i.e., very superior), with a mean of 100 and a standard deviation of 15. The WPPSI-IV has been shown to have a strong correlation with other standardized measures of intelligence, in addition to other psychometric properties, such as high inter-rater reliability, and high internal consistency (Gordon, 2004).

Pervasive Developmental Disorder Behavior Inventory (PDDBI). The PDDBI is an informant-based tool designed to assess children having a PDD. This standardized scale is a measure of autism severity by assessing both adaptive and maladaptive behaviours (Cohen & Sudhalter, 2005). Standardized scores are represented as T-scores with a mean of 50 and a standard deviation of 10. The PDDBI has been shown to have strong psychometric properties, such as a high degree of internal consistency, inter-rater reliability, and good internal consistency (Cohen, Schmidt-Lackner, Romanczyk, & Sudhalter, 2003).

Scales of Independent Behavior-Revised (SIB-R). The SIB-R is a comprehensive assessment of adaptive and maladaptive behaviours. Four main areas of functioning are assessed: personal living, community living, social interaction and communication, and motor skills. It is administered using either a structured interview or a checklist procedure (Bruininks, Woodcock, Weatherman, & Hill, 1996). Standardized scores have a mean of 100 and a standard deviation of

15. The SIB-R has been shown to have strong test-retest reliability and inter-rater reliability (Sattler, 2002).

Preschool Language Scale-Fourth Edition (PLS-4). The PLS-4 assesses language skills in young children from birth to 6 years and 11 months. The diagnostic tool identifies current comprehension and expression language skills, as well as any changes in language skills over time. This test presents tasks that involve the assessment of preverbal behaviours, and linguistic skills (Zimmerman, Steiner, & Pond, 2002). Standardized scores have a mean of 100 and a standard deviation of 15. The PLS-4 has been shown to have strong test-rest reliability, inter-rater reliability, and a high degree of concurrent validity (Friberg, 2010).

Data Analysis

A multivariate regression was used to examine the relationship between the setting of service delivery and outcomes for children with ASD in the St.Amant ELP. The multivariate regression detects whether the setting of service delivery explains a significant amount of the variance in the outcome variables. That is, does the total number of service hours a child receives in a specific setting predict outcome scores? Number of service hours delivered in three settings (home, Minnetonka, and integrated child care) is the independent variables, and outcomes (SIB-R, WPPSI-IV, PDDBI, PLS-4, ABLLS-R) are the dependent variables. Five linear models were run, one per each outcome variable. All analyses were computed using SPSS 24, with a significance cut off of $p = .05$.

In order to minimize the risk of reducing power and sample size, the number of variables controlled for were kept at a minimum (i.e., only variables that were found to be associated with outcomes were controlled for). Some previous research has indicated that factors such as age and IQ at intake may serve as covariates (Perry et al., 2008; 2011). However, the current study did not control for these variables for the following reasons. First, many other studies and systematic

reviews have failed to demonstrate any relationship between age and IQ at intake with outcomes. (Eikeseth et al., 2002, 2007; Hayward, Eikeseth, Gale & Morgan, 2009; Sallows & Graupner, 2005; Smith et al., 2000). In a systematic review of 11 controlled EIBI studies, 8 of which evaluated predictors of outcomes, findings regarding IQ at intake as a predictor of outcomes are mixed. 5 studies identified IQ at intake as a predictor of outcomes, and 3 studies identified IQ at intake as either weakly associated or not associated with outcomes. Age at intake was not a significant predictor of outcomes in any of the studies reviewed. Furthermore, the age ranges of children evaluated in these reviews are comparable to the current study (i.e., 3 – 5.5 years) (Howlin, Magiati, & Charman, 2009). Second, to evaluate age and IQ at intake as possible confounding variables in the current study, a Pearson correlation was used to determine whether a relationship exists between these variables and each outcome measure. Pearson correlations demonstrated that there was no relationship between age and IQ at intake with any of the outcome variables.

Furthermore, the effects of changes in the preceding year were not controlled for in the analyses of most standardized assessments (e.g., gains made in year 1 were not controlled for in the analyses of year 2); however, the effects of changes in scores in the preceding year were controlled for in the analysis of autism severity (PDDBI) in year 1, and of skill acquisition (ABLLS-R) for all three years. This is justified with the following reasons. First, a Pearson correlation was used to evaluate whether changes in scores in each year were correlated with the changes in scores for subsequent years of service. Pearson correlations revealed that the proportion of skills mastered in a given year according to the ABLLS-R was significantly positively correlated with the proportion of skills mastered in each of the preceding years ($p <$ .001). Moreover, intake scores measuring autism severity (PDDBI) were significantly negatively correlated with changes in scores at year 1 ($p < .001$). Changes in scores across years were not

significantly correlated at any other assessment point on the PDDBI or on any of other three the standardized assessments at each assessment point. Second, the literature indicates that children make the most progress in the first year of intervention; this describes the conditions for poor correlations between changes in scores in one year of treatment to the next year of treatment (Howlin, Magiati, & Charman, 2009). Third, standardized assessments are norm-referenced scales and are therefore at risk for ceiling effects, that is once a child makes gains and approaches the norm for a specified measure, the level at which the intervention has an effect on outcomes on that measure becomes limited. However, the ABLLS-R is a criterion-referenced measure and therefore ceiling effects less likely.

Results

There were 188 children represented in the dataset. The number of children with available outcome measures diminished from year to year due to children exiting the ELP. Table 1 shows the number of children who had available outcome data for each outcome measure at each year they were enrolled in the ELP.

Distribution of Service Hours

The amount of time spent in each setting of service delivery was measured in hours. In year 1 (N = 188), the mean number of service hours per child that were delivered at home was 820.07 (*SD* = 467.19), 206.32 (*SD* = 361.43) in integrated childcare settings, and 42.40 (*SD* = 224.54) at Minnetonka. In year 2 (N = 171), the mean number of service hours per child that were delivered at home was 719.3 (*SD* = 522.14), 285.1 (*SD* = 402.4) in integrated childcare settings, and 71.95 (*SD* = 286.63) at Minnetonka. In year 3 (N = 113), the mean number of service hours per child that were delivered at home was 589.8 (*SD* = 508.32), 243.3 (*SD* = 353.83) in integrated childcare settings, and 70.05 (*SD* = 274.62) at Minnetonka. It is important to understand that the number of service hours reported in each setting varied across outcome

measures because not all assessment results were available for all children. The distributions of available service hours for each outcome measure are reported in the regression analyses below.

It is also important to recognize that the number of service hours received across settings varied considerably between and within children. While many children received a large proportion of their service hours in one setting, others received services in multiple settings. Figures 1, 2, and 3 illustrate the distribution of children across the proportions of service hours in each setting for year 1, year 2, and year 3, respectively.

In year 1 (N = 188), 138 children received 90-100% of their service hours in one setting ($N_{Home} = 115$, $N_{IntC} = 19$, $N_{Min} = 4$). Of these children, many received 100% of their service hours in that setting ($N_{Home} = 102$, $N_{IntC} = 16$, $N_{Min} = 3$). Furthermore, many children received 0-10% of their service hours in one setting ($N_{Home} = 23$, $N_{IntC} = 122$, $N_{Min} = 181$). Of these children, a number of them received 0% of their service hours in that setting ($N_{Home} = 10$, $N_{IntC} = 105$, $N_{Min} = 181$). In summary, during year 1, 94.7% of children received at least some service hours delivered at home, 44.1% in integrated childcare settings, and 3.7% at Minnetonka (see Figure 1).

In year 2 (N = 171), children received 90-100% of their service hours in one setting ($N_{Home} = 67$, $N_{IntC} = 26$, $N_{Min} = 11$). Of these children, many of them received 100% of their service hours in that setting ($N_{Home} = 58$, $N_{IntC} = 22$, $N_{Min} = 8$). Furthermore, many children received 0-10% of their service hours in one setting ($N_{Home} = 37$, $N_{IntC} = 79$, $N_{Min} = 159$). Of these children, a large portion received 0% of their service hours in that setting ($N_{Home} = 32$, $N_{IntC} = 70$, $N_{Min} = 159$). In summary, during year 2, 81.3% of children received at least some service hours delivered at home, 59.1% in integrated childcare settings, and 7.1% at Minnetonka (see Figure 2).

In year 3 (N = 113), 61 children received 90-100% of their service hours in one setting ($N_{Home} = 41$, $N_{IntC} = 13$, $N_{Min} = 7$). Of these children, some received 100% of their service hours in that setting ($N_{Home} = 36$, $N_{IntC} = 13$, $N_{Min} = 6$). Furthermore, many children received 0-10% of

their service hours in one setting ($N_{Home} = 20$, $N_{IntC} = 50$, $N_{Min} = 101$). Of these children, a number of them received 0% of their service hours in that setting ($N_{Home} = 19$, $N_{IntC} = 44$, $N_{Min} = 101$). In summary, during year 3, 83.2% of children received at least some service hours delivered at home, 61.1% in integrated childcare settings, and 10.6% at Minnetonka (see Figure 3).

The distribution of hours across each setting follows a similar trend over each year of service. The majority of children received 90-100% of their service hours in one setting, with most children receiving services at home. Furthermore, the proportion of children who received services in integrated child care settings and Minnetonka increased slightly each year. Altogether, over three years of service the total number of children who had received at least some hours of service in each setting is unequal ($N_{Home} = 175$, $N_{IntC} = 135$, $N_{Min} = 16$).

Statistical Analyses

A multivariate regression model was developed to evaluate whether the number of service hours delivered at home, in integrated childcare settings, and at Minnetonka predicted outcomes (i.e., change in standardized scores on the SIB-R, WPPSI-IV, PDDBI, and PLS-4, and skills acquisition according the ABLLS-R). Furthermore, Pearson correlations were used to evaluate the degree to which the number of service hours delivered in a specific setting is related to a change in scores for each of the outcome measures. For each standardized outcome measure the total change in score was calculated for each year (e.g., SIB-R score at intake was subtracted from the SIB-R score at the end of year 1). It should be noted that a larger score on the SIB-R, WPPSI-IV, and PLS-4 represents an improvement, while a lower score on the PDDBI represents an improvement (i.e., reduction in symptoms of autism severity). The proportion of ABLLS-R skills mastered each year was calculated by dividing the total skills mastered in that year by the total number of attainable skills in the ABLLS-R curriculum (544 for girls, and 543 for boys). Tables 2, 3, and 4 demonstrate the results of the multivariate regressions across year 1, year 2,

and year 3, respectively. Table 5 demonstrates the Pearson correlations between outcome measures and service hours across settings.

Analyses of Outcomes from Intake to Year 1

Pearson correlation. A Pearson correlation revealed that service hours delivered at home during the first year of treatment were moderately positively correlated with a change in scores measuring cognitive functioning (WPPSI-IV) $r(35) = .29$, $p = .044$. Service hours delivered at Minnetonka were moderately negatively correlated with skill acquisition (ABLLS-R) $r(179) = -.14$, $p = .03$. All other correlations between service hours delivered during year 1 and outcome measures were not significant.

Regression analyses. The number of service hours delivered in each of the treatment settings was evaluated as a predictor for changes in scores from intake to the end of year 1 for each of the outcomes measures.

Adaptive functioning (SIB-R Broad Independence Standard Score). For the 76 children who had SIB-R BI SS scores at intake and year 1, the number of service hours delivered across settings during year 1 ($M_{home} = 956.53$, SD = 410.85, $M_{IntC} = 193.95$, SD = 339.06, $M_{Min} = 9.34$, SD = 68.67) were not significant predictors of change in SIB-R BI SS scores from intake to year 1. ($F(3,72) = .44$, $p = .73$), with an R^2 of .018.

Cognitive functioning (WPSSI Full Scale IQ Standard Score). For the 35 children who had WPPSI FSIQ SS scores at intake and year 1, the number of service hours delivered in each setting during year 1 ($M_{home} = 950.22$, $SD = 374.46$, $M_{IntC} = 182.55$, $SD = 321.23$ $M_{Min} = 16.79$ $SD = 99.34$) were not significant predictors of change in WPPSI FSIQ SS scores from intake to year 1 ($F(3,31) = 1.49$, $p = .24$), with an R^2 of .126.

Autism Severity (PDDBI Autism Composite Standard Score). For the 92 children who had PDDBI AC SS scores at intake and year 1, the number of service hours delivered in each

setting during year 1 (M_{home} = 977.39, *SD* = 388.82, M_{IntC} = 169.77, *SD* = 322.53, M_{Min}= 7.71, *SD* = 62.44) were not significant predictors of change in PDDBI AC SS from intake to year 1. However, scores of autism severity at intake was a significant predictor of change in scores of autism severity in year 1 β= -.39, $t(91) = -4.02$, $p = .001$, ($F(4,91) = 4.482$, $p = .002$), with an R^2 of .17.

Language (PLS-4 Total Language Standard Score). For the 86 children who had PLS-4 TL SS scores at intake and year 1, the number of service hours delivered in each setting during year 1 (M_{home} = 960.41, *SD* = 396.01, M_{IntC} = 182.38, *SD* = 330.05, M_{Min}= 8.25, *SD* = 64.57) were not significant predictors of change in PLS-4 TL SS scores from intake to year 1 ($F(3,82) = .75$, $p = .53$) with an R^2 of .027.

Skills Acquisition (ABLLS-R). For the 179 children who had ABLLS-R scores at intake and year 1, the number of service hours delivered at home and in integrated child care settings during year 1 (M_{home} = 821.05, *SD* = 465.64, M_{IntC} = 198.18, *SD* = 355.38) were not significant predictors of the proportion of skills mastered according to the ABLLS-R curriculum from intake to year 1. However, it was found that the number of service hours delivered at Minnetonka (M_{Min}= 44.53, *SD* = 230.20) explains a significant amount of the variance of change in ABLLS-R scores during year 1, β= -.18, $t(178) = -2.13$, $p = .03$. Moreover, the proportion of skills recorded at intake was a significant predictor of skills gained in year 1 β= .25, $t(178) = 3.46$, $p < .001$, ($F(4,174) = 4.62$, $p < .001$) with an R^2 of .096.

In summary, a Pearson correlation indicates that receiving a larger number of service hours at home during the first year of service may predict higher scores in cognitive functioning (WPPSI-IV), and that a larger number of service hours delivered at Minnetonka may predict lower rates of skill acquisition. Furthermore, with regression analyses, the setting of service delivery in year 1 did not significantly predict adaptive functioning, cognitive functioning, autism

severity, and language. Yet, a larger number of service hours delivered at Minnetonka predicted a smaller proportion of skills gained according to the ABLLS-R.

Analyses of Outcomes from Year 1 to Year 2

Standardized scores measuring language (PLS-4) were not evaluated at year 2 due to an insufficient number of children who had data at year 1 and year 2.

Pearson correlation. A Pearson correlation reveals that service hours delivered at home during year 2 of treatment, were positively correlated with changes in scores of adaptive functioning (SIB-R) $r(40) = .27$, $p = .048$. Whereas services hours delivered at Minnetonka during year 2, were negatively correlated with changes in scores of adaptive functioning (SIB-R) $r(40) = -.67$, $p < .001$, and were also moderately positively correlated with changes in scores of autism severity (PDDBI) (i.e., increase in autism severity), $r(55) = .29$, $p = .015$. All other correlations between service hours delivered during year 2 and outcome measures were not significant.

Regression analyses. The number of service hours delivered in each of the treatment settings was evaluated as a predictor for changes in scores from the end of year 1 to the end of year 2 for each of the outcomes measures.

Adaptive functioning (SIB-R Broad Independence Standard Score). For the 40 children who had SIB-R BI SS scores at year 1 and year 2, it was found that setting of service delivery explains a significant amount of the variance of change in SIB-R BI SS scores from year 1 to year 2 ($F(3,36) = 9.97$, $p < .001$), with an R^2 of .45. Service hours delivered at home ($M_{home} = 1017.06$ $SD = 493.61$) $\beta = .19$, $t(39) = .72$, $p > .05$, and in integrated child care settings ($M_{IntC} = 345.74$, $SD = 418.97$) $\beta = .18$, $t(39) = .69$, $p > .05$) did not significantly predict SIB-R BI SS scores. However, service hours delivered at Minnetonka ($M_{Min} = 47.82$, $SD = 276.26$) significantly predicted a decrease in SIB-R BI SS scores $\beta = -.57$, $t(39) = -3.32$ $p < .01$.

Cognitive functioning (WPSSI Full Scale IQ Standard Score). For the 15 children who had WPSSI FSIQ SS scores at year 1 and year 2, the number of service hours delivered at home and integrated child care settings during year 2 (M_{home} = 814.38 *SD* = 481.91, M_{IntC} = 626.97, *SD* = 519.05) were not a significant predictors of change in WPSSI FSIQ SS scores from intake to year 1 (F(2,14) = .094, p = .91), with an R^2 of .015. Children who received services at Minnetonka did not have WPSSI FSIQ SS data at year 1 and year 2 and therefore were not included in this analysis.

Autism Severity (PDDBI Autism Composite Standard Score). For the 55 children who had PDDBI AC SS scores at year 1 and year 2, the number of service hours delivered in each setting during year 2 (M_{home} = 1006.42, *SD* = 486.99, M_{IntC} = 321.08, *SD* = 402.94, M_{Min}= 87.91, *SD* = 344.12) were not significant predictors of change in PDDBI AC SS scores from year 1 to year 2 (F(3,51) = 1.75, p = .17), with an R^2 of .093.

Skills Acquisition (ABLLS-R). For the 111 children who had ABLLS-R scores, the number of service hours delivered in each setting during year 2 (M_{home} = 808.32, *SD* = 535.80, M_{IntC} = 293.32 *SD* = 391.23, M_{Min}= 97.06, *SD* = 333.32) were not significant predictors the proportion of skills mastered according to the ABLLS-R curriculum from year 1 to year 2. However, the proportion of skills gained in year 1 was a significant predictor of skills gained in year 2 β= .41, $t(110) = 4.68$, $p < .001$, (F(4,106) = 6.38 , p <.001), with an R^2 of .19.

In summary, a Pearson correlation indicates that children who received a larger number of service hours at Minnetonka during their second year of service, may score significantly higher in autism severity (PDDBI) and lower in adaptive functioning (SIB-R). While children who receive a larger number of service hours at home during their second year of service, may score significantly higher in measures of adaptive behaviour (SIB-R). Furthermore, with regression analyses, receiving a larger number of service hours at Minnetonka in year 2 predicted a decrease

in scores measuring adaptive functioning (SIB-R). The setting of service delivery during year 2 did not significantly predict autism severity, cognitive functioning, or skill acquisition.

Analyses of Outcomes from Year 2 to Year 3

Standardized scores measuring adaptive functioning (SIB-R), cognitive functioning (WPSSI-IV), and language (PLS-4) were not evaluated at year 3 due to an insufficient number of children who had data at year 2 and year 3.

Pearson correlation. A Pearson correlation reveals service hours delivered at Minnetonka during year 3, were positively correlated with scores of autism severity (PDDBI) (i.e., increase in autism severity), $r(23) = .55$, $p = .003$. Whereas services hours delivered in integrated child care settings, were negatively correlated with scores of autism severity (PDDBI), $r(23) = -.41$, $p = .026$. All other correlations between service hours delivered during year 3 and outcome measures were not significant.

Regression analyses. The number of services hours delivered in each of the treatment settings was evaluated as a predictor for changes in scores from the end of year 2 to the end of year 3 for each of the outcomes measures.

Autism Severity (PDDBI Autism Composite Standard Score). For the 23 children who had PDDBI AC SS scores at year 2 and year 3 it was found that setting of service delivery explained a significant amount of the variance of change in PDDBI AS SS scores from year 2 to year 3 ($F(3,19) = 6.01$, $p < .01$), with an R^2 of .49. The analysis shows that the services delivered at Minnetonka ($M_{Min} = 40.14$, $SD = 108.01$) $\beta = .25$, $t(22) = 1.23$, $p > .05$ and at home ($M_{home} = 838.28$, $SD = 666.16$) $\beta = -.44$, $t(22) = -1.91$, $p > .05$ did not significantly predict change in PDDBI AS SS scores from year 2 to 3. However, services delivered in integrated child care settings ($M_{IntC} = 391.99$, $SD = 464.84$) were significant predictors of change in PDDBI AC SS scores from year 2 to year 3, $\beta = -.56$, $t(22) = -2.58$, $p < .01$.

Skills Acquisition (ABLLS-R). For the 48 children who had ABLLS-R scores at year 2 and year 3, the number of service hours delivered in each setting during year 3 (M_{home} = 678.59, *SD* = 566.96, M_{IntC} = 344.16 *SD* = 439.67, M_{Min}= 71.40, *SD* = 256.53) were not significant predictors of the proportion of skills mastered according to the ABLLS-R curriculum from year 2 to 3. However, the proportion of skills gained in year 2 was a significant predictor of skills gained in year 3, β= .54, $t(47) = 4.23$, $p < .001$, ($F(4,43) = 5.06$, $p = .002$), with an R^2 of .32.

In summary, a Pearson correlation indicates that children who received a larger number of service hours at Minnetonka during their third year of service, may score significantly higher in autism severity. Whereas children who received a larger number of service hours in integrated child care settings may score significantly lower in autism severity. Furthermore, with regression analyses, receiving larger number of service hours in integrated child care centres during year 3 was predictive of lower scores in autism severity (PDDBI). The setting of service delivery did not predict the proportion of skills mastered in year 3 according to the ABLLS-R curriculum.

Discussion

The purpose of this project was to evaluate whether the setting in which the St.Amant EIBI Early Learning Program was delivered has an effect on outcomes for children diagnosed with ASD. Overall, the results suggest that (1) a larger number of service hours delivered at home may predict gains in cognitive functioning and adaptive behaviour, (2) a larger number of service hours in integrated child care settings may predict reduced autism severity, and (3) a larger number of service hours delivered at a centre such as Minnetonka may predict lower scores in adaptive behaviour, an increase in autism severity, and a lower proportion of skill gains. Measures of language were comparable across service settings.

Given the lack of research that directly compares outcomes for children receiving EIBI treatment in different settings, the current study provides an important foundation for

understanding more about treatment setting with regards to the typical characteristics that accompany each setting and how they might affect outcomes. Previous research states that while EIBI is effective in a variety of settings, it is unknown whether a specific setting of delivery produces superior outcomes in comparison with others (Nahmias, Kase, & Mandell, 2012; Parsons et al., 2011; Roberts et al., 2011).

The results of the current study suggest that on measures of language, scores are comparable across settings. This result may be useful in determining how resources should be allocated across settings according to other considerations (e.g. cost-effectiveness, social validity). However, the results indicate that differences may exist across settings in other domains (i.e., cognitive functioning, autism severity, adaptive behaviour, and skill acquisition). Children may show superior gains in cognitive functioning and adaptive behaviour when EIBI treatment is delivered at home, and furthermore, services delivered in integrated child care settings may also serve as a predictor of a reduction in autism severity. Whereas, services delivered at a centre such as Minnetonka may be inferior in terms of autism severity, adaptive behaviour, and skill acquisition.

Understanding where outcome differences exist across settings has important clinical implications. First, these results may guide service providers to allocate resources to the setting(s) where EIBI provides superior outcomes. Second, these results may provide additional information for families and clinicians when selecting which setting of service delivery is best suited for the child. Third, these results may prompt service providers to address characteristics within a service setting that may affect treatment quality across settings (e.g., procedural integrity)

Despite the advances the current study has made in the comparison of EIBI outcomes across three different settings, several limitations should be noted. First, the sample sizes across

settings were very uneven. More specifically, the number of children receiving services in integrated child care settings, and especially at Minnetonka, were limited. In year 1, 94.7% of children received at least some of their service hours at home, in comparison with the 44.1% of children who were exposed to services in integrated children care settings, and the 3.7% who were exposed to services at Minnetonka. The proportions of hours across settings follow a similar trend in year 2 (81.3% at home, 59.1% in integrated child care settings, and 7.1% at Minnetonka) and in year 3 (83.2% at home, 61.1% in integrated child care settings, and 10.6% at Minnetonka). The setting where a child received treatment was contingent on consultant recommendations and based on the decision of the family. For this reason, and given the retrospective nature of the study, we were unable to control the proportion of service hours distributed across settings. Furthermore, the Minnetonka classroom was not established until 2012, and only serves approximately 8 children each year; therefore, very few children represented in the total sample had received services at Minnetonka.

A second limitation includes the inability to control for other factors that might contribute to outcomes, other than setting itself. Given the analyses of retrospective data, there is limited access to information describing further information on child and family characteristics that might be specific to each setting. For example, children receiving services in integrated child care settings may be considered higher functioning. Minnetonka in particular may present unique confounding variables. At Minnetonka, the monthly clinic meetings are held on site rather than at home. Consequently, parents may have difficulty generalizing learned skills and recommendations to the home environment. Furthermore, the number of children that can be accepted at Minnetonka is limited and therefore priority is given to children who have unsuitable homes for treatment, children who require additional support, or to families who cannot afford to stay home from work or pay for daycare expenses. For these reasons, it is possible that children

attending Minnetonka may have more challenging needs, and that the quality of parent program implementation and skill generalization to the home may be disadvantaged.

Furthermore, possible covariates such as age and IQ at intake, and change in scores from preceding years of service, were not controlled for in most analyses. Given that most children do not have data at each time point for each outcome measure and that and the distribution of hours across settings was greatly unequal, the variables that were controlled for were kept at a minimum. While this may be perceived as a limitation, all variables that did demonstrate significant association with outcomes were controlled for. Other examples of potential confounding variables include: the overall health of the child and the presence of comorbid diagnoses, parental involvement, first language of the child and family and immigration status.

A third limitation is that information regarding why children received services in a particular setting is not available. Ideally, the allocation of service hours designated to a specific setting would be based on the child's needs; for example, children who would benefit from social interactions should receive a larger proportion of services in integrated child care settings. The distribution of service hours within children demonstrates a gradual trend in children receiving a larger proportion of service hours outside of the home each year that they are enrolled in the program (see Figure, 1, 2, and 3). This trend suggests that the transition of service delivery outside of the home as children grow older is supportive of children's needs where typically they would benefit more from social inclusion as they grow older (Grindle et al., 2012; Rivard et al., 2014). However, as previously described, in many cases the chosen setting of service delivery may not be based on the clinical recommendations; some children may be required to receive services in a specified setting due to other considerations (e.g., family schedules, child care centre availability or expenses).

A fourth limitation includes the use of a criterion-referenced assessment to measure skill acquisition (ABLLS-R), rather than standardized assessments that were used for measures of cognitive functioning, language, adaptive behaviour, and autism severity. A disadvantage of using criterion-referenced assessments includes the inability to compare performance of children enrolled in the St.Amant ELP with national norms. Despite this limitation, the ABLLS-R is an essential component for assessing children against predetermined learning standards, and therefore the scores remain as a useful means of comparison across settings.

Despite these limitations, the current study has provided the groundwork for the comparison of setting of service delivery of EIBI programs. With the rise in prevalence of ASD, and consequently an increase in demand for government-funded EIBI programs, a growing number of children are receiving EIBI services in a variety of different settings. The settings of service delivery vary in terms of both the physical space where they are delivered and also in the characteristics that accompany each setting. Given the limitations associated with this project and its clinical implications, the comparison of outcomes across settings of EIBI service delivery remains as a research need.

Future research should include a comparison of a larger and equal number of children receiving EIBI services in different settings. Studies should also provide more information detailing possible confounding variables such as child and family characteristics (e.g., social economic status, comorbid diagnoses, immigration status), and amount of parental involvement, to ensure that the comparison of populations of children receiving services in different settings are not biased. Future studies should also examine the proportion of service hours a child received in a setting that were allotted to treatment (e.g., how many trials were run per hour?), and whether this proportion is comparable across settings. Finally, future studies should make efforts to clearly describe the program characteristics that accompany the service setting in which

the EIBI treatment takes place. This will facilitate the understanding of how EIBI programs can vary based on their setting of service delivery, and thereby seek to understand why child outcomes may not be equivalent across settings. Replication and extension of the current study has important policy implications, as it would allow government funders to prioritize funds based on both cost-effectiveness, and program effectiveness.

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Table 1

The Number of Children with Available Outcome Data across Years and Outcome Measures

		Outcome Measures				
		SIB-R	WPSSI-IV	PDDBI	PLS-4	ABLLS-R
Year	Total Children			N		
1	188	76	35	92	86	179
2	171	40	15	55	7	111
3	113	9	2	23	7	48

Table 2

Multivariate Regression – Year 1

	Outcome Measures									
	SIB-R		WPSSI-IV		PDDBI		PLS-4		ABLLS-R	
Service Setting	t	β	t	β	t	β	t	β	t	β
Home	.22	.052	.32	.12	.33	.06	-.01	-.002	-.88	-.09
Integrated Child Care	-.36	-.082	-.42	-.15	-.02	-.004	.76	.16	.23	.02
Minnetonka	.36	.045	-1.18	-.23	1.59	.16	.32	.04	-2.13	-0.18*
Controlled Variables										
PDDBI Intake	--	--	--	--	-4.02	-.39***	--	--	--	--
ABLLS-R Intake	--	--	--	--	--	--	--	--	3.46	.25***
R^2	.018		.126		.171**		.027		.096***	
F	.44		1.49		4.48		.75		4.82	
N	76		35		92		86		179	

*$p < .05$, ** $p < .01$, *** $p < .001$

Table 3

Multivariate Regression – Year 2

	Outcome Measures							
	SIB-R		WPSSI-IV		PDDBI		ABLLS-R	
Service Setting	t	β	t	β	t	β	t	β
Home	.72	.19	-.22	-.22	-.10	-.04	1.14	.15
Integrated Child Care	.69	.18	-.31	-.32	.14	.05	1.23	.15
Minnetonka	-3.32	-.57**	--	--	.93	.28	.21	.02
Controlled Variable								
ABLLS-R Year 1	--	--	--	--	--	--	4.68***	.41
R^2	.45***		.015		.093		.19***	
F	9.97		.09		1.75		6.38	
N	40		15		55		111	

*$p < .05$, ** $p < .01$, *** $p < .001$

Table 4

Multivariate Regression – Year 3

	Outcome Measures			
	PDDBI		ABLLS-R	
Service Setting	t	β	t	β
Home	-1.91	-.44	-.91	-.14
Integrated Child Care	-2.58	-.56**	.30	.045
Minnetonka	1.2	.25	-.16	-.02
Controlled Variable				
ABLLS-R Year 2	--	--	4.23	.54***
R^2	.49**		.32**	
F	6.01		5.061	
N	23		48	

*$p < .05$, ** $p < .01$, *** $p < .001$

Table 5

Pearson Correlations between Outcome Measures and Service Hours across Settings

	Outcome Measures				
	SIB-R	WPSSI- IV	PDDBI	PLS-4	ABLLS-R
Setting Year 1					
Home	.113	.292*	.078	-.140	-.063
Integrated Child care	-.126	-.227	-.073	.159	.124
Minnetonka	.038	-.243	.088	.035	-.141*
N	76	35	92	86	179
Setting Year 2					
Home	.27*	.083	-.22	--	.017
Integrated Child care	.11	-.107	.032	--	.129
Minnetonka	-.67***	--	.29*	--	-.063
N	40	15	55	7	111
Setting Year 3					
Home	--	--	-.26	--	-.155
Integrated Child care	--	--	-.41*	--	.152
Minnetonka	--	--	.55**	--	-.043
N	9	2	23	7	48

*$p < .05$, ** $p < .01$, *** $p < .001$

Note. Correlations are not reported for comparisons with insufficient sample sizes.

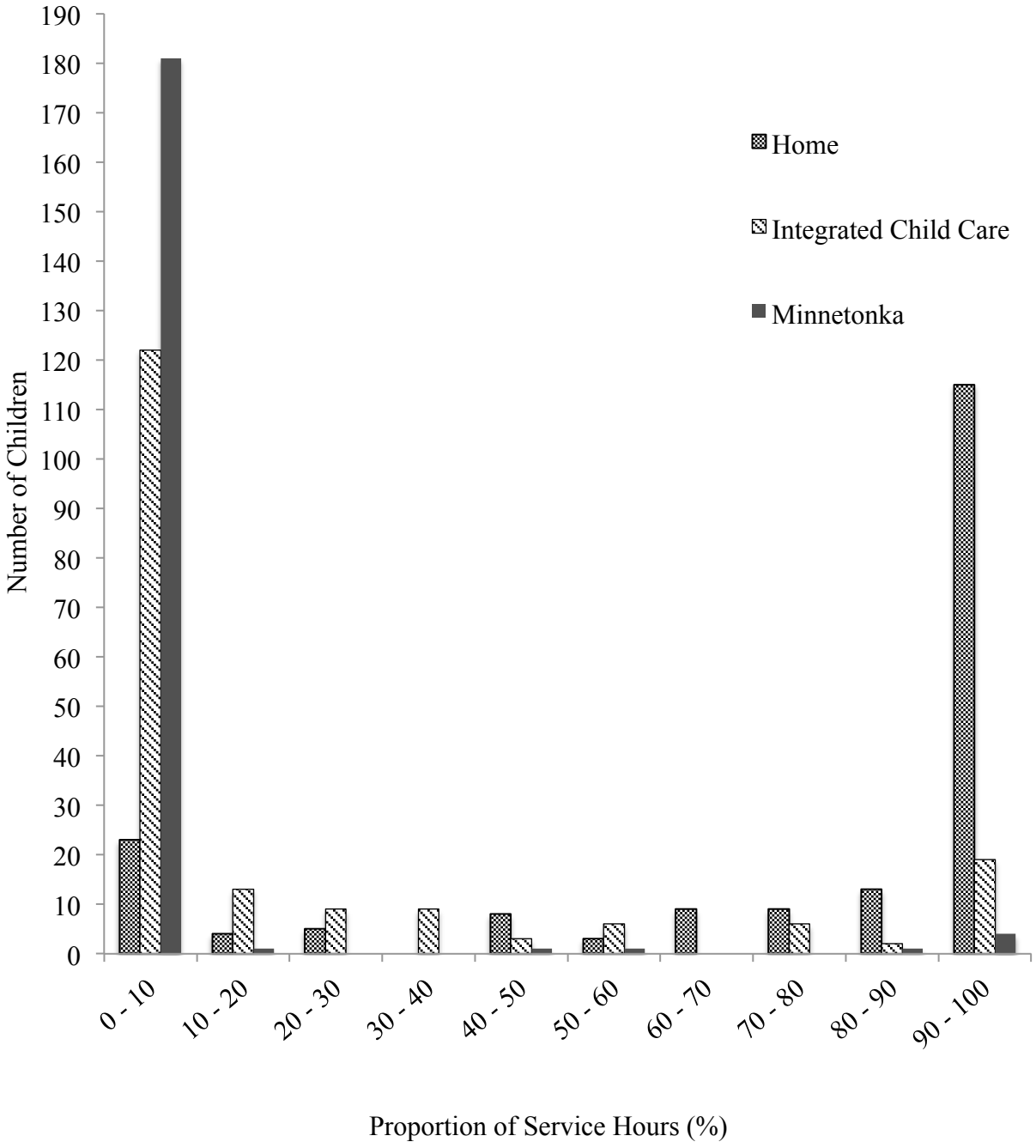

Figure 1. Distribution of children across proportions of service hours in each setting – Year 1

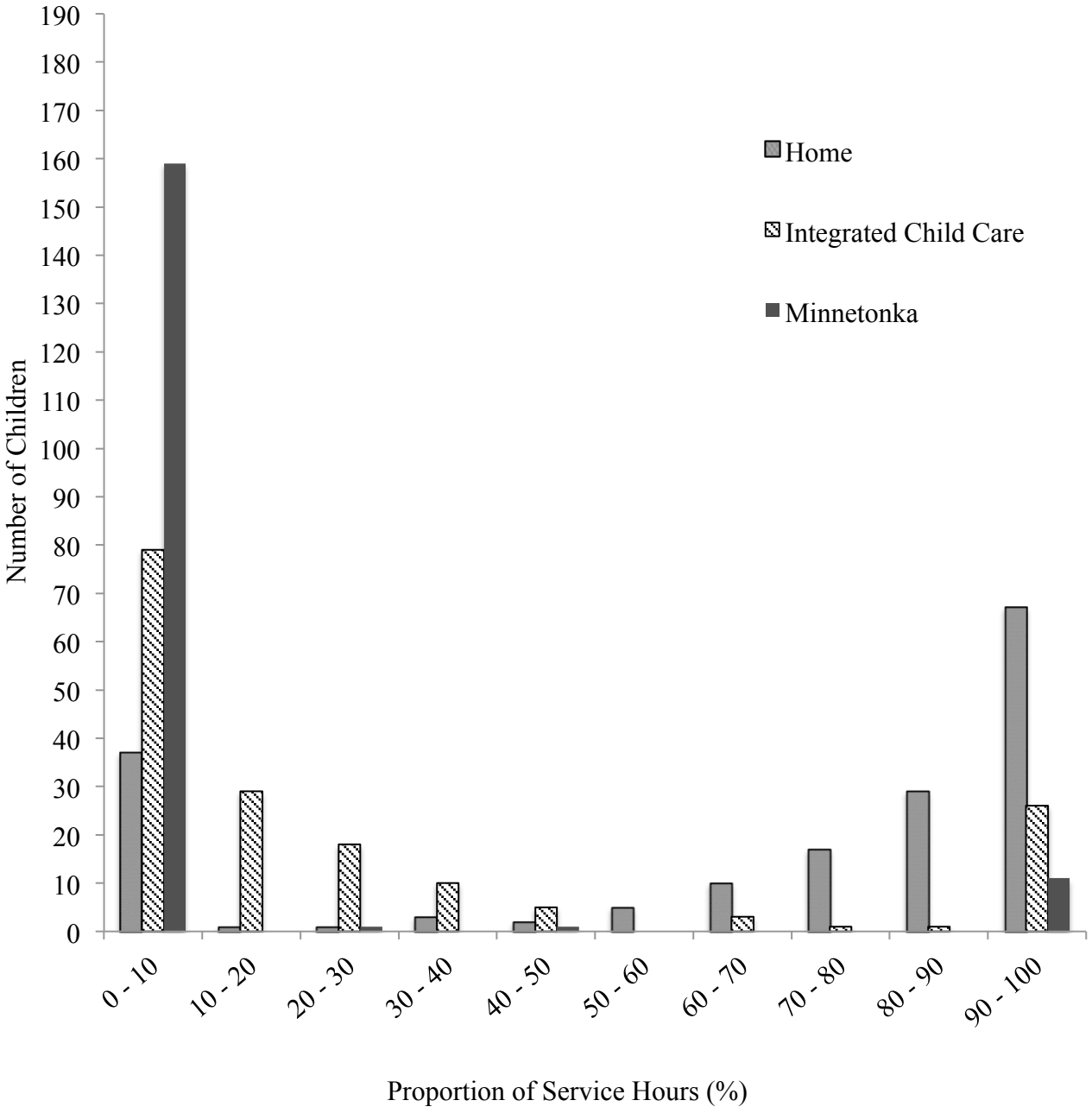

Figure 2. Distribution of children across proportions of service hours in each setting – Year 2

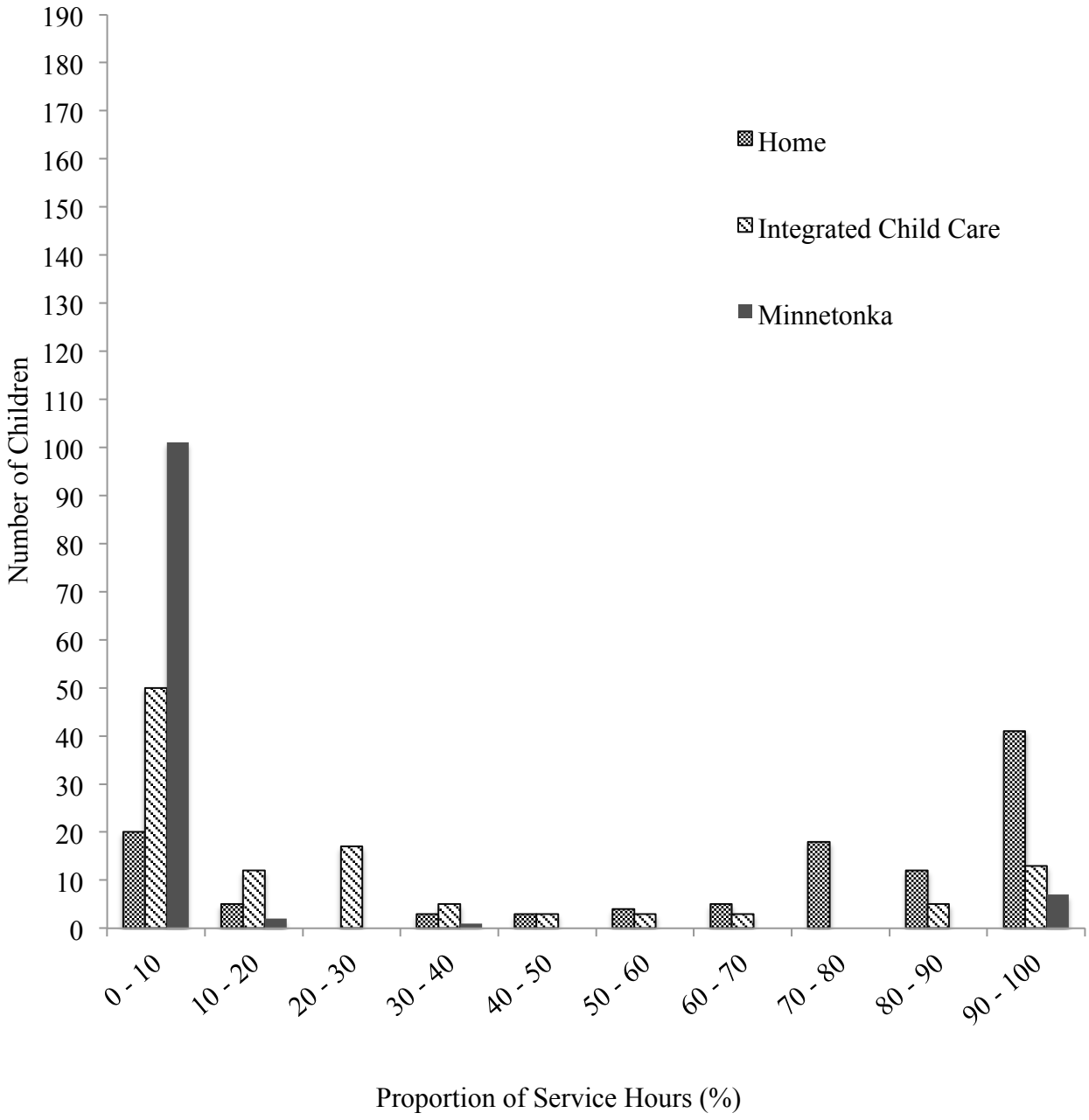

Figure 3. Distribution of children across proportions of service hours in each setting – Year 3