Journal on Developmental Disabilities
Le journal sur les handicaps du développement
JoDD
Volume 20, Number 1, 2014

Examining the Effectiveness of Intensive Behavioural Intervention in Children with Autism Aged 6 and Older

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Keywords

autism spectrum disorder, Intensive Behavioural Intervention (IBI), older children

Abstract

The effectiveness of Intensive Behavioural Intervention (IBI) was examined in 68 children who entered Ontario's public IBI programs at the age of 6 or older. The children's age at the start of IBI ranged from 6 to 13 (M = 7 years 3 months). The sample was quite heterogeneous with IQ and adaptive scores ranging from the very impaired to the average range. Results indicated that the children, as a group, did not show statistically significant gains in IQ (Time 1 M = 43, Time 2 M = 45), adaptive level (Time 1 M = 54, Time 2 M = 60), or cognitive rate of development (Time 1 M = .43, Time 2 M = .57), which differs from findings in younger children. The adaptive rate of development almost doubled, a significant increase from Time 1 (.34) to Time 2 (.62). Some children displayed clinically significant gains, particularly in adaptive behaviour. Initial IQ and adaptive scores were significantly correlated with all outcome variables, and age was less strongly related. Children aged 6 to 8 had more variable outcomes, while older children displayed uniformly poor outcomes. These results have clinical and policy implications for appropriate service selection for older children.

Autistic Disorder has diverse clinical manifestations, behavioural phenotypes, and developmental dimensions, all of which complicate selecting the appropriate intervention for children of different ages and ability levels. Research indicates that early, intensive treatment based on the principles of applied behaviour analysis (ABA), called Intensive Behavioural Intervention (IBI) in Ontario, may facilitate clinically significant gains in intellectual and adaptive functioning for at least some children with autism. Several efficacy studies of IBI have noted that children receiving IBI have better outcomes than those receiving a minimal amount of behavioural intervention (Lovaas, 1987; Smith, Groen, & Wynn, 2000), generic treatment-as-usual in the community (Cohen, Amerine-Dickens, & Smith, 2006; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005), and equal intensity special education (Eikeseth, Smith, Jahr, & Eldevik, 2002; Howard et al., 2005). However, outcomes are variable. In the seminal study of IBI, almost half of the participants made substantial gains on standardized tests of cognitive ability, functioned successfully in mainstream classrooms and were indistinguishable from typically developing children of the same age, while some children made only modest progress on standardized tests and continued to display deficits typical of autism, and some children made no progress at all (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993).

A recent meta-analysis by Reichow and Wolery (2009) revealed that, although IBI was seen to be efficacious overall, some participants in each study did not improve or even regressed on at least one outcome variable. The authors stated that it is important to determine which children do and do not benefit and why. Additionally, in their systematic review, Howlin, Magiati, and Charman (2009) concluded that IBI resulted in improved outcomes at a group level but that there was considerable individual variability. Other meta-analyses have come to similar conclusions (summarized in Reichow [2012]). These data suggest that, unfortunately, IBI is not an intervention that meets the needs of all children with autism. Child characteristics, as well as family factors and intervention factors have been implicated in outcome variance (Perry et al., 2011). Research has examined several child variables that may affect outcome, including severity of diagnosis and adaptive level (Perry et al., 2011), but particular focus has been given to cognitive level and age at start of treatment. Cognitive level has typically been shown to be related to children's subsequent intellectual functioning scores (e.g., Lovaas, 1987; Eikeseth, Smith, Jahr, & Eldevik, 2007), although this may be true regardless of IBI.

Children's starting age has been examined in a number of studies. Theoretically, from a neurodevelopmental perspective, it seems logical that starting intervention at a younger age is preferable (Borman & Fletcher, 1999). Intervention may work best before or during a "sensitive period" and before nonfunctional routines and behaviours become more entrenched in the child's repertoire. It is often assumed that IBI is most effective in children who begin treatment very early (e.g., Lovaas' protocol was for children aged 2 to 3½ years). However, the studies that have examined age as a predictor of outcome have yielded inconsistent results.

Some researchers, have reported no association between initial age and outcomes, (e.g., Hayward, Eikeseth, Gale, & Morgan, 2009; Lovaas, 1987) but it is important to note that these studies included only children aged 4 and under. Eikeseth et al. (2002), in a small study (13 children in the IBI group) of somewhat older children, aged 4 to 7 at intake, with intake IQ of 50 or above, also found that age was not reliably associated with amount of change or absolute outcomes. Thus, in several efficacy studies with restricted age ranges, initial age does not seem to be a strong determinant of outcome. However, there are no controlled studies of children over 7 years of age.

The meta-analysis by Reichow and Wolery (2009) explored moderator effects of several variables and, based on an analysis of 251 children in IBI with a mean chronological age of less than 7 years at the beginning of IBI, concluded that chronological age did not significantly predict treatment outcomes. Howlin et al. (2009) arrived at similar conclusions based on 11 studies, with all children being younger than 7 years of age. However, Makrygianni and Reed (2010) conducted a meta-analysis of 14 studies and suggested that studies of children who began treatment very early (around 3 years of age) tended to have more uniformly large effect sizes whereas studies of children beginning later had more variable effect sizes.

Several studies not included in most of the meta-analyses (because they are not controlled studies) have included some older children and have compared older versus younger children within their samples. These studies have consistently shown that younger children, however defined (e.g., above and below 4 years), show better outcomes in areas such as school placement and outcome IQ scores, than older children (Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris & Handleman, 2000; Perry et al., 2011). In a recent large study with a wide age range, Granpeesheh, Dixon, Tarbox, Kaplan, and Wilke (2009) used the number of behavioural objectives mastered as their outcome measure. They studied 245 children ranging in age from 16 months to 12 years, receiving intervention through a large-scale community-based agency. They demonstrated that the child's age has a significant impact on treatment outcome and that the efficiency of intervention decreases as the age of the child increases. However, this study did not examine standardized outcome measures such as IQ.

The Ontario IBI Program

In late 1999, Ontario launched a province-wide IBI initiative (Ministry of Community and Social Services (MCSS), 2000), in which IBI is funded by the provincial Ministry of Children and Youth Services (MCYS) and provided free of charge to children aged 2 to 5 initially, based on the research evidence (see Perry, 2002). The program has since been expanded and modified several times and now serves over 1400 children at a cost of over $180 million per year (MCYS, 2011). More information about the specifics of the program can be found in Perry et al. (2008).

In that study, Perry and colleagues examined data from 332 children aged 2 to 6 years. Results showed that there was considerable heterogeneity in outcomes, but that the majority of children showed some benefit or improvement and 11% demonstrated average functioning on developmental and diagnostic measures. For the group as a whole, there were significant reductions in autism severity, with 50% of children making clinically significant gains. There were also significant gains in cognitive functioning, with 39% making clinically significant gains. In terms of adaptive behaviour, based on parent report on the Vineland Adaptive Behavior Scale (VABS; Sparrow, Balla, & Cicchetti, 1984), age equivalent scores and adaptive rate of development increased significantly. In terms of standard scores, there were small but statistically significant increases in the Adaptive Behavior Composite (ABC) as well as the Communication and Socialization domains, but a significant *decrease* in Daily Living Skills and no change in Motor Skills. Further analyses of three subgroups showed that subgroup A (who started with Vineland ABC standard scores of 60 or greater) showed substantial gains, rather similar to those reported in the published efficacy studies. Children in Group B (who started with Vineland ABC scores between 50 and 59) made minimal gains on most measures and children in Group C (the lowest functioning group) showed slightly lower mean scores at Time 2 (Perry et al., 2008).

Upon further investigation into correlates and predictors of these heterogeneous outcomes, Perry and colleagues (2011) found that initial cognitive level, adaptive level, severity of autism and age at entry were all significant predictors. Age at entry into the program, together with initial developmental level, were strong predictors of children achieving best outcomes or average functioning. Further, children who started IBI before age 4 showed better outcomes than those who started after age 4 on a variety of outcome measures. The authors point out that their results do not demonstrate that older children do not benefit from IBI, but that they are less likely to show highly successful outcomes such as average functioning (Perry et al., 2011).

Since 2005, as a result of policy changes, Ontario's IBI program has become available to children with a diagnosis "toward the severe end of the autism spectrum," regardless of age, and children are not necessarily discharged at the age of 6. Many children with autism in Ontario do not have the opportunity to start IBI early as a result of a delay in diagnosis and the unfortunately lengthy waiting lists for IBI service. Thus, older children are being admitted into the program and remaining in the program and younger children may languish on the wait list for inordinately long periods. Yet, there is no empirical evidence demonstrating the effectiveness of IBI for children over 7, as described earlier and as concluded by an Ontario Expert Clinical Panel (Szatmari et al., 2006). Therefore, we believe it is imperative to examine the effectiveness of the Ontario IBI program for older children in light of the resources being devoted to it and the absence of an evidence-base for this age group.

Thus, the purpose of the current study was to describe the outcomes of children participating in Ontario's regional IBI programs who began treatment when they were 6 years of age and older. This study addressed three main questions:

1) Do children, as a group, show *statistically* significant changes in cognitive and adaptive functioning from the time they enter the program to a second time after about a year or more in IBI?

2) Do individual children show *clinically* significant changes from the time they enter the program to the second assessment? In particular, how many children improve to a clinically meaningful degree on cognitive and adaptive measures?

3) Which initial child characteristics are related to or predict children's outcomes? In particular, how strongly do initial age and functioning level relate to children's outcomes?

Method

This study was approved by the Research Ethics Board at York University. All nine IBI regional programs providing government funded IBI in Ontario also provided ethics approval for the study and allowed their data to be used: Child Care Resources (Sudbury), Children's Hospital of Eastern Ontario (Ottawa), ErinoakKids (Mississauga), Hamilton Health Sciences (Hamilton), Hands: The Family Help Network (North Bay), Kinark Child and Family Services (Markham), Pathways for Children and Youth (Kingston), Surrey Place Centre (Toronto), and Thames Valley Children's Centre (London).

Participants

The psychology files of all children who had received IBI services through the Autism Intervention Program and who began services at 6 years of age or older were reviewed, a total of 127 children (see results section for how this number was reduced for various analyses). This does not include children who had been in the program earlier and returned after the change to the eligibility criteria. In addition, of the 332 children in the Perry et al. (2008) study, there were 20 children who met the criteria for the current study and were included.

For our analyses, certain decisions had to be made to ensure meaningful data without losing too many participants. We only selected children who received 10 or more months of treatment and children whose Time 1 measures occurred within 4 months of starting IBI (before or after). After applying these criteria, a total of 68 children had adaptive and/or cognitive measures at both times, which is 54% of the total population of children who started IBI at the age of 6 or older.

Participant characteristics at entry are presented in Table 1 for children whose data are used in subsequent analyses. These children ranged in age from 6 to 13 years with an average age of about 7½. Eighty-two percent of the children were boys. Diagnostically, 55% had a diagnosis of Autism or Autistic Disorder, 38% had a broader diagnosis of PDD or ASD, and 7% had a diagnosis of PDD-NOS. Developmentally, the children were very heterogeneous with respect to entry into IBI. Adaptively, children had scores ranging from the 20s (severe/profound intellectual disability) to the 80s or low average range. Similarly, cognitive scores varied extremely from below 20 (very low scores because of the need to use ratio IQs) to the average range.

Measures

All measures were administered by the centre's psychology staff based on clinical appropriateness and were obtained from the child's psychology file for the present study. As was done in the Perry et al. (2008) study, the following standardized measures were used:

Cognitive level was obtained from any standardized test available. The most common tests were: the Mullen Scales of Early Learning (Mullen, 1995), the Wechsler Intelligence Scales for Children, Fourth Edition (Wechsler, 2003), the Wechsler Preschool and Primary Scale of Intelligence, Third Edition (Wechsler, 2002), and the Stanford-Binet Intelligence Scale, Fourth Edition (Thorndike, Hagen, & Sattler, 1986) or Fifth Edition (Roid, 2003). Because of the characteristics of the sample, often standard scores were not possible to obtain, and in those cases, mental age (MA) scores were used to calculate Ratio IQs. Thus, a Full Scale IQ and a MA were obtained or computed for each child. In addition, a cognitive rate of development was calculated for each child as in Perry et al. (2008).

Adaptive level was measured using the Vineland Adaptive Behavior Scales, Survey Form (VABS; Sparrow, Balla, & Cicchetti, 1984), or the Vineland Adaptive Behavior Scales-II (Sparrow, Cicchetti, & Balla, 2005), administered by parent interview. Parallel scores to those described for cognitive functioning were used: Standard Scores (the Adaptive Behavior Composite or ABC score), age equivalent (AE) scores (mean of domain AEs on the VABS; mean of subdomain AEs on the Vineland-II), and an adaptive rate of development prior to IBI and during IBI.

See Perry et al. (2008) for further details regarding these measures.

Table 1. Developmental Status at Start of IBI

	Range	M(SD)	
Age (*n* = 68) (months)	70.00–163.00	88.81	(21.94)
IBI duration (*n* = 56) (months)	10.00–69.00	19.46	(12.00)
Cognitive			
VIQ (*n* = 58)	< 20–101.00	40.58	(21.57)
NVIQ (*n* = 63)	< 20–131.00	50.79	(23.82)
FSIQ (*n* = 62)	< 20–104.00	43.26	(21.09)
MA (*n* = 62) (months)	9.50–89.44	37.64	(18.20)
Rate of development (*n* = 62)	0.12–1.04	0.43	(0.21)
Adaptive			
VABS Com SS (*n* = 67)	22.00–83.00	54.96	(12.95)
VABS DL SS (*n* = 67)	20.00–87.00	56.79	(16.11)
VABS Soc SS (*n* = 67)	26.00–79.00	56.88	(11.50)
VABS ABC SS (*n* = 67)	27.33–81.00	56.21	(12.28)
VABS Com AE (*n* = 56) (months)	6.50–92.00	29.87	(15.95)
VABS DL AE (*n* = 56) (months)	7.33–65.00	32.92	(15.23)
VABS Soc AE (*n* = 56) (months)	5.00–45.00	19.49	(10.59)
VABS ABC AE (*n* = 67) (months)	10.22–61.56	29.86	(12.36)
Rate of development (*n* = 58)	0.10–0.70	0.33	(0.14)

Results

The first research question was whether children, as a group, showed statistically significant changes in cognitive and adaptive functioning from Time 1 to Time 2. In order to answer this question, six individual Analyses of Covariance (ANCOVAs) were performed: three for cognitive outcomes (IQ, MA, and Rate) and three for adaptive outcomes(ABC, AE, and Rate); duration between the two assessments was used as the covariate. Results are shown in Table 2 and described below. The second research question involved reporting the percentage of individual children who made clinically significant gains (or losses), which were defined as a change of 1 SD in magnitude on the particular measure (as in Perry et al., 2008).

Cognitive Functioning

Full Scale IQ. Time 1 and Time 2 scores for the children who had Full Scale IQ scores at both times (*n* = 61) were compared and there was no significant difference. Clinically significant gains in IQ were defined as a child's score increasing by 15 points. There is not a universally accepted way of determining clinical significance (Kazdin, 2005). We used 15 points (one standard deviation) to be consistent with the Perry et al. 2008 study, which conducted similar analyses with younger children in IBI. The vast majority of children (89%) did not show clinically significant changes in IQ. Five (8%) children made clinically significant gains but two (3%) children had clinically significant losses.

Table 2. Comparison of Cognitive and Adaptive Scores at Start of IBI (Time 1) and After About One Year or More in IBI (Time 2)

	Time 1		Time 2				
	M (SD)		M (SD)		F	p	η^2_p
FSIQ (*n* = 61)	43.12	(21.23)	44.92	(22.52)	1.13	.29	.02
MA (*n* = 61)	37.56	(18.35)	46.62	(21.16)	3.92	.05	.06
Cognitive Rate (*n* = 61)	0.43	(0.21)	0.57	(0.65)	2.52	.12	.04
ABC SS (*n* = 56)	54.04	(11.91)	59.77	(12.62)	0.27	.60	.01
ABC AE (*n* = 55)	28.30	(12.41)	39.13	(17.10)	2.33	.13	.04
Adaptive Rate (*n* = 49)	0.34	(0.14)	0.62	(0.68)	6.07	.02	.11

* *Subgroup A = Vineland Adaptive Behaviour Composite Score of 60 and above*

Mental age. The same analysis was performed for MA and it showed a modest but significant improvement between Time 1 and Time 2 scores (Table 2). It is important to understand that MA scores, though often useful clinically, are far less psychometrically sound than standard scores and their meaning may not be the same across different ages (Sattler, 2008). Clinically significant gains in MA were defined as a change of one standard deviation (SD) at Time 1 (18 months). Consistent with IQ results, the majority of children (82%) did not show clinically significant changes in MA. Eleven (18%) children made clinically significant gains, with one of those children displaying gains of over two SDs. None of the children displayed a clinically significant loss. Note that these scores are not corrected for duration between assessments, but the correlation between MA change and the duration between assessments was not significant ($r = .32$, $p = .16$).

Cognitive rate of development. There were no statistically significant gains in the children's cognitive developmental rate. As seen from the SDs in Table 2, there was considerably greater variability in rates of development during IBI *versus* prior to IBI. Clinically significant gains in cognitive rates of development were based on at least a 1 SD gain (.21). Using this criterion, 24 children (39%) made clinically significant gains in their cognitive rate, while 14 children (23%) had clinically significant losses. The remaining 23 children (38%) did not show clinically significant changes.

Adaptive Behaviour

ABC standard scores. As seen in Table 2, Vineland ABC Scores did not increase statistically significantly from Time 1 to Time 2. The vast majority of children (86%) had standard scores which were within one SD of their Time 1 score. Clinically significant gains in ABC scores were seen in eight (14%) children, with one making very substantial gains (of 2 SDs) and none had clinically significant decreases.

Adaptive age equivalent scores. The Vineland Adaptive AEs did not increase statistically significantly from Time 1 to Time 2. Clinically significant gains in adaptive behaviour AE scores were based on a change of at least one standard deviation at Time 1 (12 months). A change of this magnitude was seen in 23 (42%) children, of whom 8 (15%) increased by two standard deviations and 2 (4%) increased by three standard deviations. Two children (4%) had clinically significantly lower scores. The remaining 30 children's scores (54%) did not change to a clinically meaningful degree. Note that the limitations of age equivalents noted above apply to these scores as well and these comparisons are not corrected for duration. However, again the correlation between the change in AE scores and the duration between the two assessments was not significant ($r = .20$, $p = .37$).

Adaptive rate of development. Children's adaptive rate of development showed a statistically significant increase, from .34 to .62, an almost doubled rate of development in adaptive skills. In addition, 27 children (55%) made clinically significant gains (at least one SD at Time 1 = .14) in their adaptive rate of development, while 11 children (22.5%) had clinically significant losses. The remaining 11 (22.5%) children did not show clinically significant changes. These rate variables, because of the way they are constructed, do take into account duration between the two time points, so these results indicate that children are gaining adaptive skills at a faster rate during IBI than they were prior to IBI. It should be noted that, although their rate of development in adaptive skills improved, it is still much lower than a typical rate of development.

Subgroup Analyses for Adaptive Skills

Even though there were few significant group changes, the clinical significance results and individual graphed data suggested that some children were showing different patterns of results, at least for adaptive skills. Therefore, we decided *post hoc*, to examine these patterns more closely by dividing the children into three groups, based on their initial Vineland ABC standard scores (as was done in Perry et al. [2008]) and looking at the specific adaptive domains separately. The subgroups were defined as follows: Group A was relatively "higher" functioning with an ABC score of 60 and above, and included 17 children (32%). The word "higher" should be thought of as a relative term; most of these children were still in the mild intellectual disability to borderline range (only 3 had scores over 85 on an IQ measure). Group B included 15 children (28%) who had an intermediate functioning level with ABC scores between 50 and 59. Group C was lower functioning, with ABC scores of 49 or lower, and included the remaining 21 children (40%).

We conducted a Repeated Measures Multivariate Analysis of Covariance (MANCOVA), with the four Vineland standard scores (Communication, Daily Living, Socialization, and ABC) with duration covaried, in order to determine whether any of the three subgroups of children made significant changes from Time 1 to Time 2. Our results showed a significant Group × Time interaction ($F(8, 94) = 2.09$, $p < .05$, $\eta^2_p = .15$), suggesting that one or more subgroups are changing from Time 1 to Time 2 on one or more subscale of the Vineland, as well as a main effect of group, indicating some groups scored higher than others (not surprisingly, since that was how the groups were formed). There was no main effect for the repeated measures factor of Time (consistent with the earlier analyses) and no main effect for the within-factor of domain (Communication, Daily Living, and so on).

Next, we examined the Group × Time interaction results more closely. The univariate tests for the subgroups for each of the four domain scores were all nonsignificant, in spite of the significant multivariate interaction, as shown in Table 3. However, examination of the mean scores in Table 3 (and visual inspection of these data in graphic form) suggested an interesting pattern which we report partly because of the discrepancy with the original Perry et al. (2008) study with younger children, even though we reiterate, these differences were not statistically significant. The pattern was, for Communication and Daily Living domains (but not Socialization), that all three groups seemed to improve with medium effect sizes for Group A and B and larger effect size for Group C. It is important to understand that, although Group C children gained more points on average, they started out much lower than Groups A and B and their Time 2 scores are still lower than the starting scores for Group B (see Blacklock, Perry, & Dunn Geier (2011) for more details).

Correlates of Outcome

In order to address our third research question related to which children have better outcomes, we ran a set of correlations between three Time 1 predictors (IQ, ABC, age at entry) and the six Time 2 cognitive and adaptive outcomes. As shown in Table 4, there were strong linear relationships between Full Scale IQ at Time 1 and all the Time 2 outcome variables. Time 1 Vineland ABC SS was also correlated with all outcome variables. Thus, initial developmental level, both cognitive and adaptive, was strongly associated with children's outcomes.

The correlations for age at entry with Time 2 outcomes, however, showed weak linear relationships. Examination of scatterplots indicated that there tends to be a curvilinear relationship

*Table 3. Comparison of Vineland Adaptive Standard Scores at Time 1 and Time 2 in Subgroups**

	Time 1 M (SD)		Time 2 M (SD)		F	p	η^2_p
Communication (n = 53)	52.64	(12.74)	59.98	(13.41)			
Group A (n = 17)	64.82	(10.68)	69.24	(13.50)	}		
Group B (n = 15)	53.20	(7.95)	60.93	(9.16)	} 0.86	.43	.30
Group C (n = 21)	42.38	(7.05)	51.81	(10.93)	}		
Daily Living Skills (n = 53)	53.57	(16.21)	61.11	(18.28)			
Group A (n = 17)	67.82	(14.45)	71.53	(17.31)	}		
Group B (n = 15)	57.20	(6.56)	63.27	(11.11)	} 1.60	.21	.06
Group C (n = 21)	39.43	(9.66)	51.14	(18.51)	}		
Socialization (n = 53)	55.09	(11.36)	59.21	(13.86)			
Group A (n = 17)	65.00	(11.91)	70.24	(11.65)	}		
Group B (n = 15)	55.00	(3.91)	58.60	(11.09)	} 0.20	.82	.01
Group C (n = 21)	47.14	(7.83)	50.71	(11.19)	}		
ABC (mean of 3) (n = 53)	53.77	(12.17)	59.76	(12.90)			
Group A (n = 17)	65.88	(11.13)	68.47	(12.77)	}		
Group B (n = 15)	55.13	(3.01)	60.65	(8.51)	} 1.76	.18	.07
Group C (n = 21)	42.98	(5.63)	52.06	(11.13)	}		

** Subgroup B = Vineland Adaptive Behaviour Composite Score between 50 and 59*
Subgroup C = Vineland Adaptive Behaviour Composite Score of 49 or lower

Table 4. Correlations of Outcome Variables After About One Year or More in IBI with Predictors at Intake

	Predictors at T1		
Outcome Variables at T2	FSIQ T1	VABS T1 ABC SS	Age T1
Cognitive Outcomes			
FSIQ at Time 2	.65** (n = 63)	.91** (n = 61)	–.14 (n = 64)
MA at Time 2	.64** (n = 63)	.84** (n = 61)	.25* (n = 64)
Cognitive rate of development during IBI	.49** (n = 61)	.32* (n = 61)	–.12 (n = 61)
Adaptive Outcomes			
VABS ABC Standard Score at Time 2	.66** (n = 49)	.75** (n = 45)	–.26 (n = 50)
VABS Age Equivalent at Time 2	.70** (n = 64)	.75** (n = 60)	.24 (n = 65)
Adapt. rate of development during IBI	.31* (n = 49)	.71** (n = 46)	.18 (n = 49)

* $p < .05$ ** $p < .01$

between the child's age at entry and the outcome variables (Blacklock et al., 2011). For both cognitive and adaptive outcomes, these indicate that relatively younger children within the sample (age 6 or 7 at entry) have more variable outcomes, with some scores being quite high and others very low. However, scores of older children (over about 8) tend to be less variable and are uniformly low. Scatterplots of these relationships are presented in another paper (Perry, Blacklock, & Dunn Geier, 2013), based on a sample which includes the children from the current study.

Discussion

In this paper, we have described the outcomes of children who entered the Ontario IBI Program at the age of 6 years and older. Results indicated that the children, as a group, did not show statistically significant gains in IQ, cognitive rate of development, adaptive behaviour standard scores or age equivalent scores during the time they were involved in the IBI program. Only their mental age scores and adaptive rate of development increased significantly. It is important to remember that both of these are based on age equivalent scores, which present several inherent limitations, as previously mentioned (Sattler, 2008). The result regarding a significant increase in mental age scores indicates that these older children are gaining some cognitive skills relative to their own starting point, however most remain far below their peers cognitively. In addition, when the mental age score change was examined in a manner that controlled for duration, using the cognitive rate of development scores, there was no significant increase, indicating that although these children are learning, they are doing so at the same rate as they were prior to IBI.

Although group changes were generally not statistically significant and the majority of children did not show clinically significant gains, it is noted that some individual children did show clinically significant gains in their cognitive and adaptive functioning, i.e., learned new skills. On the other hand, a few children also displayed clinically significant losses on these measures. Clinically significant gains were more common and of greater magnitude on the adaptive behaviour scores rather than the cognitive scores.

There were strong correlations of initial cognitive and adaptive scores, but not initial age, with all the Time 2 outcome variables. Thus, children who have higher levels of cognitive and adaptive development at Time 1 scored better at Time 2. Exploring the relationship of age to outcome more closely, we saw a curvilinear relationship between the child's age and the outcome variables, such that relatively younger children (age 6–7) had highly variable outcomes but children over 8 showed consistently poor outcomes.

Comparing these results with the Ontario study in the younger sample, we see that both the magnitude and pattern of gains is quite different. In the younger sample, children made statistically significant improvements on most variables and made bigger gains on cognitive versus adaptive scores (Perry et al., 2008). However, in the present sample, pre-post changes were not significant overall and the gains that were seen were in adaptive behaviour and mental age, not cognitive standard scores. Consistent with Perry et al. (2008), we grouped children into subgroups A, B, and C, based on the Vineland ABC standard score and the mean scores at Time 1 were very similar in the two samples. However, the pattern of results at Time 2 for the three subgroups was noticeably different in the two studies. In the younger sample, group A showed the greatest change, group B minimal improvement, and group C slight declines. In contrast, the older sample did not show this pattern. Rather, for the Communication and Daily Living Skills domains, it was Group C that displayed the most improvement although, as noted earlier, their outcome scores were still lower than the other groups' starting scores. For this reason, and because this subgroup analysis has less statistical power, the importance of this finding should not be exaggerated.

The results regarding stronger adaptive behaviour gains than cognitive gains seem contradictory to the goals of IBI. There may be several reasons for this pattern of results. The focus of the curriculum for the lower functioning, older children may be on the functional communication and self-help skills that the

Vineland measures, which may be very clinically appropriate for such children, but is not the typical goal or focus in IBI. Another reason may be that these adaptive gains are based on the Vineland, which is a parent-report measure. Parents' perceptions of progress are not necessarily the same as changes measured by standardized tests (Blacklock, Weiss, Perry, & Freeman, 2012), although both may be considered valid in different ways. Parent report may be more sensitive to everyday skills which are clinically meaningful to them and their children, but also may be subject to greater expectancy effects. Furthermore, there is the distinct possibility that we may simply be observing regression to the mean, since group C started off with a lower level of skills than groups A and B and their scores would be more likely to improve on their Time 2 assessment. However, in the younger sample (Perry et al., 2008), group C started off with similar scores to the present group C and their scores declined.

This study had several limitations and shortcomings, similar to those delineated in Perry et al. (2008). One major limitation is the inconsistency of the data collected. The data were collected from many different sites, which often had different practices. Since this was a retrospective file-review study, we had no control or influence over the measures used to assess the children and the times at which children were assessed. Moreover, there were no measures of language or problem behaviour available to us.

In addition, the measures used have several limitations. As previously mentioned, the Vineland is a parent-report measure and may therefore include parents' biases; in addition, it has a large standard error. In some cases, children's IQ was based on ratio IQ, versus standardized IQ scores, since a standardized score was not available for such a low performance. Different measures were sometimes used at the different time points, i.e., one IQ test at Time 1 but another, more appropriate for the child's level, at Time 2. In addition, the age equivalent scores from the Vineland and cognitive measures, although clinically meaningful, have psychometric limitations as noted earlier. They are only ordinal measures, are not corrected for age, and may not mean the same thing at different ages. We made certain assumptions in calculating developmental rates by comparing any two available scores. Also, there was great variability in the duration between the children's Time 1 and Time 2 assessments, although this was controlled for statistically.

Another major limitation of this study is that there was no control group against which to compare the results of the children, i.e., a group of children who received no IBI or a different treatment. Due to this shortcoming, any changes seen cannot be conclusively attributed to the effects of IBI versus other services, parents' expectations, maturation, or any other unknown factors. Further, we had no knowledge of whether children received any other intervention prior to or during IBI, e.g., special education, speech therapy, social skills groups, and so on. Furthermore, the current study did not have a measure of treatment quantity (although, most children should have been receiving 20 hours or more of treatment per week since that is the program's mandate), nor of treatment fidelity or quality. Similarly to the Perry et al. (2008) study, those performing both the intake and exit assessments were not blind to the children's participation in IBI, and were not independent of the organization providing the IBI.

The present study also has certain strengths, considering it is virtually the only study examining the community effectiveness of IBI specifically in older children and we had a larger sample size of older children than in most published IBI treatment studies. We investigated both statistical significance of group changes and the clinical significance of individual changes, as well as looking at subgroups of children in an effort to fully understand the pattern of results for these older children.

This study clearly has important clinical and policy implications. This group of older children, as a whole, did not show the same magnitude of progress as younger children typically show in IBI. Even within the age range studied, better outcomes were seen in the relatively younger children (aged 6–7) at intake, whereas children over 8, unfortunately, showed uniformly poor outcomes. This brings into question the appropriateness of these children for the IBI program. Furthermore, it is important to note that the gains that were made by individual children tended to be in adaptive behaviour more than in cognitive level, the opposite of what is typically reported in younger children receiving IBI in the literature (e.g., Smith et al., 2000) and in the Ontario IBI program (Perry et al., 2008). It appears, from our results, that older children may be receiving treatment that is more focused on adaptive skills. While this is likely clinically appropriate, an important question which needs to be addressed is whether such a focus actually falls under the mandate of IBI or whether the children would benefit from a different ABA-based program focusing specifically on these skills. For example, these skills could be taught effectively within school classrooms following ABA-based procedures or via the new MCYS-funded ABA services initiative.

The findings showing some individual children did make clinically significant gains on some measure imply that children's progress should be evaluated individually since children who may benefit could conceivably be missed by simply considering group data. Having predetermined standards of expected progress at regular time intervals as recommended by Szatmari et al. (2006) and as delineated by Freeman et al. (2008) would provide a method of determining continuation in the program or, alternatively, transition to other services, which may be more appropriate and effective. Blacklock and Perry (2010) described six case studies illustrating how this might work.

Similar to many other studies, we found that children's Time 1 cognitive and adaptive level were strongly related to their outcomes at Time 2 (though this may be the case regardless of IBI). The implication of this finding is that, perhaps, eligibility decisions should take into consideration children's IQ or their mental age, as well as their chronological age. Children with very low cognitive levels within this age range, unfortunately, did not appear to respond to IBI in the present study.

We believe this study is very important to the Ontario ABA and IBI community, as well as more widely, because it is the first study examining community-based effectiveness of IBI specifically in an older sample. Although this is not the group of children the program was intended for, currently a large proportion of children receiving IBI in the province of Ontario are over the age of 6. This research provides information about the appropriateness of IBI for these children. The current study also has significant clinical and policy implications for appropriate service selection for older children with autism. Future research should address these questions by addressing the limitations present in our study (e.g., with a prospective, controlled design). It is extremely important that we examine whether or not IBI is an appropriate intervention for children over the age of 6, in order to maximize the use of the available resources and to provide individuals with autism, of all ages, with the most suitable intervention.

Key Messages From This Article

People with disabilities: IBI does not work well for older children.

Professionals: This study of the Ontario IBI program emphasizes the importance of early intervention and highlights the need for clarification of the purpose of IBI and its intended target group.

Policymakers: This study suggests policy changes are in order for the Ontario IBI program, in particular for older children who may not benefit much from the program.

Acknowledgements

The authors would like to thank all the Ontario regional programs and their directors, without whom this project would not have been possible. Thank you to Child Care Resources (Sudbury), Children's Hospital of Eastern Ontario (Ottawa), ErinoakKids (Mississauga), Hamilton Health Sciences (Hamilton), Hands: The family Help Network (North Bay), Kinark Child and Family Services (Markham), Pathways for Children and Youth (Kingston), Surrey Place Centre (Toronto), and Thames Valley Children's Centre (London) for allowing us to conduct this research.

This work was done as the first author's Master's Thesis. She would like to thank the co-authors for all their invaluable guidance and help with this project, and Odette Weiss for her help with collecting and entering this data. Financial support for the study came from a York University Faculty of Health Small Research Grant.

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