

Differential Responses to Early Behavioural Intervention in Young Children With Autism Spectrum Disorders as a Function of Features of Intellectual Disability

Abstract

Early behavioural intervention (EBI) treatments are recognized as the most effective interventions to date for young children with autism spectrum disorders (ASD) and have a significant impact on the two domains implicated in the diagnosis of intellectual disability (ID). This study examined the role of concomitant ID features on young children with ASD's outcomes in EBI. Participants were 88 children with ASD aged 51 months on average. Their intellectual quotient (IQ, WPPSI-III), adaptive behaviours (AB, ABAS-II), and the severity of their autism symptoms (CARS) were assessed before EBI and after 12 months of EBI. Among the 55 children who met the diagnostic criteria for ID, 15 displayed such improvements in IQ and AB that they no longer met these criteria after 12 months of EBI. These children also showed improvements on the CARS, whereas the remaining 40 children with ID only improved on the CARS. Children without ID features (n = 33) showed the greatest improvements in AB. Predictors of outcomes of EBI differed by ID status. Even at a relatively low intensity, interventions based on applied behavioural analysis may improve cognitive and adaptive functioning among young children with ASD. However, profiles that correspond to diagnoses of both ID and ASD may require further considerations in terms of intensity and duration in planning interventions.

Intellectual disability (ID) is one of the conditions most often associated with autism spectrum disorder (ASD), with reported comorbidity rates ranging between 25 and 70% (Autism Developmental Disabilities Monitoring Network [ADDM], 2007; Chakrabarti & Fombonne, 2005; Charman et al., 2011; Fombonne, 2003; Yeargin-Allsopp et al., 2003). Learning and behavioural change for young children with ASD who meet the criteria for ID may unfold differently over the course of early intensive behavioural intervention (EIBI) compared to children who do not meet these criteria (Eldevik, Eikeseth, Jahr, & Smith, 2006; Eldevik et al., 2010; Perry et al., 2011). Furthermore, higher pre-intervention intellectual quotients (IQ) and adaptive behaviour (AB) scores are associated with greater responsiveness to EIBI (Bibby, Eikeseth, Martin, Mudford, & Reeves, 2002; Eikeseth, Smith, Jahr, & Eldevik, 2002; Harris & Handleman, 2000). Therefore ID may affect how children with ASD respond to early intervention. Moreover, because these interventions impact intellectual and adaptive functioning, they may also exert an influence

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on the diagnosis of ID in these children. In spite of the importance of programs such as EIBI for children who present features of ASD and ID, relatively few studies have examined this population's progression as a result of interventions delivered under real-world conditions (but see Eldevik et al., 2006; Peters-Scheffer, Didden, Mulders, & Korzilius, 2010)

Two criteria recognized by the American Association of Intellectual and Developmental Disabilities (AAIDD, 2010) for an ID diagnosis are significant limitations in intellectual functioning and adaptive behaviour (AB), as determined by scores two standard deviations below average (± 70 ; taking into account the instruments' standard error of measurement) on standardized measures of intellectual quotient (IQ) and AB. Additionally, there should have been evidence of ID prior to the age of 18. Beyond these criteria, the AAIDD recommends that the observed limitations be interpreted in the context of the child's environment and other personal characteristics, and be accompanied by an analysis of his or her support needs. Recent studies report that EIBI yields positive effects on the adaptive and intellectual functioning of children with ASD (Ben-Itzhak & Zachor, 2007; Cohen, Amerine-Dickens, & Smith, 2006; Eikeseth et al., 2002; Eikeseth, Klintwall, Jahr, & Karlsson, 2012; Eldevik et al., 2010). Behavioural intervention among children with ID generally yields gains in multiple spheres of functioning such as communication, social skills, and autonomy, as well as in challenging behaviour (Buckhalt, Baird, & Reilly, 2004; Carter & Hughes, 2007). Preschoolers with both ASD and ID who receive behavioural intervention show improvements in terms of IQ and AB, but these gains may be contingent on the intensity or duration of the intervention (Eldevik et al., 2006; Smith, Eikeseth, Klevstrand, & Lovaas, 1997). Indeed, most of the studies showing sizeable benefits from EIBI are implemented at nearly optimal intensity, that is, at a rate of approximately 40 hours per week for at least 24 months (e.g., Cohen et al., 2006; Granpeesheh, Dixon, Tarbox, Kaplan, & Wilke, 2009; Matson & Smith, 2008). Similarly, studies have demonstrated gains arising from lower-intensity interventions among children with ASD and ID that were deployed over a longer period of time (e.g., 12.5 hours/week for approximately 20 months, Eldevik et al., 2006). Thus, this group of children

may not benefit under circumstances where available resources or other concerns preclude the provision of high-intensity protocols over extended periods. In order to fulfill their mandate to support to all families of children with ASD or ID within their territory with limited resources, publicly funded rehabilitation centres in Quebec must deviate from optimal EIBI implementation parameters. As an organizational compromise to best meet their clientele's needs, centres' service allocation decisions are based upon children's age and overall profile severity. Specifically, children who are older (i.e., will soon enroll in school) or present with more severe profiles will be prioritized for the centres' most intensive offering (the program investigated here), whereas younger children with less severe profiles, or whose parents have declined to receive more intensive services, will either be offered less intensive interventions or enrolled in a low-intensity parental coaching program. The presence of features of ID are not presently taken into account in the allocation of ASD services. This report therefore presents an in-depth look at a sample of children receiving a relatively low-intensity (between 16 and 20 hours per week), community-based early behavioural intervention (henceforth labelled EBI, in contrast to higher-intensity EIBI) program over a 12-month period. These children represented a subgroup of a larger and more diverse sample of children who were recruited upon requesting services at a Quebec rehabilitation centre (Rivard, Terroux, Mercier, & Parent-Boursier, 2015). While the prevalence of ID (36.8%) was documented in the larger sample at intake, the predictive role of co-occurring ID features on children's response to EBI had not been examined in the context of this longitudinal study. The present study therefore sought to contrast the outcomes of 12 months of EBI as a function of whether or not the participants met the criteria of ID according to AAIDD (2010) prior to EBI and to examine potential predictors of responsiveness to EBI.

Methods

The research protocol for the present study was approved by the research ethics board that oversees rehabilitation centres in Quebec. Because the methodology of the larger longitudinal study within which these data were

collected was detailed in Rivard, Terroux, & Mercier (2014), only the details pertinent to the present investigation are provided here.

Participants

The present study took place in Quebec, where public rehabilitation centres provide free services to children with ASD and their families. Of the cohort enrolled in the larger longitudinal study, only participants who had been selected to receive the most intensive service available: EBI with a target intensity of 20 hours per week, and for which data pertaining to intellectual functioning and adaptive behaviour were available at intake and after 12 months of EBI, were included in the present study. Participants were 88 children with ASD (65 male) aged between 33 and 63 months ($M = 50.6$, $SD = 4.9$) prior to beginning EBI. Within this group, 55 children met the criteria for ID at intake ($M = 50.0$, $SD = 5.3$) and 33 did not ($M = 51.2$, $SD = 4.3$) according to the AIDD (2010). It should be noted that in Quebec, the term global developmental delay, rather than ID, is used for children under the age of 7. Prior to intake, 47% (total hours received: $M = 69$) and 65% (total hours received: $M = 34$) of the children in the sample had received occupational therapy services and speech language therapy services, respectively. Additionally, 31% had participated in another form of therapy (e.g., Picture Exchange Communication System, hyperbaric oxygen therapy). To the extent that children's age, the proportion of children who had participated in each type of therapy, and the average number of hours of therapy received, did not vary as a function of whether children met the criteria for ID or not; these variables were not investigated further.

Intervention

The EBI intervention used in the present study adopted a 1:1 child-to-therapist ratio (Lovaas, 1981; Maurice, Green, & Luce, 1996). Intervention sessions took place in a designated room at the child's day care at a rate of approximately 4 hours per day. Each session primarily employed discrete trial teaching, that is, 2- to 5-minute periods in which a specific behaviour or concept was taught, followed by approximately 5 minutes of free play. These sessions also included incidental teaching periods. As applicable, some sessions took place in

a group setting, for instance by involving the child's peers in the teaching of social skills.

The therapists who worked with the participants had an undergraduate degree in special education and had received direct training on EBI through the rehabilitation centre that employed them. They met every 2 weeks with their supervisor, a professional who had a master's degree in psychoeducational studies with a specialization in ASD, to ensure that interventions were aligned with the child's individualized intervention plan. The supervisors were themselves supervised by a licensed psychologist, a PhD and PsyD holder, with a specialization in behavioural psychology with 20 years of experience in EBI supervision. Finally, participants' parents received 21 hours of training in applied behaviour analysis (ABA) and ASD as their child began receiving EBI, and were instructed on how to help their child generalize skills learned in EBI sessions. Parents were encouraged to inform the therapist of their child's progress and express priorities or concerns they had with the intervention as it unfolded.

Materials

Participants' intellectual functioning was measured using the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III; Wechsler, 2002). Preliminary analyses conducted on Verbal IQ, Performance IQ, and the General Language Composite score obtained from this measure mirrored those found for the full-scale IQ in both group- and individual-level analyses. In the interest of brevity, only analyses based on the full-scale IQ are reported here. Children's AB was assessed using the Parent/Primary Caregiver Form for ages 0–5 years of the Adaptive Behaviour Assessment System-II (ABAS-II; Harrison & Oakland, 2003). This tool targets adaptive skills within the Conceptual, Social, and Practical domains as recognized by the AAIDD (Schalock et al., 2010), and yields a General Adaptive Composite score. Autism symptom severity was rated by the child's therapist using the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Rochen Renner, 1988). One of the child's parents also completed the CARS; to the extent that preliminary analyses indicated that parent and therapist ratings were strongly correlated and yielded identical patterns of results, only therapist ratings are reported.

Procedures

After having provided informed consent, each family participated in an interview during the summer months (May through August) leading up to the beginning of their child's EBI program in September. A research assistant administered a sociodemographic questionnaire to the parents and another administered the WPPSI-III to the child in another room. Both assistants were trained and supervised by a graduate student and a psychologist. Therapists from the rehabilitation centre were trained to administer the ABAS-II as a semi-structured interview with parents at the beginning of the EBI program. Therapists completed the CARS after they had observed the child for seven observation sessions, each of which lasted 1 hour. The intellectual functioning (WPPSI-III), adaptive behaviour (ABAS-II), and severity of autism symptoms (CARS) assessments were repeated after 12 months of EBI.

Statistical Analyses

As per AAIDD guidelines, children whose IQ and AB scores were two or more standard deviations below (70) the population average were considered to meet the criteria for ID. The outcomes of children who met these criteria and those who did not at the onset of EBI were first examined and compared at the group level. Both groups' changes in IQ, AB, and autism symptom severity were computed and compared to each other by means of independent samples t-tests.

Children's score changes were also analyzed at the individual level. A Reliable Change Index (RCI) was therefore computed for IQ, AB, and autism symptom severity scores for each child according to the method devised by Jacobson and Truax (1991). This measure scales differences in scores at two points in time relative to standard error of measurement of the difference, and thus helps to determine whether the magnitude of a child's score changes exceed what could be attributed to measurement error. RCI was computed as follows:

$$RCI = \frac{x_2 - x_1}{SE_{diff}} \text{ where } SE_{diff} = \sqrt{2(SE)^2} \text{ and } SE = SD_1\sqrt{1-r}$$

The standard deviation of children's scores at intake were used as an estimate of the variability in test scores within the population of children with ASD of this age group who would be selected to receive this type of EBI program. To the extent that the reliability (r) measures typically used for these computations (test-retest reliability or internal consistency) could not be obtained on the present sample, these were estimated on the basis of internal consistency values reported in each instrument's manual (for the WPPSI-III and ABAS-II, specifically using data obtained from a sample of children with ASD). A RCI exceeding ± 1.96 on a given measure indicates that the child exhibited "reliable change," that is, a robust increase or decrease on a given score between two measurement periods. The proportions of children within each group that did or did not demonstrate reliable change was then compared by Chi square tests of independence.

As a measure of clinical significance of changes, the proportion of children who did not meet the criteria for ID at any point (Group 1), children who lost their ID status after 12 months (Group 2), and those who retained it (Group 3) were computed (for a discussion of this type of clinical cutoff-based approach to clinical significance, see Jacobson & Truax, 1991). McNemar's test was then used to determine whether the proportion of children who lost their ID status was statistically significant. A change in ID status does not necessarily imply a large change in either measure, as it is a function of a child's scores relative to the numerical thresholds used to determine ID status. Therefore, follow-up analyses examined whether changes in ID status indicated quantitatively different profiles of change over time. One-way analyses of variance (ANOVAs), followed by Tukey's HSD post hoc tests, compared T1-T0 difference scores for IQ, AB, and CARS between the three groups of children formed on the basis of clinically significant changes. Inasmuch as RCI provides standardized measure of (reliable) change, a global change score could be computed for each child by averaging together RCIs for IQ, AB, and CARS after reversing the sign for the CARS RCI (such that positive RCIs indicated improvement). This average RCI could then be used to

identify which scores (IQ, AB, CARS) at intake were most predictive of overall changes noted over the 12 months of EBI through correlational analyses followed by hierarchical regression analyses. However, visual inspection of these data suggested different relations between both IQ and AB on the one hand, and average RCI on the other, as a function of level of functioning (ID status) at intake. It was therefore deemed prudent to analyze potential predictors of EBI outcomes separately for children who did and did not meet the criteria for ID at intake.

Based on Cohen's recommendations (1988), effect sizes between $d = .02-.04$ and R^2 or $\eta^2 = .01-.05$ were considered small; between $d = .05-.07$ and R^2 or $\eta^2 = .06-.13$, moderate; and $d = .08$ and R^2 or $h^2 = .14$ or greater, large.

Results

Changes in Assessment Scores as a Function of ID status

Table 1 shows average full-scale IQ, AB, and CARS scores before and after 12 months of EBI. Before EBI, 62.5% (55) of participants met the criteria for ID. This group showed a 6-point increase in IQ, 2-point increase in AB, and 1.6 point decrease in CARS scores after 12 months. On average, children who did not meet the criteria for ID showed a 6.2-point increase, a 11.5-point increase, and a 2.6-point decrease on these same measures, respectively. The latter group showed significantly greater gains in AB, $t(86) = 4.798, p < .001, d = 1.06$; the two groups did not differ in terms of change in IQ or CARS scores, $t(86) = 0.09, p = .927, d = 0.02$ and $t(81) = -0.688, p = .389, d = -0.20$.

Table 1. Children's Test Scores Before and After 12 Months of EBI as a Function of Pre-treatment ID Status

	N	All children (N = 88)		Meeting ID criteria (N = 55)		Not meeting ID criteria (N = 33)	
		T0 M (SD)	T1 M (SD)	T0 M (SD)	T1 M (SD)	T0 M (SD)	T1 M (SD)
WPPSI-III							
Full-scale IQ	88	60.5 (16.8)	66.6 (19.9)	49.7 (6.9)	55.7 (15.0)	78.6 (12.4)	84.8 (12.2)
Verbal IQ	88	63.2 (12.9)	66.5 (14.5)	56.0 (5.3)	58.4 (8.8)	75.3 (12.9)	80.0 (11.9)
Performance IQ	88	70.8 (19.1)	77.5 (22.3)	59.3 (9.9)	66.8 (18.5)	90.1 (14.6)	95.5 (15.9)
General language composite	88	63.8 (17.7) ^a	69.8 (19.1)	53.4 (7.9)	60.6 (14.9)	80.4 (16.4)	85.1 (15.3)
ABAS-II							
Global adaptive composite	88	57.7 (11.8)	63.2 (17.1)	51.1 (6.7)	53.1 (10.5)	68.6 (10.2)	80.1 (11.6)
Conceptual	88	60.7 (12.2)	68.1 (17.1)	54.4 (7.6)	58.0 (11.2)	71.2 (11.2)	84.9 (10.8)
Social	88	63.0 (13.8)	68.5 (17.7)	55.6 (7.9)	58.5 (12.1)	75.3 (12.6)	85.1 (12.2)
Practical	88	58.9 (12.1)	61.6 (15.6)	52.5 (8.2)	52.8 (10.9)	69.7 (9.5)	76.2 (10.4)
CARS							
Total	83	34.6 (8.2)	32.7 (8.9)	38.2 (6.7)	36.6 (7.9)	28.0 (6.5)	25.4 (5.5)

Note. T0: At intake, before EBI; T1: after 12 months of EBI. WPPSI-III = Weschler Preschool and Primary Scale of Intelligence - III, ABAS-II = Adaptive Behavior Assessment System - II, CARS = Childhood Autism Rating Scale.

^a The general language composite for two children was below the scoring threshold at T0, therefore N = 86.

The proportions of children who demonstrated reliable score increases or decreases over time, or no change, as per RCI computations are shown in Table 2. In order to achieve a RCI of ± 1.96 , a child would need to demonstrate a 11.42-point change in IQ, a 3.21-point change in AB, or a 8.02-point change in autism symptom severity. A greater proportion of children who did not meet the criteria for ID at the beginning of the study showed reliable improvements in terms of AB than those who initially met the criteria for ID. However, the two groups did not differ in terms of the proportion of children demonstrating reliable changes in IQ or autism symptom severity scores (see Table 2).

Fifteen (27.27%) of the children who initially met ID criteria experienced such improvements in terms of IQ and AB that they no longer met ID criteria after 12 months of EBI. The decrease in the proportion of children who met ID criteria after 12 months of EBI was statistically significant, $\chi^2(1, 88) = 13.07, p < .001$. None of the children who did not meet ID criteria at intake did so after 12 months of EBI. Means for each group at T0 and T1 are displayed in Figures 1 through 3. All three groups differed in their changes in IQ, $F(2, 85) = 24.25, p < .001, \eta^2 = .36$. The children who lost their ID status showed

IQ gains over three times larger than those who did not meet the criteria for ID at any point in time, who in turn showed higher gains than those who retained the ID status. Changes in AB also varied across groups, $F(2, 85) = 16.41, p < .001, \eta^2 = .28$. Children who did not meet the criteria for ID and those who lost their ID status did not differ, but both showed greater gains than children who retained the ID status. The groups did not differ in terms of their improvements on the CARS, $F(2, 80) = 0.95, p = .391, \eta^2 = .02$.

Predictors of Outcomes of EBI

Figure 4 on page 12 depicts children's average RCI, where a positive index denotes improvement, as a function of intake scores. Both IQ and AB appeared to be non-linearly related to average RCI: specifically, a visual inspection of these graphs suggested that these relationships may differ as a function of ID status. In contrast, autism symptom severity appeared linearly related to average RCI.

Table 3 on page 12 presents correlations between RCI and children's characteristics at intake as a function of group membership. Among children who met the criteria for ID at

Table 2. Proportion of Children Showing Reliable Increase or Decrease, or no Change, Based on ID Status at Intake

		All children (N = 88)		Meeting the criteria for ID (N = 55)		Not meeting the criteria for ID (N = 33)		χ^2
		n	%	n	%	n	%	
IQ	Decrease	1	1.1%	0	0%	1	3.0%	$\chi^2(2, 88) = 0.66^a, p = .282$
	No change	59	67.0%	39	70.9%	20	60.6%	
	Increase	28	31.8%	16	29.1%	12	36.4%	
AB	Decrease	17	19.3%	14	25.5%	3	9.1%	$\chi^2(2, 88) = 21.57, p < .001$
	No change	27	30.7%	24	43.6%	3	9.1%	
	Increase	44	50.0%	17	30.9%	27	81.8%	
CARS	Decrease	9	10.8%	21	9.3%	4	13.8%	$\chi^2(2, 88) = 0.52^a, p = .662$
	No change	73	88.0%	24	88.9%	25	86.8%	
	Increase	1	1.2%	9	1.9%	0	0.3%	

Note. A RCI of ± 1.96 was used to identify reliable score increases or decreases. IQ = intellectual quotient, AB = adaptive behaviour; CARS = Childhood Autism Rating Scale (autism symptoms).^a Fisher's exact test.

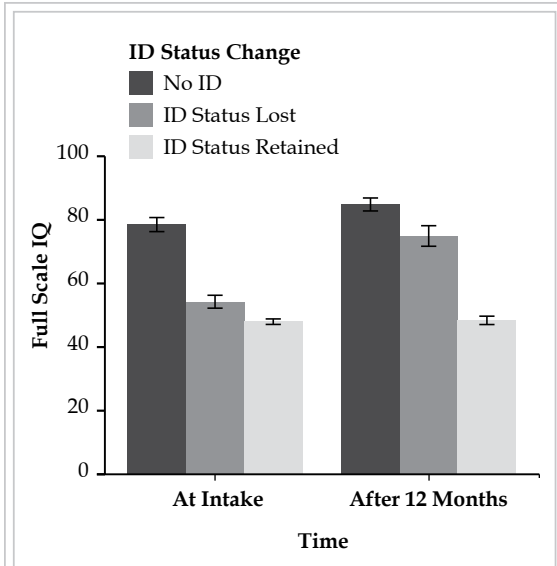


Figure 1. Mean full scale intellectual quotient (IQ) at intake and after 12 months of early behavioural intervention as a function of the evolution of the child's intellectual disability status over time. Error bars depict ± 1 standard error.

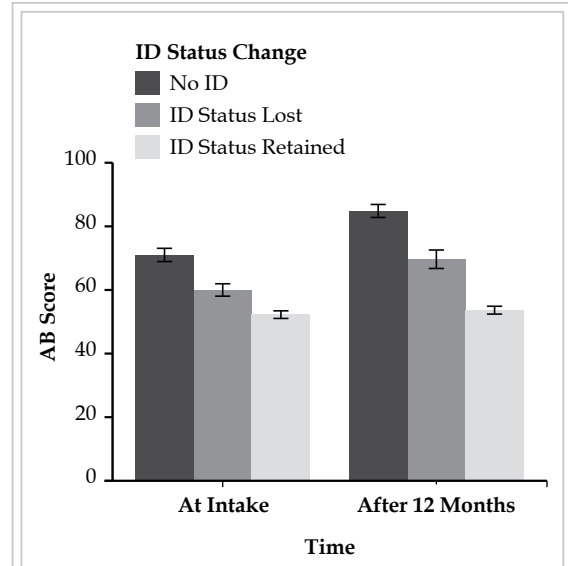


Figure 2. Mean adaptive behaviour (AB) score at intake and after 12 months of early behavioural intervention as a function of the evolution of the child's intellectual disability status over time. Error bars depict ± 1 standard error.

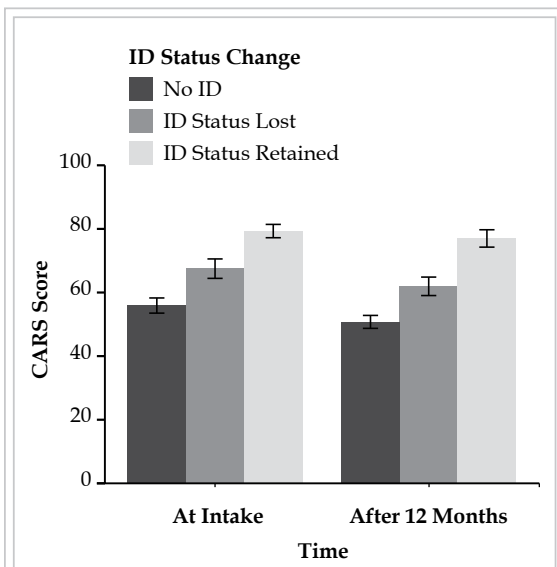


Figure 3. Mean score on the Childhood Autism Rating Scale (CARS), a measure of severity of autism symptoms, at intake and after 12 months of early behavioural intervention as a function of the evolution of the child's intellectual disability status over time. Error bars depict ± 1 standard error.

intake, IQ correlated positively with average RCI, whereas autism symptom severity scores showed a significant negative association with average RCI. Age and AB scores were uncorrelated with average RCI. Thus, a hierarchical linear regression was conducted with T0 IQ and autism symptom severity scores entered in successive steps. On its own, IQ explained 7% of the variance in RCIs. The addition of autism symptom severity scores significantly improved the model's prediction. When both variables were entered into the model, autism symptom severity scores, but not IQ, significantly contributed to the prediction. Among children who did not meet the criteria for ID, baseline IQ and AB scores were significantly and negatively correlated with average RCI, whereas age and autism symptom severity scores were not associated with RCI. IQ explained 14% of the variance in RCI. The addition of AB scores to the regression model significantly improved this prediction by 20%. Both variables significantly contributed to the predictive strength of the final model.

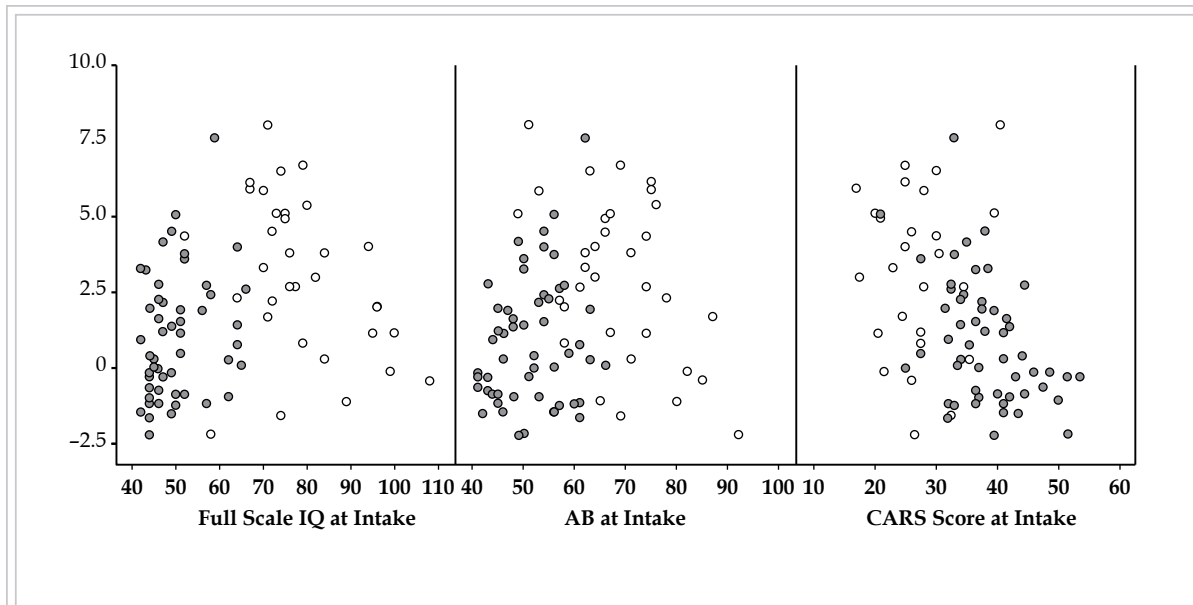


Figure 4. Reliable Change Index (RCI) across all measures as a function of intellectual quotient (IQ), adaptive behaviour (AB), and Childhood Autism Rating Scores (symptom severity; CARS) at intake. Dark dots represent the children who met the criteria for intellectual disability at intake; light dots represent those who did not.

Table 3. Bivariate Correlations and Hierarchical Regression Analyses Predicting Reliable Change Indices From Children's Characteristics at Intake

	Meeting ID criteria (N = 55)				Not meeting ID criteria (N = 33)			
	<i>r</i>	<i>p</i>			<i>r</i>	<i>p</i>		
Age	.09	.521			.24	.184		
IQ	.30	.025			-.38	.031		
AB	.24	.084			-.46	.006		
CARS	-.44	.001			.00	.987		
Predictor	ΔR^2	β	<i>F</i>	<i>p</i>	ΔR^2	β	<i>F</i>	<i>p</i>
Step 1	.07		3.77	.058	.14		5.13	.031
IQ		.26		.058		-.38		.031
Step 2 ^a	.21		9.42	.003	.20		9.25	.005
(IQ)		.14		.292		-.36		.022
CARS		-.40		.003				
AB						-.45		.005

Note. IQ = intellectual quotient, AB = adaptive behaviour; CARS = Childhood Autism Rating Scale (autism symptoms).^a The predictor entered in the second step differed by group (CARS scores for those meeting the criteria for ID, AB for those who did not).

Discussion

This study focused on the evolution of the clinical profiles of 88 children with ASD who participated in an EBI program consisting of approximately 20 hours per week of intervention services provided by a public rehabilitation centre. At the beginning of the intervention, 55 children (62.5%) met the diagnostic criteria for ID. When assessed with the same two standardized measures after 12 months of services, 15 of them had made such improvements that they no longer met the criteria for ID. A closer inspection indicated large IQ gains and modest but significant AB gains in this group, similar to Eldevik et al.'s (2006) observations among children with ASD and ID who had participated in 12.5 hours per week of EBI on average. These results suggest that EBI, even when offered in community settings and with relatively low intensity, can yield positive results among children with a dual diagnosis of ID and ASD. It should nevertheless be noted that although children who met ID criteria prior to intervention improved significantly as a whole, 70% of those 55 children still met these criteria after 12 months of EBI. This subgroup showed no statistically significant changes in either IQ or AB. All children, regardless of ID status, showed comparable improvements in autism symptom severity, however.

The fact that a number of children meeting the criteria for ID made statistically (i.e., in terms of absolute scores on standardized tests) and/or clinically significant (i.e., relative to diagnostic criteria) gains is encouraging inasmuch as previous studies found that early deficits in children diagnosed with global developmental delay tend to persist into the school years, at which point a diagnosis of intellectual disability is made (e.g., Shevell, Majnemer, Platt, Webster, & Birnbaum, 2005). Relatedly, the developmental gap in terms of IQ and AB between children with ASD and their typically developing peers tends to persist or worsen among those on a waiting list for services (Authors, 2015) or receiving control interventions (Klintwall, Eldevik, & Eikeseth, 2015; see also Eldevik et al., 2010). Furthermore, among those receiving EBI, IQ and AB at intake were both related to intervention outcomes (Eldevik et al., 2010). In contrast, results from the present study suggest that an early diagnosis of global

developmental delay (or indicators of ID present at an early age) may be somewhat fluid if children meeting the diagnostic criteria for ID gain access to behavioural intervention services during the critical preschool years. These data may be relevant to service providers who must determine whether children with ASD and indicators of ID are likely to benefit from interventions, and to parents for whom a label of global developmental delay could be a cause for concern for the child's prognosis.

Among children's intake assessment scores, previous research had identified IQ as a strong predictor of gains in EBI, and reported positive associations between IQ or AB and intervention outcomes (e.g., Ben-Itzhak & Zachor, 2007; Harris & Handleman, 2000; Magiati, Charman, & Howlin, 2007; Magiati, Moss, Charman, & Howlin, 2011; Perry et al., 2011). Here, the measures collected at intake showed different and somewhat non-linear patterns of association with 12-month outcomes as a function of whether children met the criteria for ID. For those who did not, IQ and AB were negatively correlated with overall gains. The philosophy of EBI should be to prioritize areas where the child presents the most difficulty (Rivard & Forget, 2012; Rivard et al., 2016; Smith, 2010, 2011). The closer a child's IQ and AB to average levels, the more emphasis would be placed on other aspects of the child's development and social functioning. Gains on these dimensions might then not be captured by the measures used here. In contrast, among children who met the criteria for ID, IQ was weakly but positively linked with overall improvement. Importantly, CARS scores more strongly and negatively predicted outcomes for this group. Thus children with more severe profiles did not improve as much, perhaps because they required a more intensive intervention. Alternatively, interventions for these children may have prioritized more salient and urgent difficulties, such as the presence of challenging behaviours. Thus, the strength and direction of associations between pre-intervention measures and children's outcomes reported in the literature may be a function of the variability in levels of functioning represented in a given sample.

One limitation of this study is its lack of inclusion of a control or comparison group. However, the outcomes observed here for EBI

were previously contrasted with those of a minimally intensive (1 hour/week of therapist support) parental coaching program offered by the same rehabilitation centre (Rivard et al., 2014). Furthermore, the principal goal of the present study was to compare children with different ID statuses who received the same type of treatment. On this note, while all children received EBI at a comparable intensity and under similar conditions, it is possible that some of the differential outcomes noted in the present study could be attributable to other therapies (e.g., occupational therapy, speech therapy) that some families may have elected to pursue in parallel with EBI offered by the rehabilitation centre. While pre-EBI enrolment in these other therapies did not vary as a function of group, data pertaining to these supplemental interventions were not collected during or after EBI. Another important limitation is that children were assessed by individuals who were aware of the intervention, such that expectancy effects cannot be ruled out. Nevertheless, the improvements observed here are generally consistent with those reported in the EBI literature (Eikeseth et al., 2002, 2012; Eldevik et al., 2006; Remington et al., 2007). Additionally, neither parents, therapists, nor research assistants were aware of the specific goals of this study, which was embedded in a more extensive longitudinal investigation during which various other measures were administered.

It should also be noted that the constraints and resource limitations under which Quebec rehabilitation centres typically operate limited the extent to which our study could demonstrate the potential effectiveness of EBI, particularly for children with ID or more severe clinical profiles generally. Indeed, because of the extensive waiting lists for EBI, most of the participants were older than recommended for optimal outcomes (Makrygianni & Reed, 2010; Reichow, Barton, Boyd, & Hume, 2012; Virués-Ortega, 2010) and were only able to receive 12 months of EBI before beginning school, at which point EBI services are discontinued (c.f. 20 months of lower intensity EBI in Eldevik et al., 2006). It is possible that if these children had been offered EBI sooner, or for an extended duration, they would have shown gains comparable to their peers. This would be the case if, as we speculate, challenging behaviours and other barriers to learning in these types of inter-

ventions had to be addressed first. Measures of challenging behaviour, or records of each child's intervention plan, could not be collected to verify this point. Relatedly, it is possible that more varied or sensitive measures of children's outcomes could have identified some benefits in of EBI in other areas among children who did not show appreciable gains in terms of IQ, AB, or symptom severity.

This study furthers our understanding of the effects of EBI on young children with ASD and ID. After 12 months of intervention, several children had made statistically significant improvements in terms of intellectual and adaptive functioning, two spheres of development associated with ID. These results support the idea that even relatively low-intensity behavioural interventions offered as universally available public services could benefit children with ASD, including those who present with ID. These improvements may, in turn, lead to increased autonomy and an improved quality of life for these children and their families. However, the fact that children with ID had lower AB gains as a whole and showed heterogeneous change over time profiles, as well as the suggestion that different measures best predict outcomes for children with and without concomitant ID, confirms the importance of taking this dual diagnosis into account when devising intervention plans in early childhood. This information may be especially pertinent in a context where resources are limited and the goal is to provide beneficial (if not optimal) assistance to a very large number of individuals, such that it is necessary to match service intensity to intake profiles and anticipated needs. Indeed, children who present features of ID along with ASD may derive greater benefits, or benefit in larger numbers, from EBI services offered more intensively (i.e., up to 30–40 hours per week) and over longer periods (i.e. for more than 12 months) than what is currently provided.

Key Messages From This Article

People with disabilities. You deserve services that are suited to your specific strengths and needs. We are trying to understand why some children with ASD do not get the same benefits from early intervention as others do so that we can provide better services for everyone.

Professionals. Some children with ASD who also show features of ID, especially those with more severe symptoms, may not benefit as much from established early intervention services.

Policymakers. Additional resources may be needed to help children with ASD who also show features of ID, or present with more severe symptoms, to benefit optimally from early intervention.

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