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The relative importance of age and IQ as predictors of outcomes in Intensive Behavioral Intervention

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ABSTRACT

Outcomes of Intensive Behavioral Intervention are known to be highly variable. We report on two studies examining the role of age at entry to treatment and initial IQ in relationship to cognitive and adaptive outcomes in the Ontario province-wide program. Study 1 included 207 children aged 2–14 at entry. Age was modestly negatively correlated with several outcome variables; IQ was strongly predictive of most cognitive and adaptive outcomes. Age accounted for additional variance, beyond that accounted for by IQ, for cognitive outcomes, especially change in IQ. Children who made very large gains were all under age 6 at entry. Children who were over 8 years of age and/or had very low IQ showed uniformly poor outcomes. Study 2 was a comparison of IQ-matched younger (2–5 years) versus older (6–13 years) children ($n = 60$ each). The two groups of children, who were on the same initial trajectory, showed different outcomes. Only the younger group showed substantial cognitive gains. Results strongly argue for the importance of early intervention.

1. Introduction

A recent summary of meta-analyses of the efficacy of Early Intensive Behavioral Intervention (EIBI), also called Intensive Behavioral Intervention (IBI), for young children with autism states that, "the current evidence on the effectiveness of EIBI meets the threshold and criteria for the highest levels of evidence-based treatments... EIBI is the comprehensive treatment model for individuals with ASDs with the greatest amount of empirical support..." (Reichow, 2012, p. 518).

Most of the efficacy studies on IBI in the literature are small (10–30 children) and the children are often selected in some way, typically by age (usually younger than 4 years) and often by cognitive level (children with very low IQ and/or comorbid genetic/medical syndromes are excluded). The large gains documented have most often been on measures of global developmental level, with group data showing mean IQ gains of about 20 points. These major changes in developmental trajectory are considered the objective of IBI, so that children may potentially catch up to their peers and function normally (Lovaas, 1987). Gains in everyday adaptive skills have also been reported but have generally been smaller and less consistent, on the order of 10 points, with bigger gains in communication and social domains and minimal gains in daily living skills (e.g., Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Sallows & Graupner, 2005; Smith, Groen, & Wynn, 2000). However, it is important to note that outcomes in IBI are conspicuously variable in all studies. More research is needed to understand which children benefit, what treatment characteristics are important and, especially, how these apply in the context of the transfer to community effectiveness research rather than in the small model programs which have demonstrated IBI's efficacy (Reichow, 2012).

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1.1. Initial age and IQ as predictors of outcome

Two potentially important child characteristics which have received considerable attention in the literature are the children's chronological age and their cognitive level or IQ when they begin IBI. It can easily be argued *a priori* from several theoretical viewpoints why an early start might be important. A neurological perspective would suggest possible critical periods while there is still sufficient experience-dependent synaptic plasticity (Chugani, 2005). According to developmental theory, intervening early, before a child has fallen too far behind peers, would seem to be advantageous. Behavioral theory would also argue for developing adaptive repertoires of skills early to prevent, and not have to unlearn, repertoires which are less desirable. Furthermore, it makes intuitive sense to many parents and professionals that earlier is better. Perhaps surprisingly, several studies have reported that the age at which intervention started was not correlated with children's outcomes (e.g., Hayward, Eikeseth, Gale, & Morgan, 2009; Lovaas, 1987; Sallows & Graupner, 2005). However, these studies only included very young children (2 years to 4 or 5 years in most studies). Eikeseth, Smith, Jahr, and Eldevik (2002, 2007) examined a group of children who were somewhat older (aged 4–7 years at intake) and also found age was uncorrelated with outcomes. It should be noted that restriction of range and small samples are likely to make correlation coefficients an insensitive measure in these studies. Another approach to examining the age question, which is to compare outcomes in younger versus older children within a sample, has been used in several studies. These studies typically do suggest that younger children have better outcomes than older children (Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris & Handleman, 2000; Perry et al., 2008) and the same is true of Anderson, Avery, DiPietro, Edwards, and Christian (1987) based on the individual data in the paper. However, these studies all define good outcomes differently, and they use different definitions of older and younger. In summary, the evidence regarding early age being important is not very conclusive and it would be helpful to examine this question in a larger sample, which would provide more statistical power, and within a broader age range.

Initial IQ has long been known to be associated with the prognosis of individuals with autism (Howlin, 2005; Levy & Perry, 2011). In the IBI literature, IQ has frequently been reported to be highly correlated with outcomes (e.g., Harris & Handleman, 2000; Lovaas, 1987; Sallows & Graupner, 2005) although not unanimously (Cohen, Amerine-Dickens, & Smith, 2006; Smith et al., 2000). However, it is important to recognize that this is likely the case regardless of treatment, as exemplified by results reported by Gabriels, Hill, Pierce, Rogers, and Wehner (2001) for generic treatment and the Eikeseth et al. (2002) eclectic comparison group. Thus, simple correlations of IQ at two time points are likely to be high regardless of what occurs between the two measurements. The importance of initial IQ as a predictor can only be tested by statistical procedures which control for the initial levels and/or examine magnitude of gains using IQ-point change or effect size metrics.

Several meta-analyses have now been conducted on the body of studies of IBI efficacy (see Reichow, 2012 for a summary and critical review). Of these various meta-analyses, three of them have examined predictors or moderators of outcome, including age and IQ (Makrygianni & Reed, 2010; Reichow & Wolery, 2009; Virues-Ortega, 2010). These meta-analyses included a different selection of studies and used different statistical methods but typically reported that treatment quantity (intensity, duration) and sometimes treatment model (supervisory model, inclusion of parents) had an impact on the magnitude of gains seen or effect size (ES), either pre–post difference and/or comparison of treatment to controls post-treatment. Initial age and IQ were examined in all three of these meta-analyses and were not found to be important moderators of treatment efficacy overall. However, it is important to remember the sample characteristics of the studies yielding these conclusions, as the mean IQ in most studies was in the 50s to 60s and the mean age was usually less than 4 years. If there are effects of age and IQ, they are more likely to be demonstrable in a more heterogeneous sample, where these effects could be examined individually and in combination.

1.2. The Ontario IBI program

The province of Ontario, Canada has had a publicly funded, province-wide IBI program since the year 2000. The program description, staffing model, and so on have been described in detail in earlier publications (e.g., Perry, 2002; Perry et al., 2008). The Ontario program has been the subject of a number of research studies, including several published in this journal. These studies of community effectiveness began with a retrospective, file-review study of pre–post changes in autism severity, cognitive, and adaptive functioning in 332 children who were aged 2–6 at program entry. This group of children was very heterogeneous on all developmental measures since there were no exclusion criteria for the program based on IQ or the presence of comorbid diagnoses. Children showed a wide range of outcomes (Perry et al., 2008).

Predictors of outcome in this sample were examined by Perry et al. (2011) and included age at entry, IQ, adaptive skill level, and autism severity. Looking at the role of age more specifically, Time 2 outcomes were moderately negatively correlated with age at entry. In addition, regressions to determine the relative strength of various predictors suggested that age accounted for a significant but modest amount of variance (from 1% to 6% of the variance depending on the measure). However, two additional sets of analyses suggested a non-linear relationship of initial age to children's outcomes. Children who started before the age of 4 years scored higher on all outcome measures than children who were 4 or older at intake and the children who had the best outcomes were significantly and substantially younger at entry (42 months versus 53 months) than all other outcome groups (Perry et al., 2011).

Flanagan, Perry, and Freeman (2012) then conducted a waitlist-controlled study of 142 children and found that predictors of outcome were different in the waitlist versus the IBI group. While initial developmental level (based on the Vineland as