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# Cost comparison of early intensive behavioral intervention and treatment as usual for children with autism spectrum disorder in the Netherlands

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ABSTRACT

Early intensive behavioral intervention (EIBI) may result in improved cognitive, adaptive and social functioning and reductions in autism severity and behavioral problems in children with Autism Spectrum Disorder (ASD). For a subset of children, normal functioning may be the result. However, due to the intensity (20–40 h per week for 3 years with a low child staff ratio) implementation costs are high and can be controversial. Estimated costs for education, (supported) work and (sheltered) living for individuals with ASD in the Netherlands are applied in a cost-offset model. A compelling argument for the provision of EIBI is long term savings which are approximately € 1,103,067 from age 3 to 65 years per individual with ASD. Extending these costs to the whole Dutch ASD population, cost savings of € 109.2–€ 182 billion have been estimated, excluding costs associated with inflation.

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## 1. Introduction

Autism spectrum disorder (ASD) is one of the most common developmental disorders. The disorder is characterized by impairments in communication and social interaction, by repetitive behaviors and by limited areas of interest (American Psychiatric Association, 2000; Baron-Cohen et al., 2009). In 50–80% of the individuals with ASD an intellectual disability (ID) is also present (Goldberg Edelson, 2006). Although individuals with ASD present great variability in severity and clinical picture, their prognosis without treatment is generally poor. ASD is a chronic disability and due to the unique social and communicative difficulties the majority of individuals involved requires professional care throughout their lives (Billstedt, Gillberg, & Gillberg, 2005; Mordre et al., 2011). As more people are being diagnosed with ASD and require specialized services (Wing & Potter, 2002; Yeargin-Allsop et al., 2003), the costs of public health and social welfare programs are increasing. Järbrink and Knapp (2001) estimated the lifetime costs (including costs such as family expenses, medication and daycare) to care for an individual with ASD in Britain more than € 2.5 million, excluding the costs associated with typical child rearing.

Currently, early intervention based on applied behavior analysis (EIBI) is considered the treatment of choice for children with ASD (Eikeseth, 2009). Although EIBI programs vary slightly in their approach, all programs are characterized by the following essential features: (1) systematic use of behavior analytic principles, (2) treatment is comprehensive, (3)

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systematic development from simple to more complex skills with a transfer to natural settings, (4) functional assessment of individual behavior and individualization of goals and instructional procedures, (5) the use of scientific methods to evaluate the effects of treatment, (6) early age of treatment onset, (7) a low child staff ratio, and (8) involvement and training of parents and significant others. Usually, treatment is implemented intensively (i.e., 20–40 h per week) for a long period of time (i.e., two years or more; Eikeseth, 2009; Green, Brennan, & Fein, 2002; Leaf & McEachin, 1999; Lovaas, 2003), although less intensive EIBI has also shown positive outcomes (e.g., Eldevik, Eikeseth, Jahr, & Smith, 2006; Peters-Scheffer, Didden, Mulders, & Korzilius, 2010).

Four of the five meta-analyses included in an overview of Reichow (2011) concluded that EIBI is an effective intervention strategy for many children with ASD and results in increased cognitive, social and communication skills and reductions in challenging behavior. However, great variability in outcome within and between studies is seen, with some children making rapid and remarkable progress, while other children's gains are limited (Eikeseth, 2009; Peters-Scheffer, Didden, Korzilius, & Sturmey, 2011; Reichow & Wolery, 2009). These differences in outcome are influenced by child and family factors (e.g., age of treatment onset, co-morbid conditions and pre-treatment IQ, autism symptom severity and language) and treatment characteristics (e.g., treatment intensity, treatment duration, treatment quality, and intensity and quality of supervision; Allen & Warzak, 2000; Ben-Itzchak & Zachor, 2007; Davis, Smith, & Donahoe, 2002; Eikeseth, Hayward, Gale, Gitlesen, & Eldevik, 2009; Eldevik et al., 2006; Granpeesheh, Dixon, Tarbox, Kaplan, & Wilke, 2009; Lovaas, 1987; Peters-Scheffer et al., 2010; Smith, Eikeseth, Klevstrand, & Lovaas, 1997; Smith, Groen, & Wynn, 2000; Smith, Klevstrand, & Lovaas, 1995).

Due to treatment intensity and duration, EIBI is an expensive treatment (albeit highly effective), but only a few studies have been conducted regarding the financial costs and benefits of EIBI to children with ASD. Based on the outcome of the studies by Lovaas (1987) and McEachin, Smith, and Lovaas (1993), Jacobson, Mulick, and Green (1998) estimated the costs and benefits of EIBI for children with ASD in Pennsylvania. In their model, in which EIBI outcome ranged from regular education without support (47%) and less intensive special education (42%) to intensive special education (11%), cost savings ranged from $ 187,000 to $ 203,000 per child for ages 3–22 years and from $ 656,000 to $ 1,082,000 per child for ages 3–55 years. Authors concluded that the estimated savings outweigh the differences in initial treatment costs for EIBI. Translating outcome into a cost dichotomization (i.e., successfully or unsuccessfully mainstreamed in special education), Chasson, Harris, and Neely (2007) estimated that with a success rate of 72%, $ 208,500 per child would be saved by the state of Texas across 18 years of education with EIBI. Motiwala, Gupta, and Hon (2006) used more conservative efficacy rates and therefore estimated savings lower than Jacobson et al. (1998) and Chasson et al. (2007) between 34.479 and 53.720 Canadian Dollars per individual.

Cost-effectiveness studies by Jacobson et al. (1998) and Chasson et al. (2007) have estimated costs exclusively based on best outcome studies (i.e., Lovaas, 1987; McEachin et al., 1993; Sallows & Graupner, 2005) and although Motiwala et al. (2006) used more conservative efficacy rates, none of the studies included less favorable outcomes studies published after Lovaas (1987). In these studies children received fewer hours than recommended (e.g., Anderson, Avery, DiPietro, Edwards, & Christian, 1987), program supervision was infrequent or of less quality (e.g., Bibby, Eikeseth, Martin, Mudford, & Reeves, 2002) or children had a higher pretreatment chronological age (e.g., Eikeseth, Smith, Jahr, & Eldevik, 2002; 2007) or lower IQ (e.g., Smith et al., 1997) than in the Lovaas study (1987). It is unlikely that in community-based programs children obtain the same outcome as in the Lovaas study (Mudford, Martin, Eikeseth, & Bibby, 2001). Therefore, by including studies with less favorable outcome our study may provide a more realistic estimate of the outcome of community based EIBI and the potential costs and savings of EIBI in the Netherlands.

The present study was designed to provide a cost-offset analysis of EIBI relative to treatment as usual for children with ASD in the Netherlands. An estimate of the effects of EIBI on financial costs was investigated. To date only one study regarding the effectiveness of EIBI has been published in the Netherlands (Peters-Scheffer et al., 2010). Therefore, potential cost savings including different outcomes of EIBI were based on a number of international studies and presented per child and extended to the ASD population in the Netherlands.

## 2. Cost-offset analysis

To analyze the cost and benefits of EIBI in the Netherlands, efficacy rates of EIBI and treatment as usual based on meta-analytic studies were determined first. Next, costs were identified for individuals with ASD from age 3 to 65 years including costs for education, work and living and total costs were calculated for individuals with ASD who received EIBI or treatment as usual including different outcomes (i.e., normal functioning, reduced dependency, or dependency). Lastly, avoided costs for the Netherlands through the provision of EIBI were calculated per child and for the Dutch ASD population.

### *2.1. Efficacy rates*

As still relatively few children in the Netherlands receive EIBI and pre-treatment and/or post treatment data of most children is lacking, efficacy rates of both the EIBI group and the treatment as usual group were based on published literature. Following Jacobson et al. (1998), children were categorized into three groups according to their level of functioning. The first group was comprised of children who achieve normal functioning, participate in regular education with little or no support and who are vocationally productive adult workers. The second group consisted of children who participate in less intensive

special education and evince reduced dependency throughout their lives, while the third group requires continuing specialized and intensive educational and adult services.

*2.1.1. Behavioral intervention*

Given the controversy (e.g., Schopler, Short, & Mesibov, 1989) regarding the reported efficacy of the Lovaas study (1987) and several replications (e.g., Sallows & Graupner, 2005), the efficacy figures used in our study are based on the results reported in six meta-analytic studies regarding EIBI that were recently published (i.e., Eldevik, Hastings, Hughes, Jahr, Eikeseth, & Cross, 2009; Makrygianni & Reed, 2010; Peters-Scheffer et al., 2011; Reichow & Wolery, 2009; Spreckley & Boyd, 2009; Virués-Ortega, 2010). Common measures reported in the included studies are IQ, adaptive behavior, language and school placement. Although subject to parental advocacy and school policy, school placements seem to be the best real world efficacy measurement of academic and social competence (Kazdin, 1993) and are therefore used in our analysis.

Characteristics of the studies included in the meta-analyses are displayed in Table 1. As the study of Matos and Mustaca (2005) was in Spanish, it was excluded from the analysis. Also, the control groups of the studies of Ben-Itzchak, Lahat, Burgin, and Zachor (2008) and Harris, Handleman, Gordon, Kristoff, and Fuentes (1991) were excluded, as they were not comprised of children with ASD. Sixteen of the studies reported school placements. However, the follow-up studies by Lovaas (1987), i.e., McEachin et al. (1993) and Eikeseth et al. (2002), i.e., Eikeseth, Smith, Jahr, & Eldevik (2007) used the same participants as the original studies and were therefore combined with the original papers. The actual treatment hours for the children in the low intensity group of Lovaas (1987) and Smith et al. (2000) are not reported. As these children received minimal EIBI treatment (i.e., less than 10 h per week), school placements of these groups of children were excluded from the analyses. Therefore, 14 studies were included in the analysis. There were 292 children with a mean chronological age of 41.45 months (30.2–66.3) and a mean pretreatment IQ of 60.17 (50.5–83.0). On average, children received 32.54 h of treatment per week (20–40) for 27.01 months (12–36). After treatment, 29% were placed in regular treatment, 34% were placed in less intensive special education and 37% were placed in special education.

*2.1.2. Treatment as usual*

Six studies also report school placements of children in a control group who had a mean chronological age of 42.88 months (33.2–65.0) and mean pretreatment IQ of 62.73 (59.4–65.2). After eclectic treatment or treatment as usual, 11% of the children were placed in regular treatment, 8% were placed in less intensive special education and 81% were placed in special education. These rates are roughly in line with studies on outcome of adolescents and adults with autism (e.g., Levy & Perry, 2011).

However, the rates noted above are more pessimistic than rates provided by the Dutch Association for Autism (Nederlanse Vereniging voor Autisme, 2008). They reported that 36% of the adults lived independently (18% with a partner) and 10% lived independently but with support. Twenty-nine percent had a paid job (25% with sufficient income to provide in their living), 35% worked voluntary (e.g., voluntary job, traineeship, sheltered work with support), 13% worked in a sheltered environment, and 13% participated in structured daytime activities. About 20% of the adults had no structured day care or (supported) work.[1] Half of the adults received a security income from the Dutch Government (so-called WAJONG) as major source of income and the majority (74%) indicated they needed professional support in conducting their work with 55% actually receiving this support. Therefore, emulating Motiwala et al. (2006), also the most positive figures (Freeman, 1997) were included to estimate costs for children who receive standard care in the Netherlands. In Freeman's study, 25% of the participants attained normal functioning, while 25% evinced semi-independent living, and 50% were very dependent at adulthood.

*2.2. Costs*

Costs were calculated from age 3 to 65 years for individuals with ASD who received EIBI or treatment as usual including different outcomes (e.g., normal functioning, reduced dependency, or dependency). ASD can be reliably diagnosed between two and three years of age (Kleinman et al., 2008) and costs after 65 years of age are difficult to estimate due to health costs, retirement and pension. Also, some researchers assume a higher mortality rate among individuals with ASD (Mouridsen, Brønnum-Hansen, Rich, & Isager, 2008; Picket, Xiu, Tuchman, Dawson, & Lajonchere, 2011). Estimated costs in Euros are displayed in Table 2.

*2.2.1. Education*

In the Netherlands, typically developing children receive, on average, 8 years of primary education, four to six years secondary education, and four years of intermediate or higher vocational education or university. Attending school is compulsory from the age of five, but most children start primary school when they are 4 years old (student staff ratio 14.6 to 1) and graduate between 20 and 22 years of age (Minne, Webbink, & van der Wiel, 2009; OCW, 2008).

Approximately 5% of the children in primary school attend special education (Centraal Bureau voor de Statistiek, 2009), divided into less intensive special education (student staff ratio 5.9 to 1; Minne et al., 2009) and intensive special education

[1] Some of the participants mentioned multiple jobs.

**Table 1**
Characteristics of the studies included in the meta-analysis (i.e., Eldevik et al., 2009; Makrygianni & Reed, 2010; Peters-Scheffer et al., 2011; Reichow & Wolery, 2009; Spreckley & Boyd, 2009; Virués-Ortega, 2010).

| Study | EIBI group | | | | | | | | Control group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Participants | | | Treatment characteristics | | Outcome | | | Participants | | | Treatment characteristics | | | Outcome | | |
| | N | CA | IQ | Hrs | Dur. | 1 | 2 | 3 | N | CA | IQ | Type | Hrs | Dur. | 1 | 2 | 3 |
| Anan, Warner, McGillivary, Chong, & Hines (2008) | 72 | 44.0 | 51.69 | 15 | 3 | | | | | | | | | | | | |
| Anderson et al. (1987) | 14 | 42.79 | 57.26 | 15–25 | 12–24 | 0 | 31 | 69 | | | | | | | | | |
| Baker-Ericzén, Stahmer, and Burns (2007) | 158 | 49.36 | | | 3 | | | | | | | | | | | | |
| Ben-Itzchak et al. (2008) | 44 | 27.29 | 74.84 | 45 | 12 | | | | | | | | | | | | |
| Ben-Itzchak and Zachor (2007) | 25 | 26.6 | 70.67 | > 35 | 12 | | | | | | | | | | | | |
| Bibby et al. (2002) | 66 | 45.0 | 50.8 | 30.3 | 31.6 | 5 | 53 | 42 | | | | | | | | | |
| Birnbauer and Leach (1993) | 9 | 38.1 | 45.3 | 18.72 | 21.6 | | | | 5 | 33.2 | 45 | | | 22 | | | |
| Boyd and Corley (2001) | 22 | 41.3 | – | 30–40 | 23 | 0 | 41 | 59 | | | | | | | | | |
| Cohen, Amerine-Dickens, & Smith (2006) | 21 | 30.2 | 61.6 | 35–40 | 36 | 48 | 33 | 19 | 21 | 33.2 | 59.4 | Ecl. | | 36 | 5 | 0 | 95 |
| Eikeseth et al. (2002, 2007) | 13 | 66.31 | 61.92 | 28.00 | 31.4 | 38 | 0 | 62 | 12 | 65.00 | 65.17 | Ecl. | 29.08 | 33.3 | 8 | 0 | 92 |
| Eldevik et al. (2006) | 13 | 53.0 | 41.0 | 12.5 | 20.3 | | | | 15 | 49.0 | 47.2 | Ecl. | 12 | 21.4 | | | |
| Harris and Handleman (2000) | 27 | 49.0 | 59.33 | 35–45 | | 41 | 0 | 59 | | | | | | | | | |
| Harris et al. (1991) | 9 | 50.11 | 67.56 | 35–45 | 12 | 0 | 89 | 11 | | | | | | | | | |
| Howard, Sparkman, Cohen, Green, & Stanislaw (2005) | 29 | 30.86 | 58.54 | 25–40 | 14.21 | | | | 16 | 37.44 | 53.69 | Ecl. | 25–30 | 13.25 | | | |
| | | | | | | | | | 16 | 34.56 | 59.88 | Ecl. | 15 | 14.75 | | | |
| Lovaas (1987); McEachin et al. (1993) | 19 | 34.6 | 53.0 | 40 | 24+ | 47 | 42 | 11 | 21 | <42 | > 40 | Usual | – | 24+ | 5 | 48 | 48 |
| | 19 | 40.9 | 46.0 | <10 | 24+ | 0 | 42 | 58 | | | | | | | | | |
| Magiati, Charman, & Howlin (2007) | 28 | 38.0 | 83 | 32.8 | 24 | 0 | 82 | 18 | 16 | 42.5 | 65.2 | Ecl. | 26.5 | 26 | 0 | 0 | 100 |
| Reed, Osborne, & Corness (2007) | 12 | 40 | 55.6 | 30.4 | 9 | | | | 20 | 43 | 51.9 | Ecl. | 12.7 | 9 | | | |
| | | | | | | | | | 16 | 38 | 53.3 | Port. | 8.5 | 9 | | | |
| Reed, Osborne, & Corness (2007b) | 14 | 42.9 | 57.21 | 30.4 | 9–10 | | | | | | | | | | | | |
| | 13 | 40.8 | 49.3 | 12.6 | 9–10 | | | | | | | | | | | | |
| Remmington et al. (2007) | 23 | 35.7 | 61.43 | 25.6 | 24 | 74 | 0 | 26 | 21 | 38.4 | 62.33 | Usual | | 24 | 48 | 0 | 52 |
| Sallows and Graupner (2005) | 13 | 35.0 | 50.85 | 37.58 | 48 | 48 | 43 | 9 | | | | | | | | | |
| | 10 | 37.1 | 52.10 | 31.28 | 48 | | | | | | | | | | | | |
| Sheinkopf and Siegel (1998) | 11 | 33.8 | 62.8 | 27.02 | 15.73 | 30 | 20 | 50 | 11 | 35.3 | 61.7 | Usual | 11.13 | | 0 | 0 | 100 |
| Smith et al. (1997) | 11 | 36 | 28 | 30 | 24 | | | | | | | | | | | | |
| | 10 | 38 | 27 | <10 | 24 | | | | | | | | | | | | |
| Smith et al. (2000) | 15 | 36.07 | 50.53 | 24.52 | 33.44 | 27 | 13 | 60 | | | | | | | | | |
| | 13 | 35.77 | 50.69 | | 24 | 0 | 21 | 79 | | | | | | | | | |
| Weiss (1999) | 20 | 41.5 | | 40 | 24 | 50 | 25 | 25 | | | | | | | | | |

*Note*. CA = average age in months; Hrs = average number of hours per week of treatment; Dur. = average number of months of treatment; 1 = percentage of children placed regular education with no support, minimal support (e.g., part-time support with shadow tutor, fading the shading tutor) or unknown support; 2 = percentage children with regular school placement with full-time individual support or part-time EIBI, less intensive special education (e.g., for children with communication impairments or mild ID), mixture of special education and regular education placement, private school with small classes; 3 = percentage children receiving one-to-one-treatment and special education (e.g., autism specific schools, generic special needs schools, self-contained classes); usual = treatment as usual; ecl = Eclectic treatment; port = Portage program. Since Sallows and Graupner (2005) report educational placement for the parent-directed and clinic-directed group together, placements are reported for the two groups together.

**Table 2**
Indication of costs of an individual with ASD with various outcomes between 3 and 65 years of age in the Netherlands.

| Costs | Treatment as usual | EIBI |
|---|---|---|
| *Normal range of functioning* | | |
| EIBI (weekly 32.54 h, 27.01 months) | | €100,000 |
| 8 years primary education | €32,000 | €32,000 |
| 5 years secondary education (average) | €42,500 | €42,500 |
| 4 years college or university (average) | €40,000 | €40,000 |
| **Total from 3 to 65 years** | **€114,500** | **€214,500** |
| *Reduced dependency in adulthood* | | |
| EIBI (weekly 32.54 h, 27.01 months) | | €100,000 |
| 2 year preschool | €58,000 | |
| 8 years less intensive primary education | €71,200 | €71,200 |
| 4 years secondary school | €44,000 | €44,000 |
| 2 years intermediate vocational education | €20,000 | €20,000 |
| 15 years suppl. aid to dependent children | €12,687 | €12,687 |
| 47 years of security income | €583,452 | €583,452 |
| Living and working with support | €1,882,075 | €1,882,075 |
| **Total from 3 to 65 years** | **€2,671,414** | **€2,713,414** |
| *Dependency in adulthood* | | |
| EIBI (weekly 32.54 h, 27.01 months) | | €100,000 |
| 2 years preschool for children with ID | €58,000 | |
| 14 years primary/secondary school for children with ID | €257,600 | €257,600 |
| 15 years suppl. aid to dependent children | €12,687 | €12,687 |
| 47 years of security income | €583,452 | €583,452 |
| Living and working with intensive support and intensive care | €3,354,317 | €3,354,317 |
| **Total from 3 to 65 years** | **€4,266,056** | **€4,308,056** |

(student staff ratio 3.5 to 1; Minne et al., 2009). Less intensive special education is attended by students with learning difficulties, while intensive special education serves children with visual or hearing impairments, children with severe communication impairments (including hearing problems), children with ID and children with psychiatric disorders. Some children with ASD are enrolled in special classes, but other children with ASD are mainstreamed with a mix of children with other psychiatric disorders and/or developmental disabilities such as Down syndrome, learning disabilities and ID. Children with ASD who have average or higher intellectual and linguistic ability have increasingly joined regular education in the Netherlands. Sometimes these children received additional support provided by special education staff financed by the Ministry of Education, Culture and Science (Student-linked budget; LGF). Costs for this alternative method are equivalent to the cost for special education.

After primary special education, the majority children with learning difficulties or disabilities visit secondary special education (59%; Dienst Uitvoering Onderwijs, 2010). Most of the remaining children (7%) receive secondary education with a strong emphasis on practical skills (LWOO and PRO; Dienst Uitvoering Onderwijs, 2010). In these approaches additional support is provided. After completing PRO, the majority of the students starts working (supported, regular or in combination with education BBL; Heijnens, 2009), while 90% of the children completing LWOO continues their education at an intermediate vocational education for three or four years (Oosterling, Brouwer, & Nijman, 2010). Therefore, two years of intermediate vocational education were included in the calculations.

All education costs were derived directly from websites and reports of the Dutch Government (OCW, 2008) or from studies conducted for the Dutch Government (i.e., Centraal Bureau voor de Statistiek, 2009; Oosterling et al., 2010). In 2007, annual costs for primary education per child were € 4000 in regular education, € 8900 in special education and € 18,400 in intensive special education (Minne et al., 2009). In 2008, annual costs per child were € 8500 for regular secondary education, with € 11,000 for LWOO and PRO and € 18,400 for special secondary education. Annual cost for intermediate vocational education, higher vocational education and university (excluding costs for research and development) are € 10,000, € 9200 and € 9200 (Centraal Bureau voor de Statistiek, 2009; Oosterling et al., 2010) and were set at € 10,000 for the purpose of this analysis.

To our knowledge, no exact numbers of children with ASD receiving educational services in the Netherlands exist. However, the Dutch Association for Autism (Nederlanse Vereniging voor Autisme, 2008) conducted a study in 2275 individuals with ASD (i.e., 43% PDD-NOS; 28% autism; 26% Asperger and 3% multiple complex developmental disorder) and found that approximately 39% of the children with ASD in primary school visited regular education. The remaining 23% received less intensive special education, while the other 35% received intensive special education. During secondary school, 53% of the children with ASD received special education. Approximately half of the children received additional support, while an additional 20% needed extra support. Almost 6% of the children with ASD had no educational services.

### 2.2.2. Child costs

No specific autism related costs were assumed for normal-functioning children, but parents of (semi-) dependent children between 3 and 18 years old receive a compensation in the costs of raising a child with a disability, which is € 845.80 per year (Sociale Verzekeringsbank, 2011). In addition, in the Netherlands, (parents of) individuals with ASD can apply for a

client-linked budget to fund additional therapies (e.g., speech therapy, physiotherapy), as well as daytime activities and care. Although children with ASD use a variety of effective and ineffective therapies (e.g., Green et al., 2006; Thomas, Morrissey, & McLaurin, 2007), no exact numbers exist of the amount and characteristics of children with ASD that receive such additional therapies and (specialized) services. Therefore, therapy costs were omitted from the analysis since we assumed that costs were balanced across all children and offer little to the analysis.

#### 2.2.3. Adult costs

Besides education, no specific (autism related) costs were assumed for normal-functioning adults after 18 years of age, as these adults provide their own income and pay taxes. In the Netherlands, individuals with developmental disabilities with an onset before 17 years of age are eligible for security income (WAJONG), which is 75% of the minimal wage. In 2011, the minimal monthly wage varied between € 653 and € 1435.20 depending on the chronological age of the individual (Uitvoeringsinstituut Werknemersverzekeringen, 2011).

Costs for adult living and day programs or supported work were obtained from the Dutch government (Zorgzwaartepakketten Sector GZ; Bureau HHM, 2010). Based on client characteristics (e.g., level of ID, care, motor functioning, problem behavior, nursery needs, psychosocial functioning and adaptive behavior), clients were categorized into one of the eight intensity levels of care and support. Each intensity level corresponds to a daily budget to provide for living expenses (including care and support) and for a structured day program, consisting of adapted and supported work or an alternative program to replace schooling or working with an emphasis on the maintenance or development of cognitive and adaptive skills and the regulation of behavior.

Those with reduced independence were assumed to be categorized into the second intensity level, in which individuals were able to function relatively independently in a sheltered environment. Staff needs to supervise and provide minimal help with adaptive skills and psychosocial functioning. Some support is needed with reading, writing, calculations, daily routines, decision-making and problem solving. In general, clients present no behavioral and psychiatric problems. According to Bureau HHM (2010) daily costs were € 109.71.

Needs of the dependent group seem in accordance with the fifth intensity level of care in which clients receive intensive comprehensive support and care. Individuals in this group were only able to function in society and engage in social relationships with support and sometimes staff needed to regulate behavioral problems. Care, support and supervision regarding communication, psychosocial functioning and daily living skills were provided 24 h per day. Daily costs were estimated at € 195.53 (Bureau HHM, 2010).

#### 2.2.4. EIBI

Program costs fall into five general categories (i.e., personnel, capital assets, transportation, materials and supplies and miscellaneous; Escobar, Barnett & Goetze, 1994), which were used to estimate EIBI program costs. Next to a home-based model of EIBI, also center-based EIBI was provided in the Netherlands and estimated costs were assumed to be representative for both. Although EIBI programs vary slightly in intensity, structure and supervision, most programs provide 20–40 h of intervention, which is implemented by 5–7 therapists generally for 2–6 years with the average child requiring 3 years of treatment. Intensity and duration of the program and intensity and quality of supervision are related to outcome (Granpeesheh et al., 2009; Reichow & Wolery, 2009) and have a significant impact on costs (Escobar et al., 1994). The intensity of the treatment was estimated by calculating the average intensity ($M$ = 32.54 h) and duration ($M$ = 27.01 months) of the included studies to determine efficacy (see 2.1.2). EIBI programs are supervised by a competent clinician with knowledge of and experience in implementing advanced learning principles in different types of learners. Average amount of supervision was estimated at 5 h per month (Eikeseth et al., 2009) with monthly costs set at € 500. In sum, for the total duration of the program children received on average of 3.809 h of EIBI, while therapists and parents received on average of 135 h of consultation. Employment wages are based on the average cost per hour for staff as described in the collective bargaining agreement 2009–2011 (Vereniging Gehandicaptenzorg Nederland, 2010) and set at € 13.84 per hour. Professional time was estimated at € 66,217 for the total duration of the program. Additional annual costs for the program (e.g., travel time, expanses, materials) were estimated at € 15,000 per child. Therefore, total program costs sum up to approximately € 99,967 and to calculate cost-offset, EIBI was set at € 100,000 for the total program.

### 2.3. Cost-offset analysis

As seen in Table 3 costs can be broken down into different child outcome and for children who receive treatment as usual and EIBI. Although large differences are visible in the outcome percentages between children receiving EIBI and treatment as usual as reported in the meta-analytic studies (i.e., 29% normal functioning, 34% reduced dependency, and 37% dependent vs. 11% normal functioning, 8% reduced dependency, and 81% dependent), the percentages of children attaining normal outcome is comparable between the EIBI group and the Freeman study (i.e., 25% vs. 29%). However, after EIBI relatively more children obtained reduced dependency compared to children who received treatment as usual in the Freeman study (i.e., 34% vs. 25%).

#### 2.3.1. Per child savings

Next, we broke down the costs into differential child outcomes and compared the costs to those of children who received treatment as usual. As no expectations can be made per child, analysis were conducted as a function of the percentage

**Table 3**
Differential child outcomes of EIBI compared to the cost to those of children who received treatment as usual.

| | Total costs 3–65 years with EIBI | Projected costs savings (control groups) | Projected costs savings (Freeman, 1997) |
|---|---|---|---|
| Independent (29%) | 214,500 | 3,467,313 | 2,615,007 |
| Reduced dependent (34%) | 2,713,414 | 968,399 | 116,093 |
| Dependent (37%) | 4,308,056 | −626,243 | −1,478,549 |
| Average per child | 2,578,746 | 1,103,067 | 250,761 |

(i.e., 11% normal functioning, 8% reduced dependency, and 81% dependent) resulting in an average estimate of costs of € 3,681,813 per individual. Results were also compared to Freeman (1997; average estimated costs: € 2,829,507 per individual; i.e., 25% normal functioning, 25% reduced dependency, and 50% dependent). Table 3 shows the gains and losses for each outcome of EIBI with children who received treatment as usual as baseline.

*2.3.2. Avoided costs for the Netherlands*

Next, the costs and benefits were extended to all individuals with ASD living in the Netherlands. In 2010, the population of the Netherlands consisted approximately of 16,500,000 individuals, of which 3,928,334 were younger than 20 years old and each year approximately 182,000 children are born (Centraal Bureau voor de Statistiek, 2011). The number of individuals with ASD in the Netherlands is unknown (Gezondheidsraad, 2009). According to estimates published in the international scientific literature, the prevalence of ASD is currently 60–100 per 10,000 (Baron-Cohen et al., 2009; Fernell & Gillberg, 2010). Hence, approximately 99,000–165,000 individuals with ASD live in the Netherlands, of which 23,570–39,283 are between 0 and 20 years of age. Each year approximately 1092 to 1820 children with ASD are born. When average child savings (€ 1,103,067) were applied to the prevalence rates, savings are estimated at € 1,204,549,164 to € 2,007,581,940 per birth year cohort and € 25,999,289,190 to € 43,331,780,961 when all children under 20 years had received or will receive EIBI. Approximately € 109,203,633,000 to € 182,006,055,000 can be avoided by society when all individuals with ASD received EIBI. Using the more conservative child savings based on Freeman (1997; € 250,761), savings are estimated at € 273,831,012 to € 456,385,020 per birth year cohort and € 5,910,436,770 to € 9,850,644,363 when all children under 20 years had received or will receive EIBI. In total, roughly € 24,825,339,000 to € 41,375,565,000 can be avoided by society when all individuals with ASD received or will receive EIBI.

## 3. Discussion

The current study provides a cost comparison of EIBI relative to treatment as usual for children with ASD in the Netherlands. Based on efficacy rates published in meta-analytic studies on EIBI (Eldevik et al., 2009; Makrygianni & Reed, 2010; Peters-Scheffer et al., 2011; Reichow & Wolery, 2009; Spreckley & Boyd, 2009; Virués-Ortega, 2010) estimated costs avoided for society by the provision of EIBI on a large scale are approximately € 1,103,067 per child and, extended through the school-aged population (i.e., children with ASD between 0 and 20 years), € 26–€ 43.3 billion. As concluded earlier by Jacobson et al. (1998), estimated savings seem to outweigh the costs of EIBI, which are approximately € 100,000 per program.

As with other cost-benefits studies (e.g., Chasson et al., 2007; Jacobson et al., 1998), our analysis is based on several assumptions and therefore provides an indication of future costs and savings, excluding costs associated with inflation. In addition, changes in treatment, development of new treatments, changes in public health services and funding may influence the costs and benefits of interventions including EIBI. In this analysis we assumed that children receive their diagnosis before the age of three and consequently initiate EIBI at three years of age. However, many children receive their diagnosis at a later age (Nederlanse Vereniging voor Autisme, 2008) and consequently start treatment at higher chronological age, which may result in different (i.e., less favorable) outcomes and cost savings.

In this analysis, costs regarding education, security income and (supported) living and working were included. However, costs associated with having a child with ASD are not limited to these costs. For example, children with ASD may require specialized childcare and extracurricular activities. Often parents must reduce their work hours and family activities are limited as a result of raising a child with ASD (Sharpe & Baker, 2007). Järbrink, Fombonne, and Knapp (2003) found that parents of children with ASD had weekly out-of-pocket costs of €76–€ 116, excluding expenses for education, early intervention, health services, medication and income losses (on average € 268 per week).

Since we used meta-analytic studies to estimate effectiveness, effectiveness and cost savings of EIBI were more conservative than reported in other studies, in which percentages of successfully mainstreaming children between 47% and 72% were used to calculate the costs and benefits (Chasson et al., 2007; Jacobson et al., 1998). Contrary to Jacobson et al. and Chasson et al. who assumed that most children with ASD would remain in special education throughout childhood, the effectiveness of treatment as usual in this study was based on the results of the control groups included in the meta-analytic studies in which 11% of the participants obtained normal functioning, 8% reduced-dependency, and 81% were dependent in adulthood. In addition, results were compared to Freeman (1997), who suggested that 25% of the individuals with ASD attained normal functioning, 25% reduced dependency, while 50% were very dependent in adulthood. This prognosis seems

more positive than reported in other studies (e.g., Billstedt et al., 2005; Mordre et al., 2011) and estimated savings in this analysis (€ 250,761 per child) would likely underestimate the costs that would be saved.

Several studies exploring the predictors of successful EIBI have been published and found that amongst others treatment intensity, treatment duration, intensity and quality of supervision, and pretreatment chronological age, IQ and autism severity are related to treatment outcome (e.g., Ben-Itzchak & Zachor, 2007; Eikeseth et al., 2009; Granpeesheh et al., 2009; Lovaas, 1987). Currently, estimates of the individual contributions of these predictors to the efficacy of EIBI and consequently the costs savings are imprecise and cannot be integrated in cost-offset analyses yet. However, as research on these predictors is mounting, future cost-offset studies should include these predictors to provide a more accurate estimate of cost savings.

Since few children in the Netherlands are engaged in EIBI programs, efficacy data had to be based on the existing literature. It is yet unknown to which extent these data can be generalized to the Dutch situation. Although research seems to confirm our assumptions (Nederlanse Vereniging voor Autisme, 2008), it is uncertain to which extent school placement scores predict later social and economic functioning (e.g., employment in the future, independent living). In addition, school placement does not account for within-group differences. Although EIBI in several children may not result in changes in school placement, adaptive behaviors (e.g., toilet training, independency in eating, dressing) are learned reducing their care needs and dependency.

As research on EIBI is expanding, current treatment programs may be improved and better decisions may be made about whether a child should receive EIBI. As not all children may respond positively to EIBI, further research should explore effective treatment options. This strategy may result in greater savings as additional costs due to ineffective EIBI could be avoided and more children could engage in effective treatment and consequently be mainstreamed into regular education. However, even after treatment, a substantial subset of children retains impairments related to ASD (e.g., impairments in social interaction and communication and persistent patterns of restricted and stereotyped behavior). Future research should determine how teachers, professionals and parents address the needs of these children.

While researchers have shown that in a substantial subset of children with ASD, EIBI can result in lasting improvements in IQ scores and adaptive behavior (Reichow, 2011), many children with ASD are still receiving controversial and unsupported treatments (Green et al., 2006). However, to make EIBI generally available to children with ASD in the Netherlands, several difficulties in implementing EIBI need to be eliminated. First, appropriate funding is required for identifying children with ASD at an early age and implementing the EIBI program. In addition, professionals and parents need to be educated about the costs and benefits of early interventions including EIBI and therapists and consultants need to be properly trained in applying EIBI as the quality of treatment is related to treatment outcome. These changes in policy may improve the quality of life of children with ASD and result in substantial cost savings to society.

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