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The effectiveness of applied behavior analytic interventions for children with Autism Spectrum Disorder: A meta-analytic study

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ABSTRACT

Background: Behavior Analytic interventions are interventions based on the principles of Applied Behavior Analysis (ABA). They are widely used with children with Autism Spectrum Disorder (ASD), they are highly effective, and are the most-widely studied types of interventions for children with ASD. Nevertheless, findings are not consistent regarding the *degree* of its effectiveness. The purpose of this meta-analysis was to provide an up-to-date and thorough evaluation of ABA programs for children with ASD using state of the art meta-analytic methodology.

Method: For the purposes of the present analysis, 29 studies met the inclusion criteria and were consequently analyzed. Effectiveness was evaluated in terms of three domains pertaining to child-related variables: a) IQ scores provided by verbal and non-verbal standardized tests, b) receptive and expressive language, and c) adaptive behavior. This evaluation included comparisons of pre- and post-intervention outcomes rather than comparisons between experimental and control groups.

Results and conclusions: The findings indicated that ABA programs are moderately to highly effective bringing significant benefits for children with ASD in the aforementioned areas. Specifically, they were very effective in improving intellectual abilities ($g = 0.740$); moderately to very effective in improving communication skills ($g = 0.650$), *expressive-language skills* ($g = 0.742$) *and receptive- language skills* ($g = 0.597$); moderately effective in improving IQ provided by non-verbal tests ($g = 0.463$), adaptive behavior (in total) ($g = 0.422$), socialization ($g = 0.444$); and had low effectiveness in improving daily living skills ($g = 0.138$).

1. Introduction

The prevalence or diagnosis of Autism Spectrum Disorder (ASD) has increased dramatically as indicated by a great number of epidemiological studies throughout the world (e.g. South Korea, Kim et al., 2011; United Kingdom, Baird et al., 2006; Iceland, Saemundsen, Magnússon, Georgsdóttir, Egilsson, & Rafnsson, 2013). According to the Autism and Developmental Disabilities Monitoring Network in the USA, during the decade 2002–2012 the diagnosis of ASD was increased by 121%. The increasing numbers of people diagnosed with ASD, along with the severity of the condition, underline the importance of identifying most effective therapeutic approaches for its treatment.

Applied Behavior Analytic (ABA) interventions are recognized as the most effective evidence-based interventions for children with ASD (Fein et al., 2013). The term ABA intervention refers to treatment approaches that: (a) are implemented systematically following the principles of applied behavior analysis; (b) are applied as early as possible in the child's life, preferably before the age of

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3 years; (c) are usually provided in a student-teacher ratio of one-to-one before generalization procedures are used; (c) are individualized, comprehensive, and target a great number of skills; (d) incorporate skills that are targeted following a hierarchy based on typical development; and (d) are used in conjunction with parent-education services (Healy & Lydon, 2013; Virues-Ortega, 2010). The origins of this approach are traced to the UCLA-Young Autism Project that Lovaas and his colleagues developed and run in the 1980's. This model became very well known after the influential and controversial publication that demonstrated its powerful effects imposing dramatic improvements in children with ASD (Lovaas, 1987). The findings of this study constitute a milestone for the treatment of this potentially incapacitating disorder. Since then, a great number of studies have been carried out that provide additional support regarding the effectiveness of ABA intervention. This effectiveness translates into *increases or improvement*: in IQ scores, language skills, and adaptive behavior and at the same time into decreases: in autism-related symptomatology and/or symptom intensity, in the need for support during school inclusion, and in challenging behavior (e.g., Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Eikeseth, Klintwall, Jahr, & Karlsson, 2012; Fava et al., 2011; McEachin, Smith, & Lovaas, 1993; Strauss et al., 2012; Weiss, 1999). Even though all ABA intervention studies measure behavior changes of young children with ASD as a result of the intervention applied, they vary from one another, a great deal, in terms of design parameters, population characteristics, characteristics of the intervention, and outcomes of the intervention which leads to the challenge of evaluating the parameters that may contribute most to the effectiveness of ABA interventions and the degree of their efficacy.

Despite the questions that arise from the aforementioned variability (e.g., Healy & Lydon, 2013; Howlin, Magiati, & Charman, 2009; Reichow, Barton, Boyd, & Hume, 2012; Warren et al., 2011), we may reach safe conclusions about treatment efficacy by using systematic qualitative and quantitative analysis of the findings of at least some of the intervention studies. Specifically, meta-analytic research provides an objective medium for the assessment of ABA intervention which facilitates summarizing, integrating, and interpreting a group of quantitative empirical studies with similar methodology. A meta-analysis helps us convert the results from different studies to a common metric, and statistically explore the relations between the characteristics and the findings of those studies. It is a research tool that was developed at the end of the 1970s (Lipsey & Wilson, 2001) and originally used in the social sciences. Since then, meta-analysis has become a widely accepted research tool used in a variety of disciplines. Despite its strengths, it is not always possible to use meta-analytic methodology to evaluate sets of data (Lipsey & Wilson, 2001).

The effectiveness of ABA intervention has already been the subject of nine meta-analytic studies (Eldevik et al., 2009, 2010; Kuppens & Onghena, 2012; Makrygianni & Reed, 2010; Peters-Scheffer, Didden, Korzilius, & Sturmey, 2011; Reichow et al., 2012; Reichow & Wolery, 2009; Spreckley & Boyd, 2009; Virues-Ortega, 2010) published in peer-reviewed journals. Even though each of those studies incorporated different inclusion criteria, they all demonstrated the effectiveness of ABA intervention in the treatment of ASD whether pre and post-intervention methodology or group designs were used to evaluate effectiveness.

The purpose of the present meta-analysis was to assess the efficacy of ABA intervention in improving IQ scores (provided by verbal and non-verbal standardized tests), receptive and expressive language, and adaptive behavior (total and subcategories) of children with ASD. A total of 29 studies were meta-analyzed, 20 of which were included in previous meta-analytic studies and 9 that were meta-analyzed for the first time (i.e., Eldevik, Hastings, Jahr, & Hughes, 2012; Fernell et al., 2011; Flanagan, Perry, & Freeman, 2012; Grindle et al., 2012; Peters-Scheffer, Didden, Mulders, & Korzilius, 2010; Peters-Scheffer, Didden, Mulders, & Korzilius, 2013; Rivard, Terroux, & Mercier, 2014; Smith, Klorman, & Mruzek, 2015; Zachor & Ben-Itzchak, 2010). There are multiple advantages to the present study: (a) It is the only meta-analytic study since 2012 that provides an assessment of the efficacy of ABA treatment by comparing the participants' performance before and after the application of treatment. (b) It meta-analyzed a greater number of studies than any prior meta-analysis of ABA intervention effectiveness. (c) It is one of a few meta-analytic studies that analyzed a great number of variables (eight variables) associated with treatment.

We anticipate that this study will contribute toward a thorough, comprehensive, and up-to-date assessment of the effectiveness of ABA intervention.

2. Methods

2.1. Search strategy and selection of studies

A thorough search of the literature was conducted from January 1987 to October 2017 in order to retrieve studies that met inclusion criteria for the present meta-analysis. This search was conducted by three of the authors. Computerized literature searches of PubMed and Science Direct were conducted using the keywords*: behavio(u)r analytic, or applied behavio(u)r analysis, or behavio(u)ral treatment or behavio(u)ral intervention* in combination with *autism, or autistic, or PDD*. Additionally, recent publications, reviews, and meta-analyses were also inspected manually (e.g., Eldevik et al., 2009; Kuppens & Onghena, 2012; Makrygianni & Reed, 2010; Reichow, 2012; Reichow & Wolery, 2009; Spreckley & Boyd, 2009; Virues-Ortega, 2010) and recommendations from experts in the field were taken into account in order to cross-check whether all the relevant published studies had been located.

The inclusion criteria for the ABA intervention studies in the present meta-analysis were the following: (a) using experimental or quasi-experimental design; (b) using ABA principles and teaching techniques, in general, rather than a specific ABA approach, such as pivotal response training or verbal behavior; (c) addressing various domains of the child's life rather than limiting the scope of the intervention to one area, such as language development or communication; (d) including a sample of children diagnosed with ASD, Autism, Autistic Disorder, PDD, or PDD-NOS; (d) providing child assessment measures on at least one of the following domains: intelligence (provided by verbal and non-verbal standardized tests), receptive language, expressive language, adaptive behavior (composite, communication, daily living skills or socialization), and; (e) using one or more of the following: verbal or non-verbal

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