UNIVERSITY OF CALIFORNIA
RIVERSIDE

Early Childhood ABA: Issues of Early ASD Detection and Access to Intervention

A Thesis submitted in partial satisfaction
of the requirements for the degree of

Master of Arts

in

Education

by

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March 2020

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I would like to thank Dr. Michael Solis for providing guidance and sharing his expertise during the development and completion of this project. I would also like to thank Dr. Jan Blacher and Dr. Katherine Stavropoulos for sharing their expertise, ideas, and taking the time to read my thesis. I am extremely thankful for the support provided by each of the committee members including their role in my decision to continue my doctoral studies in special education.

ABSTRACT OF THE THESIS

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by

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University of California, Riverside, March 2020
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This paper provides an overview of ABA, summarizes findings from studies of early childhood ABA with a focus on intervention dosage, and addresses the influence of demographics and culture on early ASD detection and access to early childhood ABA intervention. Although, this paper is not inclusive of all the ABA studies conducted between 1987-2007 and beyond, it summarizes the findings of some of the historical studies in early childhood ABA. These historical studies were located through two systematic reviews including studies between the years 1987- 2007 and selected if they met the following criteria: (1) intervention was based on behavioral principals (2) participants were five years of age or younger at the onset of intervention (3) intervention was in-home or clinic-based (4) utilized a group research design. A total of seven studies met the inclusion criteria. All seven studies reported increasing intellectual, educational, and behavioral gains for children with ASD. However, three of the studies did not report significant differences across all outcome measures favoring the treatment group. The seven studies reported mixed findings regarding treatment dosage with weekly treatment

dosage ranging from 40 to 19.45 hours. Additional findings indicated that demographics and culture should be considered as they influence the early detection of ASD and access to intervention. Based on these findings, future research should further investigate how these variables along with others moderate or mediate early childhood ABA outcomes associated with early ASD detection and access to intervention.

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As the prevalence rate of children diagnosed with autism spectrum disorder (ASD) increases so does the necessity for evidence-based intervention options offered during early childhood. (Hall, 2018; Wilkinson, 2017; Zwaigenbaum et al., 2016). The Individuals with Disabilities Act (IDEA) developed and implemented part C in 1986 to promote early intervention with the goal of enhancing development, minimizing dependence on special education services, and maximizing adult living outcomes (Lipkin & Okamoto, 2015). Part C focuses on children from birth to three years of age by authorizing early intervention services and promoting community/in-home services for this age group (Lipkin & Okamoto, 2015).

One of the most studied and recommended evidence-based early childhood interventions is Applied Behavior Analysis (ABA). ABA has been used to increase intellectual, educational, and communication skills and reduce rates of problem behaviors. Studies have reported increased intellectual functioning, improved language levels and adaptive skills, while reducing ASD core symptoms (Lovaas, 1987; Magiati, Charman, & Howlin, 2007; Remington et al., 2007; Sallows & Graupner, 2005; Sheinkopf & Siegel., 1998; Smith, Eikeseth, Klevstrand, & Lovaas, 1997; Smith, Groen, & Wynn, 2000). However, various studies have concluded that the following variables have an impact on both the early detection of ASD and the implementation of early childhood ABA: demographics and culture (Blacher, Cohen, & Azad, 2014; Boyd, Odom, Humphreys, & Sam, 2010; Chung, Jang, & Adams, 2014; Daniels & Mandell, 2013; Dunst & Espe-Sherwindt, 2016; Hanson & Espinosa, 2016; Ispa & Halgunseth,

2006; Kogan et al., 2007; Liptak et al., 2008; Mandell, Ittenbach, Levy, Pinto-Martin, 2007; Thomas et al., 2012; Zuckerman et al., 2014).

Currently, there is disagreement in the field about the age of eligibility for early childhood ABA intervention. The Centers for Disease Control and Prevention (CDC) addresses that children up to three years of age are eligible for early childhood intervention (https://www.cdc.gov/ncbddd/autism/treatment.html#ei). Yet, research in this area includes participants below the age of four (Lovaas, 1987; Remington et al., 2007; Sallows & Graupner, 2005; Smith et al., 1997; Smith et al, 2000) while others include participants ages four to seven (Caron, Berube & Paquet, 2017; Estes et al., 2015; Sheinkopft & Siegel, 1998). Additionally, IDEA notes that early childhood intervention can continue until a child enters kindergarten (Lipkin et al., 2015). For purposes of this paper, studies of early childhood ABA include participants up to five years of age.

The purpose of this paper is to provide an overview of the principles of ABA, summarize findings from some of the historical studies of early childhood ABA with a particular focus on intervention dosage, discuss issues associated with the early detection of ASD and access to early childhood ABA intervention. This review answers the following research questions: (1) What guidance do findings from research provide about treatment dosage for early childhood ABA? (2) How do demographics and culture influence the early detection of ASD and access to early childhood intervention?

Overview of ABA

ABA is a science that systematically implements procedures derived from the principles of behavior to improve socially significant behavior to a meaningful degree (Alberto & Troutman, 2013; Baer, Wolf, & Risley, 1968; Cooper, Heron, Heward, 2007; Hall, 2018; Storey & Post, 2017). The assumptions of ABA include the following: 1) behavior is learned and/or a physiological response, 2) behavior can be changed by altering antecedents and/or consequences, and 3) changes in the environment can be made to decrease, increase, or maintain certain behavior (Cooper et al., 2007; Storey & Post, 2017).

Some of the evidence-based strategies used in ABA are: The antecedent-behavior-consequence (A-B-C) model of behavior, reinforcement strategies, discrete trial teaching, and extinction procedures (Alberto & Troutman, 2013; Cooper et al., 2007; Hall, 2018; Storey & Post, 2017). The A-B-C model of behavior is one of the foundational strategies of ABA. This model addresses the impact of antecedents and consequences on behavior. Antecedents are stimuli changes that occur prior to the behavior, whereas consequences are those that occur after the behavior (Cooper et al., 2007). Examples of antecedents include the doorbell ringing and the statement "Time to sit." Examples of consequences include clapping and high-fives. The two types of consequences include: reinforcement and punishment. Reinforcement is stimuli that increases the future frequency of behavior and punishment is stimuli that decreases the future frequency of behavior (Cooper et al., 2007). This model is used to identify environmental stimuli that might trigger, maintain,

increase, and/or decrease behavior to help understand, teach, and shape behavior (Cooper et al., 2007).

Functional analysis is another foundational strategy. This strategy analyzes the functions of behavior to identify the type of reinforcement maintaining the behavior. The functions of behavior include social positive reinforcement, automatic positive reinforcement, social negative reinforcement, and automatic negative reinforcement (Cooper et al., 2007). Once the function(s) have been identified, a set of alternative behaviors that serve the same function can be taught. In addition to the function, the form and effort of the replacement behavior should be considered (Cooper et al., 2007). Considering the form of the replacement behavior includes identifying a replacement behavior that the child is capable of engaging in. Further, considering the effort of the replacement behavior includes selecting a replacement behavior that requires less than or the same amount of effort as the problem behavior.

For example, if the function of yelling is social negative reinforcement (e.g. escape from homework) some replacement behaviors include verbally saying "break" and handing a "break" card. If the child is non-verbal then the best replacement behavior would be handing a "break" card. To present and teach the alternative behavior the principles of the A-B-C model of behavior are used. This means that reinforcement (e.g. escape from homework) in only provided when the child engages in the alternative behavior (e.g. handing a "break" card). The goal of this is to increase the future frequency of the alternative behavior and decreasing the frequency of the problem behavior (e.g.

yelling). This foundational strategy is used to understand why behavior is occurring and to identify the best possible replacement behavior (Cooper et al., 2007).

Findings from Intervention Studies of Early Childhood ABA

Selection of Studies

The historical studies were located through two main resources. An initial list was created by utilizing the studies identified in systematic reviews of early behavioral interventions for children with ASD (Howlin, Magiati, & Charman, 2009; Peters-Scheffer, Didden, Korzilius, and Sturmey, 2011). The list of 22 studies was updated by eliminating double listings which resulted in a list of 15 studies. Studies were selected if they met the following criteria: (1) intervention was based on behavioral principals (2) participants were five years of age or younger at the onset of intervention (3) the intervention was in-home or clinic-based (4) utilized a group research design. Of the 15 studies seven met the inclusion criteria (Lovaas, 1987; Magiati, Charman, & Howlin, 2007; Remington et al., 2007; Sallows & Graupner, 2005; Sheinkopf & Siegel., 1998; Smith, Eikeseth, Klevstrand, & Lovaas, 1997; Smith, Groen, & Wynn, 2000). An additional study by Wolf, Risley, & Mees (1964) was included in this section as it is a foundational case-study addressing the first applications of behavioral strategies for a child with ASD.

While single-case design (SCD) is often used in ABA related studies, only group design studies were used as these designs allow for treatment comparison conditions (Cooper et al., 2007). The studies presented in this review are either quasi- experimental or experimental. Quasi-experimental studies were defined as studies that compared

outcomes for two groups of participants, did not utilize any type of randomization, and established the equivalence of participants by having a selection criterion and/or administering assessments prior to treatment. Experimental studies were defined as studies that compared outcomes for two groups of participants and implemented randomization procedures. Table 1 provides an overview of the intervention studies of early childhood ABA.

Foundational Studies of Early Childhood ABA

Early studies implementing applied behavior analysis as an intervention for children with ASD date to the early 1960's (Hall, 2018). Wolf, Risley & Mees (1964) conducted a case study of a three-year-old child named Dicky with ASD who engaged in high rates of aggressive, self-injurious, and non-compliant behaviors. The targeted behaviors were tantrums, sleeping independently, wearing glasses, throwing glasses, language, and eating appropriately. To target these behaviors the researchers provided one-on-one sessions for a total of seven months in which punishment, reinforcement, and shaping procedures were implemented. After the consistent implementation of the behavioral strategies a decrease in problem behavior and an increase in more functional and desirable behavior across all targeted behaviors were observed. A few years after, colleagues and graduate students who worked with Wolf and Risley opened their own programs and schools for children with ASD (Hall, 2018). One of these programs was the UCLA Young Autism Project.

Lovaas (1987) conducted a quasi-experimental study in which children with ASD below the age of four received clinic-based early childhood ABA for more than two

Table 1
Intervention Studies of Early Childhood ABA

Study	Total sample size	Participants age	Intervention	Measures	Findings
Lovaas (1987) (Quasi-experimental)	38	Below 4 years	T1 - Clinic-based early childhood ABA (40 weekly hours for ≥ 2 years) T2 - Clinic-based early childhood ABA (10 weekly hours for ≥ 2 years) T3 - Clinic-based early childhood ABA (10 weekly hours for ≥ 2 years)	Intellectual functioning (e.g. Bayley Scales of Infant Development) Behavioral observations (i.e. videotape recordings) Parent interviews Educational placement	Significant differences in IQ and educational placement favoring T1.
Magiati et al. (2007) (Quasi-experimental	44	4.5 years and below	T1- Home-based early childhood ABA (32.4 weekly hours for ≥ 2 years) Comparison - Nursery provisions (25.6 weekly hours for ≥ 2 years)	Intellectual functioning (e.g. Bayley Scales of Infant Development Adaptive behavior (Vineland Adaptive Behavior Scales) Receptive and expressive language (i.e. British Picture Vocabulary Scale II, Expressive One-word Picture Vocabulary Test) Play (i.e. Symbolic Play Test, Test of Pretend Play)	Despite large differences in IQ and language favoring T1 no significant differences between T1 and comparison across all measures.

Table 1 continued

Study	Hours	Participants age	Intervention	Measures	Findings
Remington et al. (2007) (Quasi-experimental)	44	Below 4 years	T1- Home-based early childhood ABA (25.6 weekly hours for ≥ 2 years) Comparison - Other publicly funded treatment (17 weekly hours in special education, 15 weekly hours in mainstream and 15 weekly hours in mixed placements)	Intellectual functioning (e.g. Bayley Scales of Infant Development Language (i.e. Reynell Developmental Language Scales) Adaptive behavior (Vineland Adaptive Behavior Scales) Child Behavior (e.g. The Positive Social Subscale) Social Communication Skills (i.e. The Early Social Communication Scales	Significant differences in IQ, language and adaptive behavior favoring T1.
Sallows & Graupner (2005) (Experimental)	23	Below 4 years	T1- Clinic-based early childhood ABA (40 weekly hours for ≥ 2 years) T2 - Parent-directed early childhood ABA (From 14-32 weekly hours for ≥ 2 years)	Intellectual functioning (e.g. Bayley Scales of Infant Development Language (i.e. Reynell Developmental Language Scales) Adaptive behavior (Vineland Adaptive Behavior Scales) Social Functioning (i.e. Subscales of the Vineland)	No significant differences across all measures. Combined outcomes showed 11 participants reaching average IQ (≥ 85).
Sheinkopft & Siegel (1998) (Quasi-experimental)	22	Below 4 years	T1- Home-based early childhood ABA (19.45 weekly hours for ≥ 2 years Comparison - School based and brief 1:1 treatment (11.13 weekly hours)	Intellectual functioning (e.g. Bayley Scales of Infant Development Parent Interviews Behavioral Observations	Statistically significant differences in IQ favoring T1 and less parents reports of positive DSM symptoms.

Table 1 continued

Study	Hours	Participants age	Intervention	Measures	Findings
Smith et al. (1997) (Quasi-experimental)	21	Below 4 years	T1- Home-based early childhood ABA (30 weekly hours for ≥ 2 years) T2 - Home-based early childhood ABA (10 weekly hours for ≥ 2 years)	Intellectual functioning (e.g. Bayley Scales of Infant Development Language and other types of behaviors (i.e. Intake & behavioral reports)	Statistically significant differences in IQ and language favoring T1. Higher reports of spoken words in T1.
Smith et al. (2000) (Experimental)	28	Below 4 years	T1 - Home-based early childhood ABA (30 weekly hours for ≥ 2 years) T2 – Parent-directed early childhood ABA (5 weekly hours for 3 to 9 months and 1 weekly hour of supervision)	Intellectual functioning (e.g. Bayley Scales of Infant Development Language (i.e. Reynell Developmental Language Scales) Adaptive behavior (Vineland Adaptive Behavior Scales) Socioemotional functioning (e.g. Achenbach Child Behavior Checklist, Teacher Report Form) Academic Achievement (e.g. Wechsler Individualized Achievement Test) Class Placement	Statistically significant differences in IQ, visual spatial, and language favoring T1. T1 had less restrictive educational placements. No significant differences in adaptive behavior.

Note: ABA = applied behavior analysis; T1 = treatment one; T2 = treatment two; T3= treatment three

years. Prior to intervention researchers administered IQ scales, parent-interviews, and conducted behavioral observations on self-stimulatory behavior, appropriate play, and language. Participants were placed in either the first treatment group (n = 19) who received 40 hours a week of early childhood ABA intervention or the second treatment group (n = 19) who received ten hours a week of the same ABA intervention. A total of 21 other children with ASD were selected from a larger group to serve as the third treatment group controlling for any bias in participant assignment. Intervention conditions were the same across all the groups with the exception of intervention dosage. The intervention followed the procedures outlined in the Lovaas et al. (1980) manual. The conceptual basis of the intervention relied on the reinforcement (operant) theory and discrimination methods. Operant theory and discrimination methods point out the impact of antecedents and consequences on behavior (Cooper et al., 2007). The A-B-C model of behavior plays a critical role in operant theory and discrimination methods. Thus, ideas about antecedents and consequences guided procedures used during intervention to target problem behaviors and teach new behaviors.

During the first year the target behaviors included self-stimulatory behaviors, aggressive behaviors, compliance with verbal requests, imitation, and appropriate play. During the second year, target behaviors included expressive language and interactive play with peers. The third year included appropriate expression of emotions, reading, writing, and observational learning. Post-treatment results were analyzed by comparing outcomes of the first treatment group with the combined outcomes of the second and third treatment groups. Post-treatment IQ and educational placement outcomes showed

significantly higher IQ scores ($p < .001$) and educational placement ($p < .01$) favoring the first treatment group. Lovaas (1987) reported that 47% of children in the first treatment group versus 2% of children in the combined treatment group successfully passed first grade in a general education classroom. Additionally, 47% of children in the first treatment group obtained a mean IQ score of 107 whereas 2% of children in the combined treatment group obtained a mean IQ score of 99.

This study was not only one of the first to report improved outcomes in educational and intellectual functioning for children with ASD but was the first to report that 40 weekly hours of early childhood ABA led to such outcomes. Therefore, this study set the expectation for intervention dosage: 40 weekly hours for two or more years.

Findings from Quasi-Experimental Studies of Early Childhood ABA

A decade later, Smith et al. (1997) conducted a quasi-experimental study with 21 participants below the age of four with severe ASD symptomatology. Participants were assigned to two treatment groups contingent on intervention dosage. Participants in the first treatment group (n = 11) received 30 or more weekly hours of clinic-based ABA and participants in the second treatment group (n = 10) received 10 or fewer weekly hours of the same intervention for two years. Out of the 11 participants in the first treatment group six were enrolled in the UCLA Young Autism Project and the remainder were enrolled in either the University of Oslo Autism Project or the Kansas Autism Project, both replication sites of the UCLA project. All participants in the second treatment group were enrolled in the UCLA Young Autism Project, however they only received 10 of fewer weekly hours because they did not qualify for 40 weekly hours of ABA.

Although different sites offered the intervention, all participants received early childhood ABA based on the UCLA model. Individuals who had two years of experience with the UCLA model or completed a full-time internship at UCLA supervised each site to ensure that the intervention was similar across sites. Pre and post-test measures included intellectual functioning scales, parent interviews, and coded intake and termination reports for language and problem behaviors. With the exception of IQ scores, all the pre and post-test outcomes were obtained from the intake and termination reports. Post-test results indicated statistically significant differences in IQ ($t(20) = 2.30$, $p < .001$) and language ($U(10,11) = 6$, $p < .001$) between the treatment groups. Findings in this study supported the effectiveness of early childhood ABA based on the UCLA model at increasing IQ and language skills. In addition, findings showed that children with ASD receiving 30 weekly hours of early childhood ABA could achieve similar outcomes as children who received 40 weekly hours of ABA in Lovaas (1987).

Sheinkopft and Siegel (1998) conducted another two-year quasi-experimental study around the same time with 22 participants ages four and below with ASD or pervasive developmental disorder (PPD). Children who received parent-directed early childhood ABA in addition to school-based and brief one-on-one interventions formed the treatment group (n = 11) and children who only received a combination of school-based and brief one-on-one interventions formed the comparison group (n = 11). Participants in the treatment group received a combined total of 27 weekly hours of intervention, however 19.45 weekly hours were reserved for early childhood ABA. The comparison group received 11.13 weekly hours of school-based and brief one-on-one

intervention. Participants were matched on the following variables: chronological and mental age, diagnosis, and gender. Based on a collection of parent interviews, it was concluded that participants in the treatment group received early childhood ABA based on the UCLA model. School-based interventions included services provided in special education classrooms and brief one-to-one services, such as speech and language therapy.

Pre- and post-measures included standardized cognitive assessments, parent interviews, and behavioral observations. Parent interviews and behavioral observations were used to measure symptom severity by rating each DSM-III-R symptom on a 4-point severity scale and counting the total number of symptoms present. IQ outcomes revealed statistically significant differences ($t(8) = 3.36$, $p = .01$) between the treatment and comparison group with a 25 point IQ score increase in the treatment group. Additionally, observational results indicated less DSM symptoms favoring the treatment group, however the difference did not reach statistical significance. Findings in this study showed that when compared to a combination of school-based and brief one-on-one interventions, in-home parent directed childhood ABA resulted in statistically significant IQ gains, further reinforced findings from Lovaas (1987) and provided preliminary data supporting 27 weekly hours of treatment with 19.45 weekly hours dedicated to early childhood ABA.

Two decades later, Remington et al. (2007) conducted a two-year quasi-experimental study with a total of 44 participants with ASD below the age of four. Participants were placed in the intervention group (n = 23) if they received home-based early childhood ABA or the comparison group (n = 21) if they received other publicly

funded intervention. Children in the treatment group received 25.6 weekly hours of early childhood ABA. The exact intervention dosage for the comparison group was not reported. However, it was reported that children spent 17 weekly hours in special education, 15 weekly hours in mainstream, and another 15 hours in mixed placement. Although early childhood ABA intervention was delivered by a range of service providers, they all delivered in-home one-to-one teaching based on behavioral principles.

Pre- and post-test measures included intellectual functioning assessments, language scales, adaptive behavior surveys, child behavior scales, and observational measures of nonverbal social communication. Results showed that there were significant differences in IQ, language, and adaptive behavior favoring the intervention over the comparison group. Additionally, parents reported improved social behavior. Findings in this study reinforced the effectiveness of early childhood ABA in increasing IQ, language, adaptive skills, and social behavior for children with ASD when compared to other publicly funded services (e.g. speech therapy) and provided data supporting 25.6 weekly hours of early childhood ABA.

Lastly, this same year Magiati et al. (2007) conducted a quasi-experimental study with 44 participants ages five and below with ASD. Participants were placed in the treatment group (n = 28) if they received home-based ABA by a recognized organization or the comparison group (n = 16) if they received school-based intervention. Participants in the treatment group received 32.4 weekly hours of one-on-one intervention based on behavioral principles, whereas participants in the comparison group received 25.6 weekly hours of intervention in nurseries, ASD classrooms, or general educational classes.

Outcome measures included intellectual functioning, adaptive behavior scales, language scales, and symbolic play assessments. Results showed increases in all areas, however differences between the groups were not statistically significant. Despite the lack of statistically significant results, findings in this study revealed increased gains in intellectual functioning along with other skills from early childhood ABA.

Findings from Experimental Studies of Early Childhood ABA

Two studies done nearly two decades after Lovaas (1987) replicated some of the parameters of the UCLA Young Autism Project. Smith et al. (2000) conducted an experimental study with a total of 28 participants below the age of four with ASD and PDD who received home-based early childhood ABA intervention for two years. Participants were divided into two cohorts based on their diagnosis, paired on IQ, and randomly assigned by pairs to either the first treatment group (n = 15) receiving an average of 30 weekly hours of intervention or the second treatment group (n = 13) receiving an average of six hours a week of the same intervention. The differences between groups were intervention dosage and the intervention implementer.

Outcome measures included standardized cognitive development assessments, visual spatial assessments, language scales, parent interviews for adaptive functioning, socioemotional functioning checklist, a test of academic achievement, class placement, and parent evaluations. Results indicated that there were statistically significant differences in IQ, visual spatial, and language between the two treatment groups. Participants in the first treatment group achieved a higher mean IQ by 16.8 points, visual spatial score by 15.16 points, total mean language score by 26.07 points. Therefore,

findings in Smith et al. (2000) provided data supporting 30 weekly hours of early childhood ABA intervention for children with ASD.

In 2005, Sallows and Graupner conducted an experimental study with a total of 23 participants below the age of four who received early childhood ABA for four years. Participants were randomly assigned to the first treatment group who received an average of 40 weekly hours of clinic-based ABA (n = 13) or the second treatment group who received anywhere from 14 to 32 weekly hours of parent-directed ABA (N = 10). Both groups received intervention based on the UCLA model with the only differences including intervention dosage and supervision levels.

Pre and post-test measures included IQ, language, adaptive behavior, and social functioning measures. Outcomes were not significantly different between the groups, consequently, scores were combined. Combined outcomes indicated that eight of the participants obtained an IQ score of 85 or higher after one year and that three obtained this same IQ score after three to four years of intervention, with a total of 11 participants reaching average IQ scores. Findings suggested that despite the lack of university resources as those provided in Lovaas (1987) and parents as intervention implementers, early childhood ABA increased educational and intellectual functioning for children with ASD. This was a critical finding as it pointed out that ABA was equally effective in a less rigorous setting. Consequently, prompting the possibility of expanding this intervention into the community, home, and schools.

The seven studies summarized in this section do not encompass all the early childhood ABA intervention studies. Other studies have been conducted between 1998-

2007 and beyond 2007 (Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Cohen, Amerine-Dickens, & Smith, 2006; Estes et al., 2015; Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991; Kovshoff, Hastings, & Remington, 2011). Some of these studies have focused on addressing the generalization of early childhood ABA in different settings, such as in the schools (Eikeseth et al., 2002; Eikeseth, Klintwall, Jahr, & Karlsson, 2012; Eldevik et al., 2006) and pairing ABA with other techniques, such as the Early Start Denver Model (Dawson et al., 2012; Rogers et al., 2012). The seven studies summarized in this paper represent some of the historical studies in early childhood ABA that address the effectiveness of early childhood ABA at increasing intellectual, educational, and language skills for children with ASD. ABA is a young field constantly growing to address new findings, such as those regarding definitions of early childhood ABA intervention. Despite this, studies have not been successful at addressing the influence of demographics and culture on early childhood ABA outcomes related to the early detection of ASD and access to intervention. In fact, the seven studies presented in this paper serve as an example of this (Lovaas, 1987; Magiati et al., 2007; Remington et al., 2007; Sallows & Graupner, 2005; Sheinkopf & Siegel., 1998; Smith et al., 1997; Smith et al., 2000). The following sections point out how demographics and culture influence the early detection of ASD and access to treatment and discuss the importance of accounting for these variables.

Considerations of Demographics and Culture

Importance of Early Diagnosis

Early diagnosis is a challenge confronted by all families (Boyd et al., 2010; Daniels & Mandell, 2013). A significant portion of children remain undiagnosed until school age, with specific groups of children receiving a diagnosis later in life more so than others (Kogan et al., 2007; Mandell et al., 2007; Rice, 2009; Thomas et al., 2012). The mean age range at which children receive a diagnosis is 38 to 120 months (Daniels & Mandell 2013; Zwaigenbaum et al., 2009). This is critical as the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) discusses that the onset of ASD symptoms are typically seen during the second year of life. To address this discrepancy researchers are investigating ways to effectively identify and capture the early signs of ASD (Boyd et al., 2010; Blacher et al., 2014; Johnson & Myers, 2007). Currently, studies are examining behavioral warning signs, head circumference, user-friendly ways to communicate research in ASD, culturally responsive ways to address ASD awareness, and culturally sensitive diagnostic assessment protocols (Boyd et al., 2010; Blacher et al., 2014; Johnson & Myers, 2007). This research seeks to help decrease the age at which children receive a diagnosis, consequently reducing the age at which children begin intervention.

Reports of Children Living in Low-Income Families

Socioeconomic status (SES) not only determines access to resources, but it determines the quantity and quality of resources (Chung et al., 2014; Hanson & Espinosa, 2016; Zuckerman et al., 2014). The economic welfare of children and families is critical

as living in poverty has been linked to risk factors resulting from limited access to education, food, and healthcare (Hanson & Espinosa, 2016; Jiang et al., 2017). Reports from an annual survey suggest that poverty is a problem affecting a large proportion of children in the United States. Jiang, Granja, and Koball (2017) pointed out that 10.5 million children below the age of six and 20.1 million children between the ages of six and 17 are living in low-income families. That is 45% of children under the age of six and 41% of children between ages six to 17 are living in these conditions. This shows that the percentage of children living in low-income families varies by the children's age, with children under the age of six being the most likely to live in low-income families (Jiang et al., 2017).

The same annual survey indicated that the percentage of children in low-income families varies by race and ethnicity. Reports showed that 33% of Caucasian children, 68% of African American children, 63% Hispanic children, 29% of Asian children, 65% of American Indian, and 40% of some other race live in low-income families (Jiang et al., 2017). These reports are critical as access to resources, awareness of developmental disabilities, and economic security is key for children with ASD to receive an ASD diagnosis and intervention (Liptak et al., 2008; Zuckerman et al., 2014).

Reports of ASD Prevalence

Reports from specific racial and ethnic groups has led researchers to examine the association between the prevalence rate of ASD, age of diagnosis, SES, race, and ethnicity (Kogan et al., 2007; Mandell, Ittenbach, Levy, Pinto-Martin, 2007; Rice, 2009; Thomas et al., 2012). An analysis of Medicaid- reimbursements from 1993 to 1999

addressed that Caucasian children were almost three times more likely than African American children to receive an ASD diagnosis on their first visit to a psychologist (Mandell et al., 2007). A similar study examining the school and medical records of 586 children who met surveillance criteria for ASD found that prevalence of ASD was lower in African American and Hispanic children and higher in Caucasian and Asian children (Thomas et al., 2012). Kogan et al. (2007) further reinforced such findings by reporting lower odds of ASD among African America and multiracial children. These findings also match findings by the Centers for Disease Control and Prevention (CDC). The CDC reported statistically lower prevalence rates of ASD for African Americans and Latinos (Rice, 2009). Overall, less documentation and a delayed diagnosis of ASD among Latinos/Hispanics and African Americans suggest the under identification of ASD in non-Caucasian groups.

Reports of Barriers by Latino Parents

To better understand the possible relationship between SES, race, and ethnicity, some research in developmental disabilities has focused on the experiences of specific groups of individuals (Liptak et al., 2008; Zuckerman et al., 2014). A qualitative study exploring Latino perspectives on barriers to an ASD diagnosis addressed the barriers of time (Zuckerman et al., 2014). Parents pointed out that attending and scheduling diagnostic related appointments was challenging. They explained that working multiple jobs left them with limited time to attend appointments and that while requesting time off was an option they feared that doing so would place their jobs at risk. As such, many families pushed their developmental concerns aside.

Another challenge for Latino families was economic security. Parents discussed the difficulty of attending appointments that required transportation and paying for childcare. In addition, parents communicated that covering the cost of consultation fees and treatment was not economically possible. Lastly, another barrier was poor relationships with primary-care providers. Parents discussed that they did not have strong relationships with their primary-care providers often feeling uncomfortable, insecure, and ignored when they shared their concerns. Families disclosed that they felt that their primary-care providers underestimated their knowledge about child development, therefore ignoring their concerns and opinions.

Reports by Latino parents regarding barriers match findings in a study analyzing data from the National Survey of Children's Health. Liptak et al. (2008) examined disparities in diagnosis and access to healthcare and found that Latinos followed by African Americans encountered more challenges getting medical care. Latinos and African Americans were less likely to receive medical care in a timely manner, consequently children were less likely to have regular visits to the doctor. Findings from this study further support the presence of barriers to an ASD diagnosis as reported by Latino parents and highlights the presence of disparities in the healthcare system.

Specific Cultural Variables

Culture defines the way individuals understand, categorize, and standardize behaviors (Chung et al., 2014). It impacts the expectations individuals have for the presence of specific behaviors, including eye contact, pointing, socialization levels, personal space, and physical touch. As such, when it comes to child development the

expected milestones might differ: What one parent might consider typical behavior another parent might consider concerning. As an example, in some cultures it is considered disrespectful when a child provides direct eye contact when an adult is speaking (Chung et al., 2014). In this case, a lack of eye contact would be perceived as typical rather than concerning behavior.

Another example has been observed in Latino families. Although Latino children had deficits in social skills, parents did not report this as a concern or identify a lack of social skills as a red flag (Blacher et al., 2014). In this case, Latino parents might categorize a lack of social skills as culturally respectful behavior, as children in Latino families are expected to show respect to their elders by not speaking unless spoken to (Bridges et al., 2012). Overall, these two examples highlight the impact that culture has on defining and categorizing behavior, specifically a lack of eye contact and social skills which are key markers of ASD (American Psychiatric Association, 2013).

Additionally, perceptions of disabilities stemming from cultural beliefs impact the levels at which parents disclose concerns, seek a diagnosis, and choose a treatment option. Zuckerman et al. (2014) explained how some Latino communities perceived disabilities as shameful and embarrassing. The negative stigma associated with disabilities often deterred parents from disclosing their concerns and seeking care (Zuckerman et al., 2014). Further, Chung et al. (2014) noted that in China having a child with a disability is considered a failure. As a result, many Chinese parents do not disclose their child's disability and hesitate to ask for help (Chung et al., 2014).

The Importance of Cultural Context

Parents play an active and a vital role in their child's social, emotional, and educational development. According to the ecological model, children are influenced by interrelated systems. This model places children at the center with family and social structures surrounding the child, highlighting the critical role that parents play in their child's life (Hall, 2018, Dunst & Espe-Sherwindt, 2016). This idea, also known as family-centeredness has been adopted by early childhood ABA and has led to parent-mediated and parent-directed strategies (Hall, 2018; Odom, 2004). These strategies are labeled as evidenced-based practices by The National Professional Development Center on ASD (Hall, 2018). Zwaigenbaum et al. (2016) pointed out that active family involvement during intervention sessions can positively impact outcomes by increasing intervention time, aiding with generalization, and empowering parents and family members. However, parent participation can be challenging to promote (Hall, 2018). Research suggests that cultural competence can help service providers build a collaborative and mutually respectful relationship with family members (Dunst & Espe-Sherwindt, 2016; Hall, 2018; Hanson & Espinosa, 2016; Ispa & Halgunseth, 2006; Zwaigenbaum et al., 2016).

Chung et al. (2014) and Zwaigenbaum et al. (2016) remind us that culture impacts definitions and ideas about behavior, disabilities, treatment options, and communication preferences. In ABA sessions this applies to all active participants including, the child, parents, family members, therapists, supervisors, and clinical directors. Thus, in early childhood ABA, culture might influence ideas about parenting styles, goals, priorities,

and best practices. Dismissing a family's cultural background or a lack of cultural competence on part of the service provider can lead to barriers and misunderstandings during treatment (Zwaigenbaum et al., 2016). Ispa and Halgunseth (2006) note that individualizing approaches and services is critical as goals and child-rearing practices are guided by culture. Hanson and Espinosa (2016) explain that child rearing practices, expectations, and notions about intervention differ based on the family's cultural background. Therefore, culture should be acknowledged when working with families and children with ASD.

Furthermore, Odom et al. (2004) highlights that family-centeredness is a feature of early childhood intervention and that culture should shape practice. Although Odom et al. (2004) takes a more holistic approach by addressing culture in different countries, this idea applies to more micro level situations considering the diverse cultural background of individuals in the United States (Hall, 2018). The importance of parent participation and cultural competence has led to family-centered practice scales which include the following items: staff listen to what I have to say about my child, staff respects our family's beliefs, customs, and ways of doing things, and staff talk to me in a language I understand (Dunst & Espe-Sherwindt, 2016). While researchers agree that family-centeredness and cultural competence are critical components in intervention models for children with ASD, little is known about the implementation of family centeredness practices and scales (Bruder, 2000; Dunst & Espe-Sherwindt, 2016; Hall, 2018; Hanson & Espinosa; 2016; Odom et al., 2004)

Overall, the cultural lens of families plays a critical role in the following: The categorization and understanding of child development, beliefs about disabilities, child development priorities, child-rearing practices, and expectations for early childhood interventions. The influence of culture begins prior to the identification of ASD, continues throughout the process of attaining a diagnosis/services, and lingers throughout intervention. This has led researchers to develop recommendations for working with culturally diverse families with the hope to continue spreading awareness about the importance of considering the influence of culture and training service providers in culturally responsive strategies (Hall, 2018; Wilkinson, 2017).

Discussion and Implications

The goals of this review were to provide an overview of ABA, summarize findings from some of the historical studies in early childhood ABA with a focus on intervention dosage, and discuss issues associated with early detection of ASD and access to intervention. Findings from all seven of the intervention studies of early childhood ABA reported increased intellectual functioning, educational placement, language skills, and adaptive skills for children with ASD (Lovaas, 1987; Magiati et al., 2007; Remington et al., 2007; Sallows & Graupner, 2005; Sheinkopf & Siegel., 1998; Smith et al., 1997; Smith et al., 2000). Out of the seven studies, five reported statistically significant gains favoring the treatment group (i.e. clinic or home-based early childhood ABA) across all measures (Lovaas, 1987; Remington et al., 2007; Sheinkopf & Siegel., 1998; Smith et al., 1997). Results suggest that although gains were observed across all measures, some gains did not reach statistical significance (Magiati et al., 2007; Sallows & Graupner, 2005;

Smith et al., 2000). This means that some children are either not attaining the intended level of gains, not responding to early childhood ABA, or a combination of both. Despite this, most of the studies supported the effectiveness of early childhood ABA for children with ASD.

Intervention dosage

Regarding intervention dosage, studies reported mixed results. Only three studies examined intervention dosage by comparing the intellectual and educational outcomes of two groups of children who received the same type of early childhood ABA intervention (Lovaas et al., 1987; Smith et al., 1997; Smith et al., 2000). Findings from Lovaas et al. (1987) showed that 40 weekly hours of early childhood ABA resulted in significantly higher IQ and educational placement when compared to 10 weekly hours of the same intervention. However, a decade later Smith et al. (1997) and nearly two decades later Smith et al. (2000) showed that 30 weekly hours of early childhood ABA also resulted in statistically higher IQ, visual spatial, and language skills when compared to an average of 10 weekly hours of the same intervention. Although the remainder of studies did not directly examine intervention dosage, they provided evidence that anywhere from 25 to 30 hours a week of early childhood ABA also resulted in statistically significant gains for children with ASD when compared to other types of treatment (Remington et al., 2007; Sheinkopf & Siegel., 1998). In summary, the mean weekly intervention dosage for early childhood ABA based on the seven studies was 31.10 hours with intervention dosage ranging from 40 to 19.45 hours.

Demographics

An annual survey reported that a total of 30.6 million children are living in low-income families with 10.5 million being children under the age of six (Jiang et al., 2017). Out of the 10.5 million children 5.8 million children are Hispanic and African American (Jiang et al., 2017). These same racial groups report more problems getting specialized care, a primary care provider, and documentation of ASD when compared to Caucasians. Additionally, they reported poor relationships with primary care providers due to dismissive responses when they disclosed their developmental concerns (Liptak et al., 2008; Mandell et al., 2009; Zuckerman et al., 2014).

Access to resources (e.g. health care) and economic security is essential in attaining an ASD diagnosis and intervention (Zuckerman et al., 2014). However, access to resources and economic security seems to be more challenging for specific groups of individuals as reports indicate economic, racial, and ethnic disparities in the acquisition of resources (Jiang et al., 2017; Kogan et al., 2017; Mandell et al., 2017; Rice, 2009; Thomas et al., 2012). Thus, SES, race, and ethnicity can negatively impact the age at which children receive a diagnosis of ASD and begin intervention.

Cultural Lens of Families

The cultural lens of the child's family is a factor that is important to consider. Different cultures perceive the same behavior in different ways. For example, Chung et al. (2014) discussed how eye contact and social skills are perceived very differently by individuals from diverse cultural backgrounds. While lack of eye contact and social skills are markers of ASD, the absence of these behaviors in some cultures is considered typical

(Blacher et al., 2014; Bridges et al., 2012; Chung et al., 2014). Further, different cultures perceive disabilities in different ways. Chung et al. (2014) and Zuckerman et al. (2014) discuss that having a child with a disability is considered a failure and a punishment in some cultures. As such, the cultural background of families can delay the identification of ASD by masking the early markers of ASD and deterring parents from sharing their developmental concerns and seeking a diagnosis and/or treatment (Chung et al., 2014; Zuckerman et al., 2014). As one team of researchers explained: ASD might be "in the eye of the beholder" (Blacher et al., 2014, p. 1655).

The cultural lens of families should also be considered during intervention. Understanding and respecting differing treatment expectations, priorities, and child-rearing practices helps families become active participants during treatment (Hall, 2018). However, failing to do this leads to disagreements between families and service providers, consequently negatively affecting and delaying treatment (Hall, 2018; Zwaigenbaum et al., 2016). Due to the critical role that culture plays, beginning prior to ASD detection and throughout the whole process, this variable should be acknowledged and considered in the research and application of early childhood ABA intervention.

Limitations and Future Directions

There are several limitations to be considered when interpreting the findings from this review. First, a total of seven studies of early childhood ABA intervention were identified and selected. This limits the scope of results on intellectual, educational, language, and adaptive behavioral gains for children with ASD along with intervention dosage. Second, out of the seven studies, three studies compared outcomes from early

childhood ABA with other interventions (e.g. treatment as usual) while four compared outcomes of early childhood ABA intervention with modified conditions of early childhood ABA. Third, out of the seven studies, two reported information on treatment fidelity, however description of treatment fidelity procedures along with measurement was not clear or the description provided seemed to address training procedures rather than actual treatment fidelity (Sallows & Graupner; Smith et al., 2000). Lastly, it should be noted that the literature on demographics and culture only addressed these variables as the variables influencing the trajectory and effectiveness of early childhood ABA intervention, however other variables including symptom severity, language abilities, treatment integrity, and professional competency have been addressed as influencing outcomes (Fryling, Wallace & Yassine, 2012; Hall, 2018; Harris & Handleman, 2000; Itzchack & Zachor, 2011; Peterson, Homer & Wonderlich, 1982; Wilkinson, 2017; Wheeler, Baggett, Fox & Blevins, 2006).

Despite the limitations, the literature highlighted the role of demographics and culture on masking the early signs of ASD, deterring families from disclosing developmental concerns, and impacting access to resources. Thus, while early childhood ABA is an evidence-based intervention option for children with ASD, there is much needed work to further investigate and account for important variables that might mediate or moderate outcomes associated with the early detection of ASD, access to treatment, and treatment implementation. Future research should consider controlling for the variables presented in this paper and/or other variables addressed in studies as influencing early childhood ABA outcomes by holding the selected variable constant when

comparing outcomes. Additionally, while demographics and cultural variables were presented independently of one another, it is critical to acknowledge the possibility of these variables along with others having an interaction effect. Future research should investigate the presence and strength of interactions between variables. This information could help identify the variables and/or combination of variables that might have a greater influence on early childhood ABA outcomes, in turn providing researchers with a hierarchical list of variables that should be accounted for when conducting studies in early childhood ABA.

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