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DISCUSSION AND REVIEW PAPER

Can the Early Start Denver Model Be Considered ABA Practice?

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Abstract

The Early Start Denver Model (ESDM) is an evidence-based early intervention approach for young children with autism spectrum disorder. Although the ESDM is described by its authors as being rooted in applied behavior analysis (ABA), some states, agencies, and scholars consider the ESDM to qualify as ABA practice, whereas others do not. The purpose of this article is to examine the status of the ESDM in relation to the 7 dimensions established by Baer, Wolf, and Risley ("Some Current Dimensions of Applied Behavior Analysis," *Journal of Applied Behavior Analysis*, 1(1): 91–97, 1968) to define applied behavior-analytic research and intervention, as well as to discuss implications for the field.

Keywords ABA · autism · Early Start Denver Model · naturalistic developmental behavioral intervention

Research on early intervention for autism spectrum disorder (ASD) has experienced an unprecedented growth in the past decade, including an increased number of clinical trials that test naturalistic developmental behavioral interventions (NDBIs; Dawson et al., 2010; Gengoux et al., 2019; Kasari et al., 2014; Wetherby et al., 2014)—that is, intervention packages for young children with ASD designed to blend strategies rooted in applied behavior analysis (ABA) and developmental science (Schreibman et al., 2015). NDBIs use operant conditioning principles to promote the acquisition of socially important behaviors in the context of naturalistic and socially engaging routines that incorporate children's choices and everyday-life materials. Within this framework, the environment is arranged so that the child initiates communicative interactions and experiences the natural contingencies of his or her self-initiated behavior. Intervention targets are informed by research on the developmental sequences and prerequisites for the acquisition of specific skills (e.g., joint attention, imitation, and functional play as key precursors to language), which, in turn, enable the child to participate in experiences that further contribute to his or her learning. Additional elements shared by NDBIs include the manualization of procedures for treatment delivery, fidelity monitoring, and measurement of child progress (Bruinsma, Minjarez, Schreibman, & Stahmer, 2020; Vivanti & Zhong, 2020).

Although systematic reviews and meta-analyses report positive treatment outcomes in response to NDBI approaches (Sandbank et al., 2019; Tiede & Walton, 2019), questions have been raised about the status of NDBIs in the context of ABA science and practice. For example, the Early Start Denver Model (ESDM; Rogers & Dawson, 2010a), an NDBI approach that has been described as being rooted in ABA by its developers (Rogers & Dawson, 2010a), is considered to qualify as an ABA practice for funding purposes in some US states but not in others. This is important because most states now have legislation requiring insurance coverage for ASD, and ASD services can also be funded by public early intervention programs (Part C of the Individuals with Disabilities Education Improvement Act [IDEA] of 2004). Although there is a general behavioral health benefit, some mandates specifically mention ABA, and families report denial of other evidence-based practices. Additionally, some studies include the ESDM trials as evidence supporting ABA practice (e.g., Dixon, Paliliunas, Barron, Schmick, & Stanley, 2019; Keenan et al., 2015; Lotfizadeh, Kazemi, Pompa-Craven, & Eldevik, 2018), whereas other studies have described the ESDM as falling outside of ABA (e.g., Busch, 2017).

Despite the far-reaching implications of this debate for practice and policy, to our knowledge, no systematic analysis has been conducted on whether the ESDM qualifies

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as an ABA practice. In the following sections, we address this gap by describing the main features of the ESDM and examining its status in relation to the seven dimensions established by Baer, Wolf, and Risley (1968) to define applied behavior-analytic research and intervention.

The Early Start Denver Model

The ESDM is an early intervention approach for children with ASD aged 12 to 48 months that includes a manualized set of treatment procedures and a comprehensive curriculum covering multiple developmental areas (Rogers & Dawson, 2010a, 2010b). The theoretical foundations of the ESDM include a focus on the role of active experiential learning, early interaction, and social motivation for learning and development (Dawson et al., 2004; Rogers & Pennington, 1991). Additionally, the ESDM is informed by developmental research documenting how typical children learn best in the context of affectively rich interactions, self-driven goals, and in response to the natural contingencies of their self-initiated behavior (e.g., Begus, Gliga, & Southgate, 2014; Kushnir, Wellman, & Gelman, 2009).

Against this theoretical framework, behavior change in the ESDM is targeted in the context of "joint activity routines"—that is, play activities and daily routines that build upon the child's initiative and preferences to facilitate social engagement and social learning. The joint activity routine format is designed to mimic the exchanges that take place during early development between typical children and caregivers (Ratner & Bruner, 1978), whereby adults scaffold the child's acquisition of new behaviors during face-to-face interaction (e.g., peekaboo routines, song routines, clapping games) or activities involving objects (e.g., building a tower with blocks).

Within this context, skill acquisition and management of unwanted behaviors are promoted using operant conditioning principles and behavioral strategies derived from pivotal response training (PRT; Koegel, O'Dell, & Koegel, 1987; Koegel & Koegel, 2006). Implementation of the ESDM includes the creation of measurable learning objectives developed from a comprehensive assessment of the child's behavioral repertoire (the ESDM curriculum checklist; Rogers & Dawson, 2010b), with the child's progress systematically recorded against operationally defined mastery criteria. During joint activity routines, individualized learning objectives are systematically targeted through a variety of instructional techniques, including the use of antecedent-behavior-consequence (A-B-C) sequences, shaping, fading, prompting, chaining, and other behavioral procedures operationalized through a 13-item fidelity checklist. Decision trees are used to adjust teaching techniques when data indicate slower than expected progress, including increasing structure and reinforcer strength and introducing augmentative and alternative communication tools.

The ESDM is designed to be implemented by transdisciplinary teams (including Board Certified Behavior Analysts, early childhood educators, and allied health professionals) across multiple settings and delivery formats, including therapist-delivered, parent-mediated, and teacher-delivered group-based programs in day care or preschool settings (Rogers & Dawson, 2010a; Rogers, Dawson, & Vismara, 2012; Vivanti at al., 2019). As reviewed in the Effectiveness section later, research on the ESDM includes several randomized controlled trials (RCTs) reporting treatment effects in the areas of language, social communication, and cognitive functioning (Dawson et al., 2010; Estes et al., 2015; Rogers et al., 2019; Waddington, van der Meer, & Sigafoos, 2016), as well as single-subject design studies demonstrating treatment effects in the areas of communication, play imitation, attention, and initiations (Vismara, Colombi, & Rogers, 2009; Vismara, McCormick, Young, Nadhan, & Monlux, 2013a; Vismara & Rogers, 2008; Vismara, Young, & Rogers, 2013b).

In the following sections, we will map the ESDM's practices, research, and outcomes onto the framework of applied behavior-analytic dimensions.

Status of the ESDM as an ABA Practice

In 1968, Baer et al. identified seven dimensions that guide research and practice in interventions grounded by ABA. These include (a) applied, (b) behavioral, (c) analytic, (d) technological, (e) conceptually systematic, (f) effective, and (g) generality. Although this framework is not free from debate and criticisms within the ABA field (Critchfield & Reed, 2017), these dimensions are often used to determine whether an intervention and its research support are rooted in ABA.

In the following sections, we critically examine whether the ESDM meets the parameters for each of these seven dimensions.

Applied

The *applied* dimension indicates that interventions should have a practical focus and result in a socially significant impact for the individual. The ESDM is designed to have a practical impact for children and families, as it targets behaviors known to have immediate and long-term impacts on the quality of life of the child and his or her family. Such behaviors are related to nine domains that are critical to early learning and development, including receptive and expressive communication, imitation, social skills, play skills, gross and fine motor skills, cognitive skills, and independence across play, grooming, dressing, eating, chores, and hygiene. Clinicians work with caregivers to create operationally defined goals in each of these domains to be targeted by the therapist and/or caregivers across multiple settings. The

intervention's goals are arguably socially significant to the children receiving the intervention and their families, as they reflect caregivers' priorities and societal expectations related to developmentally appropriate behaviors across home and community settings. Several studies have documented the social validity of the ESDM across indicators of acceptability, satisfaction with the intervention, and the working alliance between professionals and caregivers (Holzinger, Laister, Vivanti, Barbaresi, & Fellinger, 2019; Maye, Sanchez, Stone-MacDonald, & Carter, 2020; Ogilvie & McCrudden, 2017; Rogers et al., 2019; Vismara et al., 2013a, 2013b, 2009; Vivanti et al., 2014; Waddington, van der Meer, Sigafoos, & Bowden, 2020). For example, the recent studies by Waddington et al. (2020) and Ogilvie and McCrudden (2017), using the Treatment Acceptability Rating Form–Revised (Reimers, Wacker, Cooper, & De Raad, 1992) and semistructured interviews, documented that caregivers rated the ESDM highly across items related to effectiveness, usability, and willingness to continue the intervention and reported socially significant improvements in child behavior and in the relationship between the child and the therapist, as well as an alignment of the intervention with their own parenting practices. These and other studies reporting data from caregivers, as well as therapists, early intervention providers, and preschool teachers (e.g., Holzinger et al., 2019; Maye et al., 2020), suggest that intervention impact is experienced as socially significant by its end users.

Behavioral

The *behavioral* dimension refers to relying on unambiguous operational definitions of the behaviors being targeted. Therefore, to meet the behavioral parameter, intervention targets must be operationally defined according to measurable dimensions (e.g., frequency, duration, latency) that enable reliable quantification of behavior change. The ESDM is designed to align with this parameter, as it explicitly prescribes defining intervention targets using unambiguous operational definitions (e.g., "[Child] matches three sets of objects on the basis of color, red versus green," as opposed to "has the concept of colors" or "understands colors"; Duncan, Vivanti, Dawson, & Rogers, 2017; Rogers & Dawson, 2010a). Additional guidelines on intervention goals emphasize the unambiguous specification of the antecedent (discriminative stimulus) used to cue the targeted behavior, as well as the indication of objective metrics for determining successful mastery of the targeted skills and progress toward mastery. These include criteria related to accuracy (e.g., staying on the line for 75% of the line when tracing), quantity (e.g., naming three shapes), latency (e.g., responding to one's name within 5 s), temporal duration (e.g., playing independently with specific toys with no adult prompt for 10 min), level of independence (e.g., completing 80% of the steps needed to wash one's hands without an adult's prompt), or performance against the number of opportunities (e.g., responding to "high five" in 80% of opportunities provided). The ESDM guidelines highlight the importance of establishing a clear understanding/consensus among clinicians and data collectors on the skill being targeted and the criteria to measure progress toward mastery (Duncan et al., 2017).

Analytic

The *analytic* dimension refers to the reliance on data-based decision making. The ESDM is designed to align with the analytic parameter, as it is grounded on data-based decision-making procedures, with data on each child's treatment-related change systematically collected, reviewed, and analyzed to support decisions on whether interventions should continue or be modified (Rogers & Dawson, 2010a). Additionally, the occurrence of unwanted behaviors is systematically recorded and analyzed so that a functional behavior assessment and behavioral program are created by a Board Certified Behavior Analyst on the team. Fulton, Eapen, Črnčec, Walter, and Rogers (2014) documented that the implementation of this procedure resulted in a substantial reduction of unwanted behaviors in children receiving the ESDM.

When data show a lack of measurable progress in one or more areas, a decision tree is used to guide decision making on "where to go next." This involves a flowchart containing a series of yes or no questions, with each yes or no answer moving the user to different levels to determine which modifications should be introduced to facilitate the child's progress. Modifications are based on a toolbox of evidence-based practices, including augmentative and alternative communication techniques and adult-directed ABA approaches. For example, the default ESDM procedures of varying antecedents and settings and relying on intrinsic reinforcers might be replaced by a more structured focus on repetition of the same instruction in the same setting using extrinsic reinforcers (Rogers & Dawson, 2010a; Vivanti et al., 2017b). Data on child progress are then examined to determine whether these alterations should be retained, modified, or faded.

Technological

The ESDM is designed to meet the *technological* dimension, which refers to whether the intervention techniques are identified and described so that independent trained readers can replicate the procedures and produce similar results. This is reflected in the inclusion of practices based on PRT and other ABA approaches that have been successfully replicated in independent studies, such as capturing the child's attention before delivering an antecedent; using a clear A-B-C format in teaching episodes that are delivered during play activities; reinforcing target behaviors through natural contingencies,

pairing nonsocial reinforcers with social attention, and delivering contingent consequences; systematically reinforcing the child's attempts and using shaping, chaining, prompting, fading, and error correction to facilitate skill acquisition; optimizing the child's motivation through the use of reinforcers related to the child's goals, preferences, and choices; and interspersing novel tasks with acquired tasks to optimize motivation. In addition, practices that stem from the developmental literature, such as the use of joint activity routines, sensitivity and responsivity, dyadic engagement, and positive affect and arousal, are also operationalized in a way that arguably leaves little room for interpretation. Replicability in the ESDM is achieved through a detailed manualization of all the intervention procedures and a clear fidelity of treatment implementation guidelines (Rogers & Dawson, 2010a). The ESDM's manualized procedures have been implemented by several groups independent from the ESDM's creators, who documented successful implementation fidelity and replicated positive child outcomes (e.g., Contaldo, Colombi, Pierotti, Masoni, & Muratori, 2019; Eapen, Črnčec, & Walter, 2013; Sinai-Gavrilov, Gev, Mor-Snir, Vivanti, & Golan, 2020; Holzinger et al., 2019; Tupou, Waddington, van der Meer, & Sigafoos, 2020; Waddington, van der Meer, Sigafoos, & Ogilvie, 2019; Vismara et al., 2013a, 2013b). For example, the recent study by Tupou et al. (2020) on the implementation of the ESDM in New Zealand has reported implementation fidelity ranging from 83% to 98%.

Conceptually Systematic

The *conceptually systematic* dimension refers to intervention practices being consistent with the fundamental principles that underlie (in the words of Baer et al., 1968) "behavior development." The goal of relating practices to their underlying concepts (e.g., understanding the Picture Exchange Communication System [PECS; Bondy & Frost, 1994] in terms of reinforcement, discriminant stimuli, etc.) is to equip practitioners with the understanding of not only what they should do, but also *why* they are doing it. This, in turn, facilitates a conceptually grounded selection and customization of instructional techniques according to the circumstances, particularly when children do not show the expected learning response. The ESDM is designed to achieve this goal, as intervention procedures are described with detailed reference to their conceptual framework, so that practitioners can connect treatment practices to their underlying foundations and operate conceptually driven treatment decisions (Rogers, Vivanti, & Rocha, 2017; Vivanti, Rogers, & Dawson, 2017a). In this regard, the ESDM is more than the "collection of tricks" that Baer et al. (1968) guarded against in their definition of the conceptual criterion, as the ESDM's technologies are tied to fundamental concepts of behavior development (in typical development and ASD).

Importantly, however, these concepts encompass both behavioral and developmental principles. Whereas techniques such as fading, prompting, chaining, and so on are directly tied to behavioral research, other procedures are designed to be conceptually consistent with scientific principles of human development, which emphasize the social-pragmatic foundations of language development (Kuhl, 2010; Tomasello, 1992, 2019), the nonverbal prerequisites of verbal behaviors (Adamson, Kaiser, Tamis-LaMonda, Owen, & Dimitrova, 2020; Bruner, 1983; Mundy, 2016; Trevarthen & Delafield-Butt, 2013), the role of the child's initiative in the acquisition of new skills (Baldwin & Moses, 1996; Begus & Southgate, 2018), the influence of the quality of the child's relationship with the adult on the child's learning (Feldman, Greenbaum, & Yirmiya, 1999; Fenning & Baker, 2012; Lindsey, Cremeens, Colwell, & Caldera, 2009), and the importance of sensitivity and responsivity of the adult to the child's cues (Tamis-LeMonda, Kuchirko, & Song, 2014; Wass, Whitehorn, Haresign, Phillips, & Leong, 2020), as well as other empirically grounded concepts that do not originate from behavioral research. Is the inclusion of scientific knowledge on child development a fatal threat to the conceptual criterion? As argued in the following sections, this is unlikely to be the case.

First, the ESDM accomplishes the goal of the conceptual requirement because it provides an account of *why* procedures work in terms of basic principles of behavior development, maintaining a technically precise vocabulary of concepts and related practices across behavioral and developmental frameworks. Operational definitions are provided for developmental constructs such as joint activity routines and dyadic engagement, and these are tied to empirically validated principles that guide practice. For example, knowledge about the developmental precedence of affect-sharing over verbal communication, and of point-following over gaze-following, provides a conceptually cohesive foundation for selecting developmentally appropriate goals (e.g., targeting point-following before gaze-following) and strategies (e.g., using positive affect when teaching communication during face-to-face interaction).

Additionally, developmental and behavioral principles can arguably coexist in a conceptually cohesive system because they share the same overarching commitment to empiricism (see Kuhn, 1962). Accordingly, theoretical tenets of both behavioral and developmental science are organized around "falsifiable" explanations of behavioral phenomena. That is, they generate empirically testable predictions on the behavior of individuals. Their common adherence to the empirical testability principle provides a common ground for generating evidence-based practices and offers a clear demarcation from nonscientific theories—that is, theories that do not indicate the empirical evidence needed for their support or disconfirmation, such as psychoanalytic theories (Popper, 1934/1959).

As developmental and behavioral frameworks operate according to the same scientific rule of empirical testability, the next step for establishing their compatibility is to examine whether their assumptions, although testable, provide conflicting predictions and, consequently, unsystematic guidance for practice. This would be the case if, for example, behavioral principles would predict a decrease in a behavior under specific circumstances, whereas developmental principles would predict an increase in the same behavior. Although a comprehensive examination of this issue is beyond the scope of this article, scholars generally agree that most concepts (and related practices) derived from developmental theory are complementary rather than logically irreconcilable with behavioral concepts (e.g., Mayville & Mulick, 2011; Odom, 2016; Petursdottir, 2018; Smith, 2012). For example, the prediction that learning point-following is a developmental prerequisite for (and therefore should precede) learning gaze-following, although not originating from behavioral research, is not irreconcilable with behavioral principles informing how to target those skills using specific discriminative stimuli, reinforcers, and so on. One example of how developmental and behavioral concepts are mutually informative, rather than mutually exclusive, is the elegant work by Lifter, Sulzer-Azaroff, Anderson, and Cowdery (1993) that documented how using ABA-based techniques to teach symbolic play resulted in rapid learning when steps were targeted according to the typical developmental sequence of play development. Conversely, targeting the same behaviors out of developmental sequence resulted in poor progress.

A related issue is whether developmental principles informing the ESDM, although originating from a nonbehavioral conceptual vocabulary, describe phenomena that could be ultimately boiled down to behavioral principles of reinforcement, extinction, and so forth. This might be the case for some developmental concepts (e.g., scaffolding; see Carr & Kemp, 1989), but not for all of them, as research in developmental science and related disciplines (e.g., developmental cognitive neuroscience) encompasses phenomena that are not fully accounted for (yet) by behavioral concepts (Smith, 2014). One prominent example is the ESDM's use of developmental principles to explain aspects of language development that remain unaccounted for in Skinner's analysis of verbal behavior, such as the role of preverbal dyadic engagement as the foundation for verbal development (Adamson et al., 2020; Kuhl, 2010; Tomasello, 2019). Therefore, the ESDM is conceptually systematic, but not conceptually *overlapping* with other ABA approaches such as early intensive behavioral intervention (EIBI), a comprehensive early intervention model based on discrete-trial teaching (DTT), which does not include the post-Skinnerian concepts of the social-pragmatic foundations of language (Smith & Iadarola, 2015).

To summarize, the ESDM uses a conceptually systematic framework by relating practices to underlying concepts of behavior development, which derive from scientific disciplines that produce nonoverlapping but mutually informative empirical knowledge as the foundation for theory and practice. As argued by Stahmer (2014) and Vivanti (2017), the characterization of behavioral and developmental approaches as mutually exclusive represents a false dichotomy and an obstacle to progress in our field, as applying developmental knowledge does not hinder the concurrent application of behavioral principles and does not produce conceptually unsystematic guidance for practice.

Effective

According to the *effective* dimension, data must show that intervention procedures are having the expected impact on the target behavior. The ESDM is designed to achieve effectiveness—that is, change in the child's behavior caused by receiving the intervention. Empirical research testing this notion includes several RCTs, as well as single-subject design studies, reporting treatment effects in the areas of language, social communication, and cognitive functioning (Dawson et al., 2010; Estes et al., 2015; Rogers et al., 2019; see Ryberg, 2015; Talbott, Estes, Zierhut, Dawson, & Rogers, 2016; Waddington et al., 2016; and Vivanti & Zhong, 2020, for systematic reviews of the empirical research on the ESDM). Dawson et al. (2010) provided evidence for the efficacy of the ESDM in an RCT, reporting significant gains in cognitive and language abilities in a group of preschoolers with ASD receiving 15 hr per week of individual home-based treatment over 2 years, plus 4 hr per month of individual parent coaching, compared to a matched group of children receiving intervention as usual. Pre- to posttreatment gains in cognitive functioning reflected an increase of 17.6 points in the Mullen Scales of Early Learning (MSEL) composite standard scores, corresponding to a large effect size (d = 0.96), and a change in expressive language standard scores of 12 points, also reflecting a large effect size (d = 1.11). A follow-up study of school-age children (Estes et al., 2015) documented that gains were maintained over time and that the ESDM group had decreased symptom severity compared to the control group 2 years after discontinuation of the intervention, with a 3.2-point reduction in the Autism Diagnostic Observation Schedule severity scores, reflecting a medium effect size (d = 0.52). The largest study to date on the ESDM is a multisite RCT (Rogers et al., 2019) that included over 80 young children with ASD who received either 15 hr per week of one-to-one implementation of the ESDM by a therapist over 2 years, or community-based interventions for a similar duration and intensity. Children randomized to the ESDM group achieved better language outcomes (the primary outcome measure) compared to those in the control group,

with a 30-point change in MSEL expressive language age equivalence scores from pre- to posttreatment, corresponding to a large effect size (d = 2.52). This effect held regardless of the child's initial IQ, language ability, and symptom severity. In addition to these large, group-based studies, the ESDM literature includes evidence of behavior change at the level of the individual child using single-subject design studies (Vismara & Rogers, 2008; Vismara et al., 2009; Vismara et al., 2013a, 2013b), and the ESDM's manualized procedures involve a clear process for ensuring effectiveness with an individual child using specific criteria for defining data-based progress and changes to intervention goals and procedures. To summarize, empirical research suggests that the ESDM results in behavior change that is large enough to produce a clinically and socially meaningful impact. This is reflected in the effect sizes of intervention change in clinical trials, as well as in recent research on the health care service use and related costs associated with the ESDM. Using data from participants in the Dawson et al. (2010) clinical trial, Cidav et al. (2017) documented that between the end of their intervention and age 6, children who had received the ESDM used fewer health care services (including medical and behavioral health treatments, therapy provided by allied health professionals, and special education services) compared to those in the "treatment as usual" intervention group, resulting in significant cost savings in the amount of about $19,000 per year, per child.

Importantly, however, research on the ESDM is still in its infancy, and additional research is needed to generate a body of literature comparable to that of mainstream ABA-based approaches. For example, the comprehensive review of evidence-based practices by the National Standards Project (2015) has included hundreds of studies based on ABA, resulting in the identification of many ABA-based strategies as well-established evidence-based practices. A similar body of literature is not currently available in the study of the ESDM. Crucially, this difference in the quantity of studies focused on the ESDM versus other mainstream ABA-based approaches reflects the chronological precedence of the ABA-based treatment literature, which started over 40 years before the manualization of the ESDM, rather than the relative effectiveness of the different approaches in conferring benefits to children with ASD. Although the medium to large effect sizes observed in the clinical trials of the ESDM appear to be comparable to those reported in EIBI trials (e.g., Smith, Groen, & Wynn, 2000; Smith, Klorman, & Mruzek, 2015), any inference on the superiority of the ESDM compared to EIBI or other mainstream ABA-based approaches appears to be premature based on the currently available literature. To address this gap, a large clinical trial reporting a head-to-head comparison of the ESDM and EIBI has recently concluded. Results will provide a critical contribution to the body of literature on the effectiveness of the ESDM.

Generality

The *generality* dimension refers to the notion that interventions should result in behavior change that lasts over time and occurs across settings and with different people. The ESDM is designed to achieve generality by (a) teaching objectives in the context of daily routines in natural settings and (b) including a "generalization statement" in each treatment objective, whereby the target behavior must be observed across people, tasks, and environments. For example, a treatment objective in the ESDM might read as follows:

> During play routines with peers, when a peer offers Virginia a toy or snack by holding it out toward her (within 2 ft of her face) and makes a verbal offer (e.g., "Here, Ginny."), Virginia will take the object from the peer within 3 s, on 80% of opportunities, for two consecutive playdates, across 10 different objects, and two different peers, both in home and at school. (Rogers, et al., 2017).

B53B53Evidence suggests that generality is achieved in the ESDM, as intervention improvements have been documented across settings and people and across both proximal and distal outcome measures (e.g., change in behaviors that are directly taught, as well as behaviors reflecting downstream consequences of the skill being targeted; Rogers et al., 2019a). Additionally, the longitudinal research by Estes et al. (2015) indicates that behavior change in children receiving the ESDM lasts over time.

Discussion

In this article, we examined the status of the ESDM in relation to the seven dimensions established by Baer et al. (1968) to define what it means to have research and intervention fit within the applied behavior-analytic framework. Consistent with previous observations (e.g., Schreibman et al., 2015), our analysis suggests that the ESDM is designed to meet these parameters and can therefore be situated within the landscape of applied behavior-analytic programs.

Additionally, based on its scientific support of efficacy and systematic procedures for individualization, it appears to meet the criteria of the *Professional and Ethical Compliance Code for Behavior Analysts* (Behavior Analyst Certification Board, 2016), which requires behavior analysts to rely on knowledge based on science and behavior analysis when making service decisions (section 1.01) and states that clients have a right to effective treatment based on the literature, adapted to the individual client (section 2.09). Additional ABA parameters met by the ESDM include the main points outlined in the "ABA Treatment of ASD Practice Guidelines" (Behavior Analyst

Certification Board, 2014) for determining if a practice qualifies as ABA. These include (a) an objective assessment that includes observation of how the environment affects behavior; (b) the importance of understanding the context of behavior and its social validity; (c) the use of ABA principles and procedures to improve health, independence, and quality of life; and (d) consistent, ongoing, objective assessment and data analysis to inform decision making.

Based on these considerations, the ESDM appears to align with the key principles that guide ABA practice. Thus, there appears to be no compelling rationale for recommending against the ESDM if it is appropriate for a particular child and family, or for not covering its costs under insurance mandates on the grounds of a lack of consistency with ABA parameters. These implications have far-reaching practical relevance in the context of the limited evidence-based intervention resources available to children and families impacted by ASD. Importantly, however, the point of the arguments detailed in this article is not that state mandates should fund the ESDM because the ESDM qualifies as an ABA practice. Arguably, state mandates should fund any treatment that has demonstrated effectiveness for children with ASD, regardless of the scientific discipline and conceptual framework that the treatment draws upon. Therefore, with regard to funding, the effectiveness parameter that we have discussed as one of the seven dimensions of ABA is the most relevant consideration in fulfilling children's right of receiving evidence-based intervention (see also Vivanti & Stahmer, 2018).

Finally, there are several challenges inherent to the examination of whether the ESDM (as well as other evidence-based NDBIs) qualifies as ABA practice. First, as noted previously, although the ESDM is conceptually consistent with empirically grounded principles of behavior, it is also consistent with the conceptual framework of developmental science, as reflected in the adoption of concepts such as "scaffolding," "zone of proximal development," "sensitivity and responsivity," and other constructs that do not originate from the behavioral literature. As discussed previously, the adoption of constructs from non-ABA disciplines (e.g., developmental psychology) is not inconsistent with the theoretical alignment and practical implementation of behavioral principles, as long as these constructs are rigorously operationalized and experimental control is achieved when effectiveness is tested. However, no comprehensive attempt to "translate" all developmental principles into behavioral terms has been conducted thus far. Future efforts toward a fine-grained examination of the developmental constructs that can be reframed using the behavioral conceptual vocabulary versus those that are "orthogonal" (but not logically inconsistent) to the behavioral framework will advance research and practice in the field.

Another "translational issue" that might contribute to skepticism toward the ESDM is the deliberate avoidance, in the ESDM manual, of the technical lingo familiar to ABA practitioners, in favor of terms that can be easily understood by caregivers and non-ABA clinicians (e.g., "requesting" instead of "manding"). The use of nontechnical language is meant to support collaboration, dissemination, and implementation across settings, as well as acceptability by parents and other providers. Importantly, however, the use of a more accessible terminology does not mean that practices are conceptually fuzzy, not operationally defined, or inconsistent with empirical knowledge. The importance of conceptually grounded and unambiguous operational definitions is unequivocally emphasized in the ESDM manual, and this is arguably reflected in the successful replication of intervention procedures by independent groups (e.g., Waddington et al., 2019).

Additionally, most, although not all, research on the ESDM relies on group designs, a methodological approach that might be less familiar to many ABA practitioners compared to single-subject designs. Importantly, however, randomized trials provide a rigorous approach to infer causal relationships between intervention procedures and behavior change, and represent the gold-standard approach promoted by agencies funding scientific research and by scholars in the field (including ABA scholars; e.g., Smith et al., 2007).

Finally, an important issue raised by the examination of the ESDM in the context of an ABA framework is that of parsimony. In the context of the evolving landscape of approaches to early intervention for ASD grounded in ABA (Smith, 2012; Vivanti et al., 2018), are there clear boundaries between NDBIs, like the ESDM, and models based on DTT, like EIBI? Or is the field converging toward a unified model? Although there is evidence of ABA-grounded practices evolving toward increasingly naturalistic and developmentally sensitive approaches, the core developmental constructs used in the ESDM, such as the use of joint activity routines, positive affect and arousal, and sensitivity and responsivity, are not explicitly formalized in other ABA-based approaches such as EIBI or PRT, as reflected in manualized procedures and fidelity systems (McEachin, 2016). Therefore, a demarcation still exists between these different approaches using an ABA framework. Given the heterogeneity of needs within the population with ASD, the availability of different technologies should be seen as a strength, as long as efforts continue to be made on tying practices to the increasing body of knowledge on ASD from different scientific disciplines.

In conclusion, we were unable to identify demonstrable inconsistencies between ESDM research and practice and the guiding principles of ABA. Skepticism on the qualification of the ESDM as ABA practice might reflect a perceived (and arguably false) contrast between behavioral and developmental approaches and vocabularies, rather than theoretical or practical deviations from the seven dimensions

established by Baer et al. (1968) to define applied behavior-analytic research and intervention.

Compliance with Ethical Standards

Conflict of interest Giacomo Vivanti receives royalties from the book *Implementing the Group-Based Early Start Denver Model for Young Children With Autism*. Aubyn C. Stahmer declares that she has no conflict of interest.

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Informed consent Not applicable.

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