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Short Report: Toward Deeper Understanding and Wide-Scale Implementation of Naturalistic Developmental Behavioral Interventions

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Lay Abstract

Naturalistic Developmental Behavior Interventions (NDBIs) are a group of early

interventions that use a variety of strategies from applied behavioral and developmental sciences.

Although NDBIS have been demonstrated effective, NDBIs are not implemented on a wide scale

within early intervention programs for children on the autism spectrum. Potential reasons likely

stem from differing theoretical orientations of developmental and behavioral sciences and

practitioners' lack training, knowledge, and support for implementing NDBIs. In support of

efforts to promote wide-scale implementation of NDBIs, we: (a) clarify their common features,

(b) discuss possible misconceptions, and (c) offer reasons why NDBIs should be widely

implemented. We also provide recommendations to the autism service community, intervention

developers, and researchers.

Keywords: naturalistic developmental behavior interventions, early intervention, autism

spectrum disorders

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Abstract

Naturalistic Developmental Behavior Interventions (NDBIs) have a strong and growing evidence base. Yet, NDBIs are not implemented on a wide scale within early intervention programs for children on the autism spectrum. Potential reasons for the slow adoption of NDBIs likely stem from the differing theoretical orientations of behavioral and developmental sciences from which NDBI are derived, and a lack of training, knowledge, and support for implementing NDBIs within the behavior analytic community. In support of efforts to promote wide-scale implementation of NDBIs, we clarify their common features, discuss possible misconceptions, offer reasons why NDBIs should be widely implemented, and provide recommendations to the autism service community, intervention developers, and researchers to improve their dissemination and implementation.

Keywords: naturalistic developmental behavior interventions, early intervention, autism spectrum disorders

Short Report: Toward Deeper Understanding and Wide-Scale Implementation of

Naturalistic Developmental Behavioral Interventions

Naturalistic Developmental Behavioral Interventions (NDBIs) combine the science of developmental psychology with natural contingencies and behavioral strategies to affect developmentally important and socially valid outcomes for young autistic children (Schreibman et al., 2015). NDBIs have a strong and growing evidence base. Recent meta-analyses of early interventions for autistic children found significant positive effects for NDBIs in outcomes including social communication, cognition, language, social engagement, and play skills (Sandbank et al., 2020; Tiede & Walton, 2019). Despite this evidence and the fact that NDBIs are firmly grounded in the science of applied behavior analysis (ABA; Vivanti & Stahmer, 2021), NDBIs are currently not implemented on a wide scale. Several misconceptions likely contribute to the limited uptake including differing theoretical orientations of developmental and behavioral sciences, lack of training and knowledge of NDBIs among frontline ABA practitioners (Hampton & Sandbank, 2021), and incongruent terminology across fields over what constitutes an evidence-based practice. Theories informing developmental and behavioral approaches share many common components. However, they also stem from divergent and often conflicting pedagogy (see Figure 1), which may lead to ABA practitioners' skepticism towards NDBIs (Vivanti & Messinger, 2021). In support of efforts to increase understanding and implementation of NDBIs, we clarify their common features, discuss possible misconceptions, offer reasons why NDBIs should be widely implemented, and provide recommendations to the autism service community, intervention developers, and researchers.

Common NDBI Components

NDBI is an umbrella term for similar treatment models that employ the sciences of ABA and developmental psychology (e.g., Pivotal Response Training, Early Start Denver Model, Project ImPACT). A growing body of literature has demonstrated that there is considerable overlap of intervention components among manualized NDBI programs. To better understand common components of NDBIs, Frost and colleagues (2020) developed the *NDBI-Fi*, an observational coding fidelity tool designed to rate delivery of NDBIs. Frost and colleagues (2020) identified eight common components of NDBIs including the strategies of following the child's lead at their level, modeling, expanding, and providing communicative temptations that lead to high quality direct teaching episodes that are motivating and involve natural reinforcement. A comprehensive list of components with descriptions and alignment with developmental and behavioral learning theories is provided in Table 1. Relatedly, another measure of common NDBI components, the *Measure of NDBI Strategy Implementation-Caregiver Change* (*MONSI-CC*), was recently developed by Vibert and colleagues (2020). Both the *NDBI-Fi* and the *MONSI-CC* have considerable overlap, providing a strong foundation for current knowledge of NDBIs.

Possible Misconceptions

A possible misconception of NDBIs is that they are synonymous with embedded discrete trials in the natural environment (i.e., natural environment teaching). This misconception may trace back to earlier applications of ABA strategies to language and social communication intervention for young children. Researchers interested in reducing rote language, which was often observed with traditional and didactic approaches, developed strategies to improve the generalization of language use, incorporate motivation to the natural environment, and identify

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developmentally appropriate treatment goals (Halle, 1982). Although these strategies share some

features with NDBIs (i.e., environmental arrangements, language expansion, natural

consequences, and prompting procedures), NDBIs have extended and evolved to a group of

evidence-based treatments that incorporate developmental and behavioral approaches that are

known to facilitate positive child outcomes and center the child, family, and other stakeholders.

Integrating developmental and behavioral approaches for the treatment of young children

is gaining widespread acknowledgment as best practice in early intervention for autism

(Zwaigenbaum et al., 2015). Yet, NDBIs may be misunderstood by or in conflict with the

theoretical orientation of practitioners trained in purely behavioral or developmental approaches

(see Table 1). While the science of ABA has been used effectively to teach a wide range of

important skills to autistic children using data-driven procedures, developmental science

provides guidance about how to apply knowledge of child development and relationship

building. This is consistent with developmentally appropriate practice in early childhood

education (NAEYC, 2022) and best practices in early intervention and early childhood special

education (http://www.dec-sped.org/recommendedpractices). For instance, although NDBI

components are based on operant learning theory, NDBIs emphasize spontaneous and flexible

responding with natural reinforcement rather than completely adult-led opportunities for learning

within mostly decontextualized consequences (e.g., discrete trial training). Additionally, in

alignment with constructivist learning theory, children must be active participants in their own

learning experiences; this characteristic of NDBI shifts power away from the adult to shared

control focusing on child preferences and initiations when approaching skill acquisition

(Schreibman et al., 2015). To implement NDBIs effectively within their scope of practice,

practitioners should understand the learning theories that underpin NDBI components (see

supplemental reading guide**).**

An additional explanation for the slow adoption of NDBI among ABA practitioners can

be traced to opposing views toward definitions of evidence-based practice. There are different

interpretations of what counts as scientific evidence among ABA practitioners and non-ABA

practitioners. Behavior analysts often turn to data-based decision making focused on proximal

outcomes of observable behaviors and single-case research methodology presented in ABA

journals as guidelines to determine what is evidence-based, which can lead to the dismissal of

NDBIs, which are largely rooted in developmental science and rely on group-level and

standardized outcomes. As Slocum and colleagues (2014) suggest, ABA practitioners should

expand their framework for identifying evidence-based practices of ABA to contact

advancements in other disciplines while accounting for client values, context, and clinical

expertise.

Support for Wide-Scale NDBI Implementation

NDBIs, like other evidence-based practices, face barriers to uptake at multiple levels

including funders, leaders, practitioners, and consumers (Boyd et al., 2021). We encourage wide-

scale NDBI implementation for three reasons: (1) their strong and growing evidence base, (2)

their capacity to affect clinically and socially meaningful outcomes at a lower treatment

intensity, and (3) their emphasis on community and stakeholder development (Sandbank et al.,

2020; Tiede & Walton, 2019).

Although we acknowledge that empirical support for specific NDBIs is variable (e.g.,

Tiede & Walton, 2019) and evidence from comparisons of strictly ABA-based interventions

versus NDBIs is limited, current research suggests that NDBIs show promise of effectiveness

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(Sandbank et al., 2020). Additionally, NDBIs were designed to facilitate feasibility and

sustainability for communities. For example, NDBIs are often implemented by caregivers, and

have demonstrated efficacy for promoting both caregiver and child outcomes (Vibert et al.,

2020). NDBIs incorporate caregiver coaching to promote home-professional partnerships and

opportunities for generalization and maintenance of skills, while considering culture and values

during the assessment and planning process (Bruinsma et al., 2020). Hence, NDBIs, especially

caregiver-implemented, are a feasible way to improve equity and access to high quality care for

families for whom higher intensity services may not be an option. Moreover, children may

benefit from assistance across multiple domains that NDBIs can address (e.g., communication,

receptive and expressive language, play, cognition) and NDBIs can be implemented across a

range of practitioners (e.g., education, health, medical), which supports interdisciplinary

collaboration. Further, due to their emphasis on intervening in the natural environment as well as

their collaborative and strengths-based approach to treatment planning involving individuals

from the child's natural environments, NDBIs can support inclusion across home, educational,

and community settings (Schreibman et al., 2015). Therefore, practitioners should consider the

community and stakeholder-implementation focus of NDBIs coupled with effectiveness at a

relatively lower intensity when selecting interventions.

Recommendations

        To support wide-scale implementation of NDBIs, we offer practical actions and guidance

to practitioners (e.g., Board Certified Behavior Analysts [BCBAs], educators, and school and

clinical psychologists), intervention developers, and researchers.

Disseminating NDBIs to the Autism Intervention Community

The adoption of evidence-based practices like NDBIs is supported through the expertise and ability of practitioners to use the most up to date scientific knowledge. There are several resources that can support understanding and use of NDBI strategies. For example, the *Naturalistic Developmental Behavioral Interventions for Autism Spectrum Disorder* text (Bruinsma et al., 2020) provides general NDBI information and supporting resources like the developmental sequence of play, communication development, tips for goal selection, and sample data collection tools. We also suggest that practitioners take advantage of free resources including video clips that illustrate NDBIs and collaborative parent coaching materials from *Autism Navigator* (https://autismnavigator.com), *Autism Focused Intervention Resources and Modules* (https://afirm.fpg.unc.edu/afirm-modules), and *Help is in Your Hands* (https://helpisinyourhands.org/course). These resources, in addition to published manualized NDBIs, support understanding and use of NDBIs within community practice. The availability of NDBI intervention manuals with clear procedures can further assist with training other providers, including caregivers, and support consistency and fidelity of implementation. Further, to support this overarching goal of increased understanding and use, we suggest that Behavior Analyst Certification Board verified course sequence coordinators and BCBA supervisors assign seminal NDBI readings (e.g., Schreibman et al., 2015) to supervisees and students to support common understanding of NDBIs, especially in the context of supporting young children and families.

Aligning NDBIs with the Neurodiversity Movement

NDBIs have the potential to align with the voices of the neurodiversity movement who seek to ensure that interventions include the perspectives of the autistic community (Schuck et al., 2021). We echo Schuck and colleagues' (2021) recommendations to NDBI researchers for improved alignment by collaborating with and involving autistic individuals, improving social

and ecological validity practices, and adopting research designs such as community-based participatory research. The promotion of embedded strategies within "ecologically valid contexts, routines and materials" (Schreibman et al., 2015, p. 2417) increases the likelihood that intervention will be socially valid, particularly for those advocating against a more traditional, decontextualized approach to instruction. NDBIs center shared control and increased focus on child-led activities, developmentally appropriate practices, and naturalistic and embedded contexts for learning, all of which have been described as important treatment considerations aligned with autistic flourishing and neurodiversity (Schuck et al., 2021). Yet, it is important to note that the quality with which NDBIs are implemented can impact alignment with the neurodiversity paradigm. For example, simply implementing NDBI strategies to improve a skill based on a normative developmental sequence, without accounting for the skills most relevant to the autistic person and their preferred interests and strengths, is out of alignment with the neurodiversity movement (Schuck et al, 2021).

NDBI Researchers

There is a critical need to examine the use of NDBI strategies in partnership with community members in natural settings while centering autistic voices, involving families from culturally and linguistically diverse backgrounds, assessing social validity, and employing enlightened research design (see Schuck et al., 2021). Intervention-agnostic measures like the *NDBI-Fi* and *MONSI-CC* can be essential tools when comparing research studies across manualized intervention packages and studies of NDBIs more broadly. In addition, preliminary studies exist analyzing the distinct contribution of specific NDBI fidelity constructs to child outcomes (Waddington et al., 2020; Zitter et al., 2021). Although these measures and studies are excellent starting points for research on NDBIs in community and laboratory settings, more

studies are needed to identify which of the components are most effective for improving

outcomes of interest. There are several designs that can identify active ingredients of

multicomponent interventions, but one particularly effective and feasible method is the use of

component analysis, which is a type of single-case experimental design (Ward-Horner &

Sturmey, 2010). In a component analysis, researchers systematically assess the effect of two or

more components of an intervention on an outcome of interest. Component analysis designs are

quite flexible and can include phases with individual components as well as phases with

combinations of components. Identifying the active ingredients of NDBIs will be an important

next step for the scientific community so that we can better understand *how* NDBIs work and

why NDBIs are effective. It will also help practitioners understand which components are most

critical to implement in practice and which components can be de-emphasized or removed from

practice. Further, it will inform the necessary elements to be included within pre-service and in-

service training opportunities, which are often limited in scope and resources.

We encourage NDBI developers and researchers to focus efforts on the establishment and

subsequent empirical evaluation of free resources, which can be accessed by a variety of

practitioners with diverse levels of education and expertise. Moreover, we suggest that future

trainings be developed with a multidisciplinary audience in mind. The use of easily understood

language and caregiver-friendly terminology ensures further congruence across disciplines and

practitioners supporting autistic children. In addition, we suggest clearly identifying that the

intervention is an NDBI if it incorporates the common components of NDBIs (see Table 1), is

based on principles of ABA, uses developmentally appropriate strategies and sequences to guide

individualized goal planning, and includes a manual and procedures for assessing treatment

fidelity with ongoing progress monitoring (Bruinsma et al., 2020). Further, we suggest NDBI

researchers translate developmental concepts into behavioral terminology, including

operationalizing constructs, and vice-versa while acknowledging areas in which developmental

and behavioral roots do not overlap. The development of NDBI resources that are directly

marketed to ABA consumers using accepted terminology will greatly enhance the dissemination

of NDBI within the ABA community. These recommendations will allow for clearer

understanding by other researchers, practitioners, families, funding agents, and insurance

carriers.

Paving the Path Forward

Although ABA can inform us what and how to teach, we also need to rely on other fields

to inform us on how to teach in more socially and ecologically valid ways. Other applications of

behavior analysis, such as organizational behavioral management, positive behavior supports,

and acceptance and commitment therapy, combine behavior analytic principles with an

understanding of business principles, school systems, and therapeutic relationship processes. The

goal of autism intervention should be the same: incorporating an understanding of child

development to inform treatment goals and to work towards those goals within natural and varied

contexts and routines, using behavioral strategies influenced by developmental science

(Schreibman et al., 2015). We aim to provide a blueprint of actionable items and a deeper

understanding of NDBIs through this short report to support wide-scale NDBI implementation in

the autism community.

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Community Involvement

Not applicable

Funding

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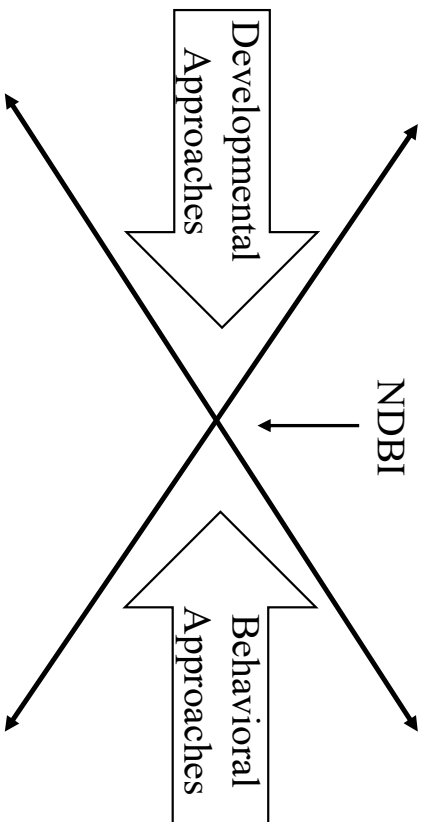
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Figure 1

Naturalistic Developmental Behavioral Interventions

Developmental Approaches

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Behavioral Approaches

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Table 1. *Common components of NDBIs, adapted from Frost and colleagues (2020)*

NDBI Component	Definition	Learning Theories
Face-to-face and on the child's level	The adult positions themself on the child's level and in their line of sight. The adult keeps the materials between themself and the child.	Social Learning Theory
Following the child's lead	The adult provides multiple options and joins in the child-selected activity or familiar routine by being a responsive partner (e.g., playing with the child, helping the child, handing more pieces, etc.), refraining from providing directions.	Self-Determination Theory, Constructivist Learning Theory, Social Learning Theory
Displaying positive affect and animation	The adult adjusts their affect to match the child's sensory needs. The adult uses positive affect to support rich engagement.	Social Learning Theory
Modeling appropriate language	The adult considers the child's developmental level and adjusts their language to match the child, while providing some language slightly above the child's level. The adult comments on the activity and avoids asking questions or providing commands.	Social Learning Theory, Observational Learning Theory
Responding to attempts to communicate	The adult addresses *all* forms of child communication as meaningful by providing verbal responses along with repetitions and expansions.	Social Constructivism Operant Learning Theory
Using communicative temptations	The adult arranges the environment to promote natural contexts for child communication and engagement by using shared control and expectant waiting. This may be used to introduce a direct teaching opportunity.	Social Learning Theory, Operant Learning Theory
Frequency of direct teaching episodes	The adult uses prompt sequences to support the child's acquisition of new or emerging skills and embeds brief periods between prompt sequences to allow for opportunities for child initiation.	Zone of Proximal Development, Operant Learning Theory
Quality of direct teaching episodes: Clear teaching opportunities Developmentally appropriate teaching targets Motivating and relevant teaching opportunities Support correct response Providing contingent, natural, and social reinforcement	The adult gives an instruction or prompt using clear and developmentally appropriate communication. The adult uses developmentally appropriate teaching targets that are contextually relevant when the child is motivated, interested, and engaged in the activity. The adult provides support for the child's response and an immediate natural reinforcement directly related to the child's correct response and/or positive social reinforcement. Reasonable attempts to respond correctly are reinforced when developmentally appropriate.	Self-Determination Theory, Operant Learning Theory, Social Constructivism

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Supplemental Material: Learning Theories Reading List

This is a supplemental reading guide developed to support understanding of learning theories from behavioral and developmental science that influence the common components of naturalistic developmental behavioral interventions (NDBI; see Table 1 in manuscript). This is not an exhaustive list; readers are encouraged to communicate and collaborate across disciplines to build deeper understanding of prominent learning theories and how they impact NDBI components.

Readings Covering Multiple Theories

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Social Constructivism

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