IDENTIFYING AND MEASURING COMMON ELEMENTS OF NATURALISTIC DEVELOPMENTAL BEHAVIORAL INTERVENTIONS

By

Kyle M. Frost

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Psychology – Master of Arts

2018

ABSTRACT

IDENTIFYING AND MEASURING COMMON ELEMENTS OF NATURALISTIC DEVELOPMENTAL BEHAVIORAL INTERVENTIONS

By

Kyle M. Frost

Evidence-based interventions for young children with autism spectrum disorder (ASD) share theoretical origins in developmental and behavioral theories, and have been acknowledged to share key strategies (Schreibman et al., 2015). However, the extent to which these interventions share strategies has not been examined in research to date. In addition, there is no standardized measure for assessing intervention implementation that was developed for use across different interventions. This paper presents two studies, the first of which had the goal of developing a comprehensive taxonomy of strategies of caregiver-mediated NDBI and refining an observational rating scheme using quantitative feedback from experts. Twenty strategies comprised the comprehensive taxonomy, 11 of which were determined to be common elements using quantitative methods. From these items, an 8-item observational rating scheme, the *NDBI-Fi*, was developed. The goal of study two was to establish preliminary reliability and validity of the *NDBI-Fi*, by rating caregiver-child interaction videos from various completed intervention trials. Results lend support to the utility of the *NDBI-Fi* as a measure of caregiver use of intervention strategies across NDBI models.

ACKNOWLEDGEMENTS

This project could not have been completed without support from numerous mentors, collaborators, family, and friends. Foremost thanks to my mentor, Brooke Ingersoll, for consistent enthusiasm, support, expertise, and encouragement. Second, I would like to thank Kaylin Russell, who dedicated so much of her time to learning the NDBI-Fi. Third, I want to thank my family, Benji, Chelsea, and my lab mates, for being the best support system someone could ask for. Last, but certainly not least, this project was completed with the expert input of numerous experts in ASD intervention (in alphabetical order), as well as their trainees and colleagues: Jessica Brian, Susan Bryson, Geraldine Dawson, Helen Flanagan, Grace Gengoux, Ann Kaiser, Connie Kasari, So Hyun Kim, Rebecca Landa, Catherine Lord, Mendy Minjarez, Jennifer Nietfeld, Sarah Rieth, Sally Rogers, Stephanie Shire, Isabel Smith, and Aubyn Stahmer. I am so thankful for the expertise you all have lent to this endeavor.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that emerges in early childhood and is characterized by deficits in social communication and the presence of restricted and repetitive interests and/or behaviors (American Psychiatric Association, 2013). According to the National Research Council, intervention for ASD should be intensive, at least 25 hours per week, and begin immediately after the diagnosis is given (2001). Current best practices for the treatment of young children with ASD include interventions that integrate developmental approaches, which focus broadly on child-centered activities and adult responsiveness, and behavioral approaches, which focus on teaching skills via contingencies (Zwaigenbaum et al., 2015). In addition, it is considered best practice to involve caregivers in their child's intervention (National Research Council, 2001; Zwaigenbaum et al., 2015).

There is a growing evidence base for several such manualized interventions, broadly classified as Naturalistic Developmental Behavioral Interventions or NDBI (Schreibman et al., 2015). While individual NDBI were developed in different labs and emphasize different theoretical perspectives, they share several common elements, including child-led teaching episodes, environmental arrangement, natural reinforcement, use of prompting techniques, turn-taking, imitation, modeling, and caregiver involvement (Schreibman et al., 2015). Although experts agree that there are several shared strategies, this question has not been addressed quantitatively.

Despite a growing evidence base for the efficacy of NDBI, there are current limitations in our knowledge of treatment mechanisms and active ingredients in these interventions. NDBI are usually studied as comprehensive treatment packages, without dismantling of their component parts. Although numerous common elements exist among these manualized interventions,

researchers do not articulate or measure these elements in the same way, and often define different components as fundamental to their interventions.

Treatment fidelity

Measuring treatment fidelity, or adherence to the intervention protocol, is essential for understanding the active ingredients of these treatments and interpreting the results of intervention trials (Wainer & Ingersoll, 2013). However, when treatment adherence or fidelity is reported in publications, it tends to be a summary rating, such as overall percent adherence to the treatment protocol. In terms of evaluating treatment outcomes in RCTs, fidelity to specific intervention techniques is often not linked directly to intervention outcomes; therefore, it is unclear what specific active ingredients result in improvements in child social communication. Further, among NDBI, measures of treatment fidelity used for research are often unpublished; therefore, it is not known which strategies contribute to the overall rating. Finally, to our knowledge, NDBI intervention fidelity measures have not been examined psychometrically in a published study, and therefore it is not known whether they are valid, reliable across short time intervals, or sensitive to change. Without common terminology to describe intervention components and a common measurement tool for reporting fidelity, researchers cannot easily compare intervention ingredients across studies. This limits our ability to understand the active ingredients of NDBI, and to identify specific elements that lead to positive outcomes.

Caregiver-Mediated Intervention

These issues are compounded when the NDBI is delivered by a caregiver rather than trained therapists. Caregiver-mediated interventions, in which the caregiver is taught to implement strategies to promote the child's development, can increase the "dose" of therapy a child receives, and creates opportunities for children to learn in a variety of settings and activities

(Bearss, Burrell, Stewart, & Scahill, 2015). In addition, collateral effects have been found for reducing parental stress and improving parents' mental health and self-efficacy (Estes et al., 2014; Ingersoll, Wainer, Berger, Pickard, & Bonter, 2016; Tonge et al., 2006), although some studies have found no reduction in parent stress (Kasari, Gulsrud, Paparella, Hellemann, & Berry, 2015). For these reasons, a number of NDBI, such as Project ImPACT (Ingersoll & Dvortcsak, 2009) and the Social ABCs, (Brian, Smith, Zwaigenbaum, & Bryson, 2017; Brian, Smith, Zwaigenbaum, Roberts, & Bryson, 2016), have been designed specifically to be delivered by caregivers, and other NDBI have been tested for efficacy as caregiver-mediated interventions (Kaiser, Hancock, & Nietfeld, 2000; Kaiser & Roberts, 2013; Kasari et al., 2015; Kasari et al., 2014; Rogers et al., 2012).

Although relatively few randomized controlled trials (RCTs) of caregiver-mediated NDBI have been completed (McConachie & Diggle, 2007; Oono, Honey, & McConachie, 2013), studies show that caregivers who receive training in NDBI can successfully implement intervention techniques with their children, and that children demonstrate improvements in specific intervention targets such as language use and joint attention (Bradshaw, Koegel, & Koegel, 2017; Brian et al., 2017; Gulsrud, Hellemann, Shire, & Kasari, 2016; Ingersoll & Wainer, 2013; Ingersoll et al., 2016; Kasari et al., 2015; Patterson, Elder, Gulsrud, & Kasari, 2014). Evidence has also been found for improvement in the quality of caregiver-child interactions in the areas of shared attention and parental synchrony (Oono et al., 2013), both of which can be considered facets of caregiver responsiveness, which is a focus in NDBI and developmental interventions. In addition, recent research has also linked caregiver intervention fidelity to child outcomes. For example, a recent study found that children whose caregivers were trained in the *Social ABCs* NDBI showed increases in vocal responsiveness as well as vocal

initiations, and that caregiver fidelity to the intervention protocol predicted child responsiveness over and above the effect of treatment group (Brian et al., 2017). Specific components of caregiver fidelity have also been shown to predict child language gains (Ingersoll & Wainer, 2013) as well as joint engagement (Gulsrud et al., 2016). However, another study did not find relationships between improvement in parent fidelity and child improvement on standardized measures (Rogers et al., 2012). In addition, not all studies have shown that caregiver-mediated NDBI improve child outcomes (Oosterling et al., 2010; Rogers et al., 2012).

Oosterling et al. investigated a low-intensity caregiver-mediated NDBI, and found no main effects of treatment; however they noted that care as usual in the Netherlands is of high quality, therefore a low-dose caregiver-mediated intervention may not have provided significant improvement above and beyond the high quality care children otherwise received (2010). Another RCT of a brief, low-dose caregiver-mediated NDBI found no effect of group assignment on outcomes; however the community intervention control group received significantly more intervention hours than those in the study treatment group, thus confounding the results (Rogers et al., 2012). Overall, limitations of these studies make it difficult to ascertain whether null effects were due to lack of efficacy, individual differences in treatment response, low fidelity of implementation, and/or good quality of community care received by the control group. Direct comparison of caregiver fidelity and child outcomes is important for understanding the efficacy and active ingredients of caregiver-mediated interventions.

Evaluating Intervention Outcomes

Studies of caregiver-mediated interventions for young children with ASD often measure caregiver and child outcomes based on behavioral coding of video-recorded caregiver-child interactions (CCXs). Observational methods are especially useful when nonverbal and “real

world" behaviors are of interest (Bakeman & Quera, 2011). Observations that take place in the home provide a useful sample of behavior in a family's natural environment (Gardner, 2000). Best practice recommendations for the assessment of young children include a focus on direct observation as well as evaluation of the functioning of the child in natural contexts (Bagnato, 2005; Division for Early Childhood, 2014), making the CCX a useful and practical focus of intervention outcome.

In addition, CCXs allow researchers to examine intervention response through multiple lenses, by looking at change in caregiver behavior (e.g. increased use of intervention strategies over time), change in child behavior (e.g. improvements in social communication skills over time), and how both play a role in shaping the interaction. This is evidenced by recent research examining the relationship between mother's behaviors, child behaviors, and the dyad's time spent in joint engagement (Kaale, Smith, Nordahl-Hansen, Fagerland, & Kasari, 2017). This study showed that maternal behaviors were predictive of time spent in a joint-engaged state, whereas child behaviors were not, although mothers' behaviors were often related to child behaviors in the same domain (i.e. maternal positive affect related to child positive affect). This study highlights the importance of considering both caregiver and child behavior concurrently when evaluating CCXs.

Despite a need for characterizing caregiver behaviors to evaluate research outcomes, there is a lack of consistency in how caregiver behaviors are measured across studies. For example, published intervention trials have evaluated caregiver behavior in various ways, including intervention fidelity (Casenhiser, Shanker, & Stieben, 2013; Gulsrud et al., 2016), ratings of caregiver responsiveness (Karaaslan & Mahoney, 2015; Mahoney & Solomon, 2016; Patterson et al., 2014; Shire, Gulsrud, & Kasari, 2016), as well as parental synchrony (Green et

al., 2010; Hudry et al., 2013; Pickles et al., 2015). Thus, there is no "gold standard" for evaluating caregiver behavior across studies. Further, many NDBI interventions involve strategies that caregivers use instinctively to some degree. A recent pilot RCT showed that, at baseline, 20% of parents were considered to have met overall fidelity, before receiving training in an NDBI (Stahmer et al., 2017). Thus, caregivers enter research studies with different repertoires of behavior, and some caregivers who naturally perform these strategies may not substantially improve in fidelity with training.

Measuring common elements to advance intervention research

A standardized way to evaluate caregiver fidelity during CCXs would allow for cross-study evaluation (e.g. meta-analysis) of NDBI techniques and treatment fidelity, as well as consortium-style collaborative research studies with larger sample sizes and more power, which are essential for evaluating the active ingredients of interventions (Tate et al., 2016). In addition, a standardized measure could be applied to better characterize similarities among treatment groups (Godfrey, Chalder, Ridsdale, Seed, & Ogden, 2007), including active treatment and treatment-as-usual control groups. Significant overlap in strategies used in research and community settings, as well as the recognition that caregivers vary widely in their use of strategies before training, may clarify the small effect sizes and null results found in some RCTs of caregiver-mediated NDBI (Oosterling et al., 2010; Rogers et al., 2012).

However, despite the similarity of key behaviors taught to caregivers across NDBI, there is currently no standardized set of common intervention elements, nor a standardized measure for assessing intervention implementation by caregivers. Development of an intervention taxonomy, or comprehensive set of intervention strategies, can support our understanding of evidence-based interventions by providing the field with standardized language, and a standardized way to

describe and compare intervention ingredients across studies (Barth & Liggett-Creel, 2014; Chorpita, Daleiden, & Weisz, 2005; Lokker, McKibbon, Colquhoun, & Hempel, 2015; McHugh, Murray, & Barlow, 2009). Accordingly, common elements of evidence-based interventions have been examined in the context of many types of behavioral treatments, including those targeting disruptive behavior disorders (Garland, Hawley, Brookman-Frazee, & Hurlburt, 2008; Kaehler, Jacobs, & Jones, 2016), obesity (Tate et al., 2016), bipolar disorder (Miklowitz, Goodwin, Bauer, & Geddes, 2008), trauma (Strand, Hansen, & Courtney, 2013), and parenting skills (Barth & Liggett-Creel, 2014).

The goals of this research were: 1) to develop a comprehensive taxonomy of common elements of caregiver-mediated NDBI based on review of existing fidelity measures and qualitative feedback from an expert panel; 2) to develop and refine an observational rating scheme via quantitative feedback from experts; and 3) to establish preliminary reliability and validity of the new measure based on ratings of CCX videos from various completed intervention trials.

STUDY 1

The purpose of this study was to develop a comprehensive taxonomy of common elements of caregiver-mediated NDBI and to determine the common elements across NDBI using quantitative data. We expected that a broad set of items could be clearly defined based on input from intervention manuals and fidelity rating schemes, as well as qualitative feedback from an expert panel. Next, we expected that a subset of these items would emerge as common across the NDBI under consideration.

METHOD

Development of an Intervention Taxonomy

Guided by the methodology proposed by McKenzie et al. (1999) to establish content validity, a multistep process was used to determine the common elements of NDBI (Figure 1). The first author requested published and unpublished NDBI fidelity measures from doctoral-level intervention developers and experts in order to develop a broad taxonomy of NDBI strategies. Several authors of the Schreibman et al. (2015) paper, as well as known colleagues who have conducted RCTs of the interventions identified by Schreibman et al. were invited by email to collaborate on this work. A total of 11 research teams (14 individuals) were approached, with some having more than one expert individual per site. One research team did not respond.

Interventions examined included *Early Achievements* (Landa, Holman, O'Neill, & Stuart, 2011), *Early Start Denver Model* (ESDM; Rogers & Dawson, 2010), *Enhanced Milieu Teaching* (EMT; Kaiser et al., 2000; Kaiser & Hester, 1994), *Joint Attention, Symbolic Play, Engagement & Regulation* (JASPER; Kasari, Freeman, & Paparella, 2006; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010), *Pivotal Response Training* (PRT; Schreibman & Koegel, 2005), *Project ImPACT* (Ingersoll & Dvortcsak, 2009), and *Social ABCs* (Brian et al., 2017; Brian et al., 2016). Each of these interventions has been examined in a research context, and has demonstrated some evidence of efficacy as a therapist-delivered and/or caregiver-mediated intervention. While the intervention approaches used in this study do not represent a comprehensive list of all interventions that could be characterized as NDBI, those with expertise in the above interventions agreed to collaborate on this endeavor.

Examination of treatment fidelity forms across research groups and interventions revealed a range of ways in which fidelity is measured. The number of items rated across

interventions varied substantially, from as few as 6 to as many as 32, suggesting variability in the comprehensiveness of these measures. While some research teams utilize interval coding methods (e.g. rating presence or absence of a behavior during each one-minute interval), others use more global measures (e.g. a 1-5 likert-type rating ranging from little-to-no use of strategies to high-quality implementation). Across research teams, scores are generally averaged and converted to an overall percent rating of treatment fidelity. Characteristics of these fidelity forms are summarized in Table 1.

A preliminary taxonomy of intervention elements was established by examining the content of available NDBI fidelity rating forms and treatment manuals. The taxonomy was inclusive of items that were intervention-specific (i.e. not common across all interventions), as well as those shared among most or all interventions. In cases when additional descriptors or clarification was needed, published and unpublished intervention manuals were reviewed and discussed with colleagues in order to define strategies. The taxonomy was refined over several iterations, integrating informal feedback and conversation with colleagues with expertise in NDBI.

A total of 20 items were defined (Appendix A). Of the 20 items, 9 focused on promoting child engagement in an activity with the adult, 3 focused on adult modeling of skills, 2 focused on encouraging spontaneous communication, and 6 focused on direct teaching strategies. Of the 6 items focusing on direct teaching strategies, 5 were considered "quality indicators," and represent different individual components of a multistep teaching procedure. Each strategy was formally defined based on the content of the examined fidelity forms and manuals; examples and non-examples were generated for each item to further clarify the definition of the strategy.

Qualitative Review

The content of the 20-item preliminary taxonomy was refined based on expert feedback using an adapted Delphi Method. The preliminary taxonomy was sent to 13 collaborators with expertise in intervention research and development for open-ended critique and commentary in the form of tracked-changes edits and comments in a word processing document. Three of the original 13 individuals did not provide written feedback; two individuals shared the taxonomy with a colleague to provide additional feedback, and one individual asked a colleague to provide feedback in her place. Thus, suggestions and revisions were obtained from a total of 12 individuals. The definitions and examples were subsequently revised. The most substantive change to content was for items pertaining to *Following the child's lead* and *Imitating the child*. In the initial draft, these two items were *Child choice of activity* and *Imitation and joining in the activity*; however, expert critique made clear that imitation was distinct from joining the child, whereas child choice and joining the child were both key aspects of following the child's lead. Additional changes included clarifying terminology, clarifying and adding to examples, and the addition of a glossary to define key terms. These items were then resent to collaborators in the form of a survey for additional feedback and refinement.

Refinement of Observational Rating Scheme

Next, a group of experts provided quantitative feedback on the refined item list in order to reduce items to the common elements and increase the content validity of the item set. Collaborators were asked to nominate additional raters with expertise in their respective interventions as needed such that each intervention would have 4 representatives, for a total of 28 raters. Specifically, collaborators were asked to nominate individuals who they would consider "experts in the intervention (e.g. past grad students, qualified intervention trainers, etc.)." Two

intervention developers nominated fewer than 4 respondents, therefore a total of 25 individuals were contacted with the survey link. Of these, 21 individuals responded (85%). In order to prevent over-representation of any one intervention, survey responses from 2-3 experts per intervention were used, with additional responses dropped from analysis. Individuals with fewer years of experience were dropped first; where there was an equal amount of intervention experience, one was chosen at random by flipping a coin. A total of 19 responses were analyzed, representing 7 NDBI.

Measures

A Qualtrics survey link was distributed to expert collaborators and their nominees. Respondents were presented with the text for the 20 revised items, and 3 questions per item. Questions included Likert-scale ratings of clarity and the extent to which items could be rated on video by an expert and by a well-trained nonexpert. In addition, respondents rated the extent to which each item was a part of a given intervention using the following scale, adapted from Lawshe (1975):

- Essential (3): This item is a component of [intervention], and it is described explicitly in the intervention manual. Interventionists use it consistently during sessions.
- Useful, but non-essential (2): This item is good clinical practice, and interventionists use it when providing [intervention], but it is not described in the intervention manual.
- Neutral (1): I would not discourage use of this strategy when providing [intervention], but interventionists do not typically use it, and it is not described in the intervention manual.

- Conflicting (0): This item conflicts with the [intervention] intervention protocol. Intervention trainees and caregivers are discouraged from using this strategy.

A content validity ratio (CVR) was calculated for each item, using the following formula:

$CVR = \frac{n_e - N/2}{N/2}$, where n_e = number of respondents indicating a rating of "essential," and N = the total number of respondents.

The CVR was used to quantitatively evaluate the extent to which each item was characteristic of NDBI. A negative CVR indicates that fewer than 50% of raters classified an item as "essential," whereas a positive CVR indicates that greater than 50% of raters classified an item as "essential." The published recommended cutoff for achieving statistically significant agreement with our sample size was (0.42) was used to determine which items will be retained in the final measure (Lawshe, 1975; Veneziano & Hooper, 1997).

RESULTS AND DISCUSSION

Clarity

Item clarity was rated on a 5-point Likert scale, ranging from extremely clear (1) to extremely unclear (5), with items with a rating greater than or equal to 3.0 considered in need of revision or exclusion from the final measure. Of all items, the average clarity rating was 1.68, with scores ranging from 1.21 to 2.16. Therefore, no items were eliminated or further refined due to lack of clarity.

Observability

Respondents were asked to rate how well each item could be rated from a 10-minute video by an NDBI expert and by a well-trained non-expert, with response options ranging from extremely well (1) to not well at all (5). Like ratings for clarity, items rated greater or equal to 3.0 were considered in need of revision or exclusion from the final measure. Across all items, the average rating was 1.47 for NDBI experts (range: 1.11 to 1.84), and 1.98 for non-experts (range: 1.32 to 2.84). No items were eliminated or further refined due to difficulty rating from video.

Content Validity

CVRs were calculated for each individual item in two ways: 1) considering the number of respondents indicating a score of “essential” only; and 2) considering the respondents who indicated a score of “essential” or “useful but non-essential” (Table 2). Examination of only items rated as “essential” accounts for strategies specified explicitly in NDBI manuals. The addition of items rated “useful but non-essential” accounts for the fact that clinicians may draw on general clinical skills when providing intervention, rather than using only elements specific to a single manualized treatment.

When considering only items rated "essential," 10 of the 20 items exceeded the statistically significant cutoff of 0.42. This suggests that there are numerous common elements of NDBI, including those focusing on increasing child engagement, modeling new skills, encouraging spontaneous communication, and teaching new skills. One additional item, which referred to use of prompting strategies to support the child's response, was examined further and refined based on feedback from the expert panel. Specifically, some interventions used a particular prompting hierarchy that was precluded based on the original wording of the item; therefore this item was modified to contain more generic language and was included in the final set of common items. As expected, these items, described below, encompass strategies found in developmental and relational interventions (e.g. child-led activities) as well as those found in applied behavior analytic interventions (e.g. direct teaching episodes based on principles of operant conditioning). This lends support to the content validity of this set of items.

When considering both 'essential' components of interventions (i.e. those which are important and defined in the treatment manual) *and* 'useful, but non-essential' items (i.e. those which are commonly used and considered good clinical practice, but not necessarily in the intervention manual), only one of the original 20 identified items did not exceed the statistically significant cutoff of 0.42: *Imitating the child*. This suggests that trained clinicians consistently use *many* strategies that are not explicit components of the specific NDBI being delivered, although they are a manualized component of at least one other NDBI. This calls into question the utility of existing fidelity measures, which may not capture the "good clinical practices" that seem to be shared among NDBI in practice, but not necessarily shared among treatment manuals and fidelity forms. In addition, the presence of these common practices may compromise direct

comparison of different interventions, and obscures our understanding of which treatment strategies promote improvement in child outcomes.

Development of *NDBI-Fi* Rating Scheme

The 10 quantitatively-derived common items as well as the revised item regarding use of prompting strategies during direct teaching were used to develop the *NDBI-Fi* measure. More specifically, an 8-item rating scheme was developed. Each item is described briefly here, and the full item text and rating anchors can be viewed in Appendix B. *Face-to-face and on the child's level* refers to how often the adult is directly in front of the child and at a similar height (i.e. within the child's line of sight). *Following the child's lead* focuses on the extent to which the adult joins the child in a child-chosen activity. *Displaying positive affect and animation* rates the extent to which the adult uses exaggerated positive vocal tone, facial expressions, gestures, etc. The focus of *Modeling appropriate language* is on how often the adult makes developmentally appropriate comments on the activity, rather than giving commands, asking rhetorical questions, or remaining silent. *Responding to attempts to communicate* rates the extent to which the adult verbally responds to the child's verbal and nonverbal attempts to communicate. The item *Using communicative temptations* refers to how often the adult nonverbally elicits communication using one of several techniques paired with wait time for the child to communicate. Several items focus on direct teaching episodes, which comprise a multi-step procedure based on principles of operant conditioning which have an antecedent-behavior-consequence (ABC) structure. These included *Clear and appropriate teaching opportunities, Motivating and relevant teaching opportunities, Supporting a correct response using prompts*, and *Providing contingent natural and social reinforcement*. Together, these were considered "quality indicators" of a direct teaching episode, and were collapsed into a single item, *Quality of direct teaching*, for the

purposes of the rating scheme. *Frequency of direct teaching* rates how many times the adult completes a direct teaching episode with an antecedent-behavior-consequence (A-B-C) structure. Together, these *Frequency* and *Quality* items account for how often and how well caregivers used direct teaching strategies.

An observational rating scheme and scoring manual was developed for the *NDBI-Fi*. A macro-level rating scheme (i.e. a 1-5 rating scale) rather than a micro-level discrete coding system was designed, both to align with many of the existing fidelity measures and to increase the likelihood that the measure would not be burdensome or costly to use. This type of rating can be accomplished without specialized computer software, and in a relatively short amount of time. Not only do many existing NDBI fidelity measures use these types of rating schemes, but research also suggests that they yield similar information in much less time than fine-grained coding approaches (Bakeman & Quera, 2011).

The *NDBI-Fi* manual includes practical considerations for rating, such as a recommended system for note-taking and the number of passes in which to rate videos. It also specifies item definitions, examples and non-examples, and includes a glossary and descriptive anchors for assigning ratings. The rating scheme was piloted on a small set of videos by two raters in order to refine the descriptive rating anchors, and to achieve inter-rater reliability. Scoring differences were discussed, and items and rating anchors were refined in order to improve clarity and ease of scoring.

STUDY 2

Study 2 piloted an intervention-independent rating scheme, the *NDBI-Fi*, whose 8 items were based on the common intervention elements defined in Study 1. To complete this goal, this study involved applying the rating scheme to videos of families who participated in completed or ongoing RCTs of NDBI, and examining the reliability, validity, and sensitivity of the measure.

METHOD

Participants

This study involved analyzing existing data from completed or ongoing treatment trials of caregiver-mediated NDBI with children with ASD aged 7 years-old or younger. Videos were contributed from several sites[1] (including Michigan State University, University of California – San Diego, and Weill Cornell Medical College) with representation from two interventions, including Project ImPACT (Ingersoll & Dvortcsak, 2009) and JASPER (Kasari et al., 2006; Kasari et al., 2010). All families consented for their videos to be used for research purposes. This study was approved by the Institutional Review Board at Michigan State University. The study sample involved 60 parent-child dyads. Demographic information is reported in Table 3. At intake, children were an average of 35.5 months old (SD = 13.4).

Measures

NDBI-Fi.

The *NDBI-Fi* is an 8-item observational rating scheme based on the common elements of NDBI ascertained in Study 1. Two raters, the first author of this paper and an undergraduate research assistant familiar with observational rating schemes but inexperienced in intervention, independently coded videos and held consensus meetings to discuss discrepancies in ratings until inter-rater reliability was met. Raters were considered reliable when 3 consecutive videos were rated with the following criteria for agreement:

- At least 7 out of 8 items were within 1 point.
- No items were greater than 2 points apart.

[1] Additional data are being obtained from other sites conducting research with other treatment models; Institutional review boards and data use agreements are pending.

- The average score was within 0.5 points (i.e. +/- 0.25 points).

The primary rater was kept blind to intervention type (specific NDBI) when possible, as well as group assignment (study treatment vs. control) for all videos.

Caregiver-child Interaction (CCX).

Collaborators contributed caregiver-child interaction (CCX) videos from existing treatment trials of their respective caregiver-mediated NDBI. All CCX videos involved an approximately 10-minute free play interaction between the child and the caregiver at the post-intervention time point, and included families in the treatment and control groups (e.g. waitlist, treatment-as-usual). Sites were asked to select English-speaking participants within the treatment and control groups at random, using an online random number generator (https://www.random.org/integer-sets).

A total of 60 post-timepoint videos were contributed from 3 intervention trials, including 37 who received treatment and 23 controls. A subset of pre-post video pairs and follow-up data from an ongoing RCT at Michigan State University were used to examine sensitivity to change and predictive validity (n=24 families).

Established NDBI Fidelity.

Caregiver percent fidelity to the intervention protocol was supplied by collaborators from two sites for each CCX video using the established fidelity measure for their respective intervention. Established NDBI Fidelity was compared to fidelity ratings on the new *NDBI-Fi* measure to determine convergent validity.

Brief Observation of Social Communication Change (BOSCC).

The BOSCC was used to code child behaviors in the CCXs to assess predictive validity. The BOSCC is an observational coding scheme that was developed as a sensitive outcome

measure for intervention studies in ASD (Grzadzinski et al., 2016). It captures change in child social communication and repetitive behaviors in the context of a short play interaction. Flow charts with specific decision points are used to score each of 15 items. Item codes range from 0 to 5, where 0 represents more typical behavior and 5 represents more atypical behavior. The BOSCC has been used in a number of studies, and has shown promise as a tool for assessing change in child behavior (Kitzerow, Teufel, Wilker, & Freitag, 2016; Nordahl-Hansen, Fletcher-Watson, McConachie, & Kaale, 2016; Pijl et al., 2016).

Mullen Scales of Early Learning (MSEL).

Age equivalent scores from the MSEL (Mullen, 1995) were used to characterize the developmental level of the sample and to evaluate discriminant validity. The MSEL has four domains that evaluate verbal development (Receptive Language and Expressive Language) and nonverbal development (Fine Motor and Visual Reception).

Analysis Plan

Behavioral rating schemes must be both reliable and valid (Chorney, McMurtry, Chambers, & Bakeman, 2015). Observer agreement in particular is essential when using observational measures with multiple raters (Bakeman & Quera, 2011). Validity was examined in line with Kazdin's (2003) recommendations for developing a new measure. This included investigating between-group differences that are consistent with the fidelity construct (criterion validity), and the correlations between measures of similar and dissimilar constructs (convergent and discriminant validity). In addition, we examined the extent to which the measure predicted relevant outcomes (predictive validity). In order to assess whether the *NDBI-Fi* has potential for use in future intervention trials, we also examined whether the measure captured change over the

course of a treatment study (sensitivity). In addition, the basic properties of the item distributions were examined.

Reliability.

Cronbach's alpha was used to evaluate the internal consistency of the items within the *NDBI-Fi*. In addition, a total of 49 videos from two sites were coded by two raters. Intra-class correlations (ICCs) were used to evaluate agreement between coders on individual items as well as overall score. ICCs were selected because they can be used for ordinal and interval data, and incorporate the magnitude of disagreement in order to estimate inter-rater reliability (Hallgren, 2012). A single-measures, two-way mixed design based on absolute agreement was used.

Validity.

To address concurrent validity, an independent samples *t*-test was used to determine if caregivers who received training differed from those who did not at the post-timepoint. We expected that caregivers who were in the active study treatment group would receive a significantly higher *NDBI-Fi* rating than caregivers who were in control groups.

Convergent and discriminant validity were examined by conducting Pearson correlations. We expected that overall ratings for the *Established NDBI Fidelity* would be significantly correlated to the *NDBI-Fi Average Rating* with a medium to large effect size. Next, we expected that the *NDBI-Fi* would not be related to child chronological age, or child developmental age equivalent (i.e. a small effect size, $r < 0.2$).

In order to assess predictive validity, a subset of videos (n=21) of the same dyad pre- and post- training were rated using the *NDBI-Fi.* These same dyads had their pre-treatment and follow-up videos rated using the *BOSCC*, which evaluates child response to intervention. Increases in caregiver use of intervention strategies form pre- to post-treatment should

theoretically relate to improvements in child social communication from pre-treatment to follow-up. Change scores for the NDBI-Fi were calculated by subtracting pre-treatment from post-treatment ratings, such that a positive change score indicated improvement. Change scores for the *BOSCC* were calculated by subtracting follow-up scores from pre-treatment scores, such that a positive change score indicated improvement. Pearson correlations were used to evaluate the extent to which change in caregiver scores on the *NDBI-Fi* related to improvement in child social communication skills.

Sensitivity.

To evaluate the sensitivity of the *NDBI-Fi*, a subset of videos of the same dyad pre- and post- training were rated (n=24). A paired samples *t*-test was used to assess for significant change in caregiver use of strategies from pre- to post- training. We expected that, on average, caregivers would score significantly higher on the *NDBI-Fi* after receiving training.

RESULTS AND DISCUSSION

The *NDBI-Fi* Average Score (M = 3.26, SD = 0.66) was adequately normally distributed (Figure 2), with skewness of -0.14 (SE = 0.31) and kurtosis of -.71 (SE = 0.61). Two individual items deviated from normality according to skewness and kurtosis values (Table 4), with one representing a low-frequency behavior with positive skew (6. Communicative Temptations) and one representing a high-frequency behavior with negative skew (7. Frequency of Direct Teaching). Frequency distributions of individual items are included in Appendix E.

Reliability

The 8 *NDBI-Fi* items yielded a Cronbach's alpha of 0.77, thereby demonstrating good internal consistency. Inter-item correlations ranging from -0.11 to 0.71. The single measures ICC for the *NDBI-Fi* Average Rating was 0.79, demonstrating excellent reliability (Cicchetti, 1994). Individual item ICCs ranged from 0.52 to 0.85 (Table 5), with 3 items with fair reliability, 2 items with good reliability, and 3 items with excellent reliability (Cicchetti, 1994). ICCs suggest that, while absolute agreement between raters for the Average Rating was excellent, some items were more difficult to rate consistently than others. However, one of the two raters did not have any direct intervention experience. Despite her limited experience, she was able to learn the rating scheme, and reach reliability according to our training criteria. For raters without intervention experience, it is possible that more stringent training criteria may be needed in order to obtain high inter-rater reliability across all measure items.

Validity

Concurrent validity.

An independent samples *t*-test was used to compare post-timepoint ratings for caregivers in the active study treatment groups (n = 37) and control groups (n = 23). Caregivers who

received training (M = 3.50, SD = 0.61) received higher *NDBI-Fi* Average Ratings than caregivers in the study control groups on average, with a large effect size (M = 2.89, SD = 0.57), $t(58) = 3.81$, $p < 0.001$, $d = 1.01$. As expected, this shows that parents who have received training in an NDBI demonstrate greater adherence to common NDBI strategies than parents in study control groups. However, there was also overlap in the frequency distributions of trained and untrained caregivers, with some untrained caregivers demonstrating high fidelity, and some trained caregivers demonstrating low fidelity (Figure 3). 54% of trained caregivers exceeded a cutoff of 3.5 on the average *NDBI-Fi* rating. Of untrained caregivers, 17% exceeded a cutoff of 3.5, which is consistent with the 20% reported by Stahmer et al. (2017). These data suggest that quantifying caregiver's use of intervention strategies pre-training is important in understanding the change in treatment dose a child receives as a result of being assigned to the treatment group in an RCT. In other words, some children assigned to the control condition (i.e. those with caregivers who naturally use NDBI strategies) may actually receive a similar dose of treatment to children assigned to the active study treatment.

Convergent and discriminant validity.

A Pearson correlation showed that the *NDBI-Fi* Average rating correlated significantly with individual intervention fidelity collected at two sites[2] with a large effect size ($r = 0.45$, $p = 0.001$). As expected, caregivers who performed the interventions at higher fidelity also received higher ratings on the *NDBI-Fi*. Pearson correlations revealed that the *NDBI-Fi* Average rating did not significantly correlate with either developmental level, as measured by averaging the age equivalent score across the four MSEL domains ($r = 0.19$, $p = 0.11$), or child chronological age

[2] Data are being collected at additional sites.

at the start of the study ($r = 0.16$, $p = 0.18$). This is consistent with our prediction and lends support to the validity of the *NDBI-Fi*.

Predictive validity.

A small subset of the sample who had received training had pre-post data for the *NDBI-Fi* as well as pre-follow up data for the BOSCC (n = 21). Improvement in *NDBI-Fi* Average Rating from pre- to post-intervention did not significantly correlate with improvement on BOSCC from pre-intervention to follow-up for the Social Communication (SC) subscale ($r = 0.23$, $p = 0.31$) or Total score ($r = 0.37$, $p = 0.10$). However, given that these analyses were underpowered, it is more useful to evaluate this relationship based on the effect size. Hemphill suggested that correlation coefficients between 0.2 and 0.3 fall within the middle third of effect sizes reported in psychological studies (2003), thus suggesting some relationship between caregiver intervention fidelity and child improvement. These results should be interpreted cautiously and considered preliminary, given the small sample with which this analysis was conducted. Although the BOSCC has demonstrated preliminary reliability, validity, and sensitivity to change (Grzadzinski et al., 2016), research has not yet linked concurrent adult behavior with child behavior using this outcome measure. Further, although the BOSCC has been demonstrated to capture change in some samples (Grzadzinski et al., 2016; Kitzerow et al., 2016), this finding has not been replicated in others (Fletcher-Watson et al., 2016; Nordahl-Hansen et al., 2016). Therefore, although we expected that improvement in *NDBI-Fi* Average Rating from pre- to post-intervention would be significantly associated with child improvement on the BOSCC from pre-intervention to follow-up testing, there are several reasons this might not be true. For example, children's behavior fluctuates, and children's "usual" level of social

communication skill may not have been captured adequately in a short observation (10 minutes) due to illness, fatigue, time of day, or challenging behavior.

Sensitivity

As expected, caregivers who had been trained on Project ImPACT scored significantly higher at post-intervention on the *NDBI-Fi* Average rating (M = 3.65, SD = 0.54) than at pre-intervention (M = 2.81, SD = 0.55), $t(23) = 5.93$, $p < 0.001$, $d = 1.53$. This indicates that the *NDBI-Fi* is sensitive to change over the short-term treatment period associated with most NDBI caregiver-mediated interventions. Therefore, it may be a useful instrument for quantifying change in a research context.

CONCLUSION

Various NDBI for young children with ASD have been independently developed and validated. While researchers acknowledge common strategies across these treatments (Schreibman et al., 2015), this study represents the first attempt to quantitatively evaluate the extent to which individual strategies are shared across manualized treatment packages to our knowledge.

Study 1 involved development of a comprehensive taxonomy of intervention techniques through the examination of treatment fidelity forms and manuals and input from individuals with expertise in various NDBI. This large collaborative effort yielded a list of 20 defined strategies, refined by expert clinical scientists, with accompanying examples and non-examples to illustrate the strategies. Given the differences in terminology often used across NDBI models, these refined definitions may be useful in translating information among research teams and in the community.

Findings demonstrated that, of these 20 items, there are several "essential" manualized strategies that are shared across NDBI, and that these strategies can be measured using an intervention-independent fidelity rating scheme. Although evidence is preliminary, the *NDBI-Fi* has the potential to facilitate multisite research that cuts across interventions by providing a mechanism for evaluating change in common NDBI strategies during intervention trials.

Study 1 also revealed that there are many strategies which are *not* explicit components of multiple NDBI manuals but *are* consistently used by clinicians with expertise in different NDBI. In other words, clinicians seem to use NDBI strategies that are part of at least one NDBI, although not necessarily the NDBI they deliver. In fact, using the broader criteria in which respondents rated their use of manualized strategies and "good clinical practice," only 1 item was

not considered a common element based on the statistically significant cutoff used for this study. This has several implications. First, it is clear that there is substantial overlap among strategies delivered across different NDBI. This overlap in strategies makes comparison among NDBI challenging, given that differences in treatment manuals may not completely reflect differences in strategy use. This is further reflected by the variability found in existing fidelity measures used in research, which ranged in comprehensiveness from 6-item to 32-item rating schemes. In addition, it is possible that some of these strategies considered good clinical practice are used by practitioners regardless of treatment model, NDBI or otherwise. Given that comparison groups in RCTs typically receive "treatment-as-usual," this speaks to a need for understanding what usual care entails. If community practitioners are indeed using many similar strategies to those delivered as part of intervention trials, this may help explain some of the modest effect sizes found in some RCTs.

In addition, pilot testing of the *NDBI-Fi* showed variability in scores of caregivers with and without training in an NDBI, with some untrained caregivers demonstrating use of several NDBI strategies, and some trained caregivers demonstrating limited used of strategies. This has implications for interpretation of efficacy trials, insofar as it affects the extent to which randomization to the study treatment group indicates meaningful manipulation of caregiver behavior. In other words, dose of intervention appears to vary substantially across participants in both treatment and control conditions. In future research, it will be important to consider how *change* in caregiver fidelity of implementation relates to child outcomes, in addition to between-group comparisons.

In practice, this finding has implications for the use of stepped-care models in caregiver-mediated interventions for ASD (Phaneuf & McIntyre, 2011; Wainer & Ingersoll, 2015; Wood,

McLeod, Klebanoff, & Brookman-Frazee, 2015). Caregivers who *do not* intuitively use many of these strategies may have the most to gain from training and may require a higher level of support to be successful. On the other hand, caregivers who *do* intuitively use some NDBI strategies may benefit from less supportive training, or training targeting other areas of need.

Last, research in implementation science has documented barriers to providing evidence-based interventions (EBIs) in the community for social services more broadly (Osterling & Austin, 2008; Pagoto et al., 2007) and for ASD interventions specifically (Pickard, Kilgore, & Ingersoll, 2016; Wood et al., 2015). Research suggests that practitioners have concerns about the use of packaged treatment manuals, perhaps due to the perceived inflexibility of treatment manuals, or difficulty knowing which treatment manual(s) to use. The present study demonstrates that NDBI have numerous shared strategies, which may alleviate clinicians' uncertainty about choosing the "right" intervention package. It also suggests that there may not be a need for training in more than one NDBI, given the demonstrated overlap across treatment models.

Limitations and Future Directions

This study was limited to examining common strategies used across a selection of NDBI for young children with ASD. Future research should attempt to evaluate this measure across additional NDBI, and on a greater number of CCX videos, which would lend further support to the validity of the measure. Data on inter-rater reliability suggest that while training a non-expert in rating caregiver fidelity can be achieved, it yields reliability estimates that are acceptable but could be improved.

In addition, future research should attempt to clarify if and how often these intervention techniques are utilized by clinicians with expertise in other areas, such as more structured

applied behavior analysis interventions, special education, and speech-language pathology. Understanding the extent to which community clinicians use similar strategies is important in determining the quality of services children receive as part of usual care. In addition, this would help clarify comparisons between NDBI and other treatment models, and NDBI and usual care.

APPENDICES

APPENDIX A

Taxonomy of NDBI Strategies

NDBI-Fi Items Table of Contents

NDBI-Fi: General Information

NDBI-Fi Development: Stages of the current project

The NDBI-Fi, currently under development, will be an observational rating scheme that evaluates caregiver implementation of common NDBI intervention strategies. The item definitions below describe intervention strategies that are used in one or more NDBIs.

Items were developed in stages. First, intervention fidelity forms and manuals, when available, were reviewed to establish an initial set of items. These were sent to experts in NDBIs for open-ended review, and further edited. Stage two (underway) involves having 4 raters per included NDBI rate the extent to which they use each strategy in a modal session of their NDBI of expertise. The NDBI-Fi item set will be refined based on the extent to which items emerge as common elements across raters. Scoring anchors, which further describe the frequency with which these strategies are meant to be used, will be developed for this set of common elements. Stage three will involve pilot testing the new measure on a set of videos of parents delivering different NDBIs.

How to rate the NDBI-Fi

The NDBI-Fi is meant to be rated on short videos of caregiver-child interactions (10 min). Videos should be rated in two passes, with the rater taking notes throughout as needed. The video may be paused if needed to write notes, and rewinding/replaying is permitted to discern difficult-to-rate sequences. Videos should take no more than 30 minutes to rate.

Who can rate the NDBI-Fi

The NDBI-Fi can be rated by non-experts (i.e. those with no experience providing direct intervention) who have been well-trained in rating behavioral observations using this rating scheme. Raters within a site are expected to obtain inter-rater reliability. Reliability criteria are forthcoming.

NDBI-Fi: Item Definitions
Promoting Engagement

1) Face-to-face and On the Child's Level

The adult is **face-to-face with the child**. The child's and adult's bodies are oriented toward each other, and they are at a similar level (or the adult can be slightly below the child's eye level), such that the adult is **within the child's line of sight**. If playing, toys are between the adult and child when possible (this may be difficult in some activities, such as building a puzzle, or playing with a large dollhouse or on a jungle gym). If the adult is required to move away from the child, or if the child walks away, the adult returns to being face-to-face as soon as possible.

- ☑ *Both sitting on the floor with a toy in between them, or sitting across from each other at a table*
- ☑ *Adult gets up to put a toy away, but quickly returns to being face-to-face*
- ☒ *Adult is sitting on the couch, child is playing on the floor*
- ☒ *Adult is sitting with the child on her lap, such that the child's back is to her*

2) Setting Up the Activity Space

The adult sets up the space, trying to avoid clutter. **Distractions in the environment, including sounds (e.g. TV), are minimized**. Once a child has chosen an activity, other toys and materials are removed or set aside. This may also include removing an item that has become a perseverative interest.

- ☑ *Child: Becomes fixated on putting tiny pieces of play dough on the floor*
  Adult: Attempts to model functional play with play dough, then later removes the play dough from the play area and brings out two different toys for the child to choose from
- ☑ *Adult takes a moment to clean up toys with lots of pieces by putting them in a bin if the floor becomes cluttered*
- ☒ *Adult leaves the TV on, with his smartphone out on the table during snack time*
- ☒ *Child dumps out 3 bins of toys onto the floor, and the adult begins to play without clearing or pushing some toys to the side*

3) Following the Child's Lead

The adult provides several ***developmentally appropriate*** **activity options**, and **allows the child to choose** which toy or activity to play with**, how to play**, and **how long** to stay with an activity. The adult then **joins in the child's chosen activity** by playing with the child, helping the child with an activity, handing the child more pieces, or playing another "role" in the activity. **The adult and child are both active participants in the activity.** If the child does not choose an activity, or expresses disinterest in or dislike of an activity, the adult **notices and responds accordingly**. This may include using the situation to practice expressing refusal, offering a choice between two new materials, or moving new toys into the child's line of sight to encourage changing activities or entice the child's interest. The adult is **permitted to set limits** (e.g. limit their child's access to more snacks) and to **intervene if the child is engaging in harmful, disruptive, repetitive or inappropriate activities**. If using intervention strategies during an adult-directed activity (e.g., dressing, washing hands), the adult incorporates child choices when possible.

- ☑ *Child: Pushes toy cars away*
  Adult: Comments, "You don't want cars," and brings bins with blocks and animals into the play space
- ☑ *During dressing routine, the adult holds up two different shirts for the child to choose from*
- ☑ *Child: Opens the bin of blocks and starts to build a tower*
  Adult: Sets aside the previous activity, and hands the child more blocks

- ☒ *Child: Playing with trains functionally and appears content*
  Adult: Abruptly cleans up trains and brings out blocks instead
- ☒ *Child: Putting shape sorter pieces into a nesting box*
  Adult: Takes the nesting box away, and directs the child to put the pieces in the shape sorter instead

4) Imitating the Child

The adult **imitates the child's actions.** Imitation may include mimicking (within a few seconds of the child) a child's play actions, ***gestures***, and/or movements.

- ☑ *Child: Puts pieces in a puzzle*
  Adult: Puts pieces in the puzzle too
- ☑ *Child: Claps and says, "yay!"*
  Adult: Claps along with the child
- ☑ *Child: Holds play tea cup up to her mouth to 'drink'*
  Adult: Pretends to sip too
- ☒ *Child feeds dolls, while adult watches quietly*
- ☒ *Adult hands the child a plate of food, then goes to wash dishes while the child eats*
- ☒ *Child drives a car back and forth while the adult builds a road with blocks*

5) Supporting Turn-Taking

The adult supports the child in turn taking, which involves a back and forth interaction in which the adult and child **exchange control of a toy or activity**. The adult helps the child anticipate this exchange if necessary (e.g. says "3, 2, 1, my turn!").

- ☑ *Adult says, "it's my turn to have some snack," takes the bowl of crackers and eats a couple, then returns the bowl to the child*
- ☑ *Child: Opens and closes the expanding ball*
  Adult: Takes the ball, opens and closes it
  Child: Says, "ball" and reaches
  Adult: Hands it back to the child
- ☒ *Child: Opens and closes the expanding ball*
  Adult: Takes the ball and begins to play with it, without handing it back to the child
- ☒ *Child: Opens and closes the expanding ball*
  Adult: Takes the ball, then builds a cube with Magnatiles

6) Displaying Positive Affect and Animation

The adult displays **rich positive affect** to promote child ***engagement***. This may include adjusting vocal quality or tone, ***gestures***, and facial expressions. Affect is **matched to the child's individual sensory needs**, such that the adult promotes engagement without over-arousing the child. On the other hand, some children may need higher levels of affect and animation due to their lack of responsiveness and low arousal level.

- ☑ *Adult pushes the child on the swing, and says "swiiiiing!" while smiling*
- ☑ *Adult laughs with the child as he pops bubbles*
- ☑ *Adult speaks in a whisper while the child quietly puts the baby doll to sleep*
- ☒ *Child: Becomes dysregulated when his block tower falls down*
  Adult: Says, "the blocks CRASHED!" loudly with an excited tone
- ☒ Adult has flat affect and appears bored during play

7) Engaging the Child in Play Routines

The adult and child participate in **collaborative *play routines* with toys**, in which the adult and child are both active participants. **Play routines** have **consistent steps, and may be repeated several times,** though they may vary in complexity based on the child's ***developmental level***. Code N/A if rating a ***home routine***.

- ☑ *The child and adult take turns putting coins in the piggy bank until it is full*
- ☑ *Together, the child and adult stack blocks on top of each other, until the tower falls, and they both begin building again*
- ☑ *Together, the child and adult build a train track, put trains on the track, load blocks onto the train cars, then drive the trains*
- ☒ *Child and adult move quickly from one activity to another throughout the session, without settling on a joint play activity*
- ☒ *Child drops marbles down a marble run while the adult feeds a baby doll*
- ☒ *Adult watches the child play and occasionally narrates what she is doing*

8) Engaging the Child in Social Routines

The adult **introduces *social routines*** into the interaction. These are joint activities which focus on the dyadic interaction between adult and child, rather than a play interaction involving toys (as in #7). Common social routines include (but are not limited to) singing songs, playing a chasing or hide-and-seek type game, jumping on the bed, rough-and-tumble play, peekaboo, playing a tickle game, etc.

- ☑ *Child: Becomes dysregulated, and flaps his hands while vocalizing*
  Adult: Begins to sing "row, row, row your boat" while swinging the child's arms
- ☑ *Child: Loses interest in playing*
  Adult: Initiates a tickle game by holding hands up and sayings, "I'm going to get you!"
- ☒ *Child: Loses interest in playing with trains*
  Adult: Continues to play with trains

9) Managing Problematic Behavior and Dysregulation

If the child engages in problem behavior (e.g. aggression, self-injury, throwing, whining), the adult uses **behavior-management strategies, and only reinforces appropriate behavior** or attempts at appropriate behavior. Common effective behavior-management strategies include withdrawing attention from the child, displaying neutral affect, redirecting the child and praising positive behavior, or providing visual or behavioral supports as needed. The adult may remove materials to maintain safety. The adult may also **preempt overt problem behavior by reducing demands** on the child or initiating sensory or social play. If problem behavior is frequent, the adult analyzes the antecedents to these behaviors (e.g. transitions, too many stimuli in the room) and makes environmental modifications to reduce the probability of such behaviors. In addition, the adult targets appropriate protesting (e.g. saying "no") in direct teaching opportunities.

- ☑ *Child: Throws a train across the room*
  Adult: Ignores the behavior, moves the trains out of reach, and directs the child to say "all done"
- ☑ *Adult notices the child becoming frustrated, and preemptively begins to sing "Old MacDonald" while pointing at different animal figures before problem behavior occurs*
- ☒ *Child: Throws a block*
  Adult: Says, "Stop that! Why'd you throw?" and stops the activity to go pick up the block
- ☒ *Adult: Asks "Want crackers, or want milk?" after child finishes a plate of snack*
  Child: Yells and protests
  Adult: Gives the child more crackers and milk without waiting for a response

Modeling Skills

10) Modeling Appropriate Language

The adult **adjusts his language to the child's *developmental level***; most utterances match the child's current abilities, while others are slightly above a child's current ability level. The adult avoids asking questions or giving commands (outside of ***direct teaching opportunities***), and **primarily comments** around the child's attentional focus and actions. Utterances are somewhat repetitive, but not overly so, and the adult models language for different objects and actions.

- ☑ *Adult narrates, "Drive the trains… Train… Push… Go," while she and her child (who primarily uses single words) drive trains together*
- ☑ *Adult narrates, "Building a tower. More pieces on top. Build with blocks," while she and her child (who speaks in short phrases) build with blocks*
- ☒ *Adult narrates, "Block… Block… Block… Block… Block" to her child (who speaks in phrases)*
- ☒ *Adult says, "Wow, are we building a huge block tower?" to her child (who is preverbal)*
- ☒ *Adult repeatedly asks, "What color?" for each block the child puts on a tower*

11) Modeling Gestures and Joint Attention Skills

The adult **models joint attention skills,** such as pointing, showing, and giving, as well as other ***gestures***, such as **emphatic or emotional gestures** and **descriptive gestures**. Gestures are clear and somewhat exaggerated.

- ☑ *Child: Says, "car"*
  Adult: Says, "blue car!" while pointing to the car
- ☑ *Adult holds up the juice box and says, "here's the juice"*
- ☑ *Adult says, "A big tower!" while holding his hands apart to indicate the size*
- ☒ *Child: Says, "car"*
  Adult: Says, "there's the car" without gesturing

12) Modeling New Play Acts

The adult models **new** play acts that **expand on the current play activity**. Play models are ***developmentally appropriate***, and do not add several "steps" to the play at a time. Play models that occur as a ***prompt*** during a ***direct teaching opportunity*** should not be considered here. Code N/A if rating a ***home routine***.

- ☑ *Child and adult build a Magnatile house together, then the adult puts an animal inside, and continues playing the way the child plays*
- ☑ *Child and adult put pieces in the shape sorter several times, then the adult drops a shape sorter piece into a butterfly net*
- ☒ *The adult leads the play with a quick series of models: feeds, gives a drink, burps, wipes face, and puts the baby doll to sleep*
- ☒ *The adult repeatedly imitates the child by putting pieces in a shape sorter and dumping them out, without adding any new steps or modifying the activity*

Encouraging Communication

13) Responding to Attempts to Communicate

The adult **verbally responds** to the child's attempts to communicate, including vocalizations, eye contact, word approximations, ***gestures***, joint attention, etc. This includes repeating, clarifying and/or expanding on the child's communication, and also responding to the child's communication as meaningful. If the child uses a joint attention skill (e.g. pointing, showing, or giving), the adult responds by incorporating a joint attention skill into a natural response.

- ☑ *Child: Says, "block"*
  Adult: Says, "build with blocks," and hands the child a block
- ☑ *Child: Points to the train*
  Adult: Gives the child the train and says "train!"
- ☒ *Child: Says, "block"*
  Adult: Does not respond
- ☒ *Child: Points to the train*
  Adult: Says, "I found some animals over here"

14) Using Communicative Temptations

The adult deliberately creates situations meant to **elicit communication from the child**. These "communicative temptations" may involve blocking the child's play, putting toys in sight but out of reach, limiting or withholding access to toys, using toys or containers for which the child needs assistance, or modeling a silly or unusual play act. In most cases, the adult will have shared control over the materials, such that s/he can limit access as needed. These strategies are followed by a brief period of **expectant waiting** to give the child an opportunity to respond. The adult may also use this as an opportunity to introduce a ***direct teaching opportunity***.

- ☑ *Adult hands the child's crackers to her in a container with the lid on, and waits to see how she responds*
- ☑ *Adult uses his finger to stop the marble from running down the track, and looks expectantly at the child*
- ☒ *Adult sets up the child's snack so that she has unobstructed access to two snacks and milk*
- ☒ *Adult dumps out a whole bin of blocks for the child to play with*

Direct Teaching

What skills or ***targets*** are taught using ***direct teaching opportunities***? Check all that apply.

- ☐ Eye contact
- ☐ Joint attention skills & gestures
- ☐ Expressive language
- ☐ Receptive language
- ☐ Play acts
- ☐ Participating in routines
- ☐ Increased attention or engagement
- ☐ Other: _____
  _____
  _____

15) Pace and Frequency of Direct Teaching Opportunities

The adult **directs the child to demonstrate new or emerging skills** by giving some kind of instruction or cue. There is at least a brief period of time between direct teaching episodes in which the child receives access to a reinforcer, and the adult leaves space for child initiations. The adult can introduce more frequent direct teaching opportunities for children who are highly motivated than for children who are not ***engaged***.

- ☑ *Adult directs the child to ask for a block when he is engaged in the activity, then helps the child build before directing the child to ask for another block*
- ☒ *Adult instructs the child to ask for blocks five times in a row, without giving the child access to blocks between teaching opportunities*

16) Varying Difficulty of Direct Teaching Target

The adult **intersperses opportunities for *target* responses that are easier** for the child with those that reflect brand new skills, to reduce frustration and maintain the skills that the child has already demonstrated.

- ☑ *Adult occasionally directs the child to say "go," which he can do independently, between opportunities targeting the word "marble," which is still difficult for the child*
- ☑ *Adult follows a teaching opportunity for a new skill (where the child needs physical support) with one that the child can complete independently*
- ☒ *Adult follows a difficult teaching opportunity where the child needs physical support with another two opportunities of the same difficult skill, leading to child frustration*

17) Using Clear and Appropriate Teaching Opportunities

Direct teaching opportunities ***target*** **behaviors that are at or just above the child's current skill level**. When giving an instruction or ***prompt***, the adult uses **communication that is clear and *developmentally-appropriate*,** such that it is clear how the child is expected to respond. Instructions and prompts are simple and direct, and the target skill remains consistent within each direct teaching opportunity.

- ☑ *(Child who speaks in short phrases) Adult: Says, "Jimmy, give me the ball."*
- ☑ *(Child who has some single words) Adult: Says, "Ball, or car?"*
- ☒ *(Child who speaks in short phrases) Adult: Says, "Hey sweetie, do you want some more of those crackers, or would you rather have some juice to wash it down?"*
- ☒ *(Child who has some single words) Adult: Says, "Hey, Jimmy, could you grab the ball for me?"*

18) Providing Motivating and Relevant Teaching Opportunities

The adult teaches skills when the child is **motivated, interested, and *engaged* in the activity.** The child's interest may be indicated by reaching for materials, approaching the adult, making eye contact with the adult, looking at the materials, etc. The ***target*** **behavior is logically related to the ongoing activity**, and the adult embeds the teaching opportunity in the context of the ongoing activity.

- ☑ *Child: Building a tower with blocks, and reaching for more pieces*
  Target skill: Two-word requests
  Adult: Withholds the next block, and directs him to say "block please"
- ☑ *Child: Eating crackers*
  Target skill: One-word request
  Adult: Asks, "Crackers, or juice?"
- ☒ *Child: Building a tower with blocks*
  Target skill: Motor imitation
  Adult: Directs him to clap his hands
- ☒ *Child: Playing with cars*
  Target skill: Functional play act
  Adult: Directs him to put a piece in the puzzle

19) Supporting a Correct Response Using Prompts

After initiating a direct teaching opportunity, if the child does not respond independently, the adult **uses *prompts* of increasing support** to help the child respond correctly. Increasing the level of support may include giving the child additional cues to respond, or scaffolding the child's learning. The adult gives **no more than a few prompts before physically helping** the child follow through. Over time (across several teaching opportunities), the adult then **decreases support as a child learns a new skill**.

- ☑ *Adult: Asks, "What do you want?"*
  Child: Does not respond
  Adult: "Juice, or crackers?"
  Child: Reaches toward juice
  Adult: Says "Juice" and points to the juice
  Child: Continues reaching for juice
  Adult: Shapes the child's hand into a point, and gives her the juice.
- ☒ *Adult: Asks, "What do you want, do you want some more blocks?"*
  Child: Does not respond
  Adult: Asks, "What do you want?
  Child: Looks at adult
  Adult: Asks, "Do you want some more blocks?"

20) Providing Contingent Natural and Social Reinforcement

Once a child responds correctly to a direct teaching opportunity (including when supported by the adult), the adult provides an **immediate** (i.e. within a few seconds) **natural reward that is directly related to the child's response**, and/or positive **social reinforcement** such as touching, verbal praise, or positive affect. Reasonable attempts to respond correctly, such as word approximations, are rewarded when ***developmentally-appropriate***. Children are not allowed access to reinforcement without providing some type of response.

- ☑ *Adult: Asks, "What should we do?*
  Child: Says, "Crash tower"
  Adult: Playfully knocks down the blocks and smiles

Frost & Ingersoll. 7/18/17

- ☑ Adult: Asks, "What do you want?"
  Child: Says, "Ju"
  Adult: Says, "Nice asking me!" and hands her a cup of juice
- ☒ *Adult: Asks, "Play ball, or play cars?"*
  Child: Says, "Play cars"
  Adult: Says, "Ok, first let's go to the bathroom" OR "Here's a sticker for telling me!"
- ☒ *Adult: Asks, "iPad or marbles?"*
  Child: Grabs iPad without communicating
  Adult: Allows the child to play with the iPad

Glossary of Terms

Developmental level and Developmental appropriateness

Developmental level refers to a child's current repertoire of skills, and often focuses on language level or play skills. These skills tend to develop in a similar trajectory across children. When teaching or modeling skills, developmentally appropriate skills are those that are at or just above a child's current ability level. For example, a teaching target (targeting language) for a child who speaks in some single words may be a two-word request, or a new one-word request that the child has not yet mastered. A teaching target (targeting play) for a child who has mastered functional and combination play might be symbolic play, such as feeding a baby doll or putting farm animals to sleep.

Language level
- ➔ Pre-verbal
  - ➔ Single words
    - ➔ Short phrases/word combinations
      - ➔ Complex language/sentences

Play level
- ➔ Sensory play
  - ➔ Functional play
    - ➔ Combination play
      - ➔ Symbolic play
        - ➔ Dramatic play

Direct Teaching Opportunity

Direct teaching opportunities refer to adult-led teaching episodes, in which the adult teaches the child a skill using a clear cue. When performed correctly, the adult uses an "A-B-C" (antecedent-behavior-consequence) approach by first giving the child some kind of cue or instruction (antecedent), supporting the child in performing the target skill (behavior) by providing ***prompts***, and then rewarding or ***reinforcing*** the child's response appropriately (consequence). Various individual NDBIs may refer to these opportunities as teaching episodes, milieu episodes, teaching trials, etc.

Direct Teaching Target

A direct teaching target is a specific skill or response that the adult wants the child to perform in response to a direct teaching opportunity. For instance, if the adult withholds the ball to initiate a direct teaching opportunity, the target might be for the child to make a one-word request by saying "ball."

Prompt

"Prompting, also referred to as scaffolding or cuing, involves inserting a cue (verbal, visual, or physical) between the instruction […] and the target behavior in order to elicit a desired response and thereby create the context for delivering the reinforcer" (Schreibman et al., 2015). Prompts vary in their level of support. Some prompts may be highly supportive (e.g. physically moving the child's hands or body to help them respond), while others may be minimally supportive (e.g. asking an open-ended question, or making a leading comment).

Engagement

Engagement refers to the extent to which the child is actively involved in an interactive activity with the adult. A child who is engaged with the adult may check in with eye contact, offer a turn, communicate for the purpose of sharing or commenting, request for a collaborative activity to continue, etc. A child who is not engaged may be fixated on a toy without attending to the adult, wander without choosing an activity, ignore the adult's social bids, etc. Although researchers have defined various more specific engagement states (Bakeman & Adamson, 1984), for the purpose of this assessment, these distinctions are not made. Engagement here would include Bakeman and Adamson's categories of 'coordinated joint engagement,' 'person engagement,' and 'passive joint engagement.' The categories of 'unengaged,' 'onlooking,' and 'object-engaged' would not be considered engagement.

Gesture

Gestures are *communicative* body and hand movements. Common gestures include pointing in order to request or direct someone's attention, nodding or shaking one's head to answer a question, clapping to indicate success or excitement, or holding one's hands up to indicate surprise. Descriptive gestures (e.g. holding one's

hands apart to indicate size), emphatic gestures (e.g. conversational "beats"), and conventional gestures (e.g. waving goodbye, moving hand towards the body to say "come here"), are all considered here.

Routines

Play routine

Play routines are collaborative, toy-play activities where both the adult and child have an active role (which may be the same or different, depending on the activity). Play routines involve distinct play actions that are repeatable. Playing differently but in close proximity (i.e. parallel play) is NOT considered involvement in a play routine. Play routines can vary in complexity based on the child's developmental level and attention, ranging from very simple (e.g. putting shapes in a shape sorter and dumping them out), to very complex (e.g. giving the baby doll a bottle, burping the baby, giving the baby a bath, and then dressing the baby).

Home routine

Home routines are activities that occur in daily routines in natural contexts. Some examples include dressing, bath time routines, hand washing routines, snack time or meal routines, etc.

Social routine

Social routines are joint activities which focus on the dyadic interaction between adult and child, rather than a play interaction involving toys. Common social routines include (but are not limited to) singing songs, playing a chasing or hide-and-seek game, jumping on the bed, rough-and-tumble play, peekaboo, playing a tickle game, etc.

Reinforcement

Reinforcement occurs at the end of a direct teaching episode, once the child has completed the desired response, and serves to encourage the child to respond similarly in the future. Reinforcement can take several forms, such as giving the child the item or activity they requested, praising them, and showing positive affect.

Natural reinforcement

"Natural reinforcement is reinforcement that is intrinsic to the child's goal rather than unrelated to the child's goal (external or extrinsic to the theme or content of the activity or interaction)" (Schreibman et al., 2015). For example, natural reinforcement for the request "car" might be handing the child a car and allowing him to play with it as he wishes. This can be contrasted with 'artificial reinforcement,' which is extrinsic or unrelated to the child's goal. For example, artificial reinforcement for the request "car" might be giving the child a sticker, or giving the child a goldfish cracker.

Social reinforcement

Social reinforcement includes praise, physical touching such as tickles or hugs, and positive affect such as smiling or a happy and excited vocal tone.

Shared Control

An adult has shared control when they have at least partial control of the activity or materials (e.g., toy, game) that the child is motivated by. Shared control can be demonstrated by the adult holding or touching all or part of the materials, or blocking the play. If the child demonstrates consistent responding to language opportunities, it may be appropriate for the adult to elicit communication without obtaining shared control in advance, however the adult should be in close proximity to the child/activity such that they would be able to regain shared control if needed.

References and Acknowledgements

Bakeman, R., & Adamson, L. B. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. Child development, 1278-1289.

Schreibman, L., Dawson, G., Stahmer, A. C., Landa, R., Rogers, S. J., McGee, G. G., ... & McNerney, E. (2015). Naturalistic developmental behavioral interventions: Empirically validated treatments for autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *45*(8), 2411-2428.

Thank you to all of the intervention developers and experts who contributed valuable feedback and support in developing this measure: Jessica Brian, Susan Bryson, Geraldine Dawson, Helen Flanagan, Grace Gengoux, Ann Kaiser, Connie Kasari, So Hyun Kim, Rebecca Landa, Catherine Lord, Mendy Minjarez, Jennifer Nietfeld, Sarah Rieth, Sally Rogers, Stephanie Shire, Isabel Smith, and Aubyn Stahmer.

APPENDIX B

NDBI-Fi Item Definitions and Rating Anchors

Promoting Engagement

Face-to-face and on the child's level ↻

*The adult is **face-to-face with the child**. The child's and adult's bodies are oriented toward each other, and they are at a similar level (or the adult can be slightly below the child's eye level), such that the adult is **within the child's line of sight**. If playing, toys are between the adult and child when possible (this may be difficult in some activities, such as building a puzzle, or playing with a large dollhouse or on a jungle gym). If the adult is required to move away from the child, or if the child walks away, the adult returns to being face-to-face as soon as possible.*

1	2	3	4	5	N/A
The adult is rarely or never face-to-face and on the child's level. The adult is almost always standing, seated above the child, or behind the child.	The adult is occasionally face-to-face and on the child's level, however, most of the time, the adult may be standing, or seated above, behind; **OR** the adult is next to the child/kitty-corner for most of the session.	The adult is face-to-face and on the child's level for about half the session. Half the time, the adult may be standing, or seated above, behind, or next to the child.	The adult is usually face-to-face and on the child's level. When the child moves, the adult adjusts somewhat slowly, but eventually returns to a face-to-face position.	The adult is face-to-face and on the child's level throughout the session. When the child moves, the adult quickly adjusts position to return to a face-to-face position.	

Following the child's lead ↻

*The adult provides several **developmentally appropriate activity options**, and **allows the child to choose** which toy or activity to play with**, how to play**, and **how long** to stay with an activity. The adult then **joins in the child's chosen activity** by playing with the child, helping the child with an activity, handing the child more pieces, or playing another "role" in the activity. **The adult and child are both active participants in the activity.** If the child does not choose an activity, or expresses disinterest in or dislike of an activity, the adult **notices and responds accordingly**. This may include using the situation to practice expressing refusal, offering a choice between two new materials, or moving new toys into the child's line of sight to encourage changing activities or entice the child's interest. The adult is **permitted to set limits** (e.g. limit their child's access to more snacks) and to **intervene if the child is engaging in harmful, disruptive, repetitive or inappropriate activities**. If using intervention strategies during an adult-directed activity (e.g., dressing, washing hands), the adult incorporates child choices when possible.*

1	2	3	4	5	N/A
The adult rarely or never joins the child in a child-led activity; **OR** signs of child interest or disinterest are largely ignored. Within home routines, the adult does not build in opportunities for the child to make choices. An adult who merely watches the child should be rated a 1.	The adult sometimes joins the child in a child-led activity, but most opportunities are missed; **OR** most signs of child's interest or disinterest are ignored. Within home routines, the adult usually does not build in opportunities for the child to make choices.	The adult joins in a child-led or child-chosen activity about half the time, but frequently directs the child to a certain activity, toy, or play action. Within home routines, opportunities for the child to choose are present but infrequent.	The adult joins in a child-led or child-chosen activity for the majority of the session, outside of direct teaching episodes. Most signs of child interest or disinterest are acknowledged. The adult may occasionally choose for the child or direct the child to play in new ways.	The adult almost always joins the child in a child-led activity, outside of direct teaching episodes. Signs of child interest or disinterest are acknowledged. In home routines, the adult creates several opportunities for child choice.	

Positive affect and animation ↻					
*The adult displays **rich positive affect** to promote child* **engagement**. *This may include adjusting vocal quality or tone,* **gestures**, *and facial expressions. Affect is **matched to the child's individual sensory needs**, such that the adult promotes engagement without over-arousing the child. On the other hand, some children may need higher levels of affect and animation due to their lack of responsiveness and low arousal level.*					
1	**2**	**3**	**4**	**5**	**N/A**
The adult's affect appears flat or uninterested throughout the session. The adult does not laugh, smile, or use exaggerated tone.	The adult occasionally displays exaggerated positive affect, but does not exaggerate vocal tone, gesture, and/or facial expression for the majority of the session; OR animation is poorly adjusted to the situation and child's sensory needs.	The adult uses a combination of vocal tone, gesture, and/or facial expression to display exaggerated positive affect for about half of the session, OR uses only one method for the majority of the session; OR animation is occasionally adjusted to the situation or child's sensory needs.	The adult usually uses a combination of vocal tone, gesture, and/or facial expression to display exaggerated positive affect, but misses several opportunities; OR the adult uses only one method of displaying positive affect throughout the session. The adult usually adjusts animation as needed.	The adult uses a combination of vocal tone, gesture, and/or facial expression to display exaggerated positive affect consistently throughout the session. The adult usually adjusts animation as needed.	
Modeling appropriate language ↻					
*The adult **adjusts his language to the child's developmental level**; most utterances match the child's current abilities, while others are slightly above a child's current ability level. The adult avoids asking rhetorical questions or giving commands (outside of direct teaching episodes), and **primarily comments** around the child's attentional focus and actions. Utterances are somewhat repetitive, but not overly so, and the adult models language for different objects and actions.*					
1	**2**	**3**	**4**	**5**	**N/A**
The adult rarely or never models developmentally appropriate comments. All of the adult's comments may be far above or below the child's level, or the adult may exclusively ask rhetorical questions or give commands.	The adult occasionally models developmentally appropriate comments, but the majority of adult utterances are too far above or below the child's level, or most of the adult's utterances are questions or commands.	The adult models developmentally appropriate comments about half the time, but about half of utterances are too far above or below the child's level, or are questions or commands.	The adult models developmentally appropriate comments for most of the interaction, but some utterances are too far above or below the child's level, or the adult sometimes asks questions or gives commands.	The adult models developmentally appropriate comments throughout the interaction. No more than a few adult utterances are too far above or below the child's level, and there are no more than a few questions or commands.	

Encouraging Communication					
Responding to attempts to communicate ◎					
*The adult **verbally responds** to the child's attempts to communicate, including vocalizations, eye contact, word approximations,* **gestures**, *joint attention, etc. This includes repeating, clarifying and/or expanding on the child's communication, and also responding to the child's communication as meaningful. If the child uses a joint attention skill (e.g. pointing, showing, or giving), the adult responds by incorporating a joint attention skill into a natural response.*					
1	**2**	**3**	**4**	**5**	**N/A**
The adult rarely or never responds to the child's vocalizations and nonverbal attempts to communicate. The adult may make unrelated comments, or perform unrelated play acts in response. If the adult provides a few verbal responses but does not treat the child's communication as meaningful, rate a 1.	The adult occasionally provides meaningful responses to child's vocalizations and nonverbal attempts to communicate, but usually fails to respond, or usually responds un unrelated ways (i.e. low quality responses).	The adult sometimes responds to child's vocalizations and nonverbal attempts to communicate by clarifying or expanding on the child's utterances. About half the time, the adult fails to respond, or responds in unrelated ways. If the adult always repeats the child's utterances, but never expands on the child's communication, rate a 3.	The adult usually provides responses to the child's vocalizations and nonverbal attempts to communicate and treats them as meaningful, but occasionally fails to respond or misses some opportunities to clarify and expand the child's communication.	The adult nearly always responds to child's vocalizations and nonverbal attempts to communicate. This includes expanding or clarifying child utterances, and responding to the child's actions as meaningful. The adult misses no more than a few opportunities to respond.	N/A: The child does not vocalize or initiate communication with the adult.
Using communicative temptations 🕘					
*The adult deliberately creates situations meant to **elicit communication from the child**. These "communicative temptations" may involve blocking the child's play, putting toys in sight but out of reach, limiting or withholding access to toys, using toys or containers for which the child needs assistance, or modeling a silly or unusual play act. In most cases, the adult will have shared control over the materials, such that s/he can limit access as needed. These strategies are followed by a brief period of **expectant waiting** to give the child an opportunity to respond. The adult may also use this as an opportunity to introduce a **direct teaching opportunity**.*					
1	**2**	**3**	**4**	**5**	**N/A**
The adult never creates clear opportunities for the child to initiate.	The adult creates clear opportunities for the child to communicate 1-2 times.	The adult creates clear opportunities for the child to communicate 3-4 times.	The adult creates clear opportunities for the child to communicate 5-10 times.	The adult creates clear opportunities for the child to communicate more than 10 times.	

Direct Teaching

Frequency of direct teaching episodes

*The adult **directs the child to demonstrate new or emerging skills** by giving some kind of instruction or cue. There is at least a brief period of time between direct teaching episodes in which the child receives access to a reinforcer, and the adult leaves space for child initiations. The adult can introduce more frequent direct teaching episodes for children who are highly motivated than for children who are not engaged.*

- ***Only count complete direct teaching episodes here** (i.e. those with all of the following: A) Instruction, B) Child response/behavior, C) Adult response or reinforcement). These do not have to be of good quality (rated in subsequent item).*

1	2	3	4	5	N/A
The adult does complete any direct teaching episodes to teach skills.	The adult completes direct teaching episodes 1-2 times in 10 minutes.	The adult completes direct teaching episodes 3-4 times in 10 minutes.	The adult completes direct teaching episodes 5-10 times in 10 minutes.	The adult completes direct teaching episodes more than 10 times in 10 minutes.	

Quality of direct teaching episodes

The adult uses high quality teaching strategies throughout direct teaching episodes. Quality indicators include:

- *Clear: When giving an instruction or prompt, the adult uses **communication that is clear and developmentally-appropriate,** such that it is clear how the child is expected to respond. Instructions and prompts are simple and direct, and the target skill remains consistent within each direct teaching opportunity.*
- *Developmentally appropriate target: DTOs **target behaviors that are at or just above the child's current skill level**.*
- *Motivating and relevant: The adult teaches skills when the child is **motivated, interested, and engaged in the activity.** The child's interest may be indicated by reaching for materials, approaching the adult, making eye contact with the adult, looking at the materials, etc. The **target behavior is logically related to the ongoing activity**, and the adult embeds the teaching opportunity in the context of the ongoing activity.*
- *Supporting a Correct Response: After initiating a direct teaching opportunity, if the child does not respond independently (but remains interested), the adult attempts to help the child respond correctly. This includes repeating the instruction, giving the child additional cues to respond, scaffolding the child's learning, or physically helping the child follow through. Over time (across several teaching episodes), the adult decreases support as a child learns a new skill.*
- *Providing contingent natural and social reinforcement: Once a provides a correct response (including when supported by the adult), the adult provides an **immediate** (i.e. within a few seconds) **natural reward that is directly related to the child's response**, and/or positive **social reinforcement** such as touching, verbal praise, or positive affect. Reasonable attempts to respond correctly, such as word approximations, are rewarded when **developmentally-appropriate**. Children are not allowed access to reinforcement without providing some type of response.*

1	2	3	4	5	N/A
All direct teaching episodes are of low quality (2 or fewer indicators). There are no high quality episodes.	2 quality indicators are consistently used across direct teaching episodes. At least one high quality episode is present.	3 quality indicators are consistently used across direct teaching episodes OR about half of episodes are poor quality (2 or fewer indicators).	4 quality indicators are present within most direct teaching episodes. Few (if any) episodes are poor quality (2 or fewer indicators).	5 quality indicators are present within nearly all direct teaching episodes. There are no poor quality episodes (2 or fewer indicators).	Adult received a score of 1 on item 15: Pace and Frequency of Direct Teaching

APPENDIX C

Tables

Table 1.
Characteristics of Established NDBI Fidelity Measures.

Intervention	Items	Subscales	Rating scale	Type of coding	Total Score
Early Achievements	21	0	1-5	Global	$\frac{average\ rating}{5} \times 100$
ESDM	13	0	1-5	Per Activity	$\frac{average\ rating}{5} \times 100$
EMT	22	0	0-2 or 3	Global	$\frac{points\ earned}{points\ possible} \times 100$
JASPER	32	7	0-5	Global	$\frac{points\ earned}{points\ possible} \times 100$
PRT [1]	8	3	0-1	Interval (1-minute)	$\frac{correct\ intervals}{total\ \ intervals} \times 100$
PRT [2]	6	0	0-1	Interval (2-minute)	$\frac{correct\ intervals}{total\ \ intervals} \times 100$
Project ImPACT [3]	29	5	1-5	Global	$\frac{average\ rating}{5} \times 100$
Project ImPACT for Toddlers [1]	19	7	1-5	Global	$\frac{average\ rating}{5} \times 100$
Social ABCs	10	0	0-1	Interval (1-minute)	$\frac{correct\ intervals}{total\ \ intervals} \times 100$

Notes. [1] University of California – San Diego site, [2] Stanford University site, [3] Michigan State University site.

Table 2.
Content Validity Ratios for Intervention Taxonomy Items.

Item		Essential or Useful	Essential
1	Face-to-face and on the child's level *	**0.89**	**0.68**
2	Setting up the activity space	**0.89**	0.37
3	Following the child's lead *	**0.89**	**0.89**
4	Imitating the child	0.37	0.05
5	Supporting turn-taking	**0.79**	0.26
6	Displaying positive affect and animation *	**1.00**	**0.68**
7	Engaging the child in play routines	**0.79**	0.16
8	Engaging the child in social routines	**0.79**	-0.37
9	Managing problem behavior and dysregulation	**1.00**	0.37
10	Modeling appropriate language *	**1.00**	**0.58**
11	Modeling gestures and JA	**0.47**	0.05
12	Modeling new play acts	**0.79**	0.37
13	Responding to attempts to communicate *	**0.89**	**0.89**
14	Using communicative temptations *	**1.00**	**0.79**
15	Pace and frequency of direct teaching opportunities *	**0.89**	**0.58**
16	Varying difficulty of direct teaching target	**0.68**	0.05
17	Using clear and appropriate teaching opportunities *	**0.79**	**0.79**
18	Providing motivating and relevant teaching opportunities *	**1.00**	**1.00**
19	Supporting a correct response using prompts *	**0.68**	0.37
20	Providing contingent natural and social reinforcement *	**0.89**	**0.79**

Note: * denotes items included in the *NDBI-Fi* Measure; Bold text denotes items exceeding the statistically significant cutoff of 0.42.

Table 3.
Participant Demographics.

Children		
Gender	**n**	**%**
Male	50	83.3
Female	10	16.7
Race	**n**	**%**
White/Caucasian	38	63.3
Black/African-American	7	11.7
Asian/Pacific-Islander	6	10.0
Biracial/Mixed Race	1	1.7
Other	5	8.3
Missing	3	5.0
Ethnicity	**n**	**%**
Hispanic/Latinx	9	15.0
Not Hispanic/Latinx	50	83.0
Missing	1	1.7
MSEL Subscale AE (months)	**M**	**SD**
Visual Reception	24.2	9.2
Fine Motor	23.8	7.9
Receptive Language	19.9	9.5
Expressive Language	19.7	9.2
Caregivers		
Gender	**n**	**%**
Male	3	5.0
Female	57	95.0
Mother's highest complete education	**n**	**%**
Graduate/Professional degree	17	28.3
Bachelor's degree	16	26.7
Associate's degree	4	6.7
High school degree/GED	18	30.0
Did not complete high school	1	1.7
Missing	4	6.7
Father's highest complete education	**n**	**%**
Graduate/Professional degree	20	33.3
Bachelor's degree	12	20.0
Associate's degree	4	6.7
High school degree/GED	12	20.0
Did not complete high school	0	0.0
Missing	12	20.0

Note. MSEL = Mullen Scales of Early Learning, AE = age equivalent

Table 4.

Mean, standard deviation, and normality of NDBI-Fi items and Average Score.

	Mean	SD	Skewness		Kurtosis	
NDBI-Fi Item			Statistic	SE	Statistic	SE
1. Face to Face	2.63	1.30	0.31	0.31	-1.03	0.61
2. Follow Child's Lead	3.47	1.42	-0.71	0.31	-0.73	0.61
3. Positive Affect	3.62	1.32	-0.59	0.31	-0.93	0.61
4. Modeling Language	3.20	1.08	-0.31	0.31	-0.79	0.61
5. Responding to Communication	3.31	1.06	-0.16	0.31	-0.42	0.61
6. Communicative Temptations	1.44	1.06	1.76	0.31	2.99	0.61
7. Frequency of Direct Teaching	3.92	0.91	-1.09	0.31	1.70	0.61
8. Quality of Direct Teaching	3.87	0.89	-0.60	0.31	0.08	0.62
Average Score	3.18	0.71	-0.14	0.31	-0.72	0.61

Note. SE = Standard Error.

Table 5.

Reliability of individual NDBI-Fi items and Average Rating.

NDBI-Fi Item	ICC	Cronbach's alpha
1. Face to Face	0.83	0.91
2. Follow Child's Lead	0.63	0.78
3. Positive Affect	0.79	0.88
4. Modeling Language	0.57	0.72
5. Responding to Communication	0.52	0.75
6. Communicative Temptations	0.68	0.81
7. Frequency of Direct Teaching	0.85	0.73
8. Quality of Direct Teaching	0.55	0.35
Average Score	0.79	0.91

APPENDIX D

Figures

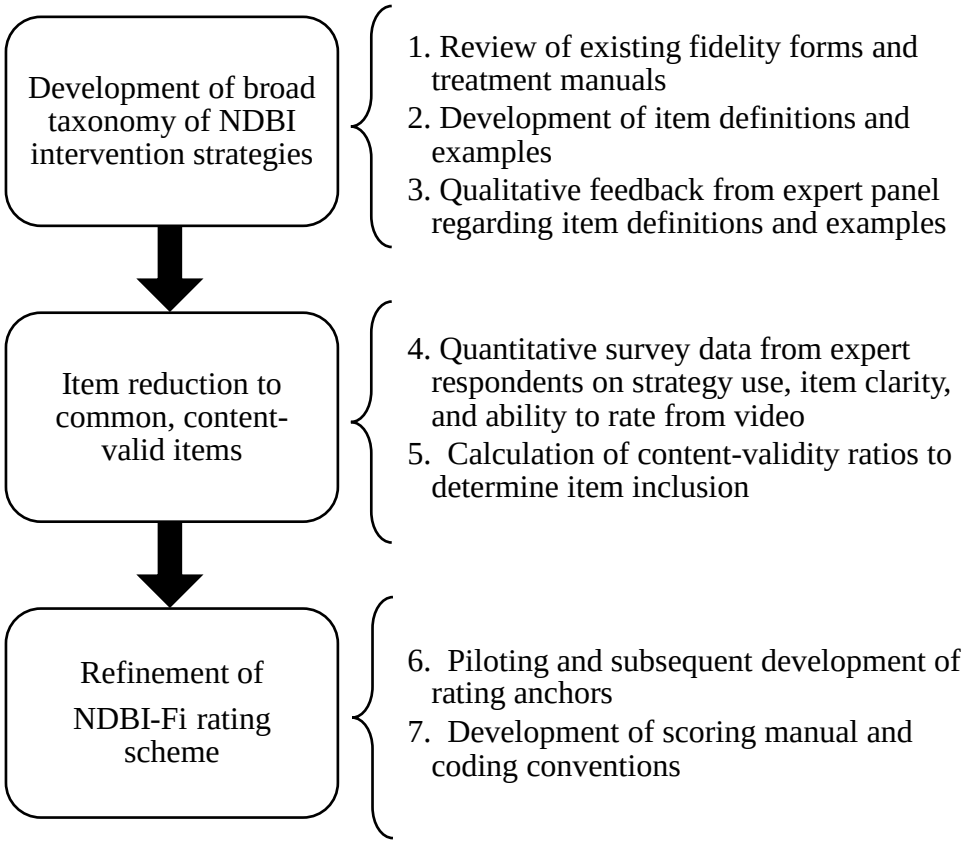


Figure 1. *Study 1 Method Flowchart.*

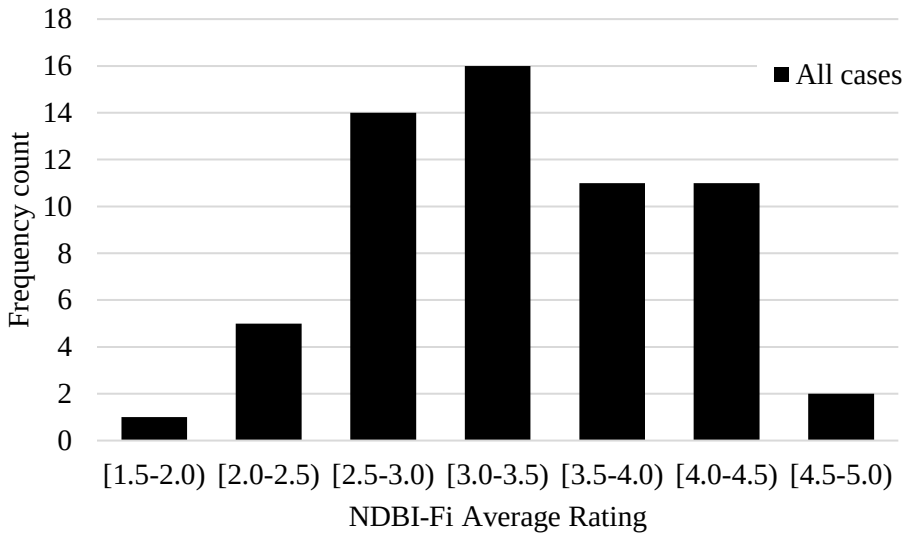


Figure 2. *Frequency distribution of NDBI-Fi Average Score.*

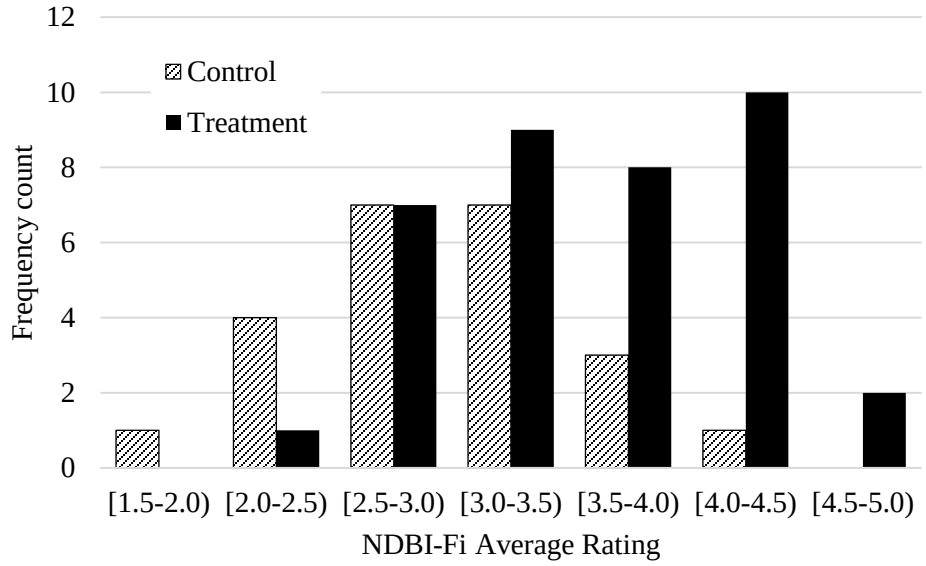
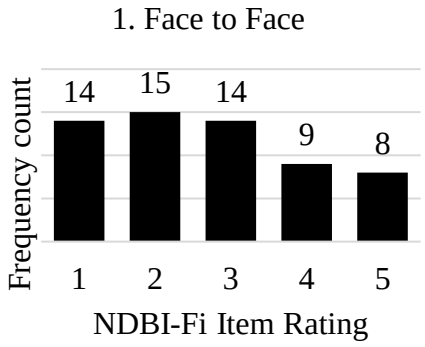
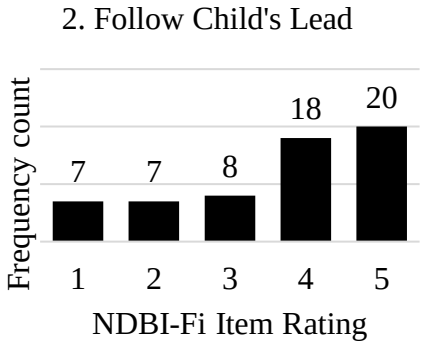


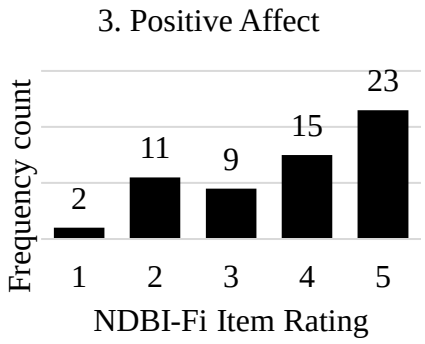
Figure 3. *Frequency distribution of NDBI-Fi average ratings by group assignment.*

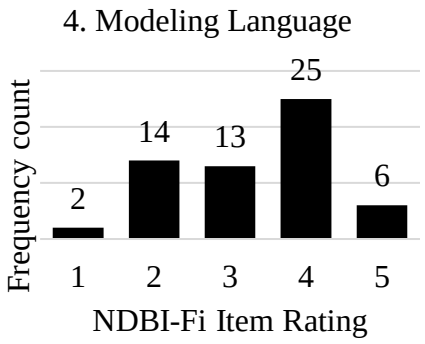
APPENDIX E

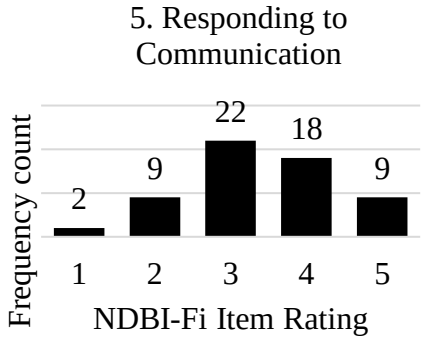
Frequency Distributions of Individual NDBI-Fi Items

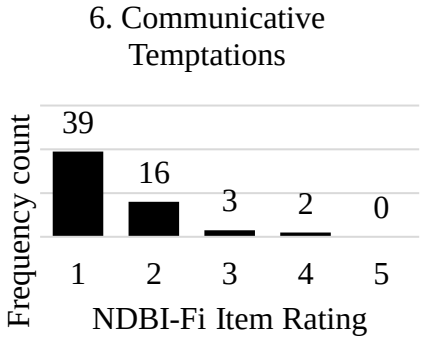

1. Face to Face
Frequency count
14
15
14
9
8
1
2
3
4
5
NDBI-Fi Item Rating

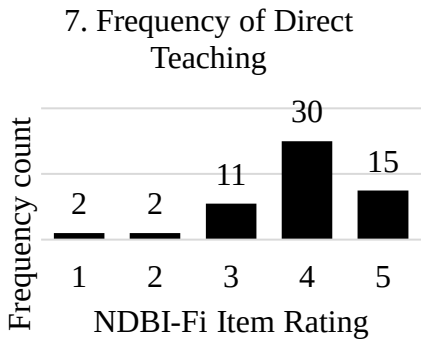

2. Follow Child's Lead
Frequency count
7
7
8
18
20
1
2
3
4
5
NDBI-Fi Item Rating

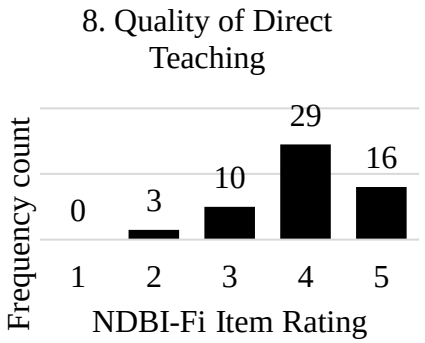

3. Positive Affect
Frequency count
2
11
9
15
23
1
2
3
4
5
NDBI-Fi Item Rating


4. Modeling Language
Frequency count
2
14
13
25
6
1
2
3
4
5
NDBI-Fi Item Rating


5. Responding to Communication
Frequency count
2
9
22
18
9
1
2
3
4
5
NDBI-Fi Item Rating


6. Communicative Temptations
Frequency count
39
16
3
2
0
1
2
3
4
5
NDBI-Fi Item Rating


7. Frequency of Direct Teaching
Frequency count
2
2
11
30
15
1
2
3
4
5
NDBI-Fi Item Rating


8. Quality of Direct Teaching
Frequency count
0
3
10
29
16
1
2
3
4
5
NDBI-Fi Item Rating

REFERENCES

REFERENCES

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Bagnato, S. J. (2005). The authentic alternative for assessment in early intervention: An emerging evidence-based practice. *Journal of Early Intervention, 28*(1), 17-22.

Bakeman, R., & Quera, V. (2011). Sequential analysis and observational methods for the behavioral sciences. In: Cambridge University Press.

Barth, R. P., & Liggett-Creel, K. (2014). Common components of parenting programs for children birth to eight years of age involved with child welfare services. *Children and Youth Services Review, 40*, 6-12.

Bearss, K., Burrell, T. L., Stewart, L., & Scahill, L. (2015). Parent Training in Autism Spectrum Disorder: What's in a Name? *Clinical child and family psychology review, 18*(2), 170-182.

Bradshaw, J., Koegel, L. K., & Koegel, R. L. (2017). Improving Functional Language and Social Motivation with a Parent-Mediated Intervention for Toddlers with Autism Spectrum Disorder. *J Autism Dev Disord, 47*(8), 2443-2458. doi:10.1007/s10803-017-3155-8

Brian, J. A., Smith, I. M., Zwaigenbaum, L., & Bryson, S. E. (2017). Cross-site randomized control trial of the Social ABCs caregiver-mediated intervention for toddlers with autism spectrum disorder. *Autism Research*.

Brian, J. A., Smith, I. M., Zwaigenbaum, L., Roberts, W., & Bryson, S. E. (2016). The Social ABCs caregiver-mediated intervention for toddlers with autism spectrum disorder: Feasibility, acceptability, and evidence of promise from a multisite study. *Autism Research, 9*(8), 899-912.

Casenhiser, D. M., Shanker, S. G., & Stieben, J. (2013). Learning through interaction in children with autism: preliminary data from asocial-communication-based intervention. *Autism, 17*(2), 220-241. doi:10.1177/1362361311422052

Chorney, J. M. L., McMurtry, C. M., Chambers, C. T., & Bakeman, R. (2015). Developing and Modifying Behavioral Coding Schemes in Pediatric Psychology: A Practical Guide. In *J Pediatr Psychol* (Vol. 40, pp. 154-164).

Chorpita, B. F., Daleiden, E. L., & Weisz, J. R. (2005). Identifying and selecting the common elements of evidence based interventions: a distillation and matching model. *Ment Health Serv Res, 7*(1), 5-20.

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological assessment, 6*(4), 284.

Division for Early Childhood. (2014). DEC recommended practices in early intervention/early childhood special education 2014.

Estes, A., Vismara, L., Mercado, C., Fitzpatrick, A., Elder, L., Greenson, J., . . . Rogers, S. (2014). The impact of parent-delivered intervention on parents of very young children with autism. *J Autism Dev Disord, 44*(2), 353-365. doi:10.1007/s10803-013-1874-z

Fletcher-Watson, S., Petrou, A., Scott-Barrett, J., Dicks, P., Graham, C., O'Hare, A., . . . McConachie, H. (2016). A trial of an iPad intervention targeting social communication skills in children with autism. *Autism, 20*(7), 771-782. doi:10.1177/1362361315605624

Gardner, F. (2000). Methodological issues in the direct observation of parent–child interaction: Do observational findings reflect the natural behavior of participants? *Clinical child and family psychology review, 3*(3), 185-198.

Garland, A. F., Hawley, K. M., Brookman-Frazee, L., & Hurlburt, M. S. (2008). Identifying common elements of evidence-based psychosocial treatments for children's disruptive behavior problems. *J Am Acad Child Adolesc Psychiatry, 47*(5), 505-514. doi:10.1097/CHI.0b013e31816765c2

Godfrey, E., Chalder, T., Ridsdale, L., Seed, P., & Ogden, J. (2007). Investigating the active ingredients of cognitive behaviour therapy and counselling for patients with chronic fatigue in primary care: developing a new process measure to assess treatment fidelity and predict outcome. *Br J Clin Psychol, 46*(Pt 3), 253-272. doi:10.1348/014466506x147420

Green, J., Charman, T., McConachie, H., Aldred, C., Slonims, V., Howlin, P., . . . Pickles, A. (2010). Parent-mediated communication-focused treatment in children with autism (PACT): a randomised controlled trial. *Lancet, 375*(9732), 2152-2160. doi:10.1016/s0140-6736(10)60587-9

Grzadzinski, R., Carr, T., Colombi, C., McGuire, K., Dufek, S., Pickles, A., & Lord, C. (2016). Measuring Changes in Social Communication Behaviors: Preliminary Development of the Brief Observation of Social Communication Change (BOSCC). *J Autism Dev Disord, 46*(7), 2464-2479. doi:10.1007/s10803-016-2782-9

Gulsrud, A. C., Hellemann, G., Shire, S., & Kasari, C. (2016). Isolating active ingredients in a parent-mediated social communication intervention for toddlers with autism spectrum disorder. *J Child Psychol Psychiatry, 57*(5), 606-613. doi:10.1111/jcpp.12481

Hallgren, K. A. (2012). Computing inter-rater reliability for observational data: an overview and tutorial. *Tutorials in quantitative methods for psychology*, *8*(1), 23.

Hemphill, J. F. (2003). Interpreting the magnitudes of correlation coefficients. *American Psychologist, 58*(1), 78-79.

Hudry, K., Aldred, C., Wigham, S., Green, J., Leadbitter, K., Temple, K., . . . McConachie, H. (2013). Predictors of parent-child interaction style in dyads with autism. *Res Dev Disabil, 34*(10), 3400-3410. doi:10.1016/j.ridd.2013.07.015

Ingersoll, B. R., & Dvortcsak, A. (2009). *Teaching Social Communication to Children With Autism: A Practitioner's Guide to Parent Training and a Manual for Parents*: Guilford Press.

Ingersoll, B. R., & Wainer, A. L. (2013). Initial efficacy of project ImPACT: a parent-mediated social communication intervention for young children with ASD. *J Autism Dev Disord, 43*(12), 2943-2952. doi:10.1007/s10803-013-1840-9

Ingersoll, B. R., Wainer, A. L., Berger, N. I., Pickard, K. E., & Bonter, N. (2016). Comparison of a Self-Directed and Therapist-Assisted Telehealth Parent-Mediated Intervention for Children with ASD: A Pilot RCT. *J Autism Dev Disord, 46*(7), 2275-2284. doi:10.1007/s10803-016-2755-z

Kaale, A., Smith, L., Nordahl-Hansen, A., Fagerland, M. W., & Kasari, C. (2017). Early interaction in autism spectrum disorder: Mothers' and children's behaviours during joint engagement. *Child Care Health Dev*. doi:10.1111/cch.12532 [doi]

Kaehler, L. A., Jacobs, M., & Jones, D. J. (2016). Distilling Common History and Practice Elements to Inform Dissemination: Hanf-Model BPT Programs as an Example. *Clin Child Fam Psychol Rev, 19*(3), 236-258. doi:10.1007/s10567-016-0210-5

Kaiser, A. P., Hancock, T. B., & Nietfeld, J. P. (2000). The effects of parent-implemented enhanced milieu teaching on the social communication of children who have autism. *Early Education and Development, 11*(4), 423-446.

Kaiser, A. P., & Hester, P. P. (1994). Generalized effects of enhanced milieu teaching. *Journal of Speech, Language, and Hearing Research, 37*(6), 1320-1340.

Kaiser, A. P., & Roberts, M. Y. (2013). Parents as communication partners: An evidence-based strategy for improving parent support for language and communication in everyday settings. *Perspectives on Language Learning and Education, 20*(3), 96-111.

Karaaslan, O., & Mahoney, G. (2015). Mediational analyses of the effects of responsive teaching on the developmental functioning of preschool children with disabilities. *Journal of Early Intervention*, 1053815115617294.

Kasari, C., Freeman, S., & Paparella, T. (2006). Joint attention and symbolic play in young children with autism: A randomized controlled intervention study. *Journal of Child Psychology and Psychiatry, 47*(6), 611-620.

Kasari, C., Gulsrud, A., Paparella, T., Hellemann, G., & Berry, K. (2015). Randomized comparative efficacy study of parent-mediated interventions for toddlers with autism. *J Consult Clin Psychol, 83*(3), 554-563. doi:10.1037/a0039080

Kasari, C., Gulsrud, A. C., Wong, C., Kwon, S., & Locke, J. (2010). Randomized controlled caregiver mediated joint engagement intervention for toddlers with autism. *Journal of autism and developmental disorders, 40*(9), 1045-1056.

Kasari, C., Lawton, K., Shih, W., Barker, T. V., Landa, R., Lord, C., . . . Senturk, D. (2014). Caregiver-Mediated Intervention for Low-Resourced Preschoolers With Autism: An RCT. In *Pediatrics* (Vol. 134, pp. e72-79). Elk Grove Village, IL, USA.

Kazdin, A. E. (2003). *Research Design in Clinical Psychology* (4th Edition ed.). Boston, MA: Allyn Bacon.

Kitzerow, J., Teufel, K., Wilker, C., & Freitag, C. M. (2016). Using the brief observation of social communication change (BOSCC) to measure autism-specific development. *Autism Res, 9*(9), 940-950. doi:10.1002/aur.1588

Landa, R. J., Holman, K. C., O'Neill, A. H., & Stuart, E. A. (2011). Intervention targeting development of socially synchronous engagement in toddlers with autism spectrum disorder: a randomized controlled trial. *Journal of Child Psychology and Psychiatry, 52*(1), 13-21.

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personnel psychology, 28*(4), 563-575.

Lokker, C., McKibbon, K. A., Colquhoun, H., & Hempel, S. (2015). A scoping review of classification schemes of interventions to promote and integrate evidence into practice in healthcare. *Implement Sci, 10*, 27. doi:10.1186/s13012-015-0220-6

Mahoney, G., & Solomon, R. (2016). Mechanism of Developmental Change in the PLAY Project Home Consultation Program: Evidence from a Randomized Control Trial. *J Autism Dev Disord, 46*(5), 1860-1871. doi:10.1007/s10803-016-2720-x

McConachie, H., & Diggle, T. (2007). Parent implemented early intervention for young children with autism spectrum disorder: a systematic review. *J Eval Clin Pract, 13*(1), 120-129. doi:10.1111/j.1365-2753.2006.00674.x

McHugh, R. K., Murray, H. W., & Barlow, D. H. (2009). Balancing fidelity and adaptation in the dissemination of empirically-supported treatments: The promise of transdiagnostic interventions. *Behav Res Ther, 47*(11), 946-953. doi:10.1016/j.brat.2009.07.005

McKenzie, J. F., Wood, M. L., Kotecki, J. E., Clark, J. K., & Brey, R. A. (1999). Establishing content validity: Using qualitative and quantitative steps. *American Journal of Health Behavior*.

Miklowitz, D. J., Goodwin, G. M., Bauer, M. S., & Geddes, J. R. (2008). Common and specific elements of psychosocial treatments for bipolar disorder: a survey of clinicians participating in randomized trials. *J Psychiatr Pract, 14*(2), 77-85. doi:10.1097/01.pra.0000314314.94791.c9

Mullen, E. M. (1995). *Mullen scales of early learning*: AGS Circle Pines, MN.

National Research Council. (2001). Educating children with autism. In C. Lord & J. P. McGee (Eds.), *Committee on Educational Interventions for Children with Autism*. Washington, DC: National Academy Press.

Nordahl-Hansen, A., Fletcher-Watson, S., McConachie, H., & Kaale, A. (2016). Relations between specific and global outcome measures in a social-communication intervention for children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 29*, 19-29.

Oono, I. P., Honey, E. J., & McConachie, H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders (ASD). *Cochrane Database Syst Rev*(4), Cd009774. doi:10.1002/14651858.CD009774.pub2

Oosterling, I., Visser, J., Swinkels, S., Rommelse, N., Donders, R., Woudenberg, T., . . . Buitelaar, J. (2010). Randomized controlled trial of the focus parent training for toddlers with autism: 1-year outcome. *Journal of autism and developmental disorders, 40*(12), 1447-1458.

Osterling, K. L., & Austin, M. J. (2008). The dissemination and utilization of research for promoting evidence-based practice. *Journal of evidence-based social work, 5*(1-2), 295-319.

Pagoto, S. L., Spring, B., Coups, E. J., Mulvaney, S., Coutu, M. F., & Ozakinci, G. (2007). Barriers and facilitators of evidence-based practice perceived by behavioral science health professionals. *Journal of clinical psychology, 63*(7), 695-705.

Patterson, S. Y., Elder, L., Gulsrud, A., & Kasari, C. (2014). The association between parental interaction style and children's joint engagement in families with toddlers with autism. *Autism, 18*(5), 511-518. doi:10.1177/1362361313483595

Phaneuf, L., & McIntyre, L. L. (2011). The application of a three-tier model of intervention to parent training. *Journal of Positive Behavior Interventions, 13*(4), 198-207.

Pickard, K. E., Kilgore, A. N., & Ingersoll, B. R. (2016). Using Community Partnerships to Better Understand the Barriers to Using an Evidence-Based, Parent-Mediated Intervention for Autism Spectrum Disorder in a Medicaid System. *American journal of community psychology, 57*(3-4), 391-403.

Pickles, A., Harris, V., Green, J., Aldred, C., McConachie, H., Slonims, V., . . . Charman, T. (2015). Treatment mechanism in the MRC preschool autism communication trial: implications for study design and parent-focussed therapy for children. *J Child Psychol Psychiatry, 56*(2), 162-170. doi:10.1111/jcpp.12291

Pijl, M. K., Rommelse, N. N., Hendriks, M., De Korte, M. W., Buitelaar, J. K., & Oosterling, I. J. (2016). Does the Brief Observation of Social Communication Change help moving forward in measuring change in early autism intervention studies? *Autism*, 1362361316669235.

Rogers, S. J., & Dawson, G. (2010). *Early start Denver model for young children with autism: Promoting language, learning, and engagement*: Guilford Press.

Rogers, S. J., Estes, A., Lord, C., Vismara, L., Winter, J., Fitzpatrick, A., . . . Dawson, G. (2012). Effects of a brief Early Start Denver Model (ESDM)–based parent intervention on toddlers at risk for autism spectrum disorders: A randomized controlled trial. *Journal of the American Academy of Child & Adolescent Psychiatry, 51*(10), 1052-1065.

Schreibman, L., Dawson, G., Stahmer, A. C., Landa, R., Rogers, S. J., McGee, G. G., . . . Halladay, A. (2015). Naturalistic Developmental Behavioral Interventions: Empirically Validated Treatments for Autism Spectrum Disorder. *J Autism Dev Disord, 45*(8), 2411-2428. doi:10.1007/s10803-015-2407-8

Schreibman, L., & Koegel, R. L. (2005). Training for parents of children with autism: Pivotal responses, generalization, and individualization of interventions. *Hibbs & Jensen (Eds.), Psychosocial treatments for child and adolescent disorders: Empirically based strategies for clinical practice*, 605-631.

Shire, S. Y., Gulsrud, A., & Kasari, C. (2016). Increasing Responsive Parent-Child Interactions and Joint Engagement: Comparing the Influence of Parent-Mediated Intervention and Parent Psychoeducation. *J Autism Dev Disord, 46*(5), 1737-1747. doi:10.1007/s10803-016-2702-z

Stahmer, A. C., Brookman-Frazee, L., Rieth, S. R., Stoner, J. T., Feder, J. D., Searcy, K., & Wang, T. (2017). Parent perceptions of an adapted evidence-based practice for toddlers with autism in a community setting. *Autism, 21*(2), 217-230.

Strand, V. C., Hansen, S., & Courtney, D. (2013). Common Elements Across Evidence-Based Trauma Treatment: Discovery and Implications. *Advances in Social Work, 14*(2), 334-354. Retrieved from

Tate, D. F., Lytle, L. A., Sherwood, N. E., Haire-Joshu, D., Matheson, D., Moore, S. M., . . . Michie, S. (2016). Deconstructing interventions: approaches to studying behavior change techniques across obesity interventions. *Transl Behav Med, 6*(2), 236-243. doi:10.1007/s13142-015-0369-1

Tonge, B., Brereton, A., Kiomall, M., Mackinnon, A., King, N., & Rinehart, N. (2006). Effects on parental mental health of an education and skills training program for parents of young children with autism: a randomized controlled trial. *J Am Acad Child Adolesc Psychiatry, 45*(5), 561-569. doi:10.1097/01.chi.0000205701.48324.26

Veneziano, L., & Hooper, J. (1997). A method for quantifying content validity of health-related questionnaires. *American Journal of Health Behavior, 21*(1), 67-70.

Wainer, A. L., & Ingersoll, B. (2013). Intervention fidelity: An essential component for understanding ASD parent training research and practice. *Clinical psychology: Science and practice, 20*(3), 335-357.

Wainer, A. L., & Ingersoll, B. R. (2015). Increasing access to an ASD imitation intervention via a telehealth parent training program. *Journal of autism and developmental disorders, 45*(12), 3877-3890.

Wood, J. J., McLeod, B. D., Klebanoff, S., & Brookman-Frazee, L. (2015). Toward the implementation of evidence-based interventions for youth with autism spectrum disorders in schools and community agencies. *Behavior therapy, 46*(1), 83-95.

Zwaigenbaum, L., Bauman, M. L., Choueiri, R., Kasari, C., Carter, A., Granpeesheh, D., . . . Natowicz, M. R. (2015). Early Intervention for Children With Autism Spectrum Disorder Under 3 Years of Age: Recommendations for Practice and Research. *Pediatrics, 136 Suppl 1*, S60-81. doi:10.1542/peds.2014-3667E