Behavior Analysis in Practice (2024) 17:1216–1227
https://doi.org/10.1007/s40617-024-01002-3

TECHNICAL AND TUTORIALS

Beyond Trial Counts: Considerations for Measuring Play and Engagement During Early Intervention for Autistic Children

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Accepted: 12 September 2024 / Published online: 11 October 2024

Abstract

Play is critical to child development. In early childhood, object play evolves from exploratory behavior to complex symbolic play. Engagement during play, particularly joint engagement, is essential for learning and social interaction. Board Certified Behavior Analysts® (BCBAs) who provide early intervention services to young autistic children may experience barriers when designing programming and data collection systems for play and engagement. In this paper, we compare Naturalistic Developmental Behavioral Intervention (NDBI) and Natural Environment Teaching (NET) approaches. Considerations for measuring object play and engagement during naturalistic play routines are presented. We encourage BCBAs to consider simple frequency counts when measuring object play actions and interval recording or rating scales for tracking engagement states. These methods may better accommodate the variability in play and engagement behavior, allow for more flexible play routines, and support a more nuanced analysis of child progress.

Keywords Naturalistic developmental behavioral interventions · Autism · Early intervention · Object play · Engagement · Measurement · Data collection

Introduction

Play and engagement are important concepts for all early interventionists to understand. Board Certified Behavior Analysts® (BCBAs®) often embed behavior analytic interventions into play contexts, and common therapy goals include teaching new play and social skills. Often, during curriculum programming, BCBAs choose pre-selected targets (e.g., rolls a ball) for skill acquisition goals across various domains (e.g., motor imitation with objects), and Registered Behavior Technicians (RBTs®) implement trial-based instruction during ABA sessions. In fact, many ABA organizations assess the quality of their services by measuring the number of trials presented by the interventionist per session (Silbaugh & El Fattal, 2022). The purpose of tracking trial counts is to monitor the number of learning opportunities during treatment sessions. In play contexts, however, there are additional ways to assess the quality of the adult–child interaction as well as child progress that should be considered. In this article, we present various data collection methods that BCBAs might use to supplement trial-by-trial data. BCBAs should keep in mind that there are multiple ways of measuring skill acquisition, and one way is not superior to another. A fictionalized vignette is provided throughout the manuscript, in italics, to situate the information into a situation many BCBAs may face.

> *Kyle is an experienced BCBA and has supervised a team of Registered Behavior Technicians (RBTs). She works in a center-based setting providing early intervention behavior analytic services to young autistic children between the ages of 18 months to 3 years old. Kyle writes treatment plans using a variety of assessment tools, including the Verbal Behavior Milestones*

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Assessment and Placement Program (VB-MAPP; Sundberg, 2008*). Kyle selects goals and targets across a variety of domains, including social communication and play and designs programming within a natural environment teaching (NET) paradigm. Within NET, Kyle coaches RBTs to contrive establishing operations, present controlled presentations of carefully chosen discriminative stimuli, implement systematic prompting hierarchies, and provide natural reinforcement (*Sundberg & Partington, 1998*). The RBTs are implementing NET protocols with high treatment fidelity, and the clients are acquiring and maintaining verbal behavior skills.*

During a supervision session, Kyle observed one of the RBTs running a NET program. The RBT and child were engaging with a small ramp and cars. The RBT playfully controlled access to the cars, contrived opportunities for several learning trials to target manding for "car" and the intraverbal fill in, "Car goes….room room". The RBT faded their prompts and reinforced the child's social communication behaviors by providing access to more cars. Kyle praised the RBT.

One of the child's targets was imitation of parking a toy car in a garage. The RBT presented a verbal discriminative stimulus, "Like me" and then modeled the pretend play action. The child did not imitate the action, and Kyle noticed that the child did not show interest in the garage. Instead, the child continued to roll cars down the ramp. Kyle provided feedback to the RBT to follow the child's lead by taking another car and imitating the child's play by rolling it down the ramp. Next, Kyle coached the RBT to use least-to-most prompting to teach the child to crash the two cars together. By the end of the routine, the child crashed the two cars together spontaneously. At the end of the supervision session, the RBT shared that he wasn't able to track imitates crashing cars because that particular target wasn't on the data sheet, and he didn't meet his trial count goal for the session.

Object Play in Early Childhood

Play is foundational to children's development and well-being (Yogman et al., 2018). One important type of play for young children is *object play* (Barton et al., 2020; Ungerer & Sigman, 1984). Object play refers to how children interact with objects, such as toys, which occurs both with and without the involvement of adults and peers. Various taxonomies of object play exist, generally beginning with *exploratory–relational* play, which involves exploring objects through the sensory system (e.g., mouthing and touching objects) and then combining objects in unspecific ways (e.g., stacking, nesting, and pushing objects together; Casby, 2003). The next stage of object play is *functional*. Functional play involves using objects as they were designed and putting toys together in simple, yet specific, ways (e.g., inset puzzles, shape sorter). Next, children develop *pre-symbolic* and *symbolic* play skills. Pre-symbolic play involves simple pretend actions with objects, directed toward self as well as objects such as dolls, action figures, and animals (e.g., pretending to feed a stuffed animal). The final stage of object play is known as *symbolic* play, wherein children learn ways to (a) bring objects to life (e.g., manipulating a stuffed dog to eat from a bowl); (b) develop multi-step pretend sequences; (c) use toys to represent (or symbolize) something else (e.g., pretending beads are food); and (d) add more imaginary qualities to play (e.g., engage in socio-dramatic play). Symbolic play has been found to be a significant predictor of several important outcomes for autistic children, including cognitive development, language, and social engagement, and is particularly important for developing emotional regulation skills in children (Kasari et al., 2006). Table 1 further describes object play with examples.

BCBAs should also be aware that repetitive play behavior is a part of typical infant and toddler development (Raulston & Machalicek, 2018), and many believe that such behaviors may provide essential learning opportunities by increasing predictability and decreasing anxiety (Cunningham & Schreibman, 2008). For example, it is common for young children to repetitively (a) bang objects such as toys; (b) request their parent read the same book over and over; or (c) recite pretend play sequences (Arnott et al., 2010). In fact, some repetitive behaviors may be conceptualized as exploratory–relational (e.g., gathering and dumping blocks). The focus of early intervention should be teaching skills, such as behavioral flexibility and play, rather than decreasing repetitive behavior (Raulston et al., 2019).

The Importance of Engagement During Object Play

When children are engaged, they learn from the environment around them and socially connect with others (Kasari et al., 2021). As children develop, they learn to coordinate their attention between people and objects, which is also known as joint engagement. There are several states of engagement, including onlooker, adult engaged, object engaged, and coordinated jointly engaged (Bakeman & Adamson, 1984). In typical child development, coordinated joint engagement emerges when infants begin to include a caregiver in their interactions with objects. Before joint engagement develops, children's attention is more solely focused on either a person *or* an object (Adamson and Bakeman, 1991). Important to note, all engagement states serve a purpose and should not be viewed as a systematic scale of skill level. It is typical

Table 1 Levels of object play

Level of object play (age of emergence in typical development)	Description	Examples
Exploratory–relational (2–10 months)	Exploratory play begins to develop in infancy, where children pick up toys and put them back down, bang, shake, squeeze, mouth, and even lick and smell toys. During this stage, infants are interacting with objects with their sensory system. Relational play involves combining objects in unspecific ways.	Picks up cups and putting them back down Bangs, shakes, squeezes, mouths Turns pages of a book Gathers blocks or rings
Functional (10–18 months)	Toddlers start to engage in more functional forms of play. They begin to take parts of toys apart like pop beads and lids from containers. Children also learn to put toys together in simple and specific ways.	Takes apart parts of toys Larger pop beads Removing lids Puts toys together in simple ways Dumping out blocks Dropping blocks into a container Puts toys together in specific ways Puzzles Shape sorter String beads Ring Stacker
Pre-symbolic (12–18 months)	Children begin to play in simple pretend ways, direct pretend actions toward themselves, and include dolls, stuffed animals, and figurines into their play. Next children include other people in their pretend play, and then include dolls and people together.	Plays in simple pretend ways Stirs spoon in bowl Pushes truck in a path Playing with animals in a barn Directed Toward Self Feed self with empty spoon Brushes own hair with plastic brush Putting a phone to their ear Includes Doll/Action Figure Brushes doll's hair Gives baby a bath Puts blanket on doll Includes other people Feeds adult with spoon Comb's adult's hair Uses same action in simple pretend play with 2 people or dolls/figures Brings cup to adult's mouth then to doll's mouth to take a drink
Symbolic (18 – 30 months)	Children learn ways to bring objects to life. Children develop 2- and 3-step pretend sequences, use toys to represent (or as a symbol) for something else and add more pretend qualities to their play. The final stage of symbolic play is socio-dramatic and thematic play, where children take on roles of characters and assign roles to others.	Moves doll/figures as if they were alive Walks a doll Toy animal eats 2–3 Step pretend action Stirs spoon in bowl then feeds doll Puts doll in bed, tucks under blanket, kisses goodnight Child uses toys to represent other items (substitution) Uses a box as a boat Puts blocks in bowl as food Child uses pretend qualities Blows on soup as if it's hot Shakes imaginary salt shaker Holds hand to ear like a phone Socio-Dramatic & Thematic Play Hospital House Construction Fantasy roles

The levels of play outlined above were adapted from the following sources: JASPER (Kasari et al., 2021) Advancing Social-Communication and Play (Boyd et al., 2018), and The Developmental Play Assessment (Lifter, 2008)

for children to move in and out of these engagement states throughout their daily activities. For example, when observing a new toy, an onlooking engagement state may be appropriate, as the person is watching someone demonstrate how to manipulate the object.

Onlooker

When children are in the onlooker behavioral state, they are watching another person but not actively involved in the play. Children may not understand how to initiate or interact with others, or they could be observing the situation. For example, a child may stand a few feet away and look with curiosity. The onlooker-child does not initiate a social interaction, but rather observes.

Person Engaged

When a child is person-engaged, their attention is focused on another person, and there are no objects involved. Person engaged activities include singing songs, nursery rhymes, and other sensory social routines (Dawson & Rogers, 2020). In typical development, this is the primary state of infants less than 6 months old before they have discovered objects (Bakeman & Adamson, 1984). For autistic children, however, this engagement state may be more difficult given the challenges they may encounter with social communication. The person-engaged child does not attend to objects, but rather focuses on the person near them.

Object Engaged

Children who are object engaged are solely focused on and playing with objects in front of them. Even if others around the child are engaging with the same toys, the child's attention is only on the objects. For example, a child might play with a gray toy cat by walking the cat across the floor and saying, "Meow!" A therapist takes a white toy cat and says, "Kitty is hungry" while walking it to a bowl of pretend food to eat it. The object-engaged child does not shift their attention to the therapist or other toy cat. Instead, the child continues to play with the gray toy cat.

Coordinated Jointly Engaged

When a child is jointly engaged, they are able to interact with shared objects *and* people at the same time. Joint engagement is evidenced by the child initiating multiple bids for joint attention, responding to adult bids for joint attention, shifting their gaze between toys and an adult, engaging in spontaneous communication at their level (e.g., pointing, gesturing, vocally saying words), and engaging in reciprocal imitation with the adult and toys. By 13 months in typical development, children sustain episodes of coordinated joint engagement (Bakeman & Adamson, 1984), and joint engagement is fully developed by around 18 months of age. Coordinated joint engagement functions to maintain social interactions and share pleasure with the adult and the play experience. Joint engagement can be supported, scaffolded by an adult, or be coordinated by the child (i.e., the child initiates bids for joint attention and play). A jointly engaged child shifts their attention between an activity or object (e.g., a picture book) and another person (e.g., caregiver) seamlessly as the interaction unfolds.

> *On her car ride home, Kyle kept thinking about what the RBT said. She wondered if there was a more flexible way to measure progress during naturalistic play-based programming. When Kyle got home, she researched continuing education opportunities related to play for young autistic children. She found a webinar on Naturalistic Developmental Behavioral Interventions and registered for the event.*

Naturalistic Behavioral Developmental Interventions

The American Academy of Pediatrics recommends that interventions for young autistic children be developmentally and behaviorally based (Lipkin et al., 2020). NDBIs are a family of interventions that combine ABA and developmental science principles to improve developmentally important outcomes, such as social communication skills (Schreibman et al., 2015). NDBIs have a robust literature base (D'Agostino et al., 2023; Schreibman et al., 2015) and are aligned with calls from the Autistic community recommending that interventions foster co-construction and agency wherein children are viewed as active participants in the therapeutic process (Schuck et al., 2022). Common developmental NDBI strategies include the adult positioning their body to be face-to-face and within the child's social spotlight, following their lead, narrating play, using exaggerated affect, modeling language and play at the child's instructional level, imitating their vocalizations and play actions, and using balanced turns (Frost et al., 2020). Common behavior analytic strategies within NDBIs include the use of antecedent manipulation and environmental arrangement strategies (e.g., communication temptations, preferred items in sight and out of reach, playful obstruction techniques); systematic prompting hierarchies; time delays; and natural reinforcement during direct teaching episodes (Frost et al., 2020). See Table 2 for operational definitions and examples of NDBI strategies.

Table 2 NDBI strategies, operational definitions, and examples

Strategy	Description	Example
Environmental arrangement	The adult uses antecedent manipulation strategies to increase the likelihood of child communication or play. The therapy environment has a clearly defined space for play with clear toy choices that are within the child's developmental play level.	The RBT selects three toy sets (e.g., wooden blocks, play food, and barn with farm animals) ahead of time and places them on the perimeter of a round rug. All other toy sets are stored away from the rug.
Positions within child's social spotlight	The adult observes where the child is facing and looking, and positions their body to be directly in front of the child, within the child's direct view and attentional focus	The RBT and child sit on the rug together with the toys. The RBT intentionally moves closer and continually changes positions, so that they can see the child's face.
Follows the child's lead	The adult observes the child's eye gaze, vocalizations, and motor movements as the child selects and shifts activities. The adult allows the child's selection to be the current activity, and the adult shifts their attention to the child's choice of activity.	The RBT and child are building a tower out of blocks. The child finds a piece of pretend watermelon and brings it to their mouth. Instead of continuing to build the tower, the RBT takes another piece of food and pretends to eat it, then says, "Yummy!"
Narrates play	The adult provides a commentary of the child's play without asking "quiz" questions.	The RBT says, "You are eating watermelon!" instead of "What food is this?"
Models developmentally appropriate language and play	The adult models communication, language, and play at the child's developmental level or one step above.	The RBT gathers other pieces of watermelon and puts them on a cutting board, takes a wooden play knife and says, "Cutting watermelon" then hands the play knife to the child.
Exaggerates affect and gestures	The adult exaggerates their affect, emotions, and gestures during play.	The child hands a pretend apple to the RBT, and the RBT says, "Crunch!" and pretends to take a huge bite, opening their mouth and using exaggerated hand and head motions.
Imitates child's vocalizations and play	The adult repeats back sounds and words and uses recasting strategies, saying words back to the child in a more advanced manner. The adult engages in similar play actions as the child.	The child says, "ah-poh" and the RBT repeats back "*A*pple!"
Prompts and time delays	The adult uses a system of least prompts progressing from modeling to physical guidance to teach play skills that are within or one developmental level ahead (i.e., instructional level), with brief amounts of time in between prompts.	The RBT models putting food into a pot and stirring it with a spoon, waits 5 seconds, says, "Your turn, stir the food," waits 5 more seconds, and then physically guides the child to stir the food.
Natural reinforcement during direct teaching episode	The adult provides feedback to the child in a natural way by using descriptive commenting strategies and providing access to preferred items or actions following child mands.	The RBT narrates the child's play during the consequence portion of the teaching trial by saying, "Stirring the food." The child mands for more food (e.g., says, "Food" while looking at it) to put into the pot. The RBT gives the child the play food, and tacts them one-by-one (e.g., "carrot, corn…")

The selected strategies for the table are not an exhaustive list of NDBI strategies

Similarities and Differences Between NDBIs and NET

Behavior analysts are no strangers to naturalistic teaching formats. Dating back more than four decades ago, the first research on incidental teaching was published by Hart and Risley (1975). Behavior analysts have since described environmental manipulations to teach and shape more complex language and play (Hancock et al., 2016). Today, most BCBAs are familiar with what is known as NET (Sundberg & Partington, 1998). The purpose of NET is to systematically program for the generalization of skills, so that children use these skills in natural contexts and settings and with a variety of communication partners (Kaiser & Hester, 1994). Mastery of naturalistic teaching formats is a required skill for certification (task list item G-9; Behavior Analyst Certification Board, 2017), and there is a robust literature base supporting its use with children with communication and developmental delays (Hume et al., 2021; National Autism Center, 2015).

While NDBIs and NET are alike in that they both aim to promote generalized behavior change with intervention occurring in natural settings and with natural stimuli (e.g., toys and books instead of cards), there are also notable differences. NET is rooted in verbal behavior and natural language paradigm theories (Sundberg & Partington, 1998). The focus is to program for the generalization of skills from structured to more natural settings. In NET, the adult contrives establishing operations, presents controlled presentations of discriminative stimuli, implements systematic prompting hierarchies, and provides reinforcement for targeted responses (Sundberg & Partington, 1998). NDBIs, on the other hand, include specific strategies based on developmental psychology (e.g., imitating the child's vocalizations and play actions, using exaggerated affect to highlight emotions) in addition to ABA-based strategies. See Table 2 for more detail.

Another notable distinction between these two approaches is related to the instructional targets. In NET, the instructional targets are more likely to be pre-determined. For example, during curriculum planning, the BCBA selects specific targets, such as play actions, to teach the child (e.g., feeds baby doll, rocks baby doll). Multiple discrete trials of each target are embedded within a play context. In contrast, within an NDBI paradigm, the instructional targets are usually not predetermined. Instead, the targeted responses are based on how the child leads and co-constructs the play. For example, as the child demonstrates a play action, the RBT imitates the same action and then expands upon the child's play by either modeling or embedding a direct teaching episode for a novel play action that is *within or one developmental level ahead*, referred to as the "zone of proximal development" (Vygotsky 1930–1934/1978) in the developmental psychology literature. Indeed, NDBIs require BCBAs and RBTs to have a rich understanding of early child development, including play milestones.

The distinctions between NET and NDBI are quite nuanced, and both are appropriate instructional arrangements for young children. We encourage BCBAs working with young autistic children to understand the origins and purposes of both approaches and design developmentally appropriate, individualized instruction based on each child's characteristics, preferences, strengths, and needs. See Fig. 1 for a comparison between NET and NDBIs.

> *During the webinar, Kyle learned that symbolic play is linked to many important distal outcomes for autistic children, including social emotional and cognitive development. She also learned about states of engagement and the importance of coordinated joint engagement. She was eager to incorporate new play and engagement goals into treatment plans for her youngest autistic clients. Thinking about her RBT's comment, she wondered about the best way to measure children's progress. Currently, most of her NET goals were measured using trial-by-trial formats and presented graphically with percent independence metrics. She wanted a more flexible approach, so that instead of embedding trials of pre-selected play targets, the RBT would be able to embed trials for any novel play action based on the child's motivation and interests.*

Measurement of Discrete Object Play Behaviors

Many object play actions are discrete responses (e.g., stacking a block, shaking pretend salt on a pretend meal). To measure discrete responses, BCBAs often utilize restricted event recording, typically coding responses as independent, prompted, or incorrect (Alberto & Troutman, 2012; Cooper et al., 2020). Within this arrangement, the metric displayed on the y-axis of progress graphs is a percentage (e.g., percent independent). Percentage metrics could cause data collection systems to be too rigid for naturalistic play. During naturalistic play routines, a child's motivation to play with various objects will undoubtedly change. As the child becomes satiated with certain toys, their attention will likely shift to different objects within the environment. Therefore, flexibility with the targets the RBT is able to embed into the routine is beneficial. The specific play actions (e.g., crashing a car, feeding a stuffed animal) will change depending on how the child directs the play during each in session. As such, BCBAs may find themselves needing to adjust data collection when incorporating NDBI principles into their programming. We recommend *simple frequency counts*, as an alternative to trial-based data collection methods, when

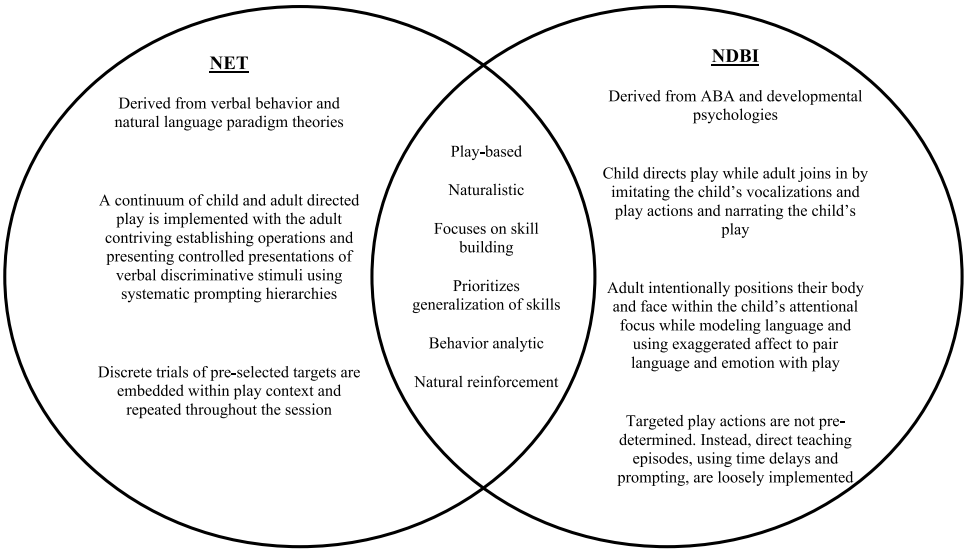

Fig. 1 Comparison of Natural Environment Training and Naturalistic Developmental Behavioral Intervention Approaches. *Note.* The diagram shows similarities and key differences between NET and NDBI approaches

measuring discrete object play responses during naturalistic play routines. This means that the metric displayed on the progress monitoring graph would be *frequency or rate*, not a percentage metric. Next, we provide BCBAs, such as Kyle, with examples when graphing simple frequency counts for visual analysis of object play skills.

Frequency Counts

When using event recording, simple frequency counts will enable BCBAs to track progress more flexibly. An example goal that would promote play variability is: During 10–15 min play routines, the child will engage in five *different* functional or pre-symbolic play actions across five therapy days within a one-month period. Figure 2 displays a graph for this goal. The histogram, indicated by the light graph bars, shows five sessions at or above the goal line, indicating mastery. Notice that these data points are not consecutive, which allows for more variability in the child's play. In other words, we are more concerned with increases in overall level and diversity of the child's object play behavior and realize that variability is both natural and ideal. The two line graphs allow the BCBA to show important decision makers (e.g., parents, funders) the increasing trend of the child's functional and emerging pre-symbolic play skills.

Cumulative Graphs

Cumulative graphs will allow BCBAs to display progress over longer periods of time. For example, if Kyle wanted to display progress showing the diversity of object play over an insurance authorization period (e.g., six-month time span), she may opt to use a cumulative graph. The graph in Fig. 3 shows global progress of the child's increase in diversity of functional and pre-symbolic play skills.

Measurement of Engagement States

Within the early intervention literature, engagement states have often been measured using duration recording (Kasari et al., 2006). Measurement of engagement typically requires a team of two observers to watch video clips in multiple passes to agree on a start and stop time of each engagement state, using computer software to record their times. Total time spent in each engagement state is often reported in the studies. Researchers have reported that scoring one 5-min video can take up to 60 min (Adamson et al., 2010). While these measurement methods are appropriate for research settings, in real-world practice settings, such procedures are not feasible. We propose two alternative methods for practitioners to consider when measuring engagement states: (1) interval recording and (2) rating scales.

Interval Recording

Interval recording is a data collection method used to estimate the amount of time spent engaged in behavior (Cooper et al., 2020). Time periods are divided into segments, or intervals, and the data collector records if the behavior occurred using whole (i.e., the behavior occurred during the entire interval); partial (i.e., the behavior occurred at

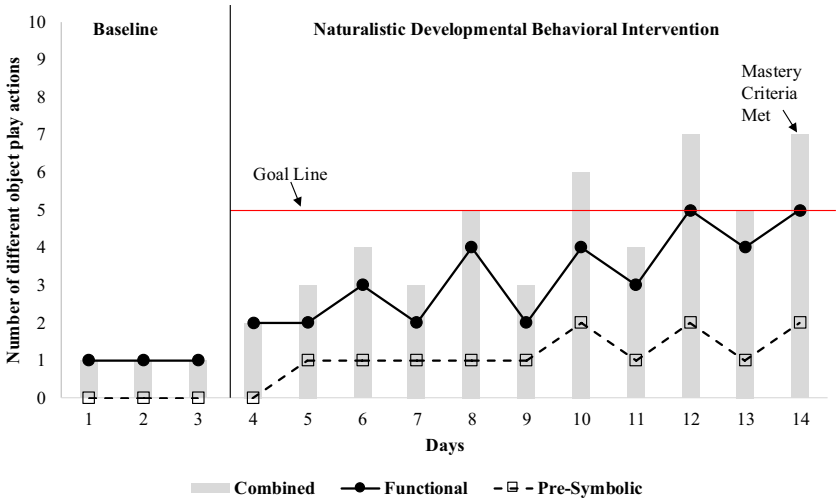

Fig. 2 Graph Displaying Diversity of Object Play Actions *Note*. The graph displays the number of different functional and pre-symbolic play actions. The closed black circles show actions at the functional play level. The open squares show actions at the pre-symbolic level, and the gray histogram shows the combined total

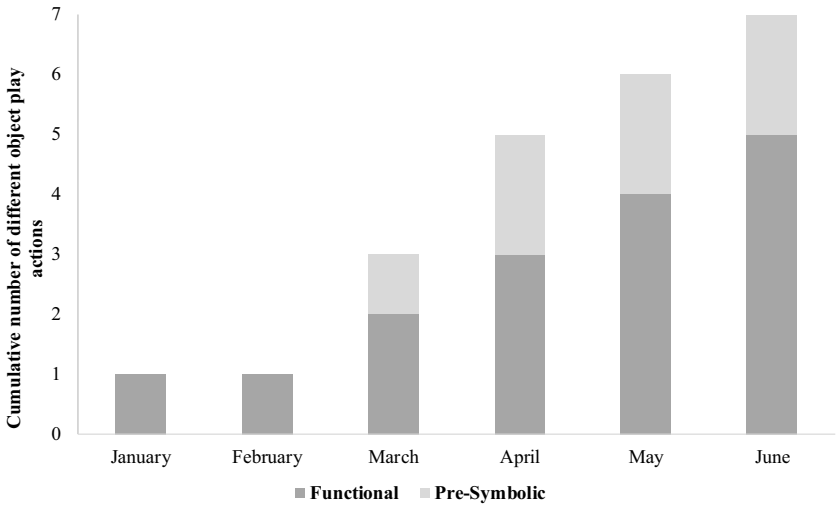

Fig. 3 Histogram Displaying Diversity of Object Play Actions over a Six-Month Time Period. *Note*. The graph displays a cumulative record of the number of different functional and pre-symbolic play actions a child engaged in over a six-month period. The darker gray bar shows functional play actions, and the lighter gray bar shows pre-symbolic play actions

any point during the interval); or momentary time sampling (i.e., the behavior occurred at the end of the interval).

If Kyle wishes to target engagement with a child, she may choose interval recording to measure progress. Figure 4 depicts a graph that would align with the following goal: During 10–15 min play routines, the child will demonstrate coordinated joint engagement for 60% of intervals across five therapy days within a two-week period. The duration of the play routine and the percentage of intervals the child is expected to spend jointly engaged will be individualized based on child characteristics (e.g., age, independent play level, presence of interfering or challenging behavior, attention span). The specific amount of time of each interval would be determined by the BCBA and would need to be feasible for an RBT to implement while also actively playing and intervening. For example, a 10-s interval might be distracting, whereas a 30-s interval may be more realistic. During the play routine, Kyle may coach the RBT to use partial interval recording to record the child's engagement state. The RBT would select the most advanced engagement state (unengaged, person *or* object, coordinated joint) observed during the interval. At the end of the routine, percent of intervals with coordinated joint engagement would be calculated using the following formula: intervals with coordinated joint engagement divided by the total number of intervals, multiplied by 100. Like all methods of measurement, there are pros and cons. One advantage of partial interval recording is that it does not require continuous observation (i.e., if the child engages in coordinated joint engagement anytime during the interval, the RBT can take a break until the next interval). A limitation is that partial interval recording overestimates behavior, especially with longer intervals.

A graphic display of hypothetical data is shown in Fig. 4. To visually analyze the data, the BCBA could use a goal line to easily see when the child engagement state was at a coordinated level for 60% of intervals. Once five non-consecutive

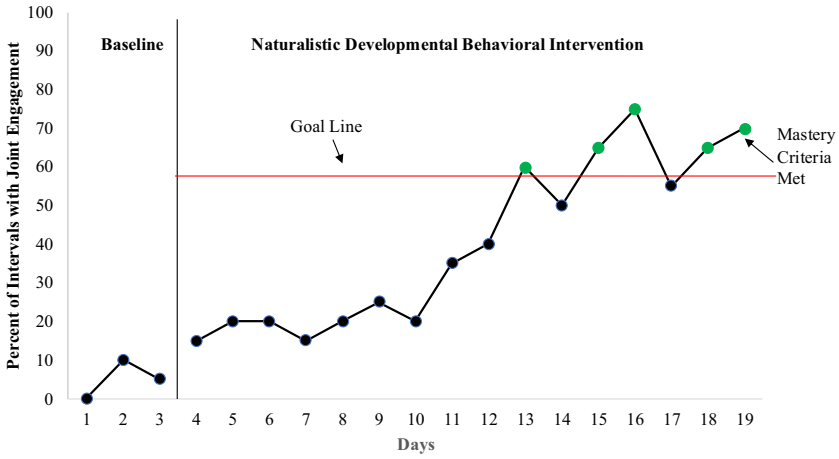

Fig. 4 Graph of Joint Engagement Measured with Interval Recording. *Note*. The graph displays the percent of intervals a child spent in a coordinated joint engagement state using partial interval recording. The green circle indicate levels of joint engagement at or above the mastery criterion

data points (shown in green in Fig. 4) sit at or above the goal line, this goal would be considered mastered.

Rating Scales

Rating scales have been utilized to measure the quality of parent–child interactions (e.g., Adamson et al., 2012); complex child behavior (e.g., Wetherby et al., 2007); engagement during classroom routines (e.g., Son et al., 2023); and fidelity of implementation of interventions (Frost et al., 2020) within literature. Additionally, rating scales have been validated to monitor progress on goals related to academic engagement and problematic behavior in school settings (e.g., Miller et al., 2014; 2017).

Rating scales are often used when the behavior of interest is embedded into a reciprocal interaction (i.e., an adult and child interaction). Rating scales may be particularly useful during naturalistic play routines as they may allow the RBT to be more fully present and respond to the child's social communication bids without needing to frequently divert their attention to a data sheet. The BCBA can customize the scale to individualize the operational definitions for each anchor of the Likert scale. See Table 3 for an example of an engagement rating scale.

When using a rating scale to measure engagement, Kyle might develop the following goal: During 5–10 min play exploratory–relational play routines, the child will demonstrate coordinated joint engagement for 80% of the routine across three days within a one-month period. Note that the child's independent play level is exploratory, with emerging functional play skills. At the end of the play routine, the RBT would review the anchors of the rating scale and select the rating that most closely matches the child's engagement during the brief routine.

A graphical display of hypothetical data is displayed in Fig. 5. To visually analyze the data, Kyle could use a goal line to easily see when the child's engagement state was at a coordinated level for 80% of the routine (a rating of a 5). Once three non-consecutive data points (shown in green in Fig. 5) sit at or above the goal line, this goal would be considered mastered. Developing anchors for rating scales and mastery criteria for goals is a highly individualized process. Kyle should consider many child factors (e.g., child's age, developmental level, social motivation) and contextual variables (e.g., setting, available stimuli and toys, typical expectations) when determining criteria for engagement goals.

A limitation of rating scales is that they have inherent subjective bias. To protect against these biases, it is imperative that the RBT has knowledge of engagement states and child development. Once this foundation has been established, the BCBA may employ behavior skills training methods to train the RBT in reliable data collection for rating the engagement state. One way a BCBA might do this is to use 5-min video clips of a child and adult playing. The BCBA can pause the video to show the distinct responses (e.g., initiating bids for joint attention, responding to adult bids for joint attention, shifting eye gaze between the toys and the adult) that the child displays. Next, the BCBA could model and verbally narrate how they used the anchors to determine the level of engagement. After several demonstrations, the BCBA and RBT would independently rate the engagement states using video and compare ratings. The BCBA would provide feedback following these practice opportunities. Reliability for rating scales is often determined by the number of identical ratings. For example, when the BCBA and RBT rated three video clips in a row the same, the training would be considered complete.

Kyle realizes that instead of entering predetermined play actions into her client's digital data sheet, it might be better for the RBT to be able to target any play action within the child's instructional play level. The child who is learning to play with cars, for exam-

Table 3 Example of engagement rating scale

Scale	Engagement state	Description
0	Mostly unengaged	The child is unengaged with toys and adults. The child is looking away from the toys/therapist, not manipulating or touching the toys, not engaging in any joint attention bids, and not responding to adult bids for joint attention.
1	Mostly person or object engaged	Person: The child is actively interacting in an activity with an adult that does not involve toys and makes a few bids for joint attention, responds to some adult bids for joint attention, and engages in some spontaneous communication at their level (e.g., pointing, gesturing, vocally saying words). Object: The child is actively interacting with toys (not light up or electronic) by manipulating the toys (e.g., moving them around, dumping, stacking) and focusing on toys (e.g., orienting toward them, looking at them).
2	Emerging coordinated joint engagement	The child is primarily engaged with either adults or objects but has brief instances of coordinated joint engagement.
3	Moderate coordinated joint engagement	(>50% of the routine): The child and therapist are engaged in a coordinated state of joint engagement for more than half of the play routine.
4	Mostly coordinated joint engagement	(>80% of the routine): The child is actively involved with an interactive play activity at their play level. The child and therapist are engaged in a coordinated state of joint engagement for most of the play routine. Coordinated joint engagement is evidenced by the child making multiple bids for joint attention, responding to multiple adult bids for joint attention, shifting their gaze between the toys and the adult, engaging in spontaneous communication at their level (e.g., pointing, gesturing, vocally saying words), and/or engaging in reciprocal imitation with the adult and toys.

This table provides an example of anchors for a rating scale of engagement states during a play routine

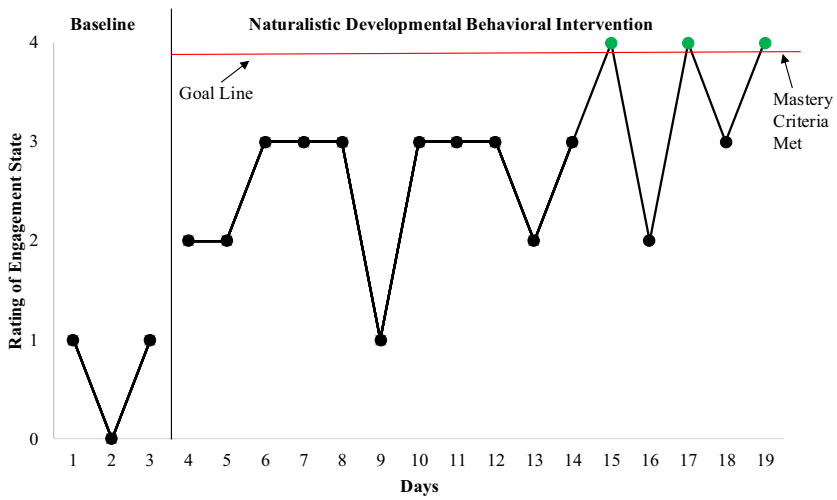

Fig. 5 Graph of Engagement State Rating. *Note*. The graph displays a child's engagement state during exploratory-functional play routines. The anchors of the Likert scale are as follows: 0: unengaged; 1: mostly person or object engaged; 2: emerging coordinated joint engagement; 3: moderate coordinated joint engagement; 4: mostly coordinated joint engagement. The green circles indicate engagement at or above the mastery criteria

ple, could park the car, race the car, or crash the car. All of these play actions are pre-symbolic. What Kyle really wants is for the child to engage in a variety of play actions that spark genuine joy. She decides to adjust the metric of the play goal. Remembering that the child's independent level of play is functional, and their instructional level is pre-symbolic. Kyle writes the play goal as follows: During 5–10 minute play routines, the child will imitate or demonstrate three different pre-symbolic play actions across three therapy days within a three week time period. This adjustment would shift the focus to increasing the complexity and diversity of the child's play. Kyle trains the RBTs to track both prompted and independent responses for comparison purposes, yet refrains from tracking "error" or "no response" for play behaviors. To simplify the demands for the RBTs, she decides to create a rating scale to track engagement during the play routine.

After rolling out the new data collection methods, Kyle checks back in with her RBT during a supervision session. She asks the RBT how data collection is going

during play routines. The RBT said, "I love it! I feel like I am able to be more present with the child, and I don't have to look down at my tablet as much to see what play actions I should be targeting. The child is much more engaged and has been smiling and laughing a lot more. I think you're onto something, here, Kyle!"

Concluding Remarks

Early behavior-analytic intervention for young autistic children focuses on many areas, including play skills and social engagement. When embedding curricular goals into naturalistic play routines, BCBAs may face barriers related to measuring progress in flexible ways. To supplement trial-by-trial data collection, we suggest BCBAs consider utilizing simple frequency counts when measuring object play actions, and interval recording or rating scales for engagement states. These methods may enable BCBAs to incorporate NDBI principles into programming and capture a meaningful picture of child progress.

Data Availability There are no data associated with this manuscript.

Declarations

Informed Consent No human or animal participants were involved in this tutorial. As such, informed consent or assent was not necessary.

Conflict of interest The authors report no potential conflicts of interest.

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