Behavior Technician Implementation of Reciprocal Imitation Teaching with Young Children with Autism Spectrum Disorder

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Abstract

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This single-case experimental design study examined the effects of virtual training and coaching on behavior technician implementation of a naturalistic developmental behavioral intervention focused on imitation, Reciprocal Imitation Teaching (RIT), with young children with autism spectrum disorder (ASD). Four behavior technicians were trained and coached in RIT's developmental and behavioral intervention strategies using bug-in-ear technology during child participants' regularly scheduled, community-based behavior analytic services. RIT's strategies are focused on improving reciprocal patterns of interactions between the implementer and the child, with the overall goal of increasing a child's ability to imitate in a social context. A multiple baseline design across behavior technician-child dyads was used to examine behavior technicians' use of RIT strategies and child imitative behavior. Increases in behavior technicians' fidelity of RIT implementation was observed over the course of training and coaching, and some indication of behavior technicians' ability to generalize RIT to an untrained routine with minimal additional support was observed. Two of the four behavior technician participants likely would have benefited from additional coaching support beyond what was provided in this study, to enhance their delivery of explicit teaching opportunities for child participants during RIT sessions. Child gains in imitative behavior were mild to moderate. Overall, behavior technicians expressed that RIT was feasible to implement, acceptable for use in their workplace, facilitated a positive relationship between behavior technician and child, and all behavior technician participants expressed an intention to continue implementing RIT beyond the context of this study. Practice and research implications are discussed.

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Dedication

To my husband and best friend, Guillermo – thank you for always believing in me.

Chapter 1: Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by challenges with social communication and social interaction skills, and the presence of restricted interests and/or repetitive patterns of behavior (American Psychiatric Association, 2013). Early intervention is recommended as soon as initial concerns for ASD arise or an individual receives an ASD diagnosis to promote best outcomes (National Institute of Mental Health, 2022). The term "early intervention" is used to refer to services and supports provided to infants and young children with developmental disabilities or delays, including ASD, and their families (Centers for Disease Control and Prevention, 2019). Early intervention (EI) simultaneously refers to a system of services delivered under Part C of the Individuals with Disabilities Education Act (2004) for children with developmental delays or disabilities from birth through age 3. As a result of the Part C focus, EI is often used to refer to services delivered during the first three years of a child's life. However, as a broad term, EI also pertains to services and supports provided to young children birth through age 5 and their families, before they enter school (Goldstein et al., 2006; Office of Early Childhood Development, 2020), as these years fall into a window of critical brain growth during early childhood (Centers for Disease Control and Prevention, 2022a). EI services may be provided inside or outside of the Part C Early Intervention system and may include pre-kindergarten programs such as Head Start and behavioral health services (Goldstein et al., 2006; Office of Early Childhood Development, 2020).

Early Intervention Programs

Practice guidelines for ASD intervention recommend that EI programs address the core characteristics of ASD; namely, social communication challenges, imitation, play, and restricted interests (Reichow et al., 2018). However, Part C EI programs for children with ASD vary from state to state, ranging from surveillance to intensive direct intervention with parent education, with about one quarter of states containing ASD-specific service guidelines (Aranbarri et al., 2021; Stahmer & Mandell, 2007).

Early Intensive Behavioral Intervention

Early intensive behavioral intervention (EIBI) is one form of EI services, often delivered outside of the Part C system, originating at the University of California, Los Angeles through the Young Autism Project (Lovaas, 1987). EIBI programs are based upon the principles of applied behavior analysis (ABA), which relies on the science of behavior to teach socially meaningful and important skills (Behavior Analyst Certification Board, n.d.). EIBI programs consist of individualized, comprehensive intervention plans developed based on a child's current skillset; use behavioral strategies to teach new skills; employ a function-based approach to reduce challenging behavior; and range from 20-40 hours per week for a span of 1 to 4 years (Reichow et al., 2018). A substantial amount of research has demonstrated the effectiveness of EIBI for children with ASD when compared with "eclectic" intervention, or treatment-as-usual (e.g., Cohen et al., 2006; Sallows & Graupner, 2005; Smith et al., 1997; Strauss et al., 2012). Over the last few decades, the relative effectiveness of EIBI has led to an industry of home- and clinic-based EIBI services, which have since been further expanded and supported through state ASD insurance mandates (McBain et al., 2020).

Naturalistic Developmental Behavioral Intervention

Naturalistic developmental behavioral interventions (NDBIs; Schreibman et al., 2015) represent a group of empirically supported interventions for children with ASD that combine best practices from ABA and developmental science. The majority of NDBIs are comprehensive in nature, meaning that they emphasize skills across developmental domains. Some NDBIs, however, are focused, meaning that they target a specific skill or subset of skills (Bruinsma et al., 2020). Reciprocal Imitation Teaching (RIT) is a focused NDBI that primarily targets the use of imitation within the context of play. Imitation represents an important skill for ASD-specific EI programs to address as imitation is a foundational skill that has cascading effects on further social communication development, and is differentially affected in young children with ASD (Rogers et al., 2003; Stone et al., 1997; Vivanti et al., 2014).

Problem Statement

Individuals delivering behavior services to young children with or at risk for ASD include behavior technicians, paraprofessionals who work under the guidance of a certified/licensed professional (i.e., Board Certified Behavior Analysts [BCBAs]). ABA services are typically delivered within a tiered service delivery model in which a BCBA designs and supervises service implementation by behavior technicians (Fisher et al., 2014). Behavior technicians are therefore likely to spend the greatest amount of time with a child receiving ABA services (Leaf et al., 2017), much of which occurs outside the direct supervision of a licensed provider (Sobeck et al., 2020). Given that behavior technicians spend a significant amount of time delivering individualized instruction to children with disabilities, they represent an important group for training in efficacious interventions for children with ASD, including NDBIs.

Recent RIT research has emphasized caregiver implementation (Hall et al., 2019; Ingersoll & Gergans, 2007; Penney & Schwartz, 2019; Wainer & Ingersoll, 2013; Zaghlawan & Ostrosky, 2016), but has yet to explore issues of fidelity when the intervention is implemented by paraprofessionals or behavior technicians. Most of the research on training behavior technicians to implement ABA procedures with children with ASD has emphasized training in discrete skills within structured settings (Gerencser et al., 2020; Higgins et al., 2017; Kipfmiller et al., 2019; Leaf et al., 2019; Rodriguez, 2020), rather than emphasizing training required to develop flexible and responsive repertoires to young learners (Leaf et al., 2021). At the same time, training requirements for behavior technicians do not include knowledge of typical child development, developmentally appropriate behavioral expectations, or strategies for engaging in developmentally appropriate play with young learners (Behavior Analyst Certification Board, 2017, 2018). This lack of training in developmental norms compounded by a lack of training in embedded and developmentally appropriate practices emphasizes the critical need for behavior technicians to receive training in naturalistic developmental behavioral intervention strategies – strategies that combine ABA with an understanding of development-enhancing adult-child patterns of interaction.

Behavior Technician Training

Many initial training programs for behavior technicians rely heavily on asynchronous, didactic training formats (Fisher et al., 2014). However, these formats do not take critical qualities of professional development based on adult learning theory into account - namely, that high quality professional development is sustained (i.e., implemented over time), job-embedded (i.e., occurs or continues within the context of the work), interactive, collegial, and integrated (Fogarty & Pete, 2004). A 2017 survey of newly certified behavior technicians assessed behavior technicians' perceived training needs and areas of weakness. Between 36.3-45.4% of survey respondents indicated training needs related to teaching skills to learners with ASD, such as identifying key components of an instructional plan and adequately preparing for an instructional session (Luiselli et al., 2017). These are critical aspects of a behavior technician's role, and emphasize the need for additional forms of professional development that facilitate upskilling, such as coaching (Kretlow & Bartholomew, 2010; Stormont et al., 2015).

Training and coaching in RIT hold promise for supporting behavior technicians' use of evidence-based and developmentally informed strategies during daily activities and routines (e.g., play time, snack time), when instruction programmed by a BCBA may be less likely to occur, thereby increasing young children with ASD's exposure to effective and developmentally appropriate intervention.

Research Questions

This project sought to address the following research questions:

1. What effect do training and coaching in RIT have on behavior technicians' implementation of RIT?
2. What effect do training and coaching in RIT have on behavior technicians' use of contingent imitation and linguistic mapping with young children with ASD?
3. How do behavior technicians rate the acceptability, feasibility, and sustainability of the use of RIT in their practice with young children with ASD?
4. What effect does behavior technician implementation of RIT strategies have on child imitative behavior?

The primary aim of this study was to evaluate whether providing training and ongoing coaching to behavior technicians in RIT led to generalized use of NDBI strategies by behavior technicians during interactions with children with ASD. A secondary aim of this study was to evaluate whether increased use of RIT led to an increase in child imitative behavior.

Chapter 2: Literature Review

The current estimated prevalence rate of autism spectrum disorder (ASD) is 1 in 44 children (Centers for Disease Control and Prevention, 2022b). Early intervention (EI) programs are considered to be a high priority for young children with or at risk for ASD, given the plasticity of the brain during early life and the impact of early experiences on development (e.g., Inguaggiato et al., 2017; Zwaigenbaum et al., 2015). EI models for children with or at risk for ASD are commonly based upon the principles of applied behavior analysis (ABA; Fuller & Kaiser, 2020; Nahmias et al., 2019), which itself is based upon the science of behavior analysis (Baer et al., 1968). EI based upon behavior analytic principles is recommended as it has been demonstrated to result in positive gains for children with an ASD diagnosis (Lovaas, 1987; Zwaigenbaum et al., 2015).

Instruction within ABA Programs

Teaching strategies used within ABA programs can be conceptualized as occurring along a continuum of decontextualized to embedded instruction (Schwartz et al., 2017). Decontextualized instruction is adult-led and occurs separately from the context in which the skill being taught naturally occurs. One benefit of decontextualized instruction is that it allows for the adult to present multiple opportunities to practice a skill beyond what is likely feasible within a natural context. A criticism of decontextualized instruction is that the lack of social context may present a challenge with promoting spontaneous use of a skill within naturally occurring opportunities (Ingersoll & Schreibman, 2006). Embedded instruction is delivered in the context in which a skill is used, typically within child-directed play or other daily routines. One benefit of embedded instruction is that generalization of the skill is highly likely given the location of skill practice. A drawback of relying on embedded instruction alone is that an insufficient number of learning opportunities may feasibly exist for an individual to acquire and become fluent with a particular skill (Wolery, 2012).

Decontextualized and embedded instructional approaches have both led to mixed outcomes across various learners (Ledford & Wolery, 2011; Jobin, 2020). Ledford and Wolery (2011) and the Division for Early Childhood (2014) recommend that providers prioritize embedding instruction for young learners, but Wolery (2012) and Jobin (2020) highlight that learners benefit from receiving both decontextualized *and* embedded instruction.

Discrete Trial Teaching

Decontextualized instruction within an ABA program is often referred to as discrete trial teaching, or DTT. DTT is a unit of instruction that consists of five components: (1) a cue, (2) a prompt, if needed, (3) the child's response to the cue and prompt (if relevant), (4) a consequence in the form of reinforcement or error correction, and (5) an intertrial interval, which is a brief pause prior to the presentation of another response opportunity for the child (Smith, 2001). In recent years the term "DTT" has become synonymous with location of instruction, often indicating that instruction is occurring in a decontextualized and highly structured fashion. However, when DTT was initially defined by Lovaas and colleagues (1973), the intention was that those implementing DTT as an instructional approach would do so flexibly and responsively to the child (Leaf et al., 2016). Since then, DTT has become more rigid with implementers inflexibly adhering to structured protocols to which they are trained, likely due to the ease of training to such protocols (Leaf et al., 2016).

Naturalistic Developmental Behavioral Interventions

Naturalistic developmental behavioral intervention (NDBI) is a term coined in 2015 by Schreibman and colleagues to refer to the growing number of interventions based upon the principles of behavior analysis and developmental science. NDBIs include child-led instruction within naturalistic settings and the use of natural reinforcement, alongside the predictable sequence of discrete trials to facilitate learning (Sone et al., 2021). NDBIs primarily rely upon embedded discrete trials for teaching new skills, but may increase the structure and potential decontextualized nature of discrete trials based upon the child's response to instruction (Bruisnma et al., 2020).

NDBIs are evidence-based, ASD-specific interventions that are consistent with developmentally appropriate practices highlighted by the National Association for the Education of Young Children (NAEYC, 2022) and recommended practices as delineated by the Division for Early Childhood of the Council for Exceptional Children (DEC, 2014; D'Agostino et al., under review). NDBIs are recommended for EI for children with or at risk for ASD and are considered best practice in early ASD intervention (Zwaigenbaum et al., 2015). Despite this, NDBIs have yet to be successfully disseminated and taken up on a wide-scale by community-based behavioral interventionists (D'Agostino et al., under review; Hampton & Sandbank, 2021).

ABA Providers

The increasing prevalence of ASD has led to an increase in the demand for ABA services and professionals with a behavior analytic background (Leaf et al., 2016). According to the Behavior Analyst Certification Board, there are currently over 50,000 certified behavior analysts and over 114,000 registered behavior technicians in the United States (Behavior Analyst Certification Board, 2022). A few decades ago, there were significantly fewer professionals with a behavior analytic background, but those who were trained behaviorally tended to have more substantial background and training in behavior analysis (Lovaas 2002, cited in Leaf et al., 2016). As the demand for ABA services has increased there is concern that the training of professionals to provide these services may not keep up and progress, with high quality, at the pace of service demand (Leaf et al., 2016; Smith, 2013). Given the lack of familiarity with NDBIs by behavior analytic practitioners (Hampton & Sandbank, 2021), it is evident that training for behavioral professionals working in early ASD intervention has not kept pace with current practice recommendations.

Registered Behavior Technicians

Behavior technicians implement behavior analytic programs under the supervision of a BCBA. Behavior technicians are paraprofessionals in the field of behavior analysis, in which the majority of working hours are spent in the delivery of direct services to consumers (Kazemi et al., 2015). To ensure minimum levels of training and oversight for the behavior technician role, the Behavior Analyst Certification Board (BACB) created the Registered Behavior Technician credential in 2014. Currently, the majority of both behavior technicians and BCBAs report providing services to individuals with ASD (Behavior Analyst Certification Board, 2022).

To become a Registered Behavior Technician, an individual must have a high school diploma, complete a 40-hour training covering behavior analytic concepts and applications, complete a competency assessment conducted by a BCBA, and pass a multiple-choice examination (Carr & Nosik, 2017). To maintain their credential, behavior technicians must receive ongoing supervision from a BCBA for at least 5% of the hours spent providing ABA services each month (Behavior Analyst Certification Board, 2021). At a minimum, this supervision must include two face-to-face contacts and at least one observation of the behavior technician providing ABA services.

Behavior technicians have previously reported high levels of stress and burnout coupled with low levels of satisfaction and accomplishment within the role (Griffith et al., 2014; Hurt et al., 2013). Kazemi and colleagues (2015) surveyed behavior technicians in California and found that satisfaction with training and supervision were significantly correlated with intentions to stay or leave the role, and that 38% of respondents reported being highly or somewhat likely to leave their role.

The Behavior Analyst Certification Board task list for Registered Behavior Technicians specifies that behavior technicians should be able to “implement discrete-trial teaching procedures” (C-3) and “implement naturalistic teaching procedures (e.g., incidental teaching)” (C-5; Behavior Analyst Certification Board, 2018). While these training requirements for behavior technicians promote their ability to implement decontextualized and embedded discrete trials, behavior technicians are not necessarily provided with support in how to interact with children when they are not engaged in instruction. One study looking at the quality of care in ABA settings collected momentary time sampling data of staff behavior across three ABA centers. They found that on average, staff were engaged in teaching interactions with clients approximately 50% of the time when in classroom or therapy settings (Grauerholz-Fisher et al., 2019). This suggests that there may be substantial “down time” within these sessions, time that may be unproductive for the learner and missed opportunities for relationship building and social interaction.

Hampton and Sandbank (2021) call for the Behavior Analyst Certification Board task list requirements to include specific content knowledge of NDBIs, given the research supporting NDBI effectiveness with the autistic population. While it is unknown why 38% of respondents to Kazemi and colleagues 2015 survey reported dissatisfaction with their role, increasing behavior technician NDBI knowledge may facilitate their ability to interact effectively with consumers outside of the context of instruction, potentially increasing job satisfaction for those who work with young learners by increasing their skill set and self-efficacy.

Reciprocal Imitation Teaching

Reciprocal Imitation Teaching (RIT) is a focused NDBI that primarily targets spontaneous imitation within an ongoing social interaction (Ingersoll, n.d.). RIT has previously been successfully taught to and implemented by researchers, caregivers, and siblings of children with ASD (Ingersoll & Gergans, 2007; Penney & Schwartz, 2019; Wainer & Ingersoll, 2013; Walton & Ingersoll, 2012). However, community-based behavior analytic professionals, both BCBAs and behavior technicians, have yet to be represented within the RIT literature. Given the call for ASD interventionists to have NDBI knowledge (Hampton & Sandbank, 2021; D'Agostino et al., under review), behavior analytic professionals represent an important group to receive RIT training.

When first implemented with a child, RIT focuses on teaching object imitation skills, followed by expanding a child's play skills, and lastly targets gesture imitation (Bruinsma et al., 2020). An RIT intervention session consists of the developmental strategies of contingent imitation and linguistic mapping, and the behavioral strategy of an embedded discrete trial (Ingersoll & Gergans, 2007; see Table 1). These strategies are consistent with those included within other NDBIs (Bruinsma et al., 2020; Frost et al., 2020; Schreibman et al., 2015; Vibert et al., 2020), while containing fewer strategies overall given its nature as a focused, rather than comprehensive, NDBI model. This feature highlights RIT's potential as a relatively cost-effective and less resource-intensive option for NDBI training, thereby a potential entry point for NDBI uptake within the behavior analytic community.

RIT can be embedded across daily activities and routines such as mealtime, bath time, and dressing (Ingersoll, n.d.). The use of RIT has resulted in gains in young children with ASD's ability to imitate after 20-30 hours of intervention when implemented by researchers and caregivers, with a recommendation for RIT to be implemented for approximately 20 minutes per day (Ingersoll, 2010; Ingersoll, 2012; Ingersoll & Lalonde, 2010; Ingersoll et al., 2007; Ingersoll & Schreibman, 2006). RIT has also led to additional, untargeted gains in the areas of expressive language, pretend play, and joint attention (Ingersoll & Schreibman, 2006; Ingersoll & Lalonde, 2010). These additional developmental gains demonstrate RIT's promise as an intervention that may facilitate broad social communication development in young children with ASD.

Table 1

RIT Components and Definitions

Component	Definition
Contingent imitation	The adult imitates the child's actions with toys, gestures/body movements, and vocalizations at the same time as the child.
Linguistic mapping	The adult describes what the child is attending to and/or doing using simplified language (e.g., ''Dog is walking'') or sound effects.
Embedded discrete trial	*Model* The adult models an action related to the child's play up to three times. Actions are paired with a verbal marker that describes the action. *Prompt* The adult uses physical guidance, a verbal command, or gestural prompt to encourage the child to imitate the modeled action if the child does not spontaneously imitate after the third model. *Praise* The adult praises the child after imitating and allows continued access to the toys.

Note. Definitions taken from Ingersoll & Gergans (2007) and Ingersoll (n.d.).

Contingent Imitation

The behavioral literature has described imitating a child's appropriate play skills as an effective way in which to pair with a client (Lugo et al., 2017). However, contingent imitation goes beyond just imitating appropriate play skills to imitate all of a child's motor movements and actions with objects (functional or not), and vocalizations during child-directed play, which has been demonstrated to enhance a child's social responsiveness (Dawson & Adams, 1984; Escalona et al., 2002). Research has shown contingent imitation to increase children with ASD's imitative behavior, proximal behavior (e.g., approaching and touching an adult), social gazes, and smiling (Contaldo et al., 2016; Dawson & Galpert, 1990; Field et al., 2001; Katagiri et al., 2010; Stephens, 2008). Contingent imitation may also be an effective way in which to obtain a child's attention prior to presenting an embedded discrete trial teaching opportunity (Ingersoll, 2008). Field and colleagues (2013) compared children with ASD's behavior when they interacted with an adult who responded to but did not imitate their actions, versus children with ASD's behavior when they interacted with an adult who contingently imitated their actions. Contingent imitation was associated with children's use of social attention and imitative behavior (Field et al., 2013). In addition, studies suggest that the effects of contingent imitation are more pronounced in children experiencing greater developmental delays (Contaldo et al., 2016; Katagiri et al., 2010).

Linguistic Mapping

The behavioral literature has also characterized describing a child's appropriate play skills as an effective way in which to pair with a client (Lugo et al., 2017). Linguistic mapping as a developmental strategy involves describing what the child is doing (functional or not) and the possible meaning behind the child's actions (Yoder & Warren, 2002). Caregiver verbal responsiveness has been shown to support typically developing children's language development and linguistic mapping has been shown to have a predictive relationship with children with ASD's language outcomes (Haebig et al., 2013; Venker et al., 2012). However, research suggests that caregivers of children with ASD tend to engage in increased levels of directiveness during play than caregivers of typically developing children (Srinivasan & Bhat, 2020). This is inconsistent with the recommendation that caregivers prioritize responsive commenting during play with children with ASD, as responsive comments are associated with improved language skills (Haebig et al., 2013; Killmeyer et al., 2019). While these behaviors have not been examined in behavior technicians, these findings pose the possibility that behavior technicians engage in primarily directive behavior during play with children with ASD.

According to the transactional model of development, reciprocal interactions between caregiver and child facilitate child development (Sameroff, 2009). Given challenges with social communication, children with ASD tend to initiate fewer interactions compared with their typically developing counterparts, resulting in reduced exposure to contingent verbal language input from caregivers (Yoder & McDuffie, 2006). At the same time, challenges with joint attention interrupt a child with ASD's ability to connect language used by others with relevant aspects of their environment (Baron-Cohen et al., 1997). Therefore, linguistic mapping can facilitate language development for children with ASD as it emphasizes connecting (or "mapping") spoken language to the *child's* attentional focus, removing the need for the child to use joint attention to interpret language around the *adult's* area of attentional focus.

RIT as a Training Package

A possible benefit of training behavior technicians in the packaged use of contingent imitation and linguistic mapping is that there is a high likelihood of reaching fidelity of implementation quickly, as caregivers have accomplished this within the home setting (Killmeyer et al., 2019). Mastery of these strategies was shown to reduce caregiver rate of question asking and direction giving during play, while leading to increased use of social eye gaze by young children who were at-risk for ASD (Killmeyer et al., 2019). Contingent imitation with linguistic mapping may represent a relatively easy-to-embed developmental strategy combination that may foster opportunities for adults to promote imitation, social engagement, and language skills among young children with ASD. RIT represents a relatively easy-to-train NDBI that may enhance behavior technicians' use of development-enhancing and developmentally appropriate adult-child patterns of interaction. The use of embedded discrete trials within RIT may also enhance behavior technician training in flexible implementation of discrete trials.

Training and Coaching

Training and coaching are umbrella terms that encompass instructional practices to support adults as implementers of intervention strategies (Steinbrenner et al., 2020). "Training" and "coaching" are frequently used interchangeably, although "training" is often used to refer to didactic instruction while "coaching" is viewed as a joint process between coach and coachee to facilitate ongoing intervention implementation (Meadan et al., 2020). For the sake of clarity, the term "coaching" will be used to refer to both training and coaching activities within this chapter.

Adult Learning Principles

Adult learning theory highlights that an adult's learning should be connected to their prior knowledge and lived experiences to make the content relevant (Trivette et al., 2009). New knowledge and skills must also be understood within the specific context in which they will be used (Bransford et al., 2000; Merriam, 2008). Adult learning principles are important to consider in the ongoing training of behavior technicians, as this group of providers delivers the majority of direct services while a BCBA supports implementation via coaching.

Trivette and colleagues (2009) conducted a meta-analysis of adult learning strategies and identified six characteristics of the strategies that are affiliated with positive learner outcomes. These characteristics are: Introduce, illustrate, practice, reflection, and mastery. *Introduce* involves providing an overview of the new skill to the learner; *illustrate* is providing a model of the skill; *practice* provides an opportunity for the learner to use the skill; *evaluate* is a process in which the learner assesses the consequence or outcome from their practice; *reflection* includes assessing the learner's acquisition of skills in order to identify next steps; and *mastery* includes assessing the learner's acquisition of skills against pre-established criteria (Trivette et al., 2009). Coaching is considered to be a specific adult learning strategy as it tends to include many, if not all, of the aforementioned characteristics (Bransford et al., 2000; Friedman et al., 2012; Trivette et al., 2009).

Coaching can enhance an interventionist's contribution to a child's intervention by capitalizing on opportunities across the day to scaffold the child's learning (McWilliam, 2015). Intervention includes interactions that occur between the behavior technician and child in between structured programs or lessons which, given the time behavior technicians spend with young children with ASD, can contribute to a child's long-term outcomes. Some of the variance in child outcomes from ABA programs may be explained by the number of high-quality interactions between behavior technician and child, as caregiver-child interactions have been suggested to explain variability in EI program outcomes (McWilliam, 2015). At the same time, a meta-analysis reviewing EIBI programs suggested that caregiver coaching moderates intervention effects (Strauss et al., 2013), suggesting the importance of implementation support for evidence-based interventions. Therefore, delivering coaching to behavior technicians that explicitly supports responsive adult-child patterns of interaction may facilitate improved outcomes for ABA recipients.

Coaching Formats

Coaching for behavior technicians may be delivered in face-to-face or virtual formats. A major benefit of face-to-face coaching is that it allows for real-time observation of the coachee coupled with the ability of the coach to model new skills directly with the child. Over the last few decades, however, research has suggested that technology may be a valid way to provide coaching from a distance (Artman-Meeker et al., 2017; Boisvert & Hall, 2014; Neely et al., 2017; Rosenberg et al., 2020). Current research supports the provision of virtual coaching to direct service providers to implement both comprehensive and focused treatment programs such as functional behavior assessment, functional communication training, discrete trial teaching, naturalistic intervention, and the Early Start Denver Model (Barkaia et al., 2017; Gibson et al., 2010; Neely et al., 2017; Steinbrenner et al., 2020; Vismara et al., 2009). Virtual coaching has demonstrated feasibility, efficacy, and satisfaction when used to teach intervention strategies to caregivers of children with ASD (Boisvert & Hall, 2014; Kobak et al., 2011; Little et al., 2018). One of the benefits of virtual coaching is that it can connect providers to content specialists (e.g., those with NDBI backgrounds or training), an important consideration given the lack of BCBA familiarity with NDBI interventions (Hampton & Sandbank, 2021).

Bug-in-ear coaching is one form of virtual coaching in which a Bluetooth earpiece is worn by the coachee while the coach observes using video conferencing, which allows for the delivery of feedback from a different location (Rosenberg et al., 2020). Bug-in-ear coaching has been shown to be an effective method for delivering distance prompts and feedback in an unobtrusive manner (Artman-Meeker et al., 2017; Rosenberg et al., 2020). Research comparing virtual coaching with face-to-face coaching has indicated that virtual coaching may promote a great number of opportunities for the individual being coached to practice implementing strategies while receiving feedback (Olsen et al., 2012). Coaches conducting face-to-face sessions have been observed to spend more time discussing and modeling strategies and less time providing the coachee with opportunities to practice (Olsen et al., 2012).

Controlled and Natural Coaching Settings

ABA programs for young children with ASD may occur across a variety of contexts, including early education programs, home, community locations, and clinics (Meadan et al., 2017). One advantage of delivering coaching within a controlled location is that distractions are more limited than in a natural setting and as such, the session itself may be more predictable. However, one of the challenges with coaching in controlled environments is that it may be more challenging for the coachee to transfer their learning to their natural contexts (Meadan et al., 2017). Coaching in a natural setting may increase the generalizability of skills acquired. Natural settings are also consistent with the adult learning principle that skills be understood within the contexts in which they will be used (Bransford et al., 2000; Merriam, 2008).

Coaching for Behavior Technicians

Most of the research literature focused on coaching behavior technicians has emphasized the implementation of discrete procedural tasks occurring in decontextualized contexts, such as behavioral assessment, preference assessment, visual analysis of single-case research design data, and decontextualized DTT (Gerencser et al., 2020; Higgins et al., 2017; Kipfmiller et al., 2019; Leaf et al., 2019; Rodriguez, 2020). However, Jimenez-Gomez and colleagues (2019) coached five novice behavior technicians to implement a naturalistic play protocol that included narration of the child's actions, imitation of the child's words and actions, clear play instructions, the use of verbal and physical prompts, and behavior-specific praise. Training and coaching were delivered via an initial, one-time didactic training that included live modeling of skills, followed by ongoing in-person coaching sessions that consisted of 5-minutes of coach observation of the behavior technician implementing the protocol, followed by 5-minutes of feedback and coach modeling. Behavior technicians mastered and maintained the use of these strategies at a 3-week follow-up probe, and generalized the use of these strategies to their play with another child. Interestingly, the authors of this research did not describe their intervention as NDBI; they instead used the term "naturalistic behavioral intervention," or NBI. However, the play protocol used strategies similar, if not identical, to the components of RIT. The lack of explicitly stating RIT as the intervention of focus or the use of the term NDBI may highlight the lack of dissemination and knowledge of NDBIs by BCBAs (Hampton & Sandbank, 2021), emphasizing the need for additional research promoting the use of NDBIs by behavior analytic professionals.

Chapter 3: Method

Participants

Four behavior technician-child dyads participated in this study. Recruitment began in Winter 2021 through emailed fliers distributed to partner ABA agency leaders across the United States. The primary investigator discussed study details with four leaders of ABA agencies located in Washington State, Virginia, and an agency with ABA centers nationwide. Behavior technician providers were recruited first, and child participants were recruited through participating providers and their supervisors (i.e., BCBAs), who were asked to share information with caregivers of children for whom providers believed imitation was an important skill to address during ABA sessions.

Behavior technician inclusion criteria required that providers (a) deliver direct intervention services to children between the ages of 1-5 with or at risk for ASD and (b) had not received prior training in RIT. Children were eligible to participate if (a) they had a diagnosis or educational classification of ASD, or caregiver or provider concern for ASD; (b) providers and caregivers indicated that imitation was a beneficial skill to address; (c) the child was between 12-months and 60-months of age at the time of caregiver consent; (d) the child participated in at least biweekly sessions with the participating behavior technician; (e) at least one of the child's caregivers spoke English; and (f) the child had no significant visual or motor impairments. Enrollment was determined on a first-come basis.

Participants were assigned pseudonyms, which are used throughout this manuscript. The four behavior technician-child dyads consisted of Sammy and Alex, Susie, and Olivia, Sofie and Liam, and Ava and Jackson (see Tables 2 and 3).

Sammy and Alex

Sammy was a 26-year-old male of mixed racial background, Asian and Black, who worked for a small (under 50 employees), privately owned ABA company in the Pacific Northwest. Sammy had a bachelor's degree and the Registered Behavior Technician credential. Sammy reported no prior training in NDBI models. Sammy had provided ABA services to Alex for 1 month at the onset of study participation. Alex was a 4.5-year-old Asian male. He had received a diagnosis of ASD at age 2.5 and had received ABA services for the past 2 years. In addition to ABA, Alex attended a special education preschool program.

Alex's primary caregiver and Sammy both indicated that they had not previously worked on object imitation with Alex, although Alex's primary caregiver specified that she had learned to imitate Alex's vocalizations as a way to encourage speech via Alex's preschool teacher.

Susie and Olivia

Susie was a 31-year-old female with a Hispanic/Latina background who worked for a small (under 20 employees), privately owned ABA company in the Pacific Northwest. Susie had a high school diploma and was in the process of obtaining the Registered Behavior Technician credential. Susie reported no prior training in NDBI models. Susie had just started providing ABA services to Olivia at the onset of study participation. Olivia was a 4.5-year-old White female. She had received a diagnosis of ASD at age 1-year, 10-months, and had received ABA services for the past 2.5 years. In addition to ABA, Olivia attended a special education preschool program where she received speech and language therapy and occupational therapy.

Olivia's primary caregiver and Susie both indicated that they had not previously worked on object imitation with Olivia. However, Olivia's primary caregiver was unsure whether any prior providers had worked on this skill with Olivia. Given that Olivia had received 2.5 years of ABA services, prior emphasis on imitation was likely.

Sofie and Liam

Sofie was a 25-year-old White female who worked for a mid-sized (under 200 employees), nonprofit ABA company in the Southeast. Sofie had a bachelor's degree and the Registered Behavior Technician credential, and was currently pursuing certification as a behavior analyst through a master's program in ABA. Sofie reported prior training in Incidental Teaching (IT), and indicated using IT strategies frequently with her clients. Sofie had provided ABA services to Liam for 6 months at the onset of study participation. Liam was a 4.5-year-old White male. He had received a diagnosis of ASD at age 2-years, 6-months, and had total face paralysis. While he had great lateral and functional vision, his peripheral vision had not been assessed. Liam had received ABA services for the past 6 months. In addition to ABA, Liam received speech and language therapy, occupational therapy, and feeding therapy.

Liam's primary caregiver and Sofie both indicated that they had previously worked on object imitation with Liam.

Table 2

Behavior Technician Demographic Characteristics

	Sammy	Susie	Sofie	Ava
Gender	Male	Female	Female	Female
Race/Ethnicity	Asian, Black	Hispanic/Latina	White	White
Age (years)	26	31	25	21
Region	Pacific Northwest	Pacific Northwest	Southeast	Midwest
Education	Bachelors	High School Diploma	Bachelors	High School Diploma
Certification	Registered Behavior Technician	Registered Behavior Technician *in process*	Registered Behavior Technician	Registered Behavior Technician
ABA Company Size	<50 employees	<20 employees	<200 employees	1500+ employees

Ava and Jackson

Ava was a 21-year-old White female who worked for a large (over 1,500 employees), nationwide, privately owned ABA company, and provided services in the Midwest. Ava had a high school diploma and the Registered Behavior Technician credential and was pursuing a bachelor's degree in psychology. Ava reported no prior training in NDBI models. Ava had provided ABA services to Jackson for 8.5 months at the onset of study participation. Jackson was a 2.5-year-old male of mixed racial background, Black and White. He had received a diagnosis of ASD at age 1-year, 7-months, and had received ABA services for the past 7 months. In addition to ABA, Jackson received home-based Part C early intervention services.

Jackson's primary caregiver and Ava both indicated that they had previously worked on object imitation with Jackson.

Table 3

Child Demographic Characteristics

	Alex	Olivia	Liam	Jackson
Gender	Male	Female	Male	Male
Race/Ethnicity	Asian	White	White	Black, White
Age	4 yrs, 6 mos	4 yrs, 6 mos	4 yrs, 6 mos	2 yrs, 6 mos
Age at ASD Diagnosis	2 yrs, 6 mos	1 yr, 10 mos	2 yrs, 6 mos	1 yr, 7 mos
Length of ABA Services	2 yrs	2 yrs, 6 mos	6 mos	7 mos
ABA Session Setting	Home	Home	Clinic	Home
Other Services	Special education preschool	Special education preschool; speech-language therapy; occupational therapy	Speech-language therapy; occupational therapy; feeding therapy	Part C early intervention (unspecified)

Setting and Materials

Setting

All study activities were conducted remotely using Zoom (Zoom Video Communications, Inc., 2021). Participants connected to a participant-unique Zoom room from the setting in which the child received ABA services. For Sammy and Alex, Susie and Olivia, and Ava and Jackson, this was the home setting. For Sofie and Liam, this was an ABA clinic. Data were collected via video recordings using the Zoom recording feature and were collected twice per week during the child's regularly scheduled ABA sessions. At every session data were collected across two routines: play time and snack time. Coaching provided to behavior technicians in RIT delivery was conducted remotely using bug-in-ear technology during the child's ABA sessions.

An introductory, 90-minute RIT training was conducted virtually via Zoom for each behavior technician at a time chosen by the participant, without the child present.

Materials

Behavior technicians were mailed an iPod Touch, tripod, and Bluetooth headset for use during data collection and bug-in-ear coaching. Upon completion of the introductory training in RIT, behavior technicians received the RIT manual (Ingersoll, n.d.) via email.

Each behavior technician received a set of 10 duplicate sets of objects (i.e., developmentally appropriate, open-ended toys) via mail. The set contained vehicles, stuffed animals, sensory balls, slinkies, play-doh, musical bells, and crayons, which were selected as representative samples of objects that promote open-ended play as well as to demonstrate to participants what "duplicate sets of objects" may look like for use in an RIT session. Behavior technicians were not required to use these materials during the study and were encouraged to identify duplicate sets of materials that met the child participant's interests during the introductory RIT training.

Behavior technicians received $100 in electronic gift cards for participation in the study. Gift cards were disbursed in increments of $25 based on completion of baseline data collection, introductory RIT training, intervention data collection, and follow-up data collection. Follow-up data collection was incomplete at the time of manuscript preparation and is therefore not reported here. Caregivers of child participants received a $10 electronic gift card for completing a child demographic questionnaire at study onset. BCBAs overseeing child participants' ABA programming received $20 in electronic gift cards disbursed in increments of $10 based on completion of a structured imitation assessment with the child participant at study onset and again at completion of intervention.

This study was approved by the University of Washington Institutional Review Board and funded through an Association for Positive Behavior Support (APBS) Student Research Grant. All providers and caregivers gave informed consent before participation.

Independent Variables

Introductory RIT Training

Behavior technicians were provided with an initial, 90-minute online training in RIT via Zoom. This training was adapted from an RIT workshop created for Part C early intervention providers by the Research in Early Autism Detection and Intervention (READi) Lab at the University of Washington. The primary investigator conducted the training, which consisted of didactic instruction, video examples of RIT, and role play. Behavior technicians were encouraged to ask questions throughout the training. Didactic instruction included an overview of ASD, an overview of imitation and its role in social communication development, a rationale for targeting imitation during play and within an ABA program, and a description of RIT components, including implementation preparation, imitating and describing the child's play, and implementing embedded discrete trials. Video examples demonstrated contingent imitation, linguistic mapping, and discrete trials. Role play followed didactic instruction and video exemplars to rehearse the components of RIT. The primary investigator and behavior technician took turns role playing as the child and as the interventionist. Positive and constructive feedback was provided to the behavior technician during behavior technician role play as the interventionist. At the end of the training, the primary investigator emailed the behavior technician a copy of the RIT manual (Ingersoll, n.d.) to review on their own, and instructed behavior technicians to contact the primary investigator with questions or concerns.

Following the introductory training, behavior technicians were instructed to implement RIT for 20 minutes twice per week for data collection purposes for the study. During this time participants implemented RIT on their own for 10 minutes, followed by bug-in-ear coaching for 10 minutes. While not a component of the study, participants were encouraged to use RIT outside of the context of the study as well.

Bug-in-Ear Coaching

Following the introductory training, behavior technicians received twice weekly bug-in-ear coaching during their implementation of RIT with the child participant. This was delivered by the primary investigator over Zoom to the behavior technician, who wore a Bluetooth earpiece.

Data Collection

Demographics

Demographic information was collected from behavior technicians and caregivers upon study enrollment. Caregivers were sent a survey using REDCap electronic data capture tools hosted at the University of Washington (Harris et al., 2009; 2019). REDCap (Research

Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies. The survey that caregivers received contained child demographic questions including age, gender, race, age at ASD diagnosis, length of time in ABA services, other services received, and prior imitation-focused intervention. Behavior technicians were sent a survey using REDCap that contained demographic questions including age, gender, race, education level, credentials, length of time providing services to their participating client, prior delivery of imitation-focused intervention to the client, and prior training in NDBI models. Specifically, behavior technicians were asked about prior training in the following NDBI approaches: Incidental Teaching, Pivotal Response Training, Early Start Denver Model, Enhanced Milieu Teaching, Reciprocal Imitation Teaching, Project ImPACT, Joint Attention, Symbolic Play, Engagement, & Regulation (JASPER), Social Communication/Emotional Regulation/Transactional Supports (SCERTS), Early Achievements, Learning Experiences & Alternative Program (LEAP), Early Social Interaction Project (ESI), and Social ABCs.

Dependent Measures

Behavior Technician Data

RIT Fidelity. Behavior technician fidelity of RIT implementation was measured using a fidelity form developed by the RIT developer and used in prior RIT research (Ingersoll & Lalonde, 2010; Ingersoll et al., 2013; Ingersoll et al., 2017; Penney & Schwartz, 2018; Wainer & Ingersoll, 2013; see Appendix A for the RIT Fidelity Checklist). The fidelity form uses a Likert rating scale from 1 (low fidelity) to 5 (high fidelity) to rate the implementer's use of contingent imitation (imitating the child's toy play, gestures, and vocalizations), linguistic mapping (use of simplified, repetitive language around the child's attentional focus), modeling actions (around the child's focus of interest), pacing (model an action every 1-2 minutes), prompts (physically prompt the child after three presentations of an action), and praise (both spontaneous and prompted imitation). For the purposes of this study, the scale was adjusted to range from 0 (low fidelity) to 4 (high fidelity) to reduce inflation of fidelity scores in the absence of RIT implementation.

RIT fidelity summary scores were calculated by reviewing video recordings of behavior technician-child interactions, rating each item, and summing scores across items. Total fidelity scores ranged from 0-24.

Contingent Imitation. To determine if behavior technicians were using contingent imitation as specified in the manual (for approximately 2/3 of an intervention session), behavior technicians' use of contingent imitation was measured using 10-second partial interval recording of video recorded behavior technician-child interactions. Contingent imitation was defined as the behavior technician imitating the child's actions with objects, gestures, body movements, and/or vocalizations for any duration of time simultaneously or within 2 seconds of the child's behavior (Walton & Ingersoll, 2012; see Appendix B for Behavior Technician Behavior Coding Manual). Data were summarized as the percentage of intervals in which the behavior occurred (see Appendix A for Behavior Technician Behavior Coding Sheet). Intervals in which the child spent 100% of the interval off camera were excluded from analysis.

Linguistic Mapping. To determine if behavior technicians were using linguistic mapping as specified in the manual (for approximately 2/3 of an intervention session), behavior technicians' use of linguistic mapping was measured using 10-second partial interval recording of video recorded behavior technician-child interactions. Linguistic mapping was defined as the behavior technician putting the child's actions or attentional focus into words (Yoder & Warren, 2002); the behavior technician describing or narrating the child's actions or the child's attentional focus using words or sound effects for any duration of time (see Appendix B for Behavior Technician Behavior Coding Manual). This did not include asking the child questions, giving the child directions, or explicit directing of the child's attention (Walton & Ingersoll, 2012). Data were summarized as the percentage of intervals in which the behavior occurred (see Appendix A for Behavior Technician Behavior Coding Sheet). Intervals in which the child spent 100% of the interval off camera were excluded from analysis.

RIT Dosage. To understand behavior technicians' use of RIT and approximate dosage child participants received, behavior technicians received a daily survey via email from REDCap after completing the introductory RIT training. The survey consisted of the following questions: "Did you provide ABA services today with the child whom you are supporting in this study?" If not, the survey ended. If yes, behavior technicians were asked, "Did you use RIT today with the child whom you are supporting in this study?" If not, the survey ended. If yes, behavior technicians were asked, "Approximately how long did you use RIT today with the child whom you are supporting in this study?" Response options were 1-5 minutes, 6-10 minutes, 11-15 minutes, 16-20 minutes, 21-25 minutes, 26-30 minutes, and 31+ minutes. Each behavior technicians' responses were summed and averaged across the number of weeks they participated in RIT implementation, to approximate weekly RIT dosage for child participants and to understand whether behavior technicians used RIT outside of the context of the study activities.

Child Data

Motor Imitation Scale. The Object Imitation portion of the *Motor Imitation Scale* (MIS; Stone et al., 1997) was conducted with each child participant prior to baseline and again upon completion of intervention to assess child object imitation skills. The MIS is a structured imitation assessment that includes eight actions with objects and eight motor tasks. Actions are modeled up to three times with the instruction, “Now you do it” or “Your turn!” Participants receive a score of 0 for no imitation, 1 for partial imitation, and 2 for complete imitation. Item scores are totaled, resulting in a total MIS score and subscale scores for Object Imitation and Body Imitation. Only the Object Imitation portion was implemented which took approximately 10 minutes to administer.

This assessment was completed by the child’s ABA program supervisor (i.e., BCBA), who received an MIS assessment kit via mail. The MIS kit included the MIS manual with administration guidelines and data collection sheets (Stone, 2015), and a set of toys/objects needed to complete the specific object imitation tasks. BCBAs were offered support from the primary investigator with administration; however, no BCBAs accepted administration support. Given that the MIS tasks approximate tasks of other skill-based assessments required for ABA services, it was expected that BCBAs would be comfortable administering the MIS upon reviewing the assessment administration guidelines.

Imitation. Child participants were anticipated to receive a minimum of 3-7 hours of RIT intervention across the span of the study. Prior RIT research has shown gains in child imitation after 20-30 hours of intervention (Ingersoll, 2010; Ingersoll, 2012; Ingersoll & Lalonde, 2010; Ingersoll et al., 2007; Ingersoll & Schreibman, 2006). As such, gains in imitation were anticipated to be mild based on the lower dosage. To optimize the possibility of capturing small increases in child imitative behavior, child imitation was measured as both “full imitation” and “partial imitation,” based on descriptions of each from the MIS assessment.

Full Imitation. Child full imitation was measured using 10-second partial interval recording of video recorded behavior technician-child interactions. Full imitation was defined as the child completing an entire behavior modeled by the behavior technician within 10 seconds of the modeled action, using the same object and/or body part (see Appendix B for Child Behavior Coding Manual). This did not include imitation of actions that occurred after the behavior technician had presented a different action. Data were summarized as the percentage of intervals in which the behavior occurred (see Appendix A). Intervals in which the child and/or the behavior technician spent 100% of the interval off camera were excluded from analysis.

Partial Imitation. Child partial imitation was measured using 10-second partial interval recording of video recorded behavior technician-child interactions. Partial imitation was defined as the child using the same object and/or body part to perform part but not all of a modeled behavior, or the child using another object and/or body part to perform all or part of a modeled action, within 10 seconds of the modeled action (see Appendix B for Child Behavior Coding Manual). This did not include imitation of actions that occurred after the behavior technician had presented a different action. Data were summarized as the percentage of intervals in which the behavior occurred (see Appendix A). Intervals in which the child and/or the behavior technician spent 100% of the interval off camera were excluded from analysis.

Experimental Design

A multiple baseline design (Baer et al., 1968) across participant dyads was used to examine the effects of training and bug-in-ear coaching on behavior technicians' fidelity of RIT implementation across two routines. The multiple baseline design was implemented in accordance with the guidelines for *Meets Standards with Reservations* described in the What Works Clearinghouse Standards Handbook Version 4.1 (What Works Clearinghouse, 2020). This was due to the number of baseline sessions, as each dyad completed a minimum of three baseline sessions to prevent participants from remaining in extended baseline periods. Implementation of intervention was initiated with the dyad with the most stable RIT fidelity data at that time. Introduction of the intervention staggered across time, resulting in the length and timing of phase changes differing across dyads.

This study included two phases for each dyad: (a) baseline and (b) RIT implementation with bug-in-ear coaching. Each phase included two conditions: (a) a training condition (i.e., play time) and (b) a generalization condition (i.e., snack time). The training condition acted as the primary intervention condition, whereas the generalization condition was to assess for generalization of RIT strategies from the training condition of play time to snack time.

Procedures

Videos of training and generalization sessions were recorded using Zoom on an iPod Touch. Each behavior technician received a unique Zoom room code that was set to automatically record upon entering the room. These recordings were automatically saved to the HIPAA compliant Zoom cloud. Recordings were downloaded by the primary investigator, named using a unique number, and stored on a password-protected Internet sharing site.

Baseline

Baseline sessions consisted of a 10-minute play and a 10-minute snack time with the behavior technician and child. These sessions occurred twice per week. Sessions were video recorded on Zoom for later behavior coding. All baseline videos were coded for behavior technician RIT fidelity, behavior technician use of contingent imitation and linguistic mapping, and child imitation. Behavior technician RIT fidelity during play drove decisions around phase changes.

Play Sessions. Participants were provided with a set of seven duplicate objects and were told to play together as they typically would, with or without the objects provided and/or with other materials available to the child in the home or clinic environment, for 10-minutes. No further instructions were provided.

Snack Sessions. Participants were told to engage in a snack time routine as they typically would in their setting for 10-minutes. Snack sessions were not required to immediately precede or follow the play session but rather, occurred at a naturally occurring snack time opportunity within the child's ABA session (i.e., at a time in which the child was ready for a snack). No further instructions were provided.

Intervention

Introductory RIT Training. Behavior technicians attended a one-time, 90-minute virtual training in RIT at a time that was convenient for them, without the child present. At the end of the training, bug-in-ear coaching sessions were scheduled for the intervention portion of the study.

RIT Intervention and Coaching. Like baseline, intervention sessions consisted of a 10-minute play and a 10-minute snack time with the behavior technician and child. At this point in the study, the play sessions became the time during which behavior technicians were instructed to implement RIT with their client. Snack sessions served as the generalization condition to observe whether the training and ongoing coaching behavior technicians received resulted in generalized use of RIT and/or RIT strategies to a new routine with the client. Thus, play sessions will now be referred to as "training sessions" and snack sessions as "generalization sessions."

Training and generalization sessions continued to occur twice per week and were video recorded on Zoom for later behavior coding. All videos were coded for behavior technician RIT fidelity, behavior technician use of contingent imitation and linguistic mapping, and child imitation.

Training Sessions. Training sessions were 20 minutes in length and behavior technicians were instructed to implement RIT during this time. The first 10-minutes of training sessions were video recorded for later data analysis. The primary investigator was on Zoom but off camera during this time period and did not provide any comments or feedback. Ten-minutes was selected as the time for data collection via video recordings, because prior RIT research has found similar rates of behavior during the first and second 10-minute intervals of 20-minute RIT sessions (Ingersoll et al., 2013).

Following solo behavior technician RIT implementation, the primary investigator provided 10-minutes of bug-in-ear coaching to support fidelity of RIT implementation. Bug-in-ear coaching consisted of the following steps: (1) state the focus of the session, (2) check for questions, (3), ask behavior technician to practice RIT and/or a specific RIT strategy with the child, (4) provide positive feedback to the behavior technician, and (5) provide constructive feedback to the behavior technician (see Appendix C for Coaching Fidelity Checklist). The focus of coaching sessions moved in the sequence of the use of RIT strategies within an RIT cycle, with coaching initially focused on the behavior technician's use of contingent imitation, followed by linguistic mapping, and then the implementation of embedded discrete trials. Once a behavior technician met fidelity with an RIT strategy (a score of 3 or 4), the next strategy was emphasized during coaching unless the behavior technician had already met fidelity with that component.

Generalization Sessions. Generalization sessions occurred the same way as the snack sessions in baseline, and video recordings were collected for later data analysis. Snack was selected as the generalization setting as it is a routine activity that was realistic to consistently implement across participant dyads, whether their ABA sessions occurred in the home or clinic setting. Snack is a routine that was likely to already occur during a child's ABA sessions or was realistic to ask participants to temporarily include within their sessions.

Data Coders and Data Coder Training

The primary investigator served as the primary data coder, and graduate research assistants served as reliability coders for this study. Graduate research assistants were students in a master's program in ABA and had prior experience implementing behavioral programs with young children with ASD. Coders read and discussed coding manuals and practiced coding video clips of toddler and adult play-based interactions collected by the primary investigator. For partial interval recording coders were required to reach a minimum of 80% agreement on two video clips before coding data for this study (Carter et al., 2008). For RIT fidelity scoring coders were required to reach 100% agreement within 1 point of each item on two video clips before coding data for this study (Pellecchia et al., 2022).

Procedural Fidelity

To ensure consistency across introductory RIT trainings, 100% (*n*=4) of training recordings were reviewed by a graduate research assistant to measure procedural fidelity. The research assistant filled out a checklist containing components of the introductory training. These components included: (a) describe imitation, (b) provide a broad overview of the RIT cycle, (c) describe imitating the child's actions, (d) describe describing the child's actions, (e) describe the "model, prompt, and praise" sequence/discrete trial, (f) share video clip examples of RIT, (g) check for and answer behavior technician questions, (h) role play imitating and describing the child's actions, (i) role play linguistic mapping, (j) role play the "model, prompt, and praise" discrete trial sequence, and (k) provide feedback to the behavior technician (see Appendix C for Training Fidelity Checklist). This was to ensure that all behavior technicians received exposure to the same content, video models, and opportunities for practice across trainings. Procedural fidelity was 100% across all trainings.

To assess procedural fidelity of bug-in-ear coaching, a self-report checklist was completed during 100% of coaching sessions to promote consistent coaching structure across participants and sessions. The components of this checklist were: (a) state the focus for the session, (b) check for behavior technician questions, (c) ask behavior technician to practice RIT and/or a specific strategy with the child, (d) provide positive feedback to the behavior technician, and (e) provide constructive feedback to the behavior technician (see Appendix B for Coaching Fidelity Checklist). Average procedural fidelity was 98.86% across participants (range: 80-100%). Two coaching sessions for Sammy were missing one component each from the Coaching Fidelity Checklist - asking the behavior technician to practice RIT or a specific strategy, and stating the focus for the coaching session.

Interobserver Agreement

Interobserver agreement (IOA) data were obtained for 20% of randomly selected video submissions across participants, phases, and conditions. Graduate research assistants served as reliability coders, and were masked to study condition of videos. For behavior technician contingent imitation and linguistic mapping and child imitation, interval-by-interval percent agreement was calculated. For behavior technician RIT fidelity, IOA was calculated as the total number of RIT component rating agreements divided by the total number of RIT component rating agreements plus disagreements, multiplied by 100. Discrepancies were discussed and resolved through consensus.

Average IOA for behavior technician use of contingent imitation and linguistic mapping was 87.13% (range: 80-100%) across participants, phases, and conditions. Average IOA for behavior technician fidelity of RIT implementation was 90.83% (range: 83.33-100%) across participants, phases, and conditions. Average IOA for child imitation was 98.67% (range: 85-100%) across participants, phases, and conditions.

Social Validity

Social validity data were collected from behavior technicians one time at the end of the study using the Usage Rating Profile-Intervention Revised (URP-IR; Chafouleas et al., 2011), to assess behavior technician perceptions of the acceptability, feasibility, and sustainability of the use of RIT in their work. The URP-IR was distributed via email using REDCap. The URP-IR measures intervention acceptability and feasibility using a Likert scale rating system, from 1 (strongly disagree) to 6 (strongly agree). The measure provides a total social validity score and six subscale scores under the categories Acceptability, Understanding, Home School Collaboration, Feasibility, System Climate, and System Support.

All subscales except for the Home School Collaboration subscale were measured, given that there was no home school collaboration component as part of intervention procedures. Two open-ended questions were added to the end of the social validity questionnaire: (1) Will you continue to use RIT with your client who is enrolled in the study and/or with other clients? If so, why? If not, why not?, and (2) Is there anything else you would like to share regarding your experience with RIT?

Data Analysis

RIT fidelity served as the primary dependent variable to drive the intervention. Contingent imitation, linguistic mapping, and child imitation were considered secondary dependent variables and were not used to make decisions regarding phase changes.

Visual analysis was used to analyze the trend, level, and variability of the session-by-session data across settings, phases, and participants (Ledford & Gast, 2014). Visual analysis was analyzed on an ongoing, weekly basis to inform coaching provided to behavior technicians and to determine a functional relationship between the independent and dependent variables. Baseline data were collected for a minimum of three sessions per dyad, and until data demonstrated a stable trend as indicated by minimal variability around the phase level. When a dyad entered intervention, the primary investigator reviewed the data to determine immediacy of effect and overlap between baseline and intervention data (Lobo et al., 2018). Data across tiers were reviewed at this time to assess for stability, indicating a functional relationship between the independent and primary dependent variables (Ledford, 2018).

Changes on the MIS Object Imitation subscale from pre- to post-intervention were evaluated using one-tailed paired *t*-tests. One-tailed tests were selected due to the small number of participants and the predicted direction of effect (Ingersoll & Schreibman, 2006).

Descriptive statistics (mean, standard deviation) were calculated to measure approximate RIT dosage for child participants and the URP-IR subscale scores for behavior technician participants. Responses to open-ended questions were reviewed to further interpret URP-IR subscale scores.

Chapter 4: Results

RIT Fidelity

RIT fidelity data were collected to evaluate the effect that RIT training and bug-in-ear coaching had on the fidelity with which behavior technicians implemented RIT strategies within the training condition, and the generalization condition in which bug-in-ear coaching did not occur. Fidelity was coded from video recordings collected during these sessions.

All behavior technicians showed increases in RIT fidelity within the training condition (see Figure 1). Sammy and Susie exhibited greater variability in fidelity scores and demonstrated increases in fidelity across time, primarily due to low and inconsistent implementation of discrete trials. Sofie and Ava met and maintained high levels of RIT fidelity.

Behavior technicians exhibited inconsistent increases in RIT fidelity within the generalization condition. Sammy began to embed RIT once asked to do so due to stable, low rates of fidelity for one month. Susie demonstrated a slow and steady increase in RIT fidelity, primarily due to her increased use of linguistic mapping. Sofie inconsistently exhibited higher implementation fidelity scores due to inconsistent increases in linguistic mapping and contingent imitation. Ava's RIT fidelity scores did not increase during the course of the study within the generalization condition.

Sammy

During baseline, Sammy exhibited stable rates of low RIT fidelity across both the training and generalization conditions (see Figure 1). In the training condition, fidelity scores ranged from 1-3 (M = 1.67, SD = 1.15) due to moderate to high use of linguistic mapping. In the generalization condition, fidelity remained stable at a level of 2 as a result of low to moderate use of linguistic mapping and low use of contingent imitation in the form of imitating Alex's vocalizations.

During intervention Sammy's RIT fidelity immediately increased within the training condition. Sammy's RIT fidelity continued in an upward and variable trend, with increases followed by dips in fidelity which ranged from 6-21 (M = 14.79, SD = 5.39). Use of linguistic mapping remained the highest scored RIT item across the training condition, with use of and scores for contingent imitation and discrete trials fluctuating and consistently requiring coaching support. Sammy attained fidelity of RIT implementation (scores of 3 and 4 on each RIT component) during sessions 12 and 13. Following an instruction to implement RIT in the generalization condition starting with session 14, Sammy's RIT fidelity in the training condition immediately dropped, followed by an increase over the remaining sessions. RIT fidelity (scores of 3 and 4 on each RIT component) was not attained again during the training condition for the remainder of the study. Drops in fidelity were due to a decreased rate of discrete trials and inconsistent follow through when discrete trials were presented.

During intervention Sammy's RIT fidelity remained low and stable within the generalization condition at a level of 1 (range: 1-2; *M* = 1.13, *SD* = 0.35) for the first month (through session 13) due to low to moderate use of linguistic mapping. Following this initial month of intervention without a change in level or trend of RIT fidelity in the generalization condition, Sammy was asked to implement RIT in the generalization setting. No further instructional or coaching support was provided in the generalization condition. Following this request, Sammy's RIT fidelity immediately increased in generalization sessions, remaining fairly stable at a level of 5 due to an increase in his use of linguistic mapping and low to moderate use of contingent imitation of Alex's vocalizations and movements. During the final generalization session, Sammy reached fidelity of RIT implementation (scores of 3 and 4 on each RIT component) due to adding in discrete trials targeting Alex's use of gestures (range: 2-21; *M* = 7.17, *SD* = 6.88).

No play or snack occurred on sessions 10 and 11 due to family cancellation due to child illness.

Susie

During baseline, Susie exhibited mildly variable, low rates of RIT fidelity in the training condition and low, stable rates of implementation in the generalization condition (see Figure 1). In the training condition, fidelity scores ranged from 2-6 (*M* = 3.60, *SD* = 2.07) with low to high use of linguistic mapping and low to moderate use of contingent imitation of Olivia's body movements. During training sessions 2 and 3 Susie modeled play actions for Olivia but did not follow through on Olivia's imitation of these actions. In the generalization condition, fidelity remained stable at a level of 1 (range: 1-2; *M* = 1.20, *SD* = 0.45) with low use of linguistic mapping.

During intervention Susie's RIT fidelity immediately increased within the training condition. Susie's RIT fidelity continued in an upward trend, with increases followed by brief dips in fidelity which ranged from 8-21 (*M* = 17.10, *SD* = 4.51). Susie consistently received high fidelity scores for her use of contingent imitation and linguistic mapping in the training condition, but required coaching support for implementing and the pacing of discrete trials. Susie's implementation of discrete trials attained fidelity scores of 4 by session 10; however, Susie consistently struggled with the pacing of discrete trials, often limiting discrete trials to one to two every 10 minutes, rather than once every 1-2 minutes. Susie never met fidelity of RIT implementation (scores of 3 and 4 on each RIT component).

During intervention Susie demonstrated a slow upward trend of RIT fidelity within the generalization condition (range: 1-5; *M* = 2.75, *SD* = 1.49) due to increased use of linguistic mapping over time and a slight increase in the use of contingent imitation, primarily of Olivia's vocalizations.

No data were collected on sessions 8, 15, 16, and 17 due to family cancellation (birth of a new child) and to behavior technician cancellation (child illness). Additionally, a generalization session did not occur on session 19 due to lack of opportunity (client disinterest).

Sofie

During baseline Sofie exhibited moderately variable, low rates of RIT fidelity in the training condition (range: 4-9; *M* = 5.40, *SD* = 2.19; see Figure 1), exhibiting moderate use of linguistic mapping, low use of contingent imitation of Liam’s vocalizations, and occasional modeling new play actions with objects. In the generalization condition, fidelity remained relatively stable at a low level of 1 (range: 1-3; *M* = 1.40, *SD* = 0.89) with low to moderate use of linguistic mapping.

During intervention Sofie’s RIT fidelity immediately increased within the training condition (range: 23-24; *M* = 23.67, *SD* = 0.50). Sofie immediately reached fidelity of RIT implementation (obtaining scores of 3 and 4 on each RIT component) during the first training session and maintained this level of fidelity for the remainder of the study.

During intervention Sofie demonstrated an increase in variability of RIT fidelity within the generalization condition (range: 1-6; *M* = 3.13, *SD* = 1.55) due to minor increased use of linguistic mapping and minor, variable increases in the use of contingent imitation, primarily of Liam’s vocalizations.

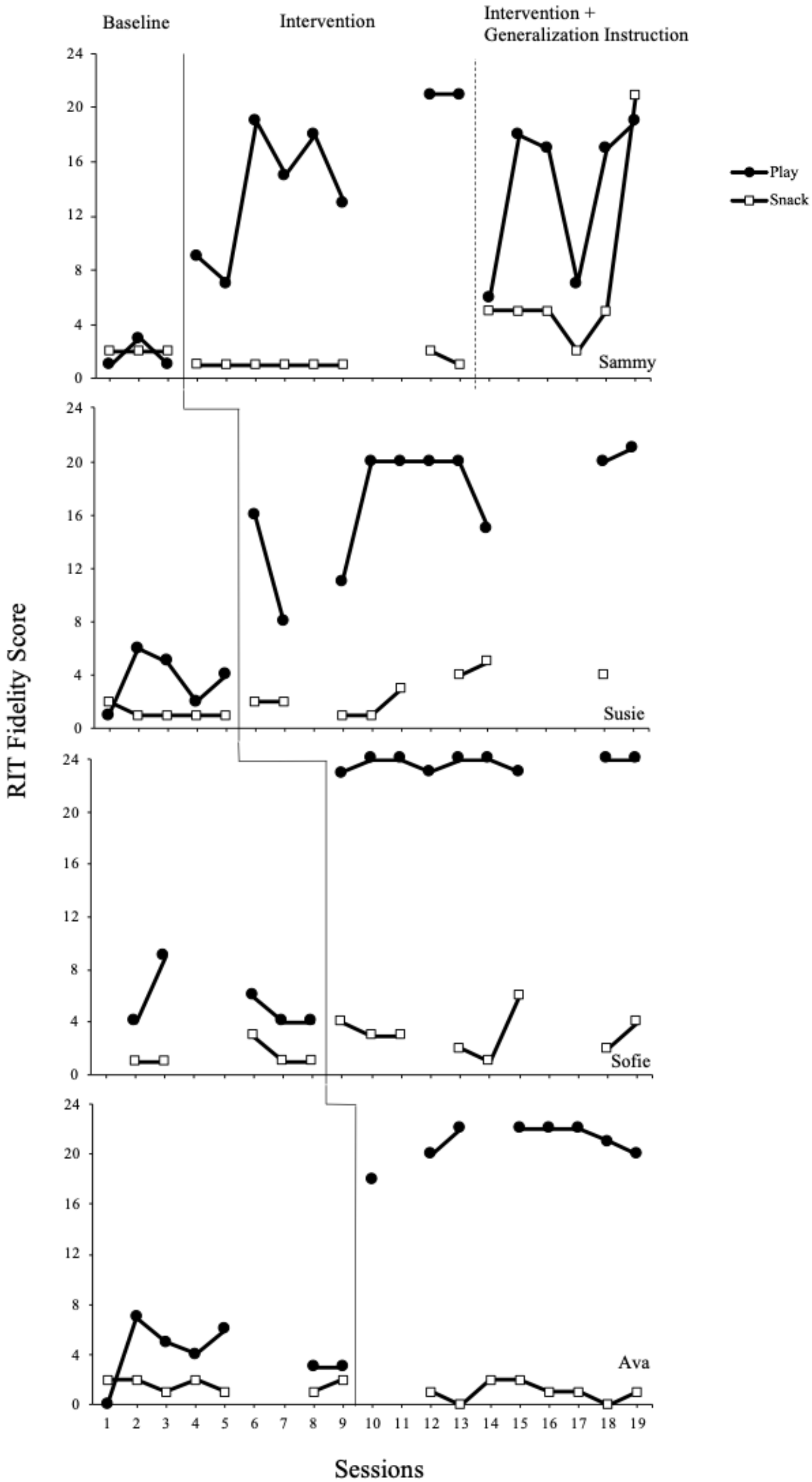
No data were collected on sessions 1, 4, and 5 due to family cancellation, or on sessions 16 and 17 due to ABA program closure.

Ava

During baseline Ava exhibited moderately variable, low rates of RIT fidelity within the training condition (range: 2-7; *M* = 4.00, *SD* = 2.31; see Figure 1). Ava demonstrated low to

Figure 1

RIT Fidelity



moderate use of linguistic mapping, contingent imitation of Jackson's vocalizations, and modeling of new play actions. Ava exhibited low, stable rates of RIT fidelity within the generalization condition (range: 1-2; *M* = 1.57, *SD* = 0.53) with low to moderate use of linguistic mapping and low use of contingent imitation of Jackson's vocalizations.

During intervention Ava's RIT fidelity immediately increased within the training condition (range: 18-22; *M* = 20.88, *SD* = 1.46). Ava reached fidelity of RIT implementation (obtaining scores of 3 and 4 on each RIT component) during session 13, and maintained fidelity until the final session when her fidelity score dipped to 20 due to a decrease in the use of linguistic mapping. During intervention Ava's RIT fidelity remained consistent with baseline levels within the generalization condition (range: 1-2; *M* = 1.00, *SD* = 0.76).

No data were collected on sessions 6, 7, and 12 due to family cancellation and on session 14 due to behavior technician vacation.

Overall Behavior Technician RIT Fidelity

Taken together, participant data demonstrate a functional relationship between the virtual training and bug-in-ear coaching on behavior technician's RIT fidelity during play. A functional relationship was not established between the virtual training and bug-in-ear coaching on the generalization of RIT from the training environment to an untrained routine.

Contingent Imitation

Contingent imitation data were collected to evaluate the effect that RIT training and bug-in-ear coaching had on behavior technician implementation of this developmental intervention strategy within the training condition and the generalization condition in which bug-in-ear coaching did not occur. Use of contingent imitation was coded using 10-second partial interval recording from video recordings collected during these sessions.

All behavior technicians showed increases in their use of contingent imitation within the training condition, while maintaining low usage within the generalization condition (see Figure 2). Sammy began to implement contingent imitation within the generalization condition once asked to do so due to stable, low rates of use for 1 month. Susie demonstrated an increase in use of contingent imitation within the generalization condition towards the end of the study. Sofie and Ava's use of contingent imitation within the generalization condition did not increase during the course of the study.

Sammy

During baseline Sammy exhibited stable rates of low use of contingent imitation within both the training (range: 0-1.75%; *M* = 0.58%, *SD* = 1.01%) and generalization conditions (range: 0-3.45%; *M* = 2.26%, *SD* = 1.96%; see Figure 2).

During intervention Sammy immediately increased his use of contingent imitation within the training condition, with variable use and an overall increasing trend (range: 25-60.71%; *M* = 42.17%, *SD* = 15.60%). Following the first two sessions, RIT coaching shifted from focusing on contingent imitation to focusing on Sammy's use of discrete trials. This coaching focus corresponds to a dip in Sammy's use of contingent imitation, followed by an increase. Sammy's use of contingent imitation within the training condition continued to increase after receiving instruction to also implement RIT within the generalization condition (range: 40-69.44%; *M* = 55.53%, *SD* = 12.75%).

During intervention Sammy's use of contingent imitation became slightly more variable within the generalization condition, but remained low (range: 0-9.09%; *M* = 2.47%, *SD* = 3.30%). Following 8 sessions (i.e., 1 month) without a change in level or trend for RIT fidelity, Sammy was asked to implement RIT during the generalization condition. No further instructional or coaching support was provided. Following this request Sammy's use of contingent imitation immediately increased during the generalization condition (range: 4.76-36.67%; *M* = 22.07%, *SD* = 10.46%).

Susie

During baseline Susie exhibited variable rates of low use of contingent imitation within the training condition (range: 1.67-29.17%; *M* = 9.76%, *SD* = 11.39%) and low, stable rates of contingent imitation within the generalization condition (range: 0-3.51%; *M* = 0.70%, *SD* = 1.57%; see Figure 2).

During intervention Susie immediately increased her use of contingent imitation within the training condition and maintained increased use throughout intervention, with variability (range: 60-93.33%; *M* = 77.74%, *SD* = 11.08%). Susie's use of contingent imitation remained low and stable within the generalization condition until the last two data points where usage jumped to 15% and 18.75% (range: 0-3.03%; *M* = 5.10%, *SD* = 7.42%).

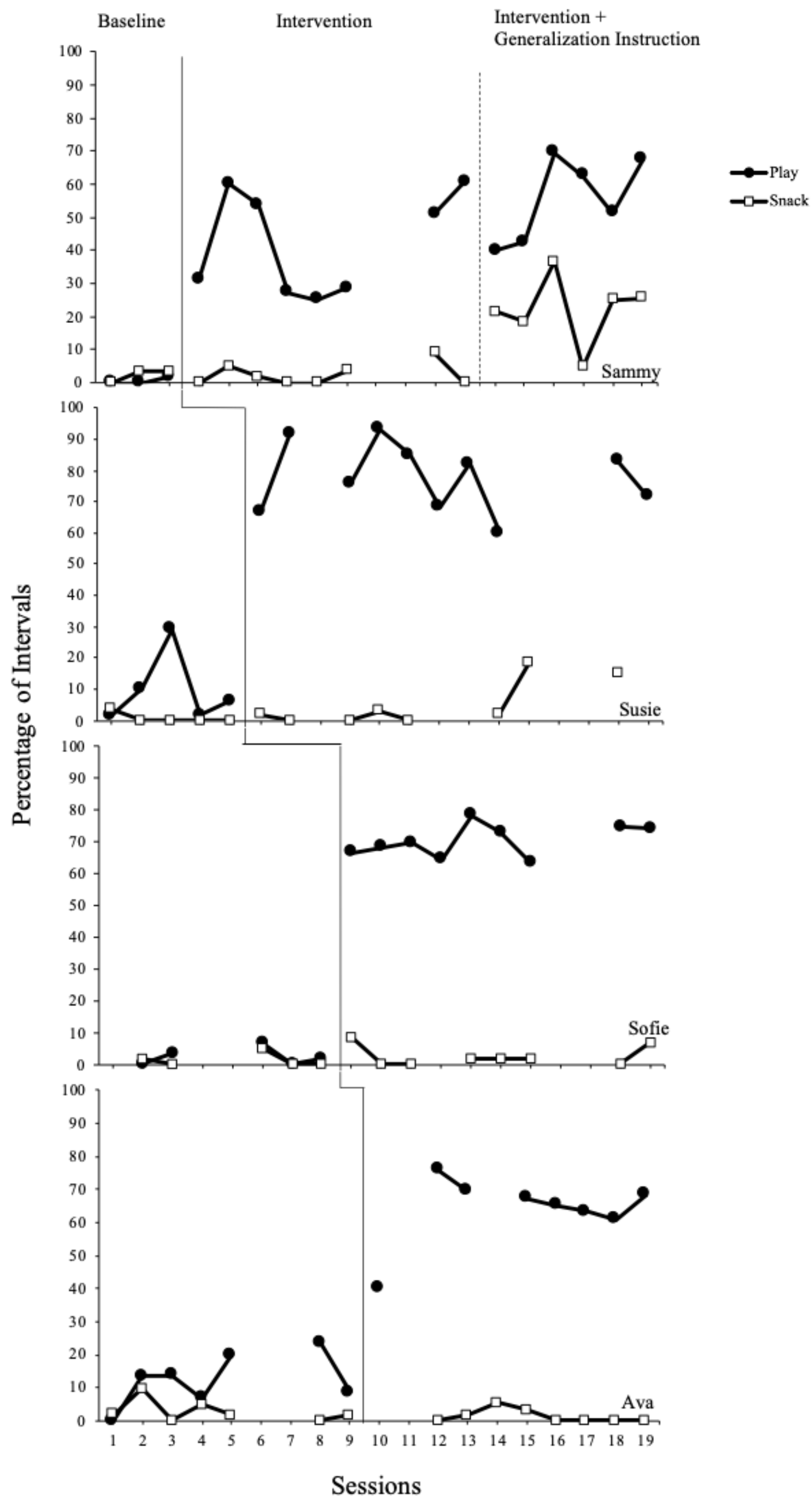
Sofie

During baseline Sofie exhibited low, stable rates of use of contingent imitation within both the training (range: 0-6.67%; *M* = 2.33%, *SD* = 2.79%) and generalization conditions (range: 0-1.69%; *M* = 1.34%, *SD* = 2.17%; see Figure 2). During intervention Sofie immediately increased her use of contingent imitation within the training condition and maintained increased use at a consistent level (range: 63.46-78.33%; *M* = 70.27%, *SD* = 5.04%). Sofie's use of contingent imitation increased slightly at the start and again at the end of intervention, yet primarily remained low and stable at baseline levels across the generalization condition (range: 0-8.33%; *M* = 2.50%, *SD* = 3.21%).

Ava

Figure 2

Contingent Imitation



During baseline Ava exhibited low to moderate use of contingent imitation with a slightly increasing trend within the training condition (range: 0-23.53%; *M* = 12.29%, *SD* = 8.00%), and low, stable rates of contingent imitation within the generalization condition (range: 0-9.76%; *M* = 2.85%, *SD* = 3.48%; see Figure 2).

During intervention Ava immediately increased her use of contingent imitation within the training condition, with an initially steep increasing trend followed by a slightly decreasing trend (range: 40-75.86%; *M* = 63.82%, *SD* = 10.60%). Ava's use of contingent imitation was low and stable within the generalization condition, with a slight decrease in use overall compared with baseline (range: 0-5.36%; *M* = 1.30%, *SD* = 2.04%).

Overall Behavior Technician Contingent Imitation

Taken together, participant data demonstrate a functional relationship between the virtual training and bug-in-ear coaching on behavior technician's use of contingent imitation during play. A functional relationship was not established between the virtual training and bug-in-ear coaching on the generalization of contingent imitation from the training environment to an untrained routine.

Linguistic Mapping

Linguistic mapping data were collected to evaluate the effect that RIT training and bug-in-ear coaching had on behavior technician implementation of this developmental intervention strategy within the training condition and the generalization condition in which bug-in-ear coaching did not occur. Use of linguistic mapping was coded using 10-second partial interval recording from video recordings collected during these sessions.

All behavior technicians showed increases in their use of linguistic mapping within the training condition. Sammy, Susie, and Sofie exhibited a sustained increase in use, while Ava exhibited an increase followed by a consistently decreasing trend.

Within the generalization condition, Sammy increased use of linguistic mapping once asked to do so due to stable, low rates of use for 1 month. Susie demonstrated an increasing use of linguistic mapping across intervention within the generalization condition. Sofie demonstrated increased variability and slightly higher usage overall during intervention. Ava exhibited lower usage of linguistic mapping during intervention in this condition compared to baseline.

Sammy

During baseline Sammy exhibited moderate to high, variable rates of linguistic mapping within the training condition (range: 29.41-64.15%; *M* = 42.30%, *SD* = 19.03%), and moderate rates of linguistic mapping with a decreasing trend within the generalization condition (range: 20-40%; *M* = 28.05%, *SD* = 10.56%; see Figure 3).

During intervention Sammy immediately increased his use of linguistic mapping within the training condition followed by a slightly decreasing trend (range: 63.64-86.67%; *M* = 73.81%, *SD* = 8.36%). Within the generalization condition, Sammy's use of linguistic mapping remained fairly low and stable (range: 9.80-26.32%; *M* = 18.26%, *SD* = 6.67%). Following 8 sessions Sammy was asked to implement RIT within the generalization setting. No further instructional or coaching support was provided. Following this request, Sammy's use of linguistic mapping immediately increased within the generalization condition (range: 42.86-82.61%; *M* = 70.09%, *SD* = 14.73%) and within the training condition (range: 80-93.02%; *M* = 84.16%, *SD* = 4.80%).

Susie

During baseline Susie exhibited low to high, variable rates of linguistic mapping with an increasing trend within the training condition (range: 8.33-60.42%; *M* = 44.62%, *SD* = 21.28%), and low to moderate, variable rates of linguistic mapping with an increasing trend within the generalization condition (range: 3.51-26.67%; *M* = 13.82%, *SD* = 8.61%).

During intervention Susie exhibited an initially steep, increasing trend line within the training condition, followed by relatively stable rates of use (range: 46.67-90%; *M* = 77.86%, *SD* = 12.17%). During intervention Susie's use of linguistic mapping immediately increased within the generalization condition, with an overall increasing trend and greater variability compared to baseline (range: 33.33-80.85%; *M* = 54.09%, *SD* = 17.86%).

Sofie

During baseline Sofie exhibited moderate, stable rates of linguistic mapping within the training condition (range: 45-56.67%; *M* = 51.50%, *SD* = 4.66%) and moderate, variable rates of linguistic mapping within the generalization condition, with an increasing followed by a decreasing trend (range: 24.07-48.33%; *M* = 32.23%, *SD* = 9.94%).

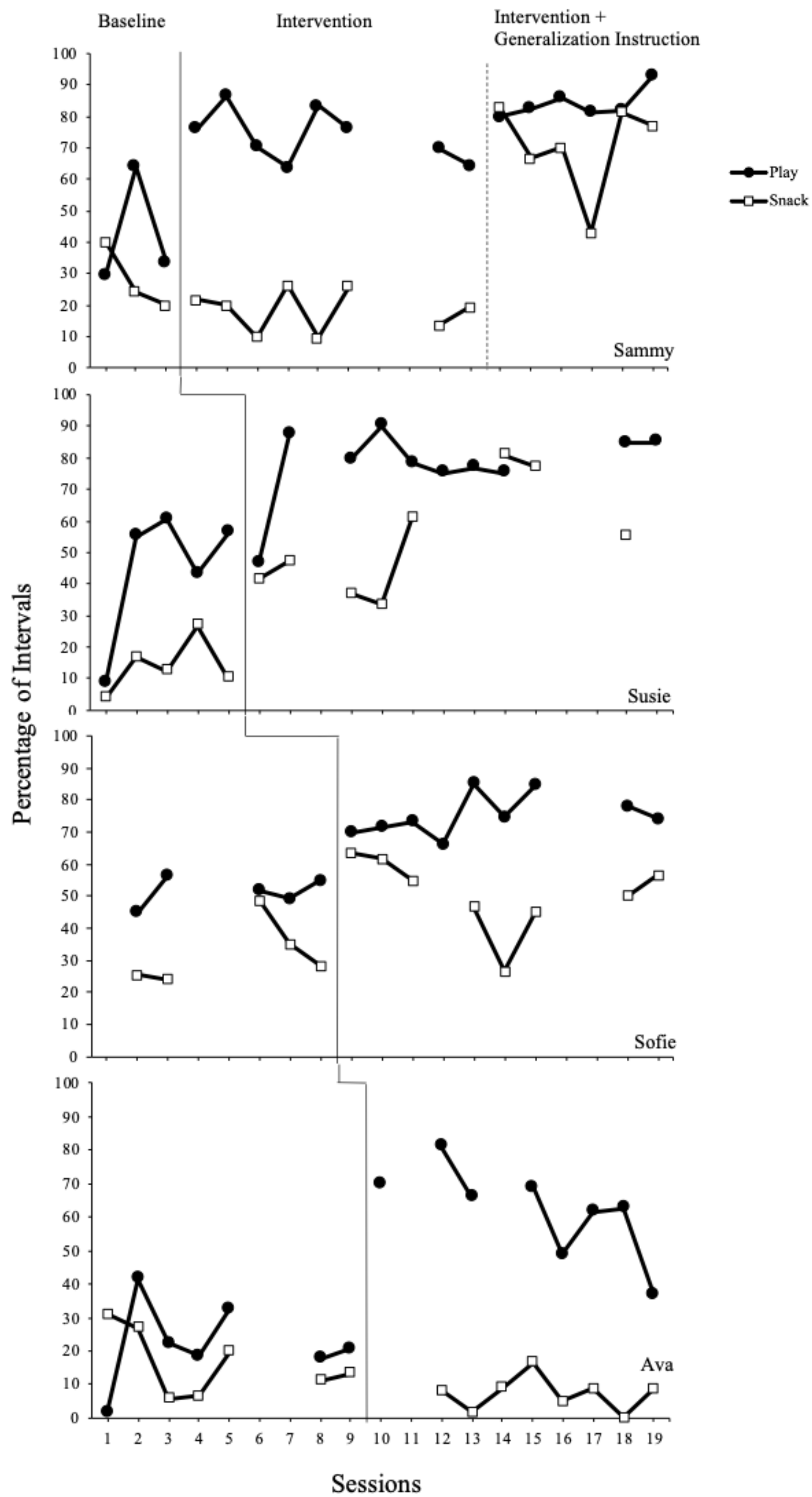
During intervention Sofie immediately increased her use of linguistic mapping within the training condition with a slightly increasing trend over time (range: 66.10-85%; *M* = 75.25%, *SD* = 6.33%). Sofie's use of linguistic mapping remained moderate and variable within the generalization condition, but at a higher level compared to baseline. Generalization condition data followed a decreasing followed by an increasing trend (range: 26.67-63.33%; *M* = 50.63%, *SD* = 11.71%).

Ava

During baseline Ava exhibited low to moderate, variable rates of linguistic mapping within the training condition, with an increasing followed by a decreasing trend (range: 1.67-

Figure 3

Linguistic Mapping



41.67%; *M* = 22.21%, *SD* = 12.56%). Ava exhibited low to moderate, variable rates of linguistic mapping within the generalization condition with an overall decreasing trend (range: 5.66-30.91%; *M* = 16.36%, *SD* = 9.83%).

During intervention Ava immediately increased her use of linguistic mapping within the training condition followed by a steadily decreasing trend, but with a higher level overall compared to baseline (range: 36.59-81.03%; *M* = 62.01%, *SD* = 13.67%). Ava's use of linguistic mapping remained low and relatively stable within the generalization condition, with an overall decrease in level from baseline (range: 0-16.67%; *M* = 7.28%, *SD* = 5.16%).

Overall Behavior Technician Linguistic Mapping

Taken together, participant data did not establish a functional relationship between the virtual training and bug-in-ear coaching on behavior technician's use of linguistic mapping during play or on the generalization of linguistic mapping to an untrained routine. However, all participants did show an increase in level from baseline to intervention in their use of linguistic mapping in the training condition. Two out of four participants showed an increase in level from baseline to intervention in the generalization condition and one participant (Sammy) showed an increase in level when instructed to implement RIT in the generalization condition.

RIT Dosage

RIT dosage data were collected to understand child exposure to the intervention, and whether the intervention was implemented beyond what was asked for the purposes of the study. Behavior technicians self-reported this information via a daily survey.

Behavior technicians implemented RIT for approximately 40 minutes per week within the intervention phase of the study (20 minutes of independent implementation, and 20 minutes

Table 5

RIT Dosage

	Sammy & Alex	Susie & Olivia	Sofie & Liam	Ava & Jackson
Approximate minutes per week	47-62	30-38	29-36	36-46
Total approximate minutes	327-435	178-230	144-180	182-230

supported via bug-in-ear coaching). Only Sammy and Ava reported RIT usage that suggests occasional implementation beyond what was asked for the study (see Table 5).

Sammy and Alex

Sammy reported implementing RIT for approximately 327-435 minutes total with Alex during the intervention phase of the study (see Table 5). This averaged to approximately 47-62 minutes of RIT per week of intervention for Alex.

Susie and Olivia

Susie reported implementing RIT for approximately 178-230 minutes total with Olivia during the intervention phase of the study. This averaged to approximately 30-38 minutes of RIT per week of intervention for Olivia.

Sofie and Liam

Sofie reported implementing RIT for approximately 144-180 minutes total with Liam during the intervention phase of the study. This averaged to approximately 29-36 minutes of RIT per week of intervention for Liam.

Ava and Jackson

Ava reported implementing RIT for approximately 182-230 minutes total with Jackson during the intervention phase of the study. This averaged to approximately 36-46 minutes of RIT per week of intervention for Jackson.

MIS Assessment

Three out of four child participants demonstrated an increase in their MIS scores from pre- to post-intervention (see Table 4). Alex's, Olivia's, and Jackson's pre-intervention scores were 4 and Liam's was 9. Alex's post-intervention score was 6, Olivia's and Jackson's were 9, and Liam's was 2. At the group level, these changes in scores were not significant ($t(3) = -0.44$, $p = .34$).

Table 4

MIS Object Imitation Scores

Participant	Pre	Post
Alex	4	6
Olivia	4	9
Liam	9	2
Jackson	4	9

Note. Highest possible score = 16.

Interestingly, Liam's score on this measure did not follow the trend of other participants. Liam's pre-intervention MIS Object Imitation score was the highest of all four participants, but his post-intervention score was the lowest. Liam's BCBA described that during the Time 1 assessment, Liam accepted objects presented to him even if he did not attempt to imitate the modeled action, whereas during the Time 2 assessment Liam did not accept the objects presented to him. His BCBA shared that by the Time 2 assessment, his level of attending had decreased when presented with novel or non-preferred items. Unfortunately, Liam's BCBA left for another organization shortly following the Time 2 assessment so was not available for additional insight and discussion around the environmental context of the Time 2 administration. When Liam's data were removed from the analysis, changes in performance on the MIS Object Imitation subscale were significant across remaining participants ($t(2) = -4.00$, $p < .05$).

Child Imitation Data

Alex

Partial Imitation. During baseline Alex exhibited zero rates of partial imitation across both training and generalization conditions (see Figure 4). During intervention Alex's rate of partial imitation continued to be at zero levels across both conditions, except for two training condition sessions in which Alex's rate of partial imitation increased slightly (range: 0-3.92%; $M = 0.47\%$, $SD = 1.23\%$).

Full Imitation. During baseline Alex exhibited zero rates of full imitation across both conditions (see Figure 5). During intervention Alex's rate of full imitation continued to be at zero levels across both conditions except for one training session (range: 0-1.96%; $M = 0.14\%$, $SD = 0.52\%$), and the final generalization session in which Alex imitated gestures to make requests (range: 0-2.94%; $M = 0.21\%$, $SD = 0.79\%$). This increase in full imitation corresponds to the generalization session in which Alex's behavior technician, Sammy, met fidelity of RIT implementation.

Total Imitation. During baseline Alex exhibited zero rates of total imitation across both conditions (see Figure 6). During intervention Alex's rate of total imitation continued to be at zero levels across both conditions, except for two training sessions in which Alex's rate of total imitation increased slightly (range: 0-5.88%; $M = 0.61\%$, $SD = 1.68\%$), and the final snack session in which Sammy implemented RIT with fidelity and Alex imitated gestures to make requests (range: 0-2.94%; *M* = 0.21%, *SD* = 0.79%).

Olivia

Partial Imitation. During baseline Olivia exhibited low and stable rates of partial imitation within the training condition (range: 0-2.63%; *M* = 0.94%, *SD* = 1.30%) and zero rates of partial imitation within the generalization condition. During intervention Olivia's rate of partial imitation occurred at a slightly lower and stable rate within the training condition (range: 0-2.08%; *M* = 0.38%, *SD* = 0.80%), and remained at zero levels across the generalization condition.

Full Imitation. During baseline Olivia exhibited zero rates of full imitation across both conditions. During intervention Olivia's rate of full imitation remained at a low and stable rate within the training condition, with a slow increase over time (range: 0-3.39%; *M* = 1.01%, *SD* = 1.42%). Olivia's rate of full imitation within the generalization condition remained at zero levels.

Total Imitation. During baseline Olivia exhibited low and stable rates of total imitation within the training condition (range: 0-2.63%; *M* = 0.94%, *SD* = 1.30%) and zero rates of partial imitation within the generalization condition. During intervention Olivia's rate of total imitation remained at a low and stable rate within the training condition, with a slight increase over time (range: 0-3.39%; *M* = 1.39%, *SD* = 1.34%). Olivia's rate of total imitation within the generalization condition remained at zero levels.

Liam

Partial Imitation. During baseline Liam exhibited low and stable rates of partial imitation within the training condition, with a slight decrease over the course of baseline (range: 0-1.72%; *M* = 0.68%, *SD* = 0.93%). Liam exhibited zero rates of partial imitation within the generalization condition during baseline. During intervention Liam's rate of partial imitation immediately increased slightly, followed by variable increases and decreases across training condition sessions (range: 0-6.78%; *M* = 3.08%, *SD* = 2.71%). Lima's rate of partial imitation remained at zero levels within the generalization condition during intervention.

Full Imitation. During baseline Liam exhibited low and stable rates of full imitation within the training condition (range: 0-1.67%; *M* = 0.33%, *SD* = 0.75%) and zero rates of partial imitation within the generalization condition. During intervention Liam's rate of full imitation within the training condition immediately increased and continued in an upward trend until session 13, after which there was a decreasing trend followed by another increasing trend at session 18 (range: 3.33-11.67%; *M* = 6.66%, *SD* = 2.89%). Liam's rate of full imitation within the generalization condition remained at zero levels.

Total Imitation. During baseline Liam exhibited low and stable rates of total imitation within the training condition (range: 0-1.72%; *M* = 1.01%, *SD* = 0.92%) and zero rates of total imitation within the generalization condition. During intervention Liam's rate of total imitation immediately increased slightly followed by variable increases and decreases across training condition sessions (range: 0-18.33%; *M* = 9.74%, *SD* = 4.02%), and remained at zero levels within the generalization condition.

Jackson

Partial Imitation. During baseline Jackson exhibited low to moderate, variable rates of partial imitation within the training condition with an increasing followed by a decreasing trend (range: 0-8.77%; *M* = 2.22%, *SD* = 3.43%), and zero rates of partial imitation within the generalization condition. During intervention Jackson's rate of partial imitation within the training condition was stable at a lower level than that of baseline (range: 0-3.39%; *M* = 0.64%, *SD* = 1.26%), and remained at zero levels within the generalization condition.

Full Imitation. During baseline Jackson exhibited low to moderate, variable rates of full imitation within the training condition (range: 0-5.36%; *M* = 1.53%, *SD* = 2.14%), and low and stable rates of full imitation within the generalization condition (range: 0-2.44%; *M* = 0.35%, *SD* = 0.92%). During intervention Jackson's rate of full imitation within the training condition immediately increased and alternated between decreasing and increasing trends, with an increasing trend overall (range: 0-16.33%; *M* = 8.18%, *SD* = 5.07%). Jackson's rate of full imitation remained at zero levels within the generalization condition.

Total Imitation. During baseline Jackson exhibited low to moderate use of total imitation with an increasing followed by decreasing trend within the training condition (range: 0-8.77%; *M* = 3.75%, *SD* = 4.14%), and low and stable rates of total imitation within the generalization condition (range: 0-2.44%; *M* = 0.35%, *SD* = 0.92%). During intervention Jackson's rate of total imitation within the training condition immediately increased and alternated between decreasing and increasing trends with an increasing trend overall (range: 0-16.33%; *M* = 8.82%, *SD* = 4.87%). Jackson's rate of total imitation remained at zero levels within the generalization condition.

Overall Child Imitation

Taken together, participant data did not establish a functional relationship between behavior technician-implemented RIT and child imitation. However, increases in level and trend from baseline to intervention were observed for two out of four child participants.

Figure 4

Partial Imitation

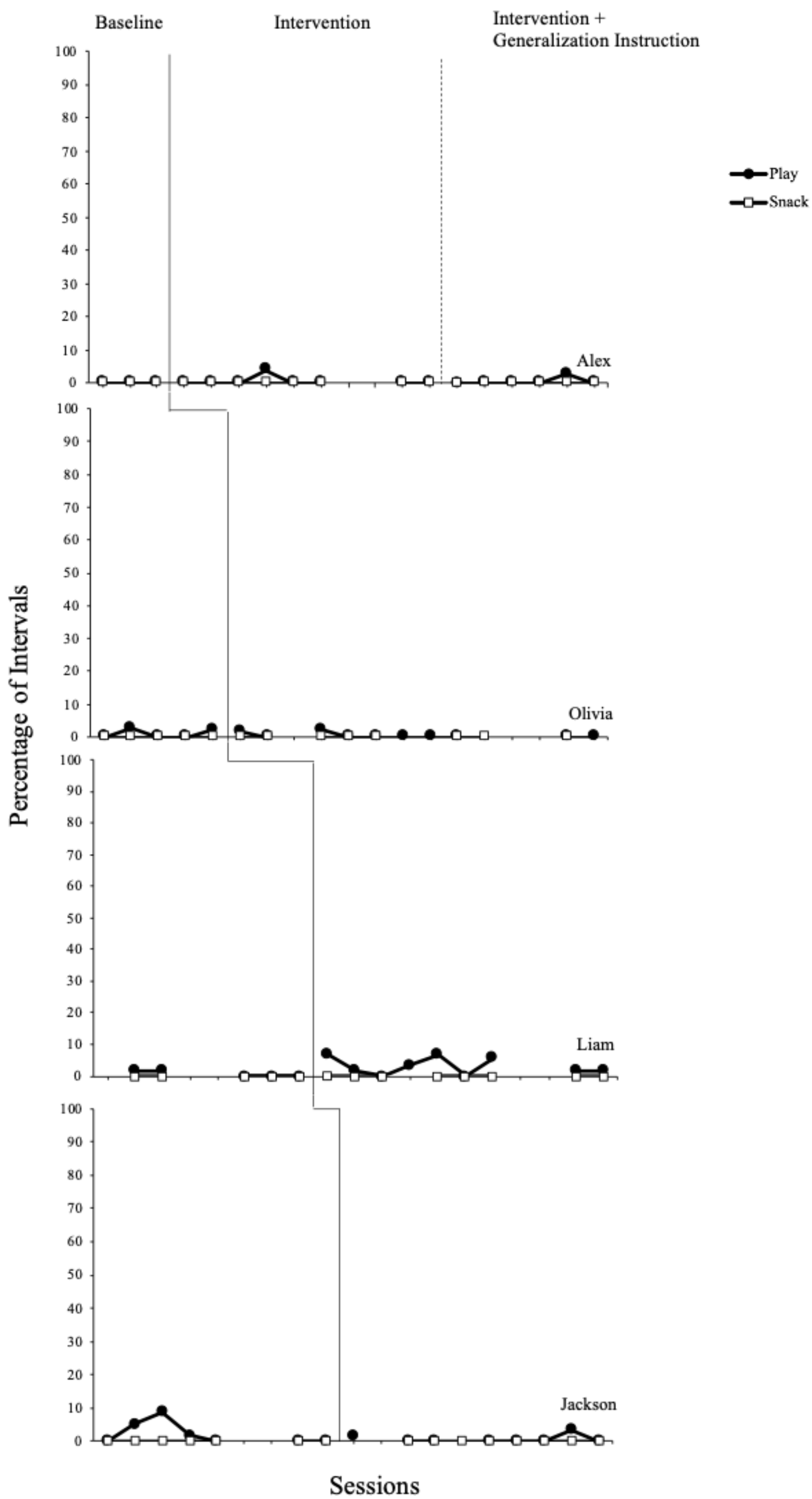


Figure 5

Full Imitation

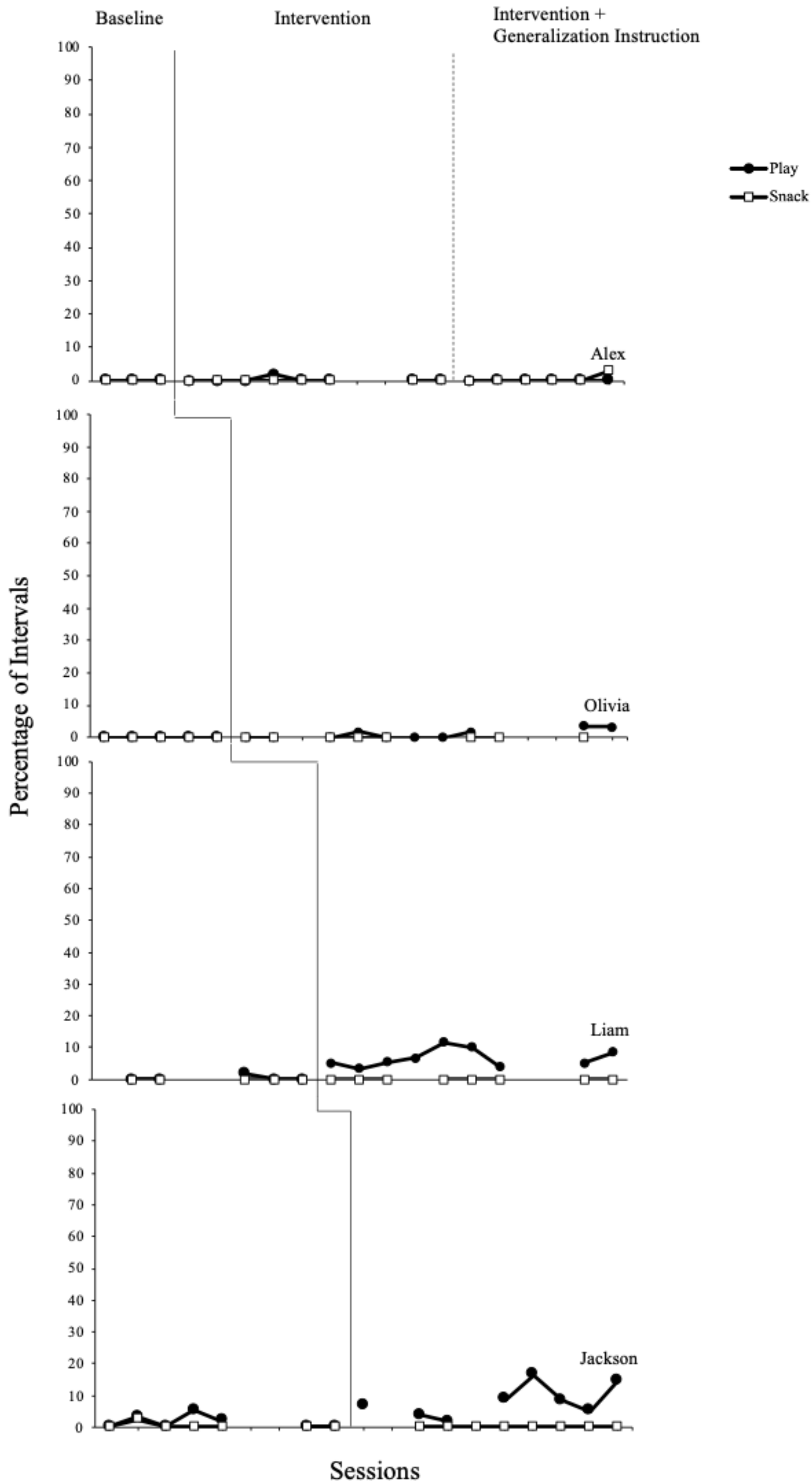
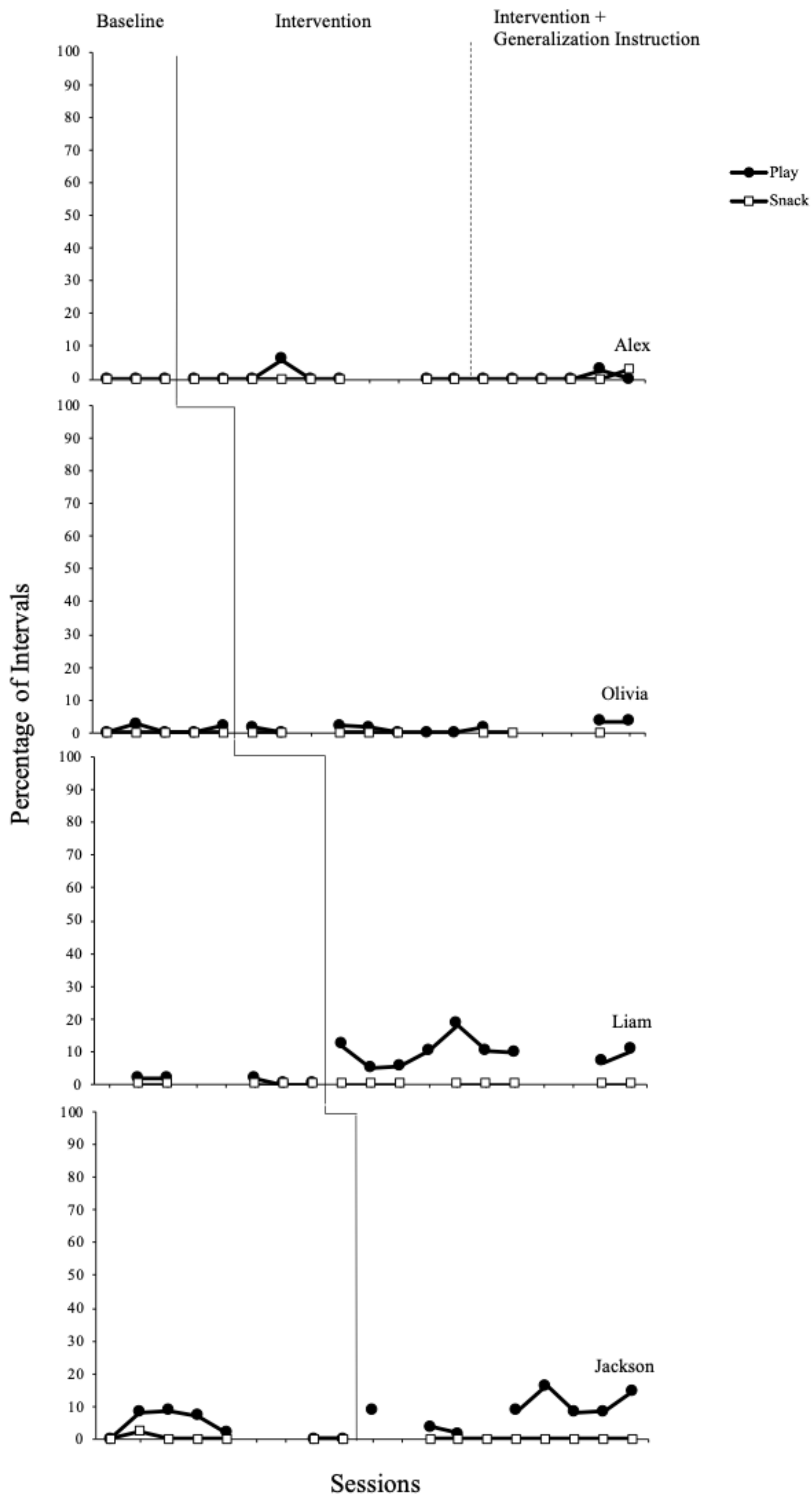


Figure 6

Total Imitation



Social Validity

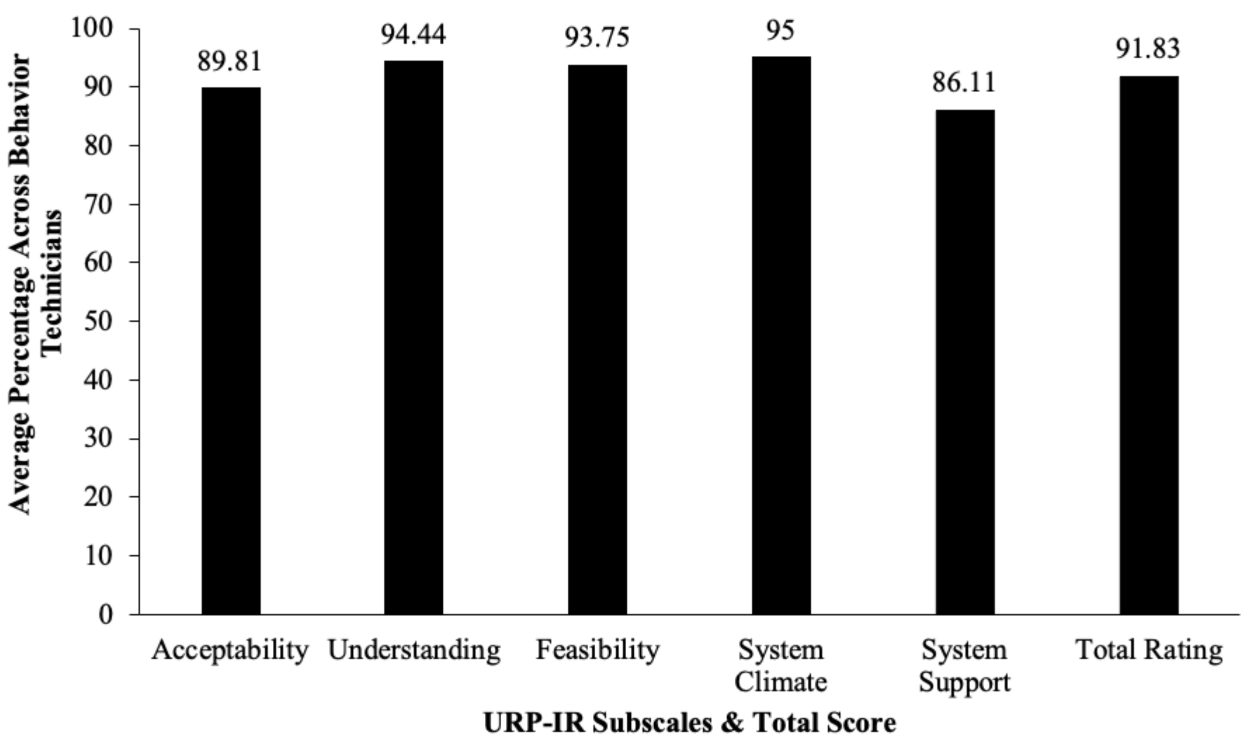
All behavior technicians responded to the social validity survey containing the URP-IR and additional open-ended questions about general impressions and intentions to continue to implement RIT in the future.

URP-IR

The average total URP-IR score across behavior technicians was 91.83% (see Figure 7), suggesting the presence of facilitators and low barriers to implementation of RIT in behavior technicians' work settings (Briesch et al., 2013). The highest average rating was in the System Climate subscale (95%), indicating high intervention compatibility with behavior technicians' work environments. This was followed by the Understanding subscale (94.44%), indicating high

Figure 7

URP-IR Subscale & Total Scores



understanding of RIT implementation. The Feasibility subscale score (93.75%) indicates high participant perception of ability to implement RIT and the Acceptability subscale score (89.81%) suggests high levels of enthusiasm for implementing RIT. Finally, the System Support subscale score (86.11%) suggests low perceptions of external support needs to implement RIT. However, Sammy responded, “slightly disagree” to the statement, “Preparation of materials needed for RIT would be minimal,” and “slightly agree” to the statement, “I would need consultative support to implement RIT.”

Open-ended Responses

All behavior technicians indicated that they would continue to use RIT with the child participant. Sammy did not elaborate on this intention or share additional details about his experience implementing RIT with Alex.

Susie described RIT as having facilitated a bond with Olivia, stating that, “I want to continue to nourish that bond to see my client continue to grow.” Susie shared that she intended to implement RIT with her other clients and at home with her infant son.

Sofie described RIT as a way to better help her interact with Liam, stating that, “He does not engage playfully with people very often but frequently laughed and appeared to enjoy engaging in activities with me during RIT implementation.” Sofie shared that Liam “imitated actions throughout the study which had not occurred prior,” and that she intended to continue to use RIT with future clients who struggle with imitation.

Ava described RIT as fun for both her and for Jackson and shared that she had seen a reduction in challenging behavior since beginning to implement RIT. Ava stated that Jackson was “copying movements that I am not able to get [Jackson] to do when I tell them to and model without a full physical prompt.”

Chapter 5: Discussion

In this study behavior technicians participated in virtual training and coaching to support their implementation of Reciprocal Imitation Teaching (RIT) with young children with autism spectrum disorder (ASD). All behavior technician participants increased their use of RIT strategies within the training condition and there was promising evidence of the ability of behavior technicians to generalize these strategies to a new activity or routine within an ABA session, when asked to do so. Although there were significant increases in MIS Object Imitation subscale scores for 3 out of 4 children, there were minimal to moderate changes in child imitation during the training condition and no meaningful changes in child imitation during the generalization condition.

Prior research has shown RIT to be an effective intervention for increasing imitation skills in children with ASD after 20-30 hours of intervention, and when implemented by researchers, caregivers, and siblings (Ingersoll & Gergans, 2007; Penney & Schwartz, 2019; Wainer & Ingersoll, 2013; Walton & Ingersoll, 2012). The current study extends this literature by assessing RIT implementation by community-based behavior technicians and examining the effects of a low dose of RIT intervention on the imitative behavior of children with ASD.

RIT Implementation

Bug-in-ear coaching was used to facilitate behavior technician RIT fidelity following an introductory training. Didactic training, while convenient and cost-effective, most often changes content knowledge rather than practice, and research recommends coaching as a more effective form of professional development (e.g., Artman-Meeker et al., 2015; Joyce & Showers, 2002; Rush & Shelden, 2011). Telecoaching can serve as a time- and cost-efficient way to provide supervision and feedback, and bug-in-ear coaching specifically has been demonstrated to be well-received by behavior technicians working with children with ASD in preschool classrooms (Artman-Meeker et al., 2017).

Three out of 4 behavior technicians met fidelity of RIT implementation (scores of 3 or 4 on each RIT component) within the training condition. Sofie reached RIT fidelity immediately following the virtual training and maintained high fidelity for the remainder of the study, posing the possibility that for her, the initial RIT training may have been enough to facilitate accurate implementation. Sammy, Susie, and Ava increased their fidelity scores over time, indicating that bug-in-ear coaching may have facilitated accurate implementation for these participants beyond the initial training.

Sammy exhibited the greatest variability in RIT implementation while receiving the greatest number of coaching sessions, typically scoring lower on RIT components of modeling new play actions, prompting, and pacing of discrete trials. Susie never met fidelity (a score of 3 or 4) on the RIT component of pacing, i.e., implementing discrete trials at a rate of once every 1-2 minutes. This was unexpected, given behavior technicians' background in ABA and the ABA emphasis on the discrete trial teaching loop. Sammy consistently expressed at the start of coaching sessions that Alex was tired, given that Alex was experiencing sleeping challenges and frequently woke up very early, and mentioned this as a rationale for avoiding delivering discrete trials at the frequency specified in RIT. Sammy would include discrete trials during coaching when support was provided for pacing, but he limited discrete trials during independent RIT implementation. This may have been a meaningful adaptation of RIT to meet this client's needs (Edmunds et al., 2022), yet it also represented limited explicit teaching opportunities for Alex. Strategies to adapt the rate of teaching trial presentation in RIT and in other types of both decontextualized and embedded instruction to meet the needs of individual learners is an area that requires further research. Susie expressed uncertainty about how to physically prompt Olivia, so bug-in-ear coaching included support around providing predictable vocal cues before delivering a prompt (e.g., “I’m going to help you!”) and selecting actions that were easy and quick to prompt. Susie expressed that these strategies were helpful, and Olivia was not observed to protest physical prompts that were delivered. However, Susie continued to implement discrete trials at a slow pace during independent RIT implementation, outside of bug-in-ear coaching sessions. Another potential reason for the hesitancy around discrete trial implementation for Sammy and Susie could be that in RIT, specific actions are not targeted but rather, actions are presented based on the child’s play, which could require a more flexible and responsive approach to instruction than many behavior technicians are trained in. It could also be that for Sammy and Susie discrete trial teaching represented an area of challenge in general, beyond the context of RIT, and likely required coaching support beyond what was provided in this study. In a study of classroom-based bug-in-ear coaching, behavior technicians expressed that combining bug-in-ear coaching with in-person debriefing could have enhanced collaboration between the coach and coachee (Artman-Meeker et al., 2017). To minimize study tasks for participants, separate planning and debriefing sessions were not scheduled with behavior technicians for this study. However, these additional coaching activities could have been beneficial to facilitate Sammy’s and Susie’s discrete trial implementation. Further, incorporating opportunities to review video models or to role play may have enhanced the effectiveness of coaching.

Only one behavior technician, Sammy, generalized RIT to the generalization condition of snack time. However, this was only after he was explicitly told to begin implementing RIT during snack, after which he immediately increased his RIT fidelity in this setting. Sammy met fidelity during the final generalization session, which facilitated a mild increase in imitation from

Alex. There are not enough data to suggest whether Sammy was likely to sustain RIT fidelity during snack beyond the study; however, his variable implementation of RIT during play suggests that if he did continue to incorporate RIT during snack, implementation may continue to be variable. However, his increase in implementation highlights that simply delivering an instruction to generalize a strategy (Stokes & Baer, 1977), while receiving support in another environment, could be enough to facilitate broader strategy use. This is an important consideration for BCBAs, who may be limited in their ability to supervise behavior technicians' use of a strategy across an ABA session due to scheduling conflicts and may need to focus coaching within specific routines.

Overall, there was a lack of generalization of RIT from the training condition to the generalization condition, evidenced by both the data collected within the generalization condition and the self-reported RIT dosage data which indicated little use of RIT outside of study requirements. This could be due to competing demands regarding other interventions required of behavior technicians to be implemented across clients' ABA sessions. Additionally, RIT teaching trials are not scripted and require flexibility and shared control on the part of the behavior technician. This may be challenging for behavior technicians, who may primarily be trained to follow protocols written by their supervising BCBA under specific conditions (Gerencser et al., 2020; Higgins et al., 2017; Kipfmiller et al., 2019; Leaf et al., 2019; Rodriguez, 2020). Absent explicit instruction to incorporate a strategy into a particular routine, behavior technicians may be less likely to do so. However, in order to best serve children with ASD, paraprofessionals need to be trained beyond a "technician" role in order to respond to and interact with young children responsively and successfully absent explicit supervisor instruction. With that in mind, behavior technicians may benefit from training that includes how to interact in developmentally appropriate and enhancing ways outside of explicit teaching protocols. This represents an important, ongoing training gap that exists in the field of ABA for the providers who deliver the majority of intervention services.

Contingent Imitation & Linguistic Mapping

All behavior technicians demonstrated low use of contingent imitation and moderate use of linguistic mapping during baseline across both conditions. Moderate use of linguistic mapping in baseline is consistent with findings from a study by Zaghlawan and Ostrosky (2016), in which caregivers entered the study using moderate levels of linguistic mapping and increased their use after receiving coaching in RIT. All behavior technicians in this study immediately increased their use of contingent imitation and linguistic mapping after participating in the virtual training and bug-in-ear coaching within the training condition. Contingent imitation did not generalize to snack time for any participants; however, linguistic mapping immediately increased for Susie and the level of linguistic mapping from baseline to intervention increased for Sofie within the generalization condition. While Susie's and Sofie's linguistic mapping exhibited an upward trend within both conditions during baseline, there was an immediate and sustained change in the level of this behavior during intervention, suggesting generalization of this specific RIT strategy from the training environment to a new routine. Linguistic mapping may represent "low hanging fruit" in training, given the potential tendency for caregivers and behavior technicians to independently use this strategy to a mild to moderate extent and to boost use upon explicit training. Linguistic mapping could therefore be more amenable to spontaneous generalization than strategies adults are less likely to implement naturally with children with ASD, such as contingent imitation or discrete trials.

Child Imitation

Total imitation data showed gains for Liam and Jackson in the training condition. There was a slight increase in the range of the data from baseline to intervention for Alex and Olivia in the training condition, suggesting slight gains as well, but these increases were minimal. Interestingly, Olivia's and Jackson's rates of *partial* imitation decreased from baseline to intervention; however, their rates of *full* imitation increased from baseline to intervention, suggesting that partial imitation may have decreased due to their imitative behavior becoming more exact.

Liam and Jackson's rates of imitation increased the most from baseline to intervention within the training condition. However, differences between their data and Alex's and Olivia's data could be due to the number of opportunities Sammy and Susie presented for them to imitate. Given that Sammy and Susie often presented fewer opportunities for Alex and Olivia to imitate during RIT, Alex and Olivia's data may simply reflect a lack of opportunity for imitation to occur.

Though initially the data for total imitation may look as though child imitation did not increase in a meaningful way across participants, it is important to consider these changes in the context of a 10-minute RIT session. When RIT is implemented with fidelity, providers deliver opportunities for the child to imitate approximately 30% of a session. Thus, imitation occurring during 30% of intervals would represent spontaneous imitation occurring during most, if not all, opportunities presented to do so. Jackson's highest total imitation data point (16.33%) and Liam's highest total imitation data point (18.33%) represent each child imitating modeled actions during approximately 50% of opportunities. According to the RIT parent manual, imitating around 50% of actions modeled is when a child may be considered to be "consistently imitating actions with objects" (Ingersoll et al., n.d.), given that it is not expected that any child will imitate 100% of actions presented. Thus, Jackson and Liam may have approached consistent imitation of actions with objects within the RIT intervention framework. Their increasing skills may have been better represented by a different data collection system, such as measuring the percent of opportunities in which participants spontaneously imitated, rather than using a partial interval recording system. However, the goal of a partial interval recording method was to capture additional imitative behavior that may occur outside the context of an explicitly presented opportunity. For example, if a child engaged in an action with a toy, paused while watching the behavior technician engage in that same behavior, and then resumed engaging in that behavior an additional time, a partial interval recording system would capture this as an instance of spontaneous imitation whereas a system measuring percentage of opportunities would not. This highlights a question around how best to measure imitation - namely, whether it is best to capture moments of reciprocal patterns of imitation, which some may argue does not represent “true” imitation, or to solely capture instances of imitation of novel actions.

Jackson, Alex, and Olivia all exhibited gains in the MIS assessment from pre- to post-intervention, strengthening the claim that these participants experienced gains in imitation. However, Liam exhibited a decreased MIS score from pre- to post-intervention, counter to his behavioral data. The BCBA who administered his assessment indicated that Liam was not “accepting novel or non-preferred items” at the time of the post-assessment, suggesting that perhaps the lack of imitation was due to object disinterest rather than a lack of ability. Given that these assessments were not video recorded, it is unclear if Liam’s results represent imitative challenges for Liam, disinterest in the materials, and/or whether this represented an administration error. Video recording MIS assessment administration would have provided some clarity for these results.

Mild improvements in children's spontaneous imitation skills as seen in this study are consistent with findings from Zaghlawan and Ostrosky (2016). Zaghlawan and Ostrosky (2016) hypothesized that minimal improvements in child participants' imitation skills were due to modifications that the researchers made to RIT, which included a decreased wait time between presented actions and a reduction in the number of models presented during a teaching trial from three to two. In the current study, mild improvements in imitation may be due to RIT dosage. Whereas in prior research RIT has been delivered for an average of 20-30 minutes per day, or 2-3 hours per week, for 10 weeks (Ingersoll, 2010; Ingersoll, 2012; Ingersoll & Lalonde, 2010; Ingersoll et al., 2007; Ingersoll & Schreibman, 2006), in the current study RIT was implemented between 30-60 minutes per week for 5-8 weeks. Overall, the findings of the present study suggest that community-based behavior technician-implemented RIT can increase imitation skills in children with ASD, even when implemented for as little as 30-60 minutes per week for 5 weeks.

Social Validity

While all participants indicated that RIT was an acceptable and feasible intervention and that they intended to continue using it, behavior technicians did not indicate that they had incorporated RIT into their ABA sessions beyond the study requirements. While it could be that ABA session structures did not support incorporation of RIT beyond study requirements, this lack of generalization or additional use of RIT brings up additional questions regarding social validity. If participants did like the intervention, why was it not incorporated into ABA sessions to a greater extent? Was this due to competing demands, additional training needs, or perhaps a disinterest in RIT that participants were uncomfortable expressing? Did behavior technicians require greater support to promote shared control and the use of embedded versus decontextualized instruction? Sammy did indicate a possible need for consultative support in order to implement RIT, which was consistent with his fidelity data indicating variable implementation. This provides some support for the possibility that additional training needs may be behind the lack of additional RIT use. However, more information is needed in order to truly understand why there was limited additional and generalized use of RIT. It may be that explicit instruction to incorporate RIT strategies such as contingent imitation across an ABA session would be enough implementation support, but it is likely that more robust feedback is needed to promote integrated and sustained RIT use. ABA intervention session structures should be examined to understand how much freedom behavior technicians have, or believe they have, to vary from a session outline created by a supervising BCBA. Baseline data suggest that there was not much intervention or interaction occurring during play or snack time. The idea that instructional time is all the time across an ABA session may be something that we need to include in behavior technician training. Additionally, an implementation science framework may be important for identifying inner context implementation factors (e.g., individual adopter characteristics, organizational structure) that facilitate NDBI strategy use in community-based ABA programs (Moullin et al., 2019).

Overall, behavior technicians' strong ratings of RIT provide support for training behavior technicians in this intervention when working with young children with ASD, both to facilitate children's imitation skills and to facilitate positive adult-child interactions.

Addressed Gaps in the Literature

This study adds to the existing RIT literature as it involves behavior technicians implementing the intervention within the context of community-based ABA programs. Training and coaching in RIT may serve to facilitate behavior technicians' ability to engage in meaningful play interactions with their clients given that participating behavior technicians described RIT as fun, as having increased signs of child enjoyment during play (i.e., laughter), and as having promoted positive relationships between behavior technician and child.

While the behavior technicians did not demonstrate generalized use of all aspects of RIT to interactions with clients outside of a play context, most behavior technicians increased their use of descriptive commenting (i.e., linguistic mapping) with their clients during untrained daily routines (i.e., snack time). Thus, RIT may serve as a way to promote a responsive interaction style between behavior technicians and child clients within an ABA session, which has been demonstrated to facilitate children's positive cognitive and emotional outcomes in addition to fostering positive relationships (Kong & Carta, 2013).

Implications for Practice

Though virtual training and coaching have been shown to support effective implementation of behavior analytic procedures (Tomlinson et al., 2018), there has been limited research about how training and coaching can support behavior technicians' ability to play with young clients and how to have positive, therapeutic, socially engaging interactions with young clients outside of explicit teaching interactions. All instruction for young learners, whether decontextualized or embedded (Schwartz et al., 2017), is implemented within the context of engagement. EIBI and ABA programs should consider adopting a tiered delivery framework, similar to that of positive behavior supports in schools (Horner, 2000) or the Building Blocks (Sandall et al., 2019) or Pyramid Model (Fox et al., 2003) in early childhood programs. In EIBI and ABA programs, behavior technicians are trained primarily in the delivery of intensive, 1:1 behavior and instructional practices. However, behavior technician training does not often include basic interaction skills for working with young children, often considered a "bottom tier" or foundational layer within a multi-tiered service model, and is considered an imperative component of effective individualized supports (Blackburn & Witzel, 2018). Promoting developmentally appropriate and development-enhancing interactions between children and adults should therefore be considered a foundational aspect of behavior technician training when working with young children in order to perform their role most effectively. This is additionally important because appreciating the adult-child social relationship is consistent with the call to improve the social validity of ABA services by aligning with the neurodiversity movement (Schuck et al., 2021).

A strong evidence-base exists to support NDBI models of intervention such as RIT (Bruinsma et al., 2020; Schreibman et al., 2015), but NDBIs are not yet mainstream in ABA practice (D'Agostini et al., under review; Hampton & Sandbank, 2021). However, the developmental strategies included in NDBIs such as contingent imitation and linguistic mapping may serve as key components of a "foundational tier" for behavioral service delivery - namely, a positive and responsive adult-child relationship. ABA programs, particularly those supporting young children, should consider adopting these strategies program-wide to promote a consistent expectation for training and coaching around these strategies to occur and to facilitate meaningful uptake.

Implications for Future Research

Although all participants demonstrated their ability to implement RIT strategies, when and how frequently behavior technicians used RIT strategies remained problematic. All participants could have benefited from explicit generalization support. Future research should incorporate intentional planning for generalization by practitioners, such as explicitly stating from the get-go to use RIT across contexts. While RIT was described as an intervention that could be embedded across daily routines during the initial RIT training, the expectation to generalize was not made explicit and as a result, did not naturally occur. Sammy incorporated RIT strategies into snack once asked to do so and even began to incorporate communicative opportunities for Alex within RIT. Thus, behavior technicians may benefit from explicit instructions on when to incorporate specific interventions.

Participants likely would have benefited from individualized approaches to coaching, where for some, separate time for feedback and planning outside of the bug-in-ear session would have been beneficial. Future research should combine bug-in-ear coaching with additional coaching activities such as planning and debriefing sessions in order to best facilitate coachee success. Given that behavior technicians did not implement RIT outside the explicit study context, future research should look further at implementation practices that may facilitate adoption and integration of RIT and other NDBI strategies across ABA sessions.

Limitations

While this study offers insight into training and coaching for behavior technicians in RIT, some limitations must be acknowledged. Given the packaged use of training and bug-in-ear coaching, it is unclear which aspects of professional development contributed to behavior technician RIT fidelity. Another limitation was the sole reliance on twice weekly, 10-minute bug-in-ear sessions for coaching. Relying solely on bug-in-ear meant that there were no opportunities to model a skill for behavior technicians in vivo. Because coaching activities took place on Zoom during child participants' ongoing ABA sessions, coaching activities such as separate time for planning and reflection were not incorporated into this study, limiting opportunities for more in-depth discussion separate from the child participant.

Additionally, RIT dosage for child participants was less than that of prior RIT studies and developer recommendations (Ingersoll, n.d.; Ingersoll, 2010; Ingersoll, 2012; Ingersoll & Lalonde, 2010; Ingersoll et al., 2007; Ingersoll & Schreibman, 2006). While this was in an attempt to keep study activities low for participants given the ongoing realities of COVID-19 and with the aim of reducing participant attrition, this may have limited the ability to understand behavior technicians' RIT implementation impact on child imitative behavior. Additionally, the way in which child imitative behavior was measured (i.e., partial interval recording) may not best measure child gains in imitative skill sets. These data collection procedures were not sensitive to opportunities for imitation presented by behavior technicians, which may have impacted rates of child imitation.

Information obtained about RIT use and dosage relied on behavior technician self-report. This was obtained via survey asking behavior technicians to provide a daily approximation (i.e., 1-5 minutes, 6-10 minutes, etc.). This survey did not consider what behavior technicians believed it meant to implement RIT. Given Sammy's and Susie's primary implementation of contingent imitation and linguistic mapping with low rates of discrete teaching trials, their reported times of RIT use may have included few to no actual opportunities for the child to imitate, indicating that this would not in fact constitute full RIT implementation (Edmunds et al., 2022).

The decision to provide a generalization instruction to Sammy after 1 month of a lack of generalization of RIT from play to snack was made during the study, not a priori. Because the study ended right at the 1-month mark of RIT implementation for Ava, there was no opportunity to replicate this generalization instruction provision with her, despite the fact that she too demonstrated no increase in RIT fidelity within the generalization condition. Repeating this instruction to Ava would have provided additional data regarding effectiveness of instructing a behavior technician to generalize RIT into a new routine.

Finally, the primary investigator served as the primary video coder. This was to ensure that videos were coded in time to make coaching decisions around RIT, but could have introduced potential bias into the coding of data. Due to the overall applied nature of the study, consistency of data collection was impacted. All behavior technician-child dyads canceled sessions at some point across the study, resulting in missing data.

Conclusion

In conclusion, the findings of this study are consistent with previous research suggesting RIT is effective in increasing spontaneous imitation during play (Hall et al., 2019; Ingersoll & Schreibman, 2006; Ingersoll et al., 2007; Ingersoll & Gergans, 2007; Penney & Schwartz, 2019; Wainer & Ingersoll, 2013; Zaghlawan & Ostrosky, 2016). The results of this study also suggest that virtual training and bug-in-ear coaching in RIT can be an effective approach to supporting behavior technicians' implementation of NDBI. Behavior technicians may increase their use of linguistic mapping across routines as a result of coaching in RIT during play, and may be able to generalize the use of RIT across other routines and activities simply by being asked to do so. This group of providers represent a potentially important demographic for NDBI dissemination and training given the frequency and duration with which they provide intervention services to young children with ASD.

While this study demonstrates that training and ongoing, brief coaching in RIT can result in behavior technician implementation of RIT with fidelity, greater support may be needed in order for behavior technicians to incorporate adequately paced and consistent discrete teaching opportunities. The field of ABA would benefit from additional research examining how coaching and training in NDBI strategies may facilitate a strong foundation of positive and fun, developmentally appropriate and development-enhancing interactions between paraprofessionals and children with ASD, strengthening the overall value of services.

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Appendix A: Data Sheets

Form A1. *RIT Fidelity Checklist*

Imitate the child:

Describe the play:

Model action:

Pacing:

Prompt imitation:

Praise:

Total Fidelity:

RIT Component	Low Fidelity 0	1	2	3	High Fidelity 4
Imitate the child Imitate child's toy play, gestures, and vocalizations.	Therapist does not imitate the child's gestures, vocalizations, and toy play	Therapist imitates a few of the child's gestures, vocalizations, and toy play, but misses the majority of opportunities	Therapist imitates the child's gestures, vocalizations, and toy play up to 50% of the time, but misses many opportunities	Therapist imitates more than 50% of the child's gestures, vocalizations, and toy play when the child is appropriately engaged, but misses opportunities	Therapist imitates almost all of the child's gestures, vocalizations, and toy play throughout the session when the child is appropriately engaged.
Describe the play Use simplified, repetitive language around child's attentional focus.	Therapist does not use simplified language around the child's attentional focus, language is too complex, or therapist does not use any language.	Therapist uses simplified language around the child's attentional focus during some of the session, but misses the majority of opportunities or majority of language is too complex.	Therapist uses simplified language around the child's attentional focus up to 50% of the time, but misses many opportunities.	Therapist uses simplified language around the child's attentional focus for more than 50% of the session, but misses opportunities *or* language is not appropriate for child's level of language.	Therapist uses simplified language around the child's attentional focus throughout the session. Almost all of the therapist's language is appropriate for child's language level.
Model action Model actions around child's focus of interest.	Therapist models actions that are inappropriate for child's level/interest *or* does not recruit child's attention.	Therapist models some actions that are appropriate for child's level/interest but also many that are not or often fails to recruit the child's attention.	Therapist models some actions that are appropriate for child's level/interest and recruits child's attention some of the time.	Therapist models actions that are appropriate for child's level/interest more than 50% of the time and recruits child's attention the majority of the time.	Therapist models actions that are very appropriate for child's level/interest and recruits child's attention.
Pacing Model an action every 1-2 minutes. Adjust rate when necessary to keep child engaged.	Therapist models actions at a significantly lower or higher rate throughout session. Pacing significantly disrupts child's engagement or learning.	Therapist models actions at a significantly lower or higher rate throughout session. Pacing somewhat disrupts child's engagement or learning.	Therapist models actions at a somewhat lower or higher rate throughout session. Pacing does not significantly disrupt child's engagement or learning.	Therapist models at an appropriate rate for some, but not all of the session. Pacing does not significantly disrupt child's engagement or learning.	Therapist models actions at an appropriate rate throughout session. Pacing is appropriate for keeping child engaged and learning. Therapist models at least 5 trials, and no more than 10.
Prompt imitation Physically prompt child to imitate after 3 presentations of action.	Therapist does not physically prompt child to imitate action after presenting the action 3 times.	Therapist prompts child to complete action after third trial a minority of the time, but misses many opportunities or prompting often does not result in imitation (e.g., child switches activities without imitating).	Therapist prompts child to complete action after third trial up to 50% of the time, but misses many opportunities or prompting does not result in imitation (e.g., child switches activities without imitating).	Therapist prompts child to complete action after third trial the majority of the time, but misses opportunities or prompting occasionally does not result in imitation (e.g., child switches activities without imitating).	Therapist consistently prompts child to complete action after third trial if child has not spontaneously imitated. Once therapist begins a trial, therapist follows through such that the trial ends in imitation.
Praise Animatedly praise child's spontaneous or prompted imitation.	Therapist does not praise child's spontaneous or prompted imitation or consistently praises incorrect responses.	Therapist praises a minority of the child's spontaneous and prompted imitations, but misses the majority of opportunities or praises multiple responses.	Therapist praises some of the child's spontaneous and prompted imitations, but misses many opportunities or praises incorrect responses.	Therapist praises the majority of the child's spontaneous and prompted imitation, but misses some opportunities or praise is provide for an incorrect response.	Therapist praises all of the child's spontaneous and prompted imitation throughout the session. Praise is withheld for incorrect responding.

Form A2. *Behavior Technician Behavior Coding Sheet*

0:01-0:10	0:11-0:20	0:21-0:30	0:31-0:40	0:41-0:50	0:51-1:00
☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable
1:01-1:10	**1:11-1:20**	**1:21-1:30**	**1:31-1:40**	**1:41-1:50**	**1:51-2:00**
☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable
2:01-2:10	**2:11-2:20**	**2:21-2:30**	**2:31-2:40**	**2:41-2:50**	**2:51-3:00**
☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable
3:01-3:10	**3:11-3:20**	**3:21-3:30**	**3:31-3:40**	**3:41-3:50**	**3:51-4:00**
☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable
4:01-4:10	**4:11-4:20**	**4:21-4:30**	**4:31-4:40**	**4:41-4:50**	**4:51-5:00**
☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable	☐ CI ☐ LM ☐ None ☐ Uncodable

5:01-5:10	5:11-5:20	5:21-5:30	5:31-5:40	5:41-5:50	5:51-6:00
CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable
6:01-6:10	**6:11-6:20**	**6:21-6:30**	**6:31-6:40**	**6:41-6:50**	**6:51-7:00**
CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable
7:01-7:10	**7:11-7:20**	**7:21-7:30**	**7:31-7:40**	**7:41-7:50**	**7:51-8:00**
CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable
8:01-8:10	**8:11-8:20**	**8:21-8:30**	**8:31-8:40**	**8:41-8:50**	**8:51-9:00**
CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable
9:01-9:10	**9:11-9:20**	**9:21-9:30**	**9:31-9:40**	**9:41-9:50**	**9:51-10:00**
CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable	CI LM None Uncodable

Contingent Imitation:____________/_____________=_____________x 100 =__________% of intervals
(CI intervals) (# of intervals)

Linguistic Mapping:____________/_____________=_____________x 100 =__________% of intervals
(LM intervals) (# of intervals)

Form A3. *Child Behavior Coding Sheet*

0:01-0:10	0:11-0:20	0:21-0:30	0:31-0:40	0:41-0:50	0:51-1:00
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
1:01-1:10	**1:11-1:20**	**1:21-1:30**	**1:31-1:40**	**1:41-1:50**	**1:51-2:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
2:01-2:10	**2:11-2:20**	**2:21-2:30**	**2:31-2:40**	**2:41-2:50**	**2:51-3:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
3:01-3:10	**3:11-3:20**	**3:21-3:30**	**3:31-3:40**	**3:41-3:50**	**3:51-4:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
4:01-4:10	**4:11-4:20**	**4:21-4:30**	**4:31-4:40**	**4:41-4:50**	**4:51-5:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable

5:01-5:10	5:11-5:20	5:21-5:30	5:31-5:40	5:41-5:50	5:51-6:00
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
6:01-6:10	**6:11-6:20**	**6:21-6:30**	**6:31-6:40**	**6:41-6:50**	**6:51-7:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
7:01-7:10	**7:11-7:20**	**7:21-7:30**	**7:31-7:40**	**7:41-7:50**	**7:51-8:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
8:01-8:10	**8:11-8:20**	**8:21-8:30**	**8:31-8:40**	**8:41-8:50**	**8:51-9:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable
9:01-9:10	**9:11-9:20**	**9:21-9:30**	**9:31-9:40**	**9:41-9:50**	**9:51-10:00**
☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable	☐ FI ☐ PI ☐ None ☐ Uncodable

Full Imitation:_____________/_____________=_____________x 100 =_________% of intervals
(FI intervals) (# of intervals)

Partial Imitation:_____________/_____________=_____________x 100 =_________% of intervals
(PI intervals) (# of intervals)

Appendix B: Coding Manuals

Form C1. *Child Behavior Coding Manual*
This manual is to guide coding of child imitative behavior. Coding will be done using a **partial interval recording** system using 10-second intervals. Every 10-second interval in which the child engages in imitation for *any amount of time* will be marked as having had that behavior occur.

Imitation is scored when the child imitates any part of a modeled action **within 10 seconds** after the adult engages in the behavior (Ingersoll & Meyer, 2011).

Imitation of a previous action that occurs after presentation of a new action is *not* scored.

Only motoric imitative behaviors are scored; imitation of an adults' vocalizations is *not* scored (Stone et al., 1997).

Imitation must be **initiated** by the child and not *vocally or physically prompted* by the adult. A child's behavior is **vocally prompted** if the adult engages in any of the following behaviors within 3 seconds *before* the child's behavior:

- Adult says, "do this," "copy me," "do what I'm doing," "do (action)," or "can you (action)?"

Intervals will be coded for **full imitation** and **partial imitation** (Stone & Ousley, 2008).

Full Imitation: Child completes the entire modeled behavior, using the same body part and/or same or functionally similar object.

Partial Imitation: Child uses the **same/similar object** and/or body part and performs part *but not all* of the modeled action, or child uses **another/different object** and/or body part and performs *all or part* of the modeled action.

* Both FI and PI may be coded within the same interval.
* "Spillover counts" – if the child begins imitating in one interval and continues that same action into the next interval *without stopping*, count as imitation across both intervals.

If the child repeats an action they have emitted *after the behavior technician copies this behavior*, consider this to be child imitation *if:*

- There is at least 1 second that passes in between the child's initial occurrence of the action and the repeat action, *and*
- the child is looking in the direction of the behavior technician at the same time that the behavior technician copies them.

If the child's directional gaze is *not visible* or is *unclear* in this instance, do not code as child imitative behavior – mark as "<u>uncodable</u>" (see below for uncodable time description).

Action	**Full Imitation**	**Partial Imitation**	**No Imitation**

Shaking a rattle back-and-forth	Shakes a rattle back and forth at least two times so that it makes noise.	Shakes rattle only once, without back-and-forth motion. Shakes a different object in their hand, that may or may not emit noise.	Holds rattle and examines it visually; drops rattle to the floor. Engages in a different action with a different object.
Rolling a car back-and-forth across a table	Rolls a car back-and-forth across a surface at least one time.	Rolls car in one direction only. Rolls a different object across a surface, in one direction only or back-and-forth. Object may or may not have wheels.	Spins wheels on car; bangs car on table. Engages in a different action with a different object.
Drumming hands on a table, alternating hands.	Drums hands on table, alternating hands, with each hand touching the table at least once.	Drums both hands on table at the same time; drums one hand on table. Drums hands on a different surface/object.	Touches adult's hands. Engages in a different action with a different object.

Note. Examples adapted from Stone & Ousley, 2008.

<u>Codable/Uncodable Time:</u>

- If the behavior technician and/or child's actions are *not visible/off camera for some or most of the interval* and *FI or PI are not observed* for the codable portion of the interval, mark as "none."
- If the behavior technician is not visible/off camera for the entire interval (10 seconds), mark the interval as "uncodable."
- If the child's actions are not visible/off camera for the entire interval (10 seconds), mark the interval as "uncodable."
- If the video is frozen for the entire interval, mark as "uncodable."
- If selecting "uncodable," no other codes should be selected for that interval.

Form C2. *Behavior Technician Behavior Coding Manual*
This manual is to guide coding of behavior technician contingent imitation and linguistic mapping behavior. Coding will be done using a **partial interval recording** system using 10-second intervals. Every 10-second interval in which the behavior technician engages in contingent imitation or linguistic mapping for *any amount of time* will be marked as having had that behavior occur.

Contingent Imitation (CI): Behavior technician imitates the child's actions with objects, gestures, body movements, and/or vocalizations for any duration of time simultaneously or within 2 seconds of the child's behavior.

Linguistic Mapping (LM): Behavior technician puts the child's actions or attentional focus into words (Yoder & Warren, 2002). Behavior technician describes or narrates the child's actions or the child's attentional focus using words or sound effects for any duration of time.

- This does *not* include asking the child questions (e.g., "Are you having fun?", "What color is it?" - includes statements followed by a "huh?" or "right?" e.g., "You are holding the tablet, huh," or, "You are walking, right").
    - giving the child directions (e.g., "Do this," "Pick up the toy,"),
    - or explicit directing of the child's attention (e.g., "Look at this!" "It's over here!" "Here you go!", "[Child's name]!", "See the [toy]?").
- This does *not* include description or narration within behavior-specific praise statements provided for completing an adult-directed action (e.g., "You copied me!" "You did the same!" "You drove the car!", "Good job drawing a circle!").
    - *If the behavior-specific praise is simply for an action the child does SPONTANEOUSLY/without being verbally told to do so, then count it as LM.*
- This does *not* include describing the behavior technician's own actions if their actions are different from the child's and the child isn't looking at them.
- This does *not* include stand-alone statements of, "Yeah," "Uh-huh," or similar statements of agreement.
- If you cannot hear a behavior technician's vocalizations, do *not* code as LM.

Examples:

Action	Contingent Imitation	Linguistic Mapping
Child shakes a rattle	Behavior technician shakes a rattle, shakes another object, or mimes shaking an object.	"Shake, shake, shake!" "Shake the rattle!" "We're shake, shake, shaking!" "Bop, bop, bop!"

Non-examples:

Action	Contingent Imitation	Linguistic Mapping
Child shakes a rattle	Behavior technician picks up and drops rattle. Behavior technician hops another toy on the ground.	"What should we do next?" "What else can you do with the rattle?" "Look at me shaking the rattle!"

		"Play with the car!"

<u>Codable/Uncodable Time:</u>

- If the behavior technician and/or child's actions are *not visible/off camera for some or most of the interval* and <u>*CI or LM are not observed* for the codable portion of the interval</u>, mark as "none."
- If the *child's actions* are not visible/off camera for the entire interval (10 seconds), mark the interval as "uncodable."
- If the video is frozen for the entire interval, mark as "uncodable."
- If selecting "uncodable," no other codes should be selected for that interval.

<u>Coding CI/LM While Behavior Techs Perform New Actions</u>

- If the behavior technician models an action while narrating/describing the action
  - AND *the child's eye gaze is in the direction of the behavior technician*,
  - count as LM.
- If the child *imitates an action modeled by the behavior technician* (spontaneously OR prompted)
  - and the behavior technician <u>*then repeats*</u> *the action and/or narrates/describes the action*,
  - count as CI and/or LM.
  - Do *not* count the behavior technician narrating/describing the action <u>while they prompt the child</u> to do the action as LM.

Form C3. *RIT Fidelity Coding Guide*

Imitate the Child

BT imitates the child's actions with objects, body movements, AND vocalizations

- This includes *behavior technician's imitation of child vocalizations*

Use the partial interval recording form to help score this section

- If the BT only imitates the child for 1 or fewer intervals, give a score of "0"
- If the BT imitates between 1-39% of intervals, give a score of "1"
- If the BT imitates between 40-50% of intervals, give a score of "2"
- If BT imitates between 51-65% of intervals, give a score of "3"
- If BT imitates between 66-100% of intervals, give a score of "4"

Describe the Play

Description should be at or slightly above the child's language level

- ALL child participants are nonverbal/pre-verbal
- Majority of BT descriptions should include sound effects, single words (e.g., "Roll, roll, roll!"), or 1–2-word statements (e.g., "So fast!" "Squish ball!")

Use the partial interval recording form to help score this section

- If the BT only describes play the child for 1 or fewer intervals, give a score of "0"
- If the BT describes play between 1-39% of intervals, give a score of "1"
- If the BT describes play between 40-50% of intervals, give a score of "2"
- If BT describes play between 51-65% of intervals, give a score of "3"
- If BT describes play between 66-100% of intervals, give a score of "4"

Description should be around child's actions or attentional focus

- This does not include BT description of their <u>own</u> actions, if their actions <u>do not</u> match the child's and/or if their actions are not within the child's attentional focus

Model Action

BT models within the child's line of sight

- Is it *physically possible* for the child to see the action?
  - i.e., the action should be in front of or directly to the side of the child

BT models a 1-2 step action

- Action is not overly complex

BT models an action using a <u>similar object</u> to what the child is currently playing with

- If the child is *not* engaged with an object, BT models an action using an object similar to the *last* object played with by the child, OR a gross motor movement

BT attempts to gain attention

- Uses similar object to the child
- Says the child's name
- Blocks the child's play
- Makes action big, AND/OR
- Describes the modeled action *without giving a command* while engaging in it (e.g., "Roll, roll, roll" while rolling a ball)

This item is scored <u>independently</u> of pacing

- If a BT ONLY presents a modeled action 1 time within a video, they may still receive a higher score on this item IF the modeled action is appropriate for the child's level/interest and they have used some attempts to recruit the child's attention

Pacing

BT models a play action for the CHILD to imitate about once every 1-2 minutes

- In a 10-minute video, this should be between 5-10 modeled actions

Prompt Imitation

BT models an action 3 times prior to physically prompting imitation

- The BT should model the action 3 times total <u>before delivering support</u>
- If the child imitates spontaneously, then the BT does *not* need to deliver additional models

BT must provide opportunities for the child to imitate to receive a score of 1+ on this item

- If the BT provides NO opportunities for the child to imitate, they automatically receive a score of "0" for prompting imitation

If the child always imitates spontaneously…

- If the BT is modeling actions and the child is spontaneously imitating, then automatically give a score of "4" for this item.

This is for child imitation of actions with objects and body movements <u>only</u>

- We are not expecting BTs to prompt child VOCAL imitation

BT modeled actions ALWAYS end in the child imitating

- When the BT models an action, the teaching loop should ALWAYS be closed, ending with the child imitating

  - If the BT doesn't prompt the child to imitate after presenting 3 models AND the child doesn't spontaneously imitate, then that warrants a lower score.

Praise

BT praise MUST be contingent on the child's imitative behavior (spontaneous OR prompted)

- If the BT provides praise but it is for something other than imitation (e.g., sharing toys, looking at the BT, following a direction), do *not* count towards the score of praise

BT must provide opportunities for the child to imitate to receive a score of 1+ on this item

- If the BT provides NO opportunities for the child to imitate, they automatically receive a score of "0" for praise

Appendix C: Procedural Fidelity Checklists

Form B1. *Training Fidelity Checklist*

Item	Observed?	
1. Describe imitation	Yes	No
2. Provide a broad overview of the RIT cycle	Yes	No
3. Describe imitating the child's actions	Yes	No
4. Describe describing the child's actions	Yes	No
5. Describe the 'model, prompt, & praise' sequence /discrete trial	Yes	No
6. Share video clip examples of RIT	Yes	No
7. Check for and answer BT questions	Yes	No
8. Role play imitating & describing the child's actions	Yes	No
9. Role play linguistic mapping	Yes	No
10. Role play the 'model, prompt, & praise' discrete trial sequence	Yes	No
12. Provide feedback to BT	Yes	No
% Fidelity (Total 'Yes' / 12) x 100 =		

Form B2. *Coaching Fidelity Checklist*

Item	Observed?	
1. State the focus for the session	Yes	No
2. Check for BT questions	Yes	No
3. Ask BT to practice RIT and/or a specific strategy(ies) with the child	Yes	No
4. Provide positive feedback to the BT	Yes	No
5. Provide constructive feedback to the BT	Yes	No
% Fidelity (Total 'Yes' / 5) x 100 =		