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RESEARCH ARTICLE

The implementation of reciprocal imitation training in a Part C early intervention setting: A stepped-wedge pragmatic trial

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Abstract

Despite the development of several evidence-based Naturalistic Developmental Behavioral Interventions (NDBIs), very few have been adapted for use in community-based settings. This study examines the implementation of Reciprocal Imitation Training (RIT)—an NDBI—by community Early Intervention (EI; IDEA Part C) providers serving toddlers from birth to 3 years. Of the 87 EI providers enrolled from 9 agencies in 4 counties across Washington State, 66 were included in the current sample. A stepped-wedge design was used to randomly assign counties to the timing of RIT training workshops. Self-report measures of practice and self-efficacy regarding ASD care were collected at baseline (T1, T2) and 6-months and 12-months post-training (T3, T4). At T3 and T4, providers reported on RIT adoption and rated items about RIT feasibility and perceived RIT effectiveness; at T4, they also reported on child characteristics that led to RIT use and modifications. From pre-training to post-training, there were significant increases in providers' self-efficacy in providing services to children with ASD or suspected ASD. At T3 and T4, provider ratings indicated high levels of RIT adoption, feasibility, and perceived RIT effectiveness. At T4, providers indicated that they most commonly: (a) initiated RIT when there were social-communication or motor imitation delays, or an ASD diagnosis; and (b) made modifications to RIT by repeating elements, blending it with other therapies, and loosening its structure. While additional research is needed, RIT may help families get an early start on accessing specialized treatment within an established infrastructure available across the United States.

Lay Summary: Reciprocal imitation training (RIT) is an evidence-based treatment for ASD that might be a good fit for use by intervention providers in widely accessible community-based settings. After attending an educational workshop on RIT, providers reported feeling more comfortable providing services to families with ASD concerns, used RIT with over 400 families, and believed that RIT improved important social communication behaviors.

KEYWORDS
community-based setting, implementation science, motor imitation, Part C early intervention, reciprocal imitation training, social communication

INTRODUCTION

Numerous studies have indicated that early, specialized interventions can lead to significant improvements in social, language, cognitive, and behavioral functioning for children with Autism Spectrum Disorder (ASD; Dawson et al., 2010; Kasari et al., 2012; Koegel & Koegel, 2006; Ingersoll & Schreibman, 2006; Ingersoll & Wainer, 2013; Schreibman et al., 2015). In recent years, several of these evidence-based interventions have been classified under the broader framework of Naturalistic Developmental Behavioral Interventions (NDBIs; Schreibman et al., 2015). The NDBI framework captures the shared overarching approach of these interventions,

particularly the integration of principles from Applied Behavior Analysis (ABA) and principles from developmental science and their implementation in naturalistic settings. While each intervention has unique components and target outcomes, NDBIs also share many common elements, such as following the child's lead, using natural reinforcement, arranging the environment for success, using modeling and prompting, and involving caregivers in the intervention process (Schreibman et al., 2015).

Despite the existence of several NDBIs and their emphasis on naturalistic settings, very few have been examined and adapted for use in community-based settings where they may increase access and reduce common delays to ASD-specialized treatment for a broader segment of the population (Nahmias et al., 2019; Stahmer et al., 2005; Wise et al., 2010). The few studies that have examined NDBIs in preschool settings have found that they improved key child outcomes (Kaale et al., 2012; Sinai-Gavrilov et al., 2020; Smith et al., 2019). A recent pilot study by Stahmer et al. (2020) is the first to examine an NDBI (i.e., Project IMPACT; Ingersoll & Dvortcsak, 2010) with community-based early intervention providers and found promising results for improving parent–child interactions. Overall, progress has been slow in bridging the research-to-practice gap and translating evidence-based ASD interventions to "real-world" settings (Lord et al., 2005; Nahmias et al., 2019; Smith et al., 2007). This issue closely parallels the lengthy process frequently observed for embedding evidence-based practices in healthcare (Balas & Boren, 2000; Hodgson & Gitlin, 2015).

Implementation research in healthcare settings has identified numerous factors that delay the translation of evidence-based practices into standard clinical services, which map on to different components of the dissemination and implementation pipeline (e.g., Albers et al., 2020; Glasziou & Haynes, 2005; White, 2018). As models and frameworks such as the "funnel of attrition" (Albers et al., 2020) and the Consolidated Framework for Implementation Research (CFIR; Damschroder et al., 2009; Damschroder, 2020) indicate, challenges with adoption and dissemination of new treatments result from a lack of awareness of new treatments and/or lack of access to technical training on the interventions. Even after initial adoption occurs, several factors can limit uptake and lead to rapid attrition of usage, including fit with providers' primary, day-to-day responsibilities and goals, organizational and supervisor support, and logistical demands associated with intervention delivery (Albers et al., 2020; Damschroder, 2020; Dingfelder & Mandell, 2011; Proctor et al., 2011).

As the field looks toward accelerating the dissemination and implementation of NDBIs, it is imperative to consider which "real-world" systems are best poised for successful uptake and for having a meaningful impact on system-level and family-level outcomes of interest. Two of those considerations should be whether a system has the: (a) trifecta of fit between the intervention characteristics (e.g., complexity, effectiveness), provider goals, and the needs of their patients/clients (Albers et al., 2020; Haynes et al., 2002); and (b) capacity to scale implementation to reduce the staggering delays that exist for accessing early ASD-specialized intervention (Carbone et al., 2013; Ibañez et al., 2019; Tomlin et al., 2013).

The Part C Early Intervention (EI) system, funded under the Individuals with Disabilities Education Act (IDEA, 2004), has the potential to leverage that combination of factors. The majority of states in the United States provide these birth-to-three services at low cost to families of infants and toddlers with developmental disorders or delays, which may include those with ASD concerns or an ASD diagnosis (40th Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act, 2018). Per American Academy of Pediatrics guidelines, primary care providers (PCPs) are encouraged to refer toddlers who screen at risk for ASD at 18-month and/or 24-month well-child visits to Part C EI services (Johnson & Myers, 2007). As its general mission, the Part C EI system aims to provide family-centered care in the child's natural environments (e.g., at home during daily routines) to empower parents to be the best teachers for their children and use intervention strategies independently outside of the sessions. This approach includes a general emphasis on parent coaching, which can include the provider directly working with the child to demonstrate strategies to parents and/or to align with the parents' learning style (e.g., some parents prefer to learn during the EI sessions by only observing). While EI providers are experts on delivering developmentally appropriate intervention (e.g., speech-language pathologists, occupational therapists, physical therapists, and early child special educators), EI programs have reported critical shortages of providers who deliver ASD-related services (Bailey, 2008; Wise et al., 2010) and most providers working with young children are not trained sufficiently to provide ASD-specialized services (Stahmer & Mandell, 2007; Wise et al., 2010).

A primary way to disseminate an NDBI and build expertise and skills in delivering ASD-specialized services in the EI system is through knowledge transfer/translation (e.g., training workshops, intervention materials; Davis et al., 2003; Grol & Grimshaw, 2003; Khoddam et al., 2014). Before providing educational training, thorough consideration needs to be given to the selection of an appropriate NDBI, especially its complexity (e.g., intensity, duration; training time) and primary outcome targets. In their skills and expertise, EI providers are generalists who work with children and families with diverse intervention needs, rather than ASD specialists. They also have a limited amount of time to work with each family in their caseload (e.g., 1 h/wk) and limited resources available for professional training.

Relative to the majority of NDBIs, which require extended training, have high associated costs, and are high intensity, Reciprocal Imitation Training (RIT; Ingersoll, 2012; Ingersoll & Lalonde, 2010) stands out as a unique match for implementation within the EI system because it is easy to learn, low cost, and low intensity. RIT is a manualized, targeted ASD-specialized intervention that focuses on teaching object and gesture imitation within a play-based context. Imitation is a pivotal skill that provides an interactive context for learning social, play, and language skills, yet represents a core deficit area for young children with ASD (Ingersoll, 2008; Rogers, 1999). The use of RIT with children with ASD in two randomized controlled trials has been associated with improvements not only in imitation, but also in social-communication skills such as initiating joint attention, social–emotional functioning, and expressive language (Ingersoll, 2012; Ingersoll & Lalonde, 2010). Given its low intensity and playful nature, RIT is suitable for any child with delays in imitation and is unlikely to have any negative consequences if used with children with delays who do not have ASD, who represent the broad referral population in the EI system. Previous studies also suggest that it can be easy to learn as it has been implemented with fidelity by parents, undergraduate-level therapists with limited backgrounds in ASD, and siblings (Ingersoll & Gergans, 2007; Wainer & Ingersoll, 2015; Walton & Ingersoll, 2012; Zaghlawan & Ostrosky, 2016). Ease of learning the protocol is a critical dimension for fit with the EI system given that providers have to manage time constraints and apply parent coaching to empower families with effective strategies.

One pivotal next step for better understanding the implementation and effectiveness of NDBIs such as RIT is to conduct pragmatic clinical trials, which take place in community-based settings and pay special attention to key implementation strategies and factors (e.g., feasibility) that impact adoption and sustainability (Merali & Wilson, 2017; Patsopoulos, 2011; Treweek & Zwarenstein, 2009). With the exception of the Stahmer et al. (2020) pilot study, much of the evidence available on NDBIs comes from efficacy (explanatory) studies, which are tightly controlled in order to assess causality between the intervention and improved outcomes under ideal conditions (Merali & Wilson, 2017). In contrast to these trials, pragmatic (effectiveness) trials examine the implementation of the intervention in the "real world" settings for which they were ultimately intended, and with the embedded clinicians and providers who will be using them (Loudon et al., 2013; Patsopoulos, 2011). As such, pragmatic trials are more ecologically valid and tend to have fewer restrictions for eligibility criteria and intervention delivery, which allows providers to exercise flexibility with "who" and "how" they implement an intervention (Loudon et al., 2013; Patsopoulos, 2011). These affordances may help shed light on how EI providers make decisions regarding the child characteristics that prompt them to initiate treatment and how they modify the primary intervention content and components to meet the needs of the families and the demands of the naturalistic setting. These decisions may have a substantive impact on treatment fidelity—delivering the intervention in the way in which it was designed and intended—and, consequently, also alter its effectiveness (Stirman et al., 2013; Stirman et al., 2019; Vivanti & Stahmer, 2018).

The current pragmatic trial study examines the implementation of RIT by community EI providers serving toddlers from birth to 3 years. Specifically, we examined the: (a) effectiveness of a 1-day training workshop for increasing EI providers' self-efficacy from a baseline period to 12-months post-RIT training for skills that are essential when providing intervention to toddlers with ASD or ASD concerns; (b) key implementation factors related to providers' use of RIT (i.e., adoption, feasibility, and perceived effectiveness); (c) child characteristics that lead to RIT initiation; and (d) types of RIT modifications implemented.

METHOD

Overview and approach

This study was part of a larger study which examined early ASD screening and intervention in primary care and early intervention across four diverse counties in Washington State (WA) and collected data remotely (Broder Fingert et al., 2019; see Ibañez et al., 2019 for study protocol and supplementary CONSORT checklist). To examine provider intervention practices and implementation of RIT, an interrupted time-series design was applied, with RIT training workshops for EI providers representing the "interruption". The time-series consisted of four time points: baseline 1 (12–18 months prior to RIT training; T1), baseline 2 (3 months prior to RIT training; T2); 6-month follow-up (6 months after RIT training; T3); and 12-month follow-up (12 months after RIT training; T4). This design provides the strongest inferences when direct randomization to a training/treatment condition is not possible (Cooper, 2006) and controls for any externally driven self-efficacy trends with the two baseline time points. The study was reviewed and approved by the Institutional Review Board (IRB) at the University of Washington and all participants provided informed consent.

Procedures

Counties were initially identified and selected for possible participation based on: (a) demographic diversity; (b) the presence of local champions who facilitated connections between the research team and local agencies; and (c) interest from service providers (i.e., EI providers and

TABLE 1 County demographics

	County 1	County 2	County 3	County 4
Distance from diagnostic services in Seattle (miles)	61	84	143	279
Population size	118,222	75,621	246,977	475,735
Population density (people per square mile)	60.9	31	56.4	3481
% with Bachelor's degree or higher	24%	15%	16%	29%
% infants served by WIC	51%	57%	76%	51%
% White	76%	85%	46%	86%
% Hispanic	17%	9%	46%	5%
% Other (combined)	7%	6%	8%	9%

Primary Care Providers, who participated in the larger study). The counties varied on sociodemographic factors, including population size and density and the percent of the population which was Hispanic (see Table 1; Ibañez et al., 2019).

The research team met with EI agencies to provide study details, including describing RIT and the training workshop, receiving feedback, and assessing interest in participation. It was initially planned that in each county, two EI agencies with 10 providers each would participate. However, the final number of EI agencies varied by county, ranging from 1 to 5, with the most agencies in the largest county (i.e., County 4). The overall number of EI providers enrolled exceeded our initial targets. A total of 87 EI providers from 9 agencies in 4 counties were enrolled. The current sample comprised 66 EI providers who had at least one baseline time point (T1 and/or T2) and one follow-up time point (T3 and/or T4); see Table 2 for provider demographics.

EI Providers completed self-report surveys describing their intervention practices and self-efficacy at T1–T4. At T3 and T4, they provided information about RIT adoption, RIT feasibility, and perceived RIT effectiveness. At T4, they indicated which child characteristics led them to use RIT and what types of modifications to RIT they had implemented. See Figure 1 for recruitment, eligibility, and measure completion flow.

TABLE 2 Demographic characteristics of EI providers

	RIT users ($n = 56$)	Non-RIT users ($n = 10$)
County: *n* (%)		
County 1	5 (8.9)	0 (0)
County 2	6 (10.7)	2 (20.0)
County 3	6 (10.7)	1 (10.0)
County 4	39 (69.6)	7 (70.0)
Gender: *n* (%)		
Female	49 (87.5)	9 (90.0)
Male	3 (5.4)	1 (10.0)
No response	4 (7.1)	0 (0)
Race: *n* (%)		
White	50 (89.3)	10 (100)
Other	2 (3.6)	0 (0)
No response	4 (7.1)	0 (0)
Ethnicity: *n* (%)		
Hispanic	0 (0)	1 (10.0)
Non-Hispanic	48 (85.7)	8 (80.0)
No response	8 (14.3)	1 (10.0)
Professional background: *n* (%)		
Speech–language pathologist	28 (50.0)	0 (0)
Occupational therapist	11 (19.6)	3 (30.0)
Physical therapist	6 (10.7)	3 (30.0)
Family resource coordinator	2 (3.6)	2 (20.0)
Other	9 (16.1)	2 (20.0)
No response	0 (0)	0 (0)

RIT training workshops

Counties were randomly assigned (i.e., random permutation/shuffling) by the biostatistician to the timing of their training workshops using a stepped wedge approach (Ibañez et al., 2019) with four consecutive 3-month blocks. Within each 3-month training window, individual EI programs within the county received a 1-day workshop followed by a technical assistance period, during which they could ask the research team for clarification.

RIT training was conducted via a 1-day, in-person workshop for providers in each agency. These workshops were each led by two Clinical Psychology Doctoral Students, who were supervised by PI WS and Co-I LI. As part of a previous pilot project, all members of the research team were directly trained to deliver the training workshop by Dr. Brooke Ingersoll, the developer of RIT, who also shared her training materials and served as a consultant in the current study. All workshops followed a standard schedule, slide deck, and set of interactive activities. The workshop described the imitation impairments in ASD, the evidence-base on RIT, the RIT cycle steps, strategies for parent coaching, and provided live demonstrations with opportunities for direct, hands-on

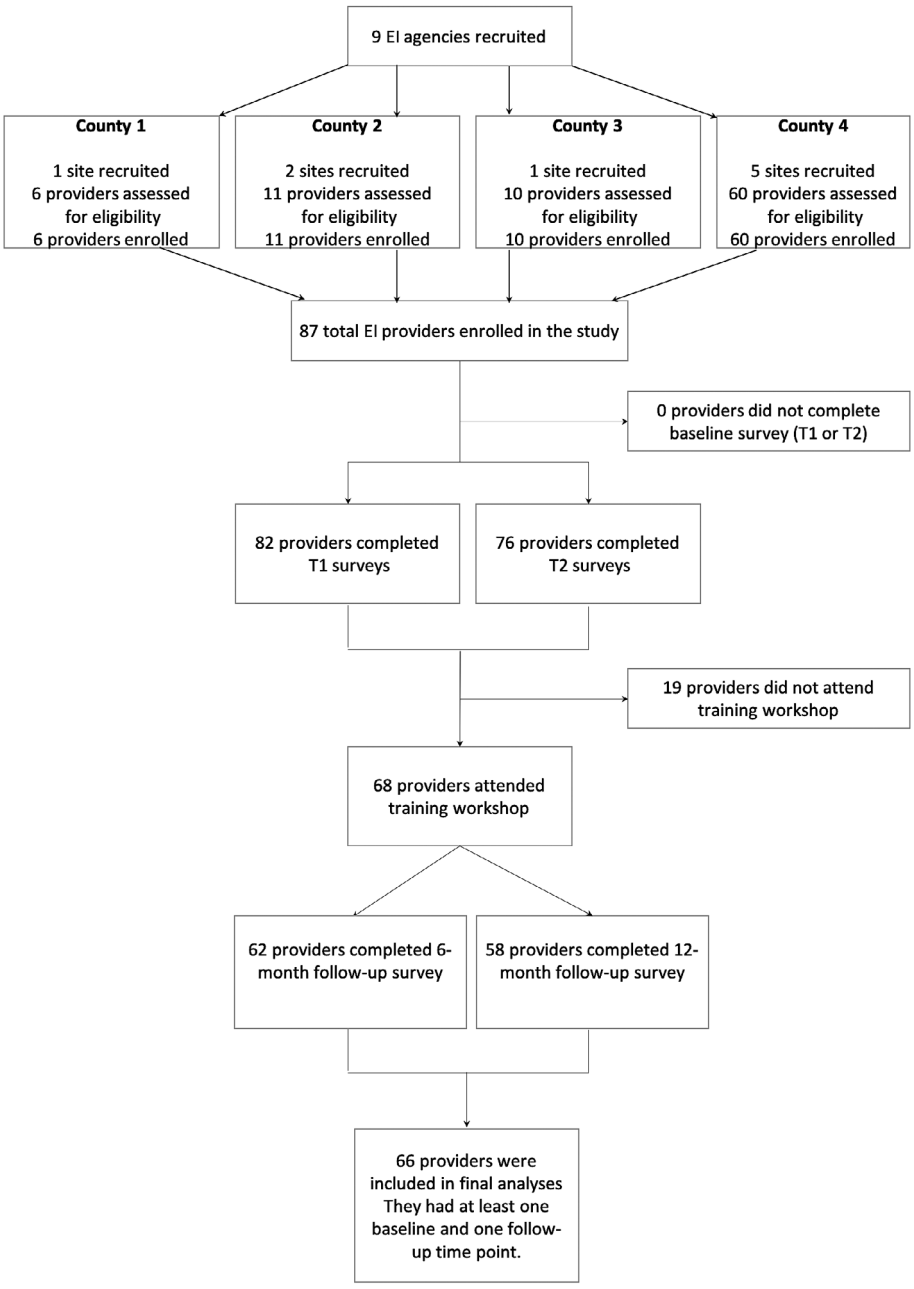

FIGURE 1 Study recruitment, enrollment, and data collection flow chart

practice with volunteer families. As part of the parent coaching portion of the training, EI providers were given strategies on how to provide families guidance and constructive corrective feedback on how to implement each step of the RIT cycle. The providers also received several supplementary documents, including the formal RIT manual, fidelity checklist, data forms to track child progress, and simple handouts for parent coaching (e.g., an RIT cycle "pocket" guide). All documents were referred to and emphasized during the training presentation and interactive activities. During the RIT cycle, the adult begins the session by imitating the child's actions, and then models a new action every 1–2 min. If the child does not spontaneously imitate on the third trial, the adult physically prompts the child to imitate, provides praise, and then proceeds to imitate the child once again. In line with the pragmatic trial approach, EI providers were afforded flexibility in implementing RIT in terms of the location of treatment and the number of treatment hours per week. They were also encouraged to coach parents in its use to maximize the amount of time a child received RIT beyond the providers' in-person sessions with the families. During the technical assistance period, the research team offered to provide more in-depth feedback for fidelity (e.g., review of video-recorded sessions) for interested EI providers at each agency/program and a webinar to discuss questions or experiences with RIT they would like to share. None of the providers sought

out additional feedback on fidelity, only three signed up and attended the webinar, and there were only two general inquires submitted to the research team.

Measures

At T1–T4, EI providers completed a self-report *Practices and Efficacy Survey*, which collected information on demographics, current practices, and self-efficacy. Self-efficacy was measured via four items, framed as statements, that covered the areas of identifying and developing treatment goals, providing parent coaching, and providing direct services to children with ASD. Providers rated their level of agreement with each statement on a bipolar 4-point Likert scale ranging from "strongly disagree (1)" to "strongly agree (4)". These items demonstrated high internal consistency reliability, $\alpha = 0.90–0.92$, and were averaged to obtain a mean self-efficacy score that ranged from 1 to 4, with higher scores indicating higher levels of perceived self-efficacy.

At T3–T4, they also completed the self-report *RIT implementation Survey*, which measured RIT adoption, feasibility, and perceived effectiveness, as well as the characteristics of children for whom it was used (T4 only), and the type of modifications they made to the RIT intervention (T4 only). For RIT adoption, providers responded to three items: (a) whether they had used RIT since the training workshop; (b) with how many children in their caseload they used RIT; and (c) how many parents they coached in the use of RIT. Their response on the first item was used to identify RIT users and nonusers in the analysis section. For RIT feasibility, five items examined EI providers' attitudes about how RIT fits with their current practices, profession, and setting, as well as the resources and materials needed to implement RIT; these items were selected and adapted from the *User Rating Profile-Revised* (Briesch et al., 2013). Their level of agreement with statements was rated on a 4-point, bipolar Likert scale ranging from "strongly disagree (1)" to "strongly agree (4)". The five items demonstrated high internal consistency reliability at T3 and T4, $\alpha = 0.84–0.85$. Items were averaged to obtain a mean perceived feasibility score that ranged from 1 to 4, with higher scores indicating higher levels of feasibility.

For perceived RIT effectiveness, three items examined RIT's effectiveness for improving children's imitation, social interactions, and communication. EI providers rated their level of agreement with each statement on a 5-point, bipolar Likert scale ranging from "strongly disagree (1)" to "strongly agree (5)", with the zero point at "neutral (3)." The three items demonstrated high internal consistency reliability at T3 and T4, $\alpha = 0.85–0.87$. Items were averaged to obtain a mean score that ranged from 1 to 5, with higher scores indicating higher levels of effectiveness.

To describe the child characteristics that led them to use RIT, EI providers responded to six options (i.e., "check all that apply"): (a) child screened positive on an autism-specific tool; (b) child had received an ASD diagnosis; (c) child was on a waitlist for an ASD evaluation; (d) child had social communication delays; (e) child had motor imitation delays; and (f) other (fill-in option). To endorse the factors that led to RIT modifications, EI providers also responded to five options (i.e., "check all that apply"): (a) child characteristics; (b) parent characteristics; (c) provider's own preferences; (d) agency characteristics; and (e) other (fill-in option). EI providers who selected any of the responses were also asked to describe the modifications in an open-ended question.

Using deductive qualitative coding, providers' descriptions of RIT modifications were classified into categories adapted from Stirman's framework (Stirman et al., 2013, 2019). The study authors conducted an initial review of the responses to develop the specific coding scheme and 7 of the 14 original Stirman categories were determined to be relevant. These categories were condensed into four categories due to conceptual overlap. The four final categories comprised: (a) *removing/skipping elements* of the RIT cycle; (b) *substituting an element* of the RIT protocol with another action; (c) *integrating RIT* with another treatment or discipline-specific therapy; and (d) *loosening the RIT structure*, which was coded when the response did not fit any of the other three categories, but the provider reported an adjustment to the order, duration, or repetition of steps. Two coders with expertise on RIT and intervention practices independently coded all responses and demonstrated high levels of agreement for each category, greater than 80%.

RESULTS

Analyses overview

Sixty-six providers met the inclusion criteria and were included in the analyses. Demographic variables for EI providers completing surveys only at baseline versus at both time points were compared using Student's *t*-test or Chi-squared test, as appropriate. The trajectory of provider self-efficacy for providing intervention services to children with ASD or ASD concerns from T1 to T4 was examined using Hierarchical Linear Modeling (HLM). Descriptive statistics were used to examine RIT adoption, RIT feasibility, and perceived RIT effectiveness at T3 and T4, and child characteristics that led to RIT usage and types of RIT modifications T4.

Provider self-efficacy

A two-level HLM using Maximum Likelihood estimation (Singer & Willett, 2003) to avoid list-wise deletion was conducted via RStudio (nmle package) to determine whether there were differences in self-efficacy providing

services to families with ASD/ASD concerns from pre-training to post-training. At T1, there were no significant differences for self-efficacy between the EI providers with and without post-treatment data, $p = 0.44$, indicating data were missing at random. At Level-1, time effects were modeled through three dummy time vectors coding for T1 through T4 to allow for direct comparisons between: (a) the two baseline periods (T1 vs. T2) to account for any changing trends in self-efficacy prior to RIT training; and (b) T3 and T4 and T2 (i.e., baseline immediately preceding RIT training); these predictors were modeled as random effects. RIT use (i.e., EI providers who reported using RIT [$n = 56$] or not using it post-training [$n = 10$]) was explored as a Level-2 predictor of random effects.

For provider self-efficacy, the final model had: (a) a significant intercept ($b = 2.22$, *s.e.* $= 0.18$, $p < 0.001$); (b) no significant difference between T1 and T2 ($b = 0.03$, *s.e.* $= 0.07$, $p = 0.63$); and (c) significant increases from baseline T2 to T3 ($b = 0.25$, *s.e.* $= 0.07$, $p < 0.001$) and from baseline T2 to T4 ($b = 0.20$, *s.e.* $= 0.08$, $p < 0.01$). RIT users had significantly higher overall levels of self-efficacy than non-users ($b = 0.72$, *s.e.* $= 0.18$, $p < 0.001$); there were no significant interactions between RIT use group and the time vectors, ps ≥ 0.31.

RIT adoption

Overall, 56 out of 66 (85%) EI providers reported using RIT at least at one post-training time point. At T3, 48 of 62 providers (77%) reported using RIT with a total of 349 children and coaching 269 parents. At T4, 47 of 58 providers (81%) reported using RIT with 459 children and coaching 343 parents. The non-RIT users ($n = 10$) indicated that they had not adopted RIT because they: (a) referred children in their caseload to receive RIT from another provider; (b) had not worked with children with ASD concerns since the workshop; and/or (c) were no longer providing direct intervention services.

RIT feasibility

EI providers who used RIT reported high levels of perceived RIT feasibility at T3 ($n = 48$; $M = 3.43$, $SD = 0.44$, median = 3.40) and T4 ($n = 47$; $M = 3.39$, $SD = 0.45$, median = 3.20), as the overall mean and median scores reflected an average of "3" (i.e., "agree") across the five items.

RIT effectiveness

EI providers who used RIT reported high levels of perceived RIT effectiveness at T3 ($n = 48$; $M = 4.24$, $SD = 0.66$, median = 4.00) and T4 ($n = 47$; $M = 4.12$, $SD = 0.66$, median = 4.00), as the overall mean and median scores reflected an average score of "4" (or "agree") across the three items.

Child characteristics that lead to RIT initiation. At T4, the majority of the 47 EI providers endorsed all of the response options: the presence of social communication delays (93%); motor imitation delays (81%); a formal ASD diagnosis (70%); not responsive to other treatment (62%); screened positive on ASD-specific screening tool (60%); and on a waitlist for a formal ASD diagnosis (51%). Importantly, 43 of 47 EI providers (91%) indicated using RIT with children with disorders other than ASD.

RIT modifications

At T4, 20 providers using RIT (43%) indicated making RIT adaptations due to their own clinical style (80%), child characteristics (60%), parent/family characteristics (50%), and/or program-related constraints (20%). Across the 22 modifications reported in the open-ended responses, three comprised the majority: removing/skipping elements (32%), integrating RIT with other therapy strategies (32%), and loosening structure (32%), while substituting elements of RIT comprised only 4%. Examples of removing/skipping elements were: "I do not hand-over-hand physical prompt if I feel it is going to sabotage my therapy session," and "[I] back off handling and follow child's lead which resorts to just a play session, but hopefully builds rapport." For loosening structure, providers stated, "I …may model less times or continue to "fish" for a motivating activity that will capture attention a bit longer" and "I don't always model exactly three times followed by hand over hand." For integrating RIT with another treatment or discipline-specific therapy, some EI providers indicated that they, "combine [RIT] with more specific speech targets and attend to a speech model" and "combine RIT with other strategies." For substituting elements, an EI provider indicated that, "it depends on the child what type of motivator I use instead of loud verbal praise."

DISCUSSION

To our knowledge, this is only the second study to examine the implementation of an NDBI (i.e., RIT) in an EI community-based setting (Stahmer et al., 2020). An interrupted-time series design, which included a training workshop as the "interruption," was applied to examine: (a) improvements in EI providers' self-efficacy for providing intervention services to children with ASD/ASD concerns from T1 to T4; (b) key implementation outcomes (i.e., RIT adoption, RIT feasibility, perceived RIT effectiveness); and (c) characteristics that were related to *how* they used RIT (i.e., child characteristics and

modifications) during the 12-month period after training. The training workshop increased self-efficacy across all EI providers, with RIT users having higher overall levels than non-users across time. The majority of EI providers reported using RIT during the 12 months following their training workshop, which was associated with high levels of perceived feasibility and effectiveness in improving child outcomes. They initiated RIT with children with ASD concerns as well as those with other disorders. Modifications were made by EI providers not only to meet the specific needs of the families in their caseload, but also to accommodate their own clinical preferences. Overall, these findings suggest that implementing RIT in an EI setting may offer a realistic route for improving widespread access to early, ASD-specialized treatment for toddlers with ASD or suspected ASD.

Fundamental to the implementation of an evidence-based practice is a provider's sense of self-efficacy regarding its use. Our results suggest that a relatively brief format for knowledge transfer (Pentland et al., 2011; Prihodova et al., 2019)—a 1-day workshop—increased EI providers' sense of self-efficacy in identifying and discussing treatment goals, and providing direct services and parent coaching when working with families with ASD/ASD concerns. As several frameworks for implementation and professional decision-making suggest (e.g., theory of planned behavior; Promoting Action on Research Implementation in Health Services), the likelihood that EI providers will implement a new intervention partially depends on their perceived expertise and behavioral control, which includes how confident they feel about being able to perform specific skills (Ajzen, 1991; Haynes et al., 2002; Kitson et al., 2008). Interestingly, it appears that providers who went on to use RIT had higher overall levels of self-efficacy than non-users, which may also be an important determinant and predictor for adoption. Furthermore, it seems that lack of opportunity (e.g., no children with ASD concerns in caseload) also partially contributed to some providers not implementing RIT after the training workshop.

In addition to feeling confident in delivering services to families with ASD/ASD concerns, the majority of EI providers used RIT with their caseload and rated it highly on feasibility. Feasibility is closely related to adoption because it indicates that EI providers consider RIT to be a good fit with their context, mission, and demands (Damschroder et al., 2009; Glasziou & Haynes, 2005; White, 2018), which is significant given some of the logistical constraints they encounter (e.g., limited time; other intervention goals). Given that feasibility is also a determinant of sustainability (Barwick et al., 2020), it is notable that these ratings remained high 12 months post-training, after EI providers had likely established a large experience-base with RIT.

Importantly, EI providers perceived RIT to be effective not only for improving motor imitation skills, but also for improving other pivotal outcomes such as social interactions and communication. These findings are consistent with previous studies employing RIT in one-on-one clinical settings (Ingersoll, 2012; Ingersoll & Lalonde, 2010), and point to the high translational potential of this approach. Additionally, EI providers indicated that their use of RIT was not limited to children with ASD concerns, suggesting its broader applicability in EI settings, when diagnostic information is often not yet available. Overall, RIT may have a *relative advantage* over the other strategies available to providers because they directly observed the effectiveness and benefits of the intervention (Damschroder et al., 2009). Within the CFIR framework, relative advantage has been described as the ultimate "sine qua non" condition for successful adoption and sustainability (Barwick et al., 2020). These findings align with our a priori rationale for selecting RIT as the NDBI of focus in the study. We believe that embedding RIT in the EI system may facilitate a *preventive intervention* approach, in which toddlers who show signs or risk for ASD begin receiving the intervention while they wait for diagnostic evaluation. Another potential advantage is that it will strengthen PCPs' motivation to screen toddlers for ASD since it may actually lead to the tangible benefits of timely access of ASD-specialized services through the local EI system.

At 12-month follow-up, 43% of providers using RIT reported making modifications not only because of child and/or parent characteristics, but also because of their own clinical preferences. In applying Stirman's Framework (Stirman et al., 2013, 2019) to the open-ended responses, some modifications appeared to directly alter the core components of RIT (i.e., removing/skipping, substituting, and/or loosening the structure), while others integrated RIT with other therapeutic strategies. While the present study cannot determine the extent to which these modifications optimized RIT effectiveness or detracted from it, these types of changes do have significant implications for treatment fidelity. It is notable that while providers reported using RIT directly with 459 children, only 343 were receiving parent coaching, which may represent another way provider decision-making is influenced by parent and child characteristics.

Because optimizing an evidence-based intervention for "real-world" use is an iterative cycle (Curran et al., 2012; Sampson & Torres, 2015), changes to key RIT elements may lead to: (a) developing new versions of RIT if the changes are shown to optimize effectiveness; or (b) making enhancements to current RIT training for EI providers to provide guidance on which modifications should be avoided because they minimize effectiveness. Furthermore, integrating or blending RIT with other intervention strategies represents both an "elephant in the room" and a "black box" for treatment fidelity outside of research-focused settings, where the internal validity of a specific intervention is a top priority (Foster & Little, 2012; Nelson et al., 2012; Patsopoulos, 2011). Clinicians in the "real-world" incorporate different

approaches that align with their clinical training and preferences, while also potentially combining conflicting principles. Such blending makes disentangling the effects of different intervention strategies, measuring treatment fidelity, and identifying "active ingredients" a difficult and impractical process with questionable ecological validity (Nelson et al., 2012).

As the field continues to move forward with pragmatic/effectiveness trials about RIT and other NDBIs, researchers need to further characterize and understand provider decision-making, treatment modifications, and effectiveness (Nelson et al., 2012; Vivanti & Stahmer, 2018). Some "deep dive" techniques for addressing these areas include applying principles of community-based participatory research (e.g., interviews, focus groups to gain provider insights; Maguire & Britten, 2019), service design (co-creation and production; Ku & Lupton, 2020; Stickdorn et al., 2018), and objective measurement (e.g., videotapes sessions, dosage logs; Stahmer et al., 2015; Wilczynski et al., 2017). These techniques help establish a more *active research* paradigm (Hughes et al., 2008; Wallerstein et al., 2017), which has the potential to facilitate a faster iterative process for implementation and intervention development and reduce the theory-to-practice gap. Active dialogues with providers about the design of the training curriculum can be productive for increasing engagement and attendance by identifying special considerations related to time constraints (e.g., loss of billable hours) and creating clear and mutual value propositions for each component (e.g., meaningful learning objectives/outcomes). Such dialogues may help overcome challenges to training engagement as observed in the current study during the 3-month TA period when providers did not show interest in participating in post-training webinars or opportunities for fidelity feedback as offered. They may have not viewed these additional training components as adding value and/or requiring too much effort and, thus, were not motivated to attend. Overcoming such a challenge is critical given that 1-day workshops may not be sufficient for learning more comprehensive NDBIs (Stahmer et al., 2015). Additionally, the field needs to develop validated instruments for measuring both global and proximal implementation outcomes that are specifically tailored to NDBIs. While the field of implementation science has developed several instruments for key factors such as feasibility and implementation climate, those measures tend to have items that are not applicable and/or need to be edited for content to improve relevancy for the context and/or treatment. Overall, further investigation is needed to understand how to best balance the tension between rapidly disseminating NDBIs, carefully monitoring treatment fidelity (i.e., adherence and dosage), and measuring effectiveness; the latter two factors ultimately determine if an intervention is truly feasible and viable in a community-based setting (Vivanti & Stahmer, 2018; Wilczynski et al., 2017).

While this study applied an innovative design (i.e., pragmatic trial) and had notable strengths, including an extended baseline and 12-month follow-up period, there are also limitations that need to be considered. There was no direct assessment or observation of treatment fidelity (i.e., adherence to intervention protocol, dosage), modifications, or the effect of RIT on child outcomes because the study was conducted remotely; all outcomes were based on provider self-report. This significant limitation introduces the possibility that improvements in self-efficacy and high ratings on other outcomes may have reflected a social desirability response. Relatedly, we were also unable to dive deeper into understanding the factors (e.g., context, child-specific needs, parent preferences, clinical training background) that may drive provider decision-making around the modifications they indicated in their open-ended survey responses; interviews and focus groups would be better suited for generating such insights. Furthermore, despite demonstrating strong internal consistency, the data collection measures used were new and developed by the research team due to the lack of validated implementation surveys and the need to not overly burden community providers with extensive questionnaires. Finally, while EI providers appeared to have a great deal of autonomy in how they chose to implement RIT with families in their caseload, we did not directly assess other influential dimensions in the implementation process, including the EI providers' inner (e.g., leadership engagement, organizational factors) and outer setting (e.g., external policies).

In sum, a relatively brief training for EI providers led to increases in their sense of efficacy and to widespread use of an evidence-based ASD treatment over the course of 1 year after receiving training. The effectiveness of the 1-day workshops likely reflects goodness of fit between RIT's simple intervention protocol and targeted focus and the EI system's priorities and values. RIT seems promising as an accessible treatment that can help families get an early start on receiving ASD-specialized services within an established infrastructure available across the United States. These findings also have implications for how other NDBIs, particularly those that are low intensity, may be implemented and evaluated in similar community-based settings.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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