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Caregiver-Implemented Intervention for Communication and Motor Outcomes for Infants and Toddlers

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Abstract

The purpose of this study was to examine the effects of coaching caregivers to embed both communication and motor outcomes concurrently within daily routines of their infants or toddlers with significant disabilities using Enhanced Milieu Teaching (EMT) strategies. The coaching and embedding practices were part of a multicomponent intervention known as Embedded Practices and Intervention with Caregivers (EPIC). Three children, aged 15 to 23 months with significant disabilities, their caregivers, and an early intervention provider participated in this single case multiple probe design study. Primary dependent variables were caregivers' number of naturalistic teaching strategies used and rates of correctly embedded instruction for each learning target in each routine. Child motor and communication outcomes were also examined. Results provide initial support for the positive effects of the EPIC approach using EMT strategies to embed intervention on two developmental domains concurrently in caregiver's daily routines.

Keywords

infants and toddlers, caregiver coaching, embedded intervention, significant disabilities, caregiver-implemented intervention for motor and communication outcomes

Research on effective practices and program models for improving short- and long-term outcomes of infants and toddlers has increased markedly over the past decade; however, relatively little research has focused on infants and toddlers with significant disabilities (Hebbeler, Spiker, & Kahn, 2012). More than 20% of children enrolled in Part C services have diagnosed congenital, neurological, or other conditions which are likely to result in significant delays in multiple domains of development. This population includes children with genetic syndromes such as Down syndrome, cerebral palsy or other motor impairments, sensory impairments, and children who have physiological or neurological impairments (Hebbeler et al., 2007). Two identified needs for supporting these children and families are (a) effective, efficient approaches for supporting caregivers to embed learning opportunities in everyday routines and (b) the identification of intervention strategies to address outcomes in multiple developmental domains (Dunst & Espe-Sherwindt, 2016; Guralnick, 2017).

Children with significant disabilities often evidence delays in communication and motor skills and these are often intervention priorities (Horn & Kang, 2012). Examples include communication outcomes such as using gestures and words to make requests and motor outcomes such as being able to walk from room to room or independently play with toys. These skills are integral to participation in everyday routines and serve as a foundation for independence. While interventions that address communication needs for young children (e.g., Enhanced Milieu Teaching [EMT]; Kaiser & Trent, 2007) have been shown to produce positive outcomes, meta-analyses indicate that evidence for effectiveness of motor interventions is limited (e.g., Case-Smith, Frolek, Clark, & Schlabach, 2013). Also, limited research exists on systematic interventions designed to address multiple learning domains concurrently. Caregivers of children with significant disabilities may find that specialized interventions which address a single developmental domain are not expedient, requiring the caregiver to address one outcome at a time with the child or to learn different interventions for each outcome. Given increasing emphasis on the use of everyday routines and activities as the context

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for intervention (Division for Early Childhood [DEC], 2014), caregivers' interests in addressing multiple outcomes, and the dearth of cross-domain research, we argue that an integrated approach merits examination. This approach is characterized by a process in which (a) providers coach families to embed one set of intervention strategies addressing multiple outcomes into daily routines, and (b) the caregivers use these strategies to support the child's development across domains and everyday routines.

Caregiver-implemented interventions are predicated on the assumption that parents have more opportunities to embed learning targets in meaningful everyday activities than are offered by traditional home visiting practices or clinic-based therapies. Increased opportunities provide more repetition, which is critical for children with significant disabilities who often need many instructional trials to acquire skills. While specific approaches to coaching parents in their natural environments differ, there is general agreement that to improve their children's developmental outcomes, caregivers need to (a) understand their child's learning objectives, (b) identify opportunities for child participation in everyday routines, (c) use instructional strategies flexibly for different learning objectives and across different activities, (d) recognize when additional support or adaptations are needed for the child, and (e) recognize when new learning objectives are appropriate (Dunst & Espe-Sherwindt, 2016).

To support caregivers in embedding instruction, providers must use effective adult learning strategies (Knowles, Holton, & Swanson, 2011). Family-Guided Routines-Based Intervention (FGRBI) has shown promise as an effective and efficient approach for supporting caregivers to embed learning opportunities in everyday routines for children with or at risk of delays in multiple domains (Brown & Woods, 2015, 2016; Krick Osborn & Johnson, 2015). This approach aligns with recommended adult learning and family capacity building strategies by engaging the caregiver as the decision maker; gaining consensus on the child's learning priorities; using everyday routines and activities as contexts for embedding instruction; providing ongoing caregiver practice with support and feedback; and engaging the caregiver in problem solving, reflection, and planning for how they will embed intervention (Woods, Wilcox, Friedman, & Murch, 2011). The FGRBI coaching framework includes Setting the Stage for the current session, Observation and Opportunities for Practice, Problem Solving and Planning, and Reflection and Review (SOOPR). FGRBI is not discipline or strategy specific; it is a flexible framework for delivering child intervention strategies to caregivers that allows the caregiver to embed different types of targets and naturalistic instructional strategies within and across routines. Recent studies have shown FGRBI to be a promising approach for increasing caregiver capacity and competence for supporting the communication of young children with varying disabilities (Brown & Woods, 2016) and that, when coached across two or more types of routines, caregivers are more likely to generalize the use of strategies to uncoached routines, thus increasing the number of embedded intervention opportunities children may receive (Kashinath, Woods, & Goldstein, 2006).

To embed intervention, caregivers must have effective strategies for supporting the child's targeted skills. We propose that introducing one set of intervention strategies to address outcomes in multiple domains may reduce the cognitive load on caregivers and increase opportunities to embed intervention across multiple domains. There is agreement that naturalistic approaches across domains share four characteristics: (a) they occur in everyday activities and routines, (b) targeted skills are usually those needed to participate in those activities and routines, (c) learning opportunities or "trials" occur in response to child's requests or attention, and (d) the child's response is always followed by a logical consequence, making the opportunity "meaningful" for the child (Snyder, Hemmeter, McLean, Sandall, & McLaughlin, 2013). EMT possesses each of these characteristics but has not been examined with motor outcomes.

EMT is a well-defined and researched caregiver-implemented intervention that emphasizes parent responsiveness and has been shown to be effective for improving language and social communication for young children with language and developmental delays (Kaiser & Roberts, 2013; Kaiser & Trent, 2007; Wright & Kaiser, 2016). The core strategies of EMT include arranging the environment to promote communication, noticing and responding to all child communication, modeling and expanding on child communication, time delay, and least-to-most support prompting procedures occurring in response to child's interests. Consistent with the DEC (2014) recommended practices, these strategies occur in natural environments and are intended to increase child opportunities to practice targeted skills, provide reinforcement through meaningful consequences, and provide extra support when needed.

At this time, there is not a motor intervention with a similar research base to that of EMT. One motor intervention examined by Horn, Jones, and Warren (1999) shared some of the features noted above. Interventionists arranged the environment to promote engagement, cued children to perform their target skills, and provided access to toys or social reinforcement (Horn et al., 1999). The strategies of environmental arrangement and time delay closely match the strategies described for promoting opportunities within the Horn et al. study, and both interventions place emphasis on providing meaningful consequences. We propose that given its adherence to a naturalistic approach and alignment with the recommended practices described above, EMT may be appropriate for use with motor outcomes as well as communication outcomes. To date, EMT has only been used to

Table 1. Four Categories and Associated EMT Strategies Applied to Both Communication and Motor Domains.

Strategies	Examples
Environmental arrangement	
Positioning	Arrange adult's body or location of toys/materials to support child's movement
Choosing materials	Motor: Materials that require two hands to operate; materials that are the correct height for pulling up Communication: Materials that support engagement
Arranging materials	Motor: A toy on couch to encourage pulling up; toy on chest to promote hands to midline; diaper on child's chest to encourage hands to midline Communication: Toys just out of reach to encourage a request
Assistance needed	Communication: A container that needs opening, requiring child to reach for or request more
Small portions	Motor: A limited number of blocks so that the child must reach with both hands for the container or attempt to use wrist rotation to open the container Communication: A limited number of blocks so that the child must reach to request
Contingent responding (Notice and Respond plus Model and Expand)	
Notice and Respond	Respond to all child communicative and target motor skill attempts; ensure logical consequence for target behaviors (e.g., child receives materials or social reinforcement)
Balance turns	Put item in, wait for child's turn; roll ball back and forth with child; take turns vocalizing
Model	Motor: Model banging blocks at midline; model using two hands to operate toy Communication: Model pointing at child's object of interest; model vocalizing with consonants or using single words
Expand	Motor: Imitate child's current behavior and model next level (e.g., hold toy in two hands, push buttons; catch and throw; model holding diaper with two hands, give to child) Communication: Imitate child's gesture and add a word; imitate and add word to vocalization
Wait time (time delay)	
	Motor: Hold cup in hands, wait for child to grasp with both hands; rather than activating toy, wait for child to hold with one hand and activate toy (and assist as needed) Communication: Hold favorite toy in sight, wait for child to reach to request; say "on/off" several times while turning musical toy on and off, and then turn off and wait for child to vocalize
Prompting	
	Motor: Physically prompt child to place both hands on cup; provide hand over hand prompt; provide physical cue to pull up Communication: Offer child verbal choice; ask child "what do you want"

Note. EMT = Enhanced Milieu Teaching.

target communication goals. Because many children with significant disabilities also have motor delays and because this is often a priority outcome for caregivers, the ability to use EMT strategies to address both domains may increase their ability to support multiple child targets while providing the child added opportunities across routines. See Table 1 for a list of EMT strategies and how they may be used for communication or motor outcomes.

Context for the Present Study

The present study took place during a larger multisite project, the Embedded Practices and Interventions with Caregivers (EPIC) project. Key components of the EPIC approach include (a) the use of the FGRBI coaching framework for providers, (b) a 5-Question (5Q) framework and Visual Model for supporting caregivers to plan how they will embed intervention, and (c) a frontloading approach in which visits occur with greater frequency in the beginning and taper off as the caregiver demonstrates competence with the strategies (for further description of the EPIC home visit process, see Salisbury et al., 2018). Each of three project sites conducted a single case design (SCD) study. The primary purpose of the present study was to examine whether one well-established set of naturalistic teaching strategies, EMT, could be extended for caregivers teaching both communication and motor skills concurrently to infants and toddlers with significant disabilities within and across routines.

Specific research questions included the following: Is there a functional relation between the use of the FGRBI coaching approach and caregivers' use of correct learning trials (CLTs) to address motor and communication skills? Is there a functional relation between the use of the FGRBI coaching approach and use of EMT strategies? Is there a functional relation between the use of the FGRBI coaching approach and use of EMT strategies in both play and caregiving routines and across both motor and communication targets? Are effects of the intervention on caregiver implementation of EMT and CLTs observed in generalization and maintenance contexts? Does caregiver use of EMT strategies result in increases in children's total and spontaneous

Table 2. Participant Characteristics and Intervention Program.

Demographics, Intervention Types, and Assessments	Child 1	Child 2	Child 3
Demographic characteristics			
Chronological age at entry (months)	23	16	15
Gender	Male	Female	Male
Ethnicity	Caucasian	Caucasian	Caucasian
Diagnosis	Down syndrome	Microcephaly Seizure Disorder Visual impairment	Down syndrome
Medical history	Cardiac defect Heart surgery Ear tubes	Seizures	
Caregiver age	31	21	31
Caregiver education level	High school graduate	Some college	College graduate
Household income	US$40,000–US$50,000	US$20,000–US$30,000	>US$100,000
Hours of early intervention services received per month			
Occupational therapy	4	4	4
Physical therapy	8		3
Speech and language therapy	4		4
Vision therapy		4	
Total hours per month	16	8	11
Assessment scores			
MSEL			
Visual reception (mental age in months)	14	<1[a]	12
Early learning composite[b]	50	<49[a]	69
IGDI-ECI weighted total communication rate per minute (mean normed rate)[c]	5.5 (11)	1 (7)	0.67 (6)
IGDI-EMI total score rate per minute (mean normed rate)[c]	7.83 (10)	0 (7)	2.66 (6)

Note. MSEL = Mullen Scales of Early Learning; IGDI = Infant Growth and Development Indicator; ECI = Early Childhood Indicator; EMI = Early Motor Indicator.
[a]Child 2 has a visual impairment; it was not possible to derive an accurate estimate of mental age or cognitive functioning given the weight of visual reception skills for the MSEL. [b]The mean standard score on the Early Learning Composite of the Mullen is 100. [c]Normed rate per minute estimated from normed curves on child reports on www.igdi.ku.edu.

use of motor and communication targets in play and caregiving routines?

Method

Participants

Three caregiver–child dyads were recruited and consented to participate in Tallahassee, FL. Dyads were eligible to participate if the child (a) was 12 to 30 months of age; (b) was enrolled in at least weekly home-based Part C services; (c) was independently assessed and identified as having developmental delay, defined as 2 standard deviations below the mean in one or more areas of development on a standardized assessment instrument used for eligibility determination, or met the established risk category as defined by the state Early Intervention (EI) agency (e.g., Down syndrome, cerebral palsy); and (d) the presence of significant disability was confirmed in at least two domains by the ABILITIES® index (Simeonsson & Bailey, 1991). Caregivers agreed to learn routines-based intervention strategies and provided consent for participation, including completing required study measures, videotaping of home visits, and adjustments in the frequency of home visits.

Dyads. Child participants were 15 to 23 months of age at the start of the study. Each child experienced substantial delays in both communication and motor skills based on the ABILITIES® index. In each dyad, the participating caregiver was the mother. For demographic information about participants, amounts and types of EI services received, and assessment results, see Table 2.

Interventionist. To control for potential provider-related influences on implementation and obtained effects, one provider was used across all families. The provider had a doctoral degree in speech and language pathology and 3 years' experience as a primary service provider implementing the FGRBI approach with children who had significant delays across multiple developmental domains. She had participated in a previous model demonstration project that utilized

both FGRBI and EMT strategies to support communication development for infants and toddlers. Before beginning intervention, the provider participated in an online training which included narrated modules, video examples, practice identifying coaching components, and additional published resources. The training took 6 hr over 2 weeks to complete. The provider was required to obtain a score of 80% or greater on two quizzes evaluating knowledge of SOOPR and the 5Q and to score a practice video to more than 80% reliability prior to beginning intervention sessions. During intervention, she received weekly coaching and feedback on fidelity to the coaching practices and EMT strategies. A physical therapist with 30 years of experience in EI and who was experienced in FGRBI reviewed session videos and consulted with the provider to confirm that motor goals and individual EMT strategies were developmentally appropriate, functional, and would be appropriate within a routines-based approach.

Settings and Materials

Assessment and intervention activities took place in participants' homes with the provider, the participating caregiver, and child present. A videographer recorded all baseline, intervention, and maintenance sessions using a handheld digital video camera and tripod. During the baseline condition, each family identified two preferred routines based on their typical activities and schedule. Only the materials that the family typically used were used during sessions. Generalization probes included both the family's materials and materials provided by the study. Materials included a large pop-up book, a touch-and-feel book, a toddler puzzle with chunky pieces, a noisy ball toy, two rattles, a baby's comb, a small stuffed animal, a cup, a spoon, and blocks. Each caregiver was provided with a digital video camera and a tripod to film generalization probes. In the first intervention session, the provider gave the caregiver a handout describing EMT strategies and introduced the Visual Model, a framework for caregivers to use as they planned how they would embed intervention between sessions.

Design

A multiple probe SCD across caregiver–child dyads was used to determine the effects of the intervention on the caregivers' embedded instruction. The multiple probe design was selected because the collection of time-series observational data can document changes related to implementation and growth over time. Replication across participants also serves to enhance internal validity and demonstrate experimental control (Ledford & Gast, 2018). The primary dependent variables were the number of EMT strategy types used by caregivers to initiate trials and the cumulative rate per minute of CLTs in each session (number of CLTs divided by number of minutes of caregiver–child interaction in routines). Data from each session were coded, summarized, graphed, and visually examined prior to the next session. The criterion for beginning intervention with the first dyad was a stable rate of caregiver CLTs during baseline. During the baseline condition, Dyads 2 and 3 each completed one weekly probe. When Dyad 1 demonstrated a change in level or trend of CLTs, Dyad 2 completed three consecutive baseline sessions within a 7-day period and began intervention when data were stable. Dyad 3 followed the same process. To examine whether the effects of the intervention were observed in both routines for both targets, caregiver number of EMT strategy types and rate per minute of CLTs were calculated for each of the targets in each of the routines. Child rate per minute of total and spontaneous use of targets was examined for each target within each routine in the session.

Procedures

Target selection. During assessment visits, the family and provider jointly identified one communication target, one motor target, a caregiving routine, and a play routine for the intervention sessions. The targets identified for EPIC intervention were separate from those addressed in other EI services based on parent report. Identified targets and routines are shown in Table 3.

Baseline. The duration of each baseline session was approximately 10 min. Parents were instructed to engage with their child in their jointly identified play and caregiving routines using their own materials and to "do what you would normally do."

Caregiver 5Q probe and introduction to approach and EMT. Following completion of the baseline condition, the caregiver watched a video clip of routines from the last baseline session and was asked to describe what she did to teach her child during the video. The provider then introduced the approach, the EMT "How" Strategies, and the Visual Model with descriptions and handouts. The 5Q probe and introductory session lasted approximately 1 hr.

Intervention. Intervention sessions lasted between 45 and 60 min. During the first week of intervention, each dyad participated in three intervention sessions. During the second and third weeks of intervention, each dyad participated in two intervention sessions. For Dyads 1 and 2, the final 3 weeks of intervention included one intervention visit per week. For Dyad 3, after a break in visits, two sessions were conducted in the fifth week.

Each intervention session followed the FGRBI coaching framework and referenced the 5Q. During Setting the Stage, the caregiver shared updates on each of the child's targets

Table 3. Child Targets and Routines Selected for Intervention.

Target type or Routine	Child 1	Child 2	Child 3
Motor target	Use both hands to functionally engage with an object	Bring hands to midline to engage with an object or caregiver	Pull to standing position
Communication target	Use a variety of gestures to request or comment	Vocalize to request or comment	Vocalize using two syllables with consonants
Routines	Snack or mealtime Play with objects	Diaper changing/dressing Social play and play with objects	Diaper changing/dressing Physical play and play with objects

("What"), routines that occurred in between sessions ("When/Where/Who"), strategies that were used ("How"), what worked and did not work ("Is It Working"), and reflected on "Why" the targets, routines, or strategies were important. The caregiver and provider agreed on what would occur ("What," "How," "When/Where/Who") in the current visit. During Observation and Opportunities, the provider first observed the caregiver and child in identified routines and then engaged in specific coaching practices as the caregiver continued to embed intervention. Specific coaching strategies include specific and general feedback, direct teaching (e.g., describing a practice to the caregiver), demonstration with narration of strategies by the provider, guided practice to support the caregiver in practicing new strategies, and more independent caregiver practice as the caregiver became more competent and confident (for definitions of specific coaching strategies, see Friedman, Woods, & Salisbury, 2012). Problem Solving and Planning occurred throughout each visit. The provider encouraged caregiver leadership and decision making by asking the caregiver to reflect on what worked and did not work and engaging in an exchange of ideas about how to revise or expand the intervention. During Review, the provider and caregiver reflected on the current session and planned for how the caregiver would embed intervention strategies in between visits. Using the caregiver's words, they created, revised, or reviewed a 5Q Visual Model, which served as the caregiver's plan for "What" (the learning target), "Where/When/Who" (routines and partners), "How" (which EMT strategies might apply to each goal in each routine), "Why" (why the target, routine, or strategy is important to the family), and how they would know "Is It Working" in everyday activities.

In the first intervention session, the EMT strategies (the "How" of the 5Q) were introduced using a written handout (see Table 1). In each session, the caregiver offered updates about what the caregiver and child were already doing within the identified routines. Next, the provider observed the routines, offered feedback, and suggested ways to use the EMT strategies. Finally, the caregiver and provider agreed upon strategies to practice. Dyad 1, for instance, wanted to increase opportunities for the motor goal of pulling up; the caregiver decided to use wait time when transitioning to and from the changing table, redressing the child, and standing to look at pictures that were placed above the changing table. She also used environmental arrangement, placing toys just out of reach to encourage pulling up on furniture and tying ribbons (a preferred item) onto a child's gate to increase opportunities to pull up every day.

Maintenance probes. Families participated in up to five maintenance probes. Similar to the baseline conditions, caregivers and children engaged in their identified routines without any coaching and also engaged in one additional routine identified by the parent.

Generalization probes. The caregiver was asked to videotape herself and her child one time per week for 10 to 15 min engaging in three activities. These three activities included (a) engaging in a typical play routine and a caregiving routine with the family's own materials, and (b) playing with the materials provided by EPIC as described above.

Measures

The following measures were administered to characterize child development: ABILITIES® Index, Mullen Scales of Early Learning (MSEL; Mullen, 1995), the Infant Growth and Development Indicator–Early Communication Indicator (IGDI-ECI; Walker & Carta, 2010), and the Infant Growth and Development Indicator–Early Motor Indicator (IGDI-EMI; Greenwood & Carta, 2010). Assessment results are shown in Table 2. The Assessment, Evaluation, and Programming System–Second Edition (AEPS; Bricker, Capt, & Pretti-Frontczak, 2002) was administered through observation and parent interviews to guide motor and communication target development based on family priorities for their child.

CLTs, EMT strategy types, and child targets

Embedded Instruction Observation System–Early Intervention (EIOS-EI). The EIOS-EI is a direct behavioral observation system designed to quantify the frequency and accuracy of embedded instruction learning trials imple-

mented during family-identified routines and activities (Snyder, Reichow, Bishop, & Embedded Instruction for Early Learning Projects, 2015). Learning trials are considered to be accurate (correct) when an antecedent is correctly administered, the child performs the target behavior, and a logical consequence is provided; *or* the child spontaneously performs the target behavior and a logical consequence is provided; *or* an antecedent is administered, the target behavior is not performed, the adult provides extra help for the child to perform the target behavior, and the adult provides a logical consequence if the target behavior occurs or feedback if the target behavior does not occur following the extra help. In contrast, a trial is considered to be incorrect if the child does not perform the behavior and no extra help is provided *or* if the child performs the behavior but does not receive a logical consequence. The EIOS-EI was used to quantify rate per minute of CLTs, child's total use of target behaviors, and child's spontaneous use of target behaviors during the identified routines within each session. Caregiver-identified child target behaviors and routines are shown in Table 3. A cumulative rate per minute for the entire session and a rate per minute for each variable in each routine were derived. The EIOS-EI scoring sheet was adapted to include types of EMT strategies. Four core EMT strategy types were coded (environmental arrangement, contingent responding, wait time, and prompting). When the adult used EMT strategies to begin a learning trial, the specific EMT strategy type was included with each coded trial on the adapted EIOS-EI coding sheet, and the total number of strategy types was obtained.

Social Validity. Two social validity measures were used: The caregiver diary and the caregiver feedback survey. The weekly caregiver diary was used for two purposes. The caregiver recorded the number of minutes of each type of non-EPIC service received and the specific targets of each session. The caregiver also recorded the routines in which she used EMT strategies, the approximate duration of the routines, which EMT strategy types were used, and which targets were addressed. Using a Likert-type rating scale, caregivers rated the frontloading approach, the use of family routines and materials, the coaching approach, the 5Q framework, and the Visual Model, with 1 representing *not at all useful* and 4 representing *very useful*. They also answered two questions pertaining to their continued use of EMT strategies.

Implementation Fidelity. Fidelity of provider implementation was completed for all intervention sessions using a checklist which included components of SOOPR, the 5Q, and delivery of the content of the EMT strategies. Mean procedural fidelity for the provider was 85% (range: 67%–100%).

Interobserver Agreement (IOA)

A minimum of 30% of sessions for each participant in each condition was independently coded by a second coder to ensure ongoing IOA for each coding system (Implementation Fidelity Checklist, CLTs, EMT strategy types, child targets). Mean IOA for the Implementation Fidelity Checklist was 86% (range: 82%–94%). Mean IOA for CLTs was 88% (range: 75%–100%). Mean IOA for EMT strategy types was 84% (range: 50%–100%). Mean IOA for child target behavior was 90% (range: 71%–100%).

Results

Caregivers' Use of CLTs and EMT Strategy Types

Data for combined rate per minute of CLTs, number of EMT strategy types, rate of child use of target behaviors, and rate of spontaneous child use of target behaviors across sessions in the multiple probe design across dyads are shown in Figure 1. A functional relation was observed for both rate of CLTs and number of EMT strategy types, with an immediate change in trend and level occurring upon introduction of the intervention. The number of EMT strategy types for each caregiver during baseline was low, with no more than one type used in each session by Caregiver 1 and Caregiver 3 and up to two strategies used by Caregiver 2. Each caregiver used all four strategy types (i.e., environmental arrangement, contingent responding, wait time, prompting) starting in their first intervention session and no fewer than three EMT strategy types in any intervention session. In each dyad, the caregiver's rate of CLTs during the baseline condition was low. Upon introduction of the intervention, an immediate change was observed in the trend and level of CLTs.

During maintenance, for Dyad 1, in two sessions, the number of EMT strategy types used and the overall rate of CLTs decreased but remained above baseline levels during the two maintenance sessions. In Dyad 2, during the five maintenance sessions, the number of different EMT strategy types used by the caregiver decreased during maintenance but remained above baseline levels; the caregiver rate of CLTs was variable but remained near intervention levels. In Dyad 3, the number of EMT strategy types used by the caregiver decreased during maintenance but remained above baseline levels. The rate of CLTs returned to baseline levels during the first two maintenance sessions and was above baseline levels in the third session.

Caregiver Use of EMT Strategy Types and CLTs in Both Play and Caregiving Routines and Across Both Motor and Communication Targets

EMT strategy types and CLTs for communication targets in the play routine. The number of EMT strategy types used

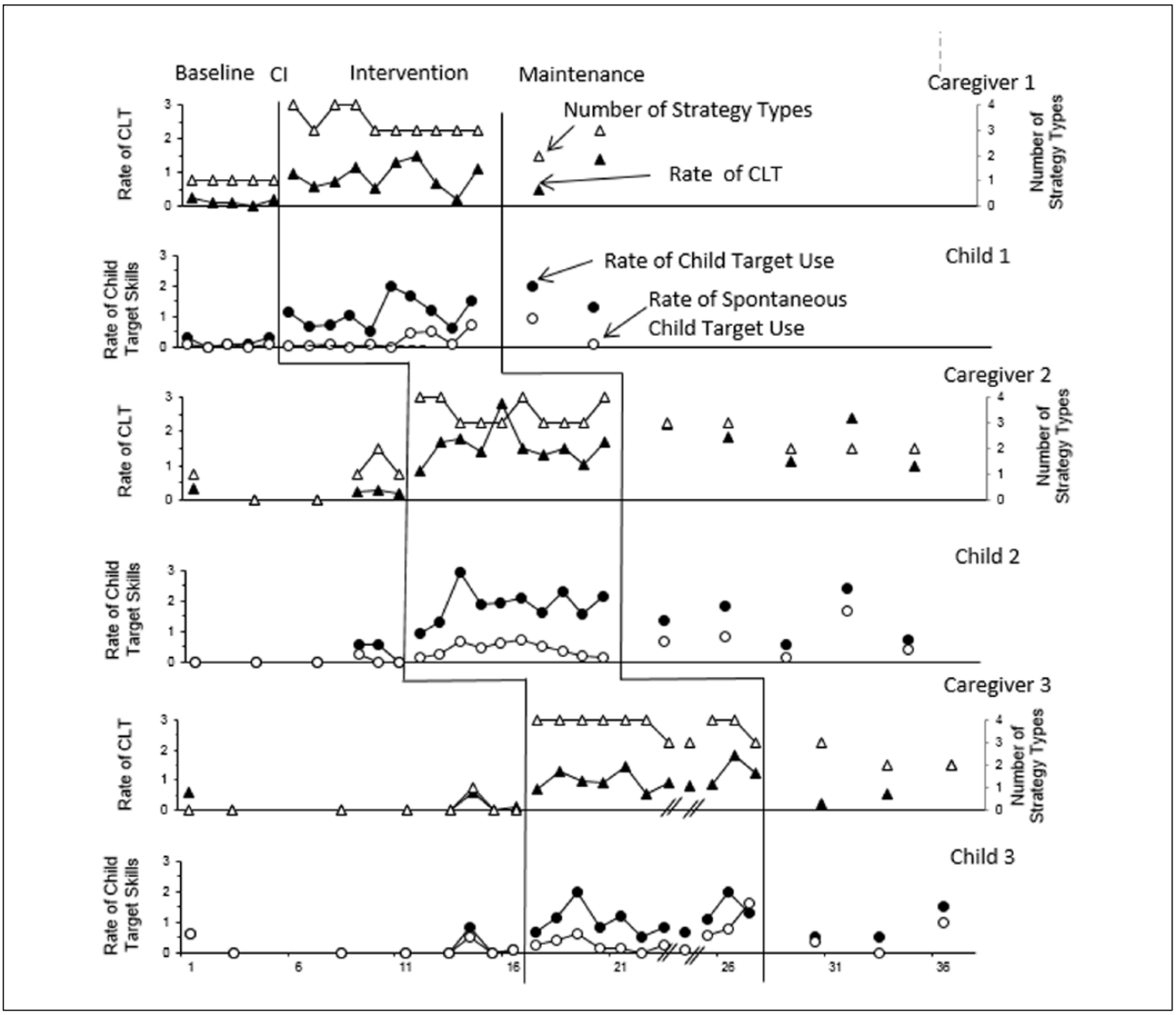
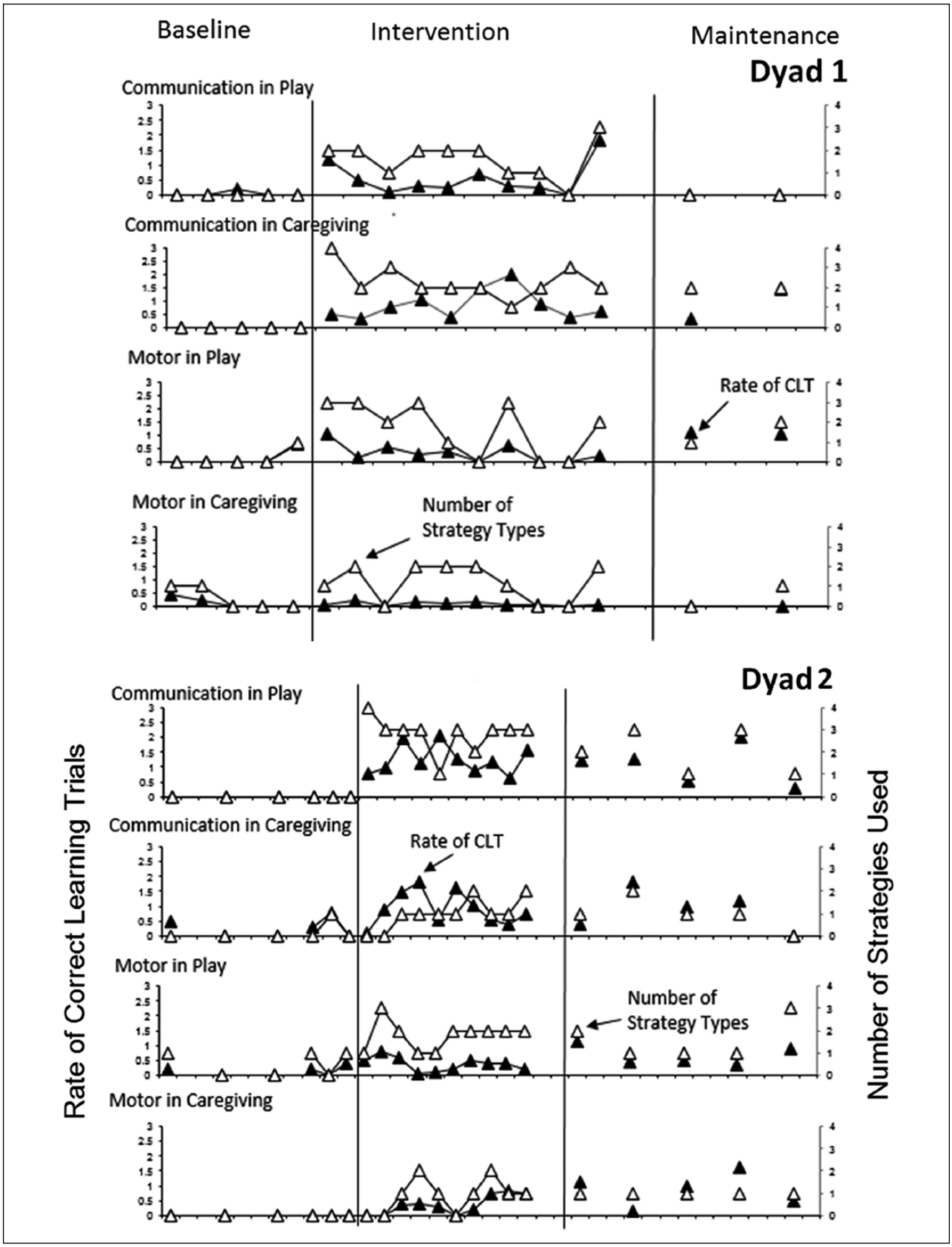


Figure 1. Multiple baseline design across dyads. Caregivers' rate per minute of CLTs (left axis) and number of strategies (right axis), and rate per minute of child total and spontaneous targets. Broken lines for Dyad 3 represent two breaks of 8 or more days.
Note. CLTs = correct learning trials; CI = Caregiver 5Q Interview during Introductory Session.

for communication targets for Dyad 1 in the play routine was zero for all baseline sessions; the number for Dyads 2 and 3 was zero for all sessions except one. During intervention, each dyad experienced a change in the level of EMT use for the communication target in the play routine. During maintenance, average EMT strategy types for the communication target in play returned to zero for Dyad 1, and declined but remained above baseline levels for Dyad 2, and returned to near baseline level for Dyad 3. For all caregivers, the rate of CLTs for the communication target in the play routine during the baseline sessions was low or zero. Upon introduction of intervention, a change in level was observed for each dyad. CLTs during maintenance returned to baseline level for Dyad 1 and remained above baseline level for Dyads 2 and 3. Results for CLTs and EMT strategy types for each target within each routine are displayed in Figure 2.

EMT strategy types and CLTs for communication targets in the caregiving routine. The number of EMT strategy types for communication targets for Dyad 1 in the play routine was zero for all baseline sessions; the number for Dyads 2 and 3 was zero for all sessions except one. During intervention, Dyads 1 and 2 demonstrated an immediate change in level of EMT use for the communication target in the caregiving routine. The number of strategy types used in maintenance remained above baseline levels for Dyad 1 and Dyad 2 and returned to baseline levels for Dyad 3. For all caregivers,


Baseline
Intervention
Maintenance
Dyad 1
Communication in Play
Communication in Caregiving
Motor in Play
Rate of CLT
Motor in Caregiving
Number of Strategy Types
Dyad 2
Communication in Play
Communication in Caregiving
Rate of CLT
Motor in Play
Number of Strategy Types
Motor in Caregiving
Rate of Correct Learning Trials
Number of Strategies Used

(continued)

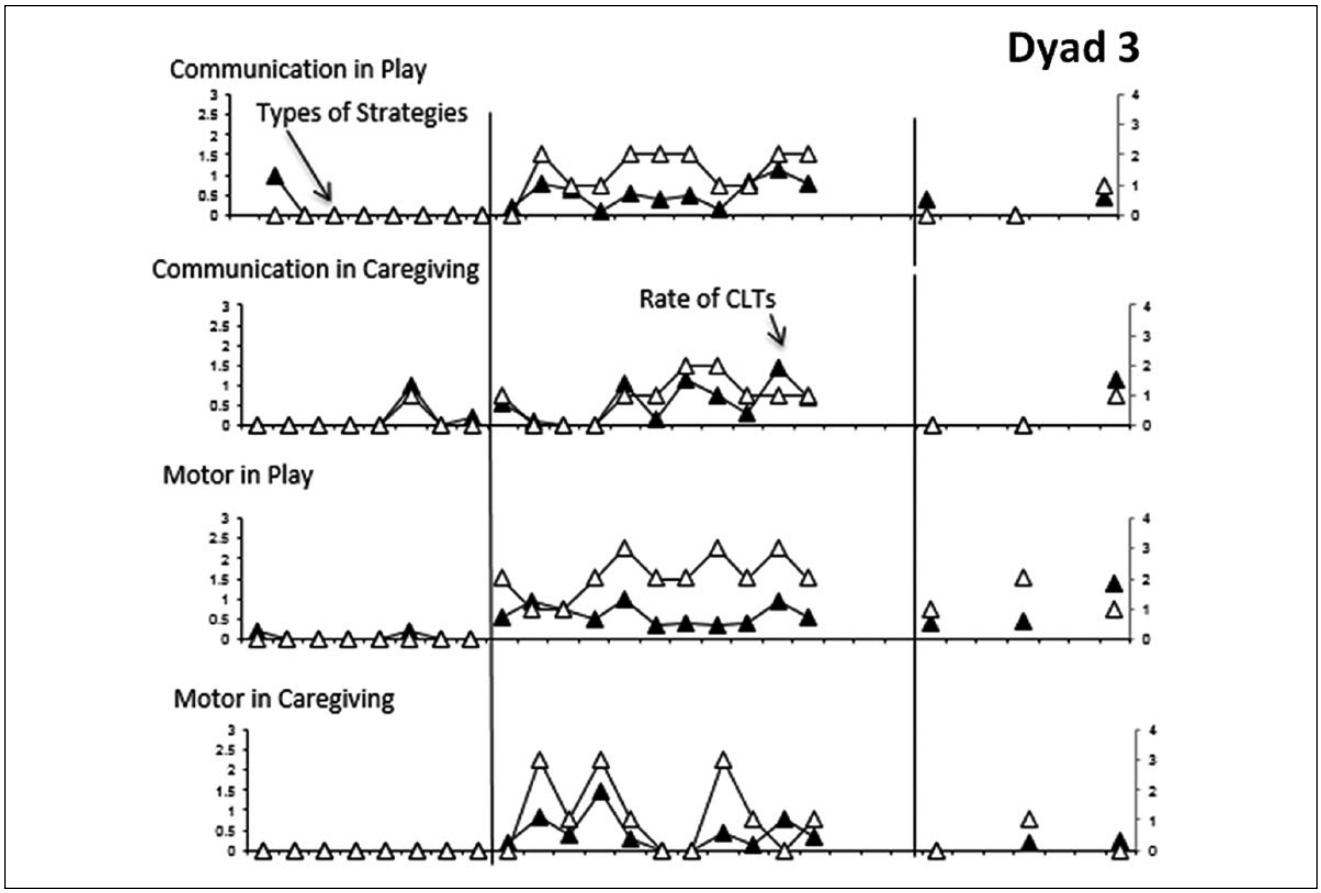


Figure 2. Each dyad's rates of caregiver correct learning trials and number of strategies for communication and motor targets in play and caregiving.

the rate of CLTs for the communication target in the caregiving routine during the baseline sessions was low. Upon introduction of the intervention, an immediate change in level was observed for Dyad 1, a change in level was observed beginning in the second intervention session for Dyad 2, and CLTs were variable with a slight ascending trend for Dyad 3. During maintenance, the rate of CLTs remained above baseline for Dyad 1 and 2, but returned to baseline for all but one session for Dyad 3.

EMT strategy types and CLTs for motor targets in the play routine. During baseline, the level for the number of EMT strategy types used for motor targets in the play routine was low for each dyad. During intervention, Dyad 1 experienced an immediate change in level; however strategy use became more variable later in the intervention. Dyads 2 and 3 experienced an immediate change in level, which remained above baseline levels throughout intervention and maintenance. During maintenance sessions, the number of EMT strategy types remained above baseline levels for each dyad. For all caregivers, the rate of CLTs for the motor target in the play routine during the baseline sessions was zero in all but one session for Dyad 1 and two sessions for Dyad 2. During intervention, the rate of CLTs for Dyad 1 was variable but consistently above zero. The rate for Dyad 2 remained low, and the rate for Dyad 3 showed an immediate change in level. During maintenance, the rate of CLTs remained above baseline levels.

EMT strategy types and CLTs for motor targets in the caregiving routine. During baseline, the level for the number of EMT strategy types used for motor targets in the caregiving routine was low for Dyad 1 and was zero for Dyads 2 and 3. During intervention, each dyad experienced a change in level of number of strategy types used for the motor target in the caregiving routine, but data were variable. During maintenance, the number of strategy types used returned to baseline level for Dyads 1 and Dyad 3 and remained stable for Dyad 2. For all caregivers, the rate of CLTs for the motor target in the caregiving routine during the baseline sessions was low. Upon introduction of the intervention, a change in CLTs for Dyad 1 was not observed. For Dyads 2 and 3, while data were variable, an increase in level was observed.

During maintenance, the rate of CLTs remained at baseline level for Dyad 1, increased for Dyad 2, and returned to zero for Dyad 3.

Generalization

Caregiver-collected video probes. Dyad 1 completed two video probes during the baseline condition and one during the intervention condition. The rate per minute of CLTs for the two baseline probes was 0 and 0.61, respectively. The rate during the intervention probe was 0.79. The caregiver used three of the four EMT strategy types in the second baseline probe and all of the four strategy types in the intervention probe. Dyad 2 completed two generalization probes during the baseline condition and two during the intervention condition. The caregiver used up to three EMT strategy types during both baseline and intervention probes for both targets and both routines and up to 0.8 CLTs per minute. Dyad 3 completed a video for a baseline generalization probe, but the video file was corrupted and not codable; thus, it was not possible to compare the probes across phases. The caregiver collected three generalization probes during intervention. The caregiver used up to three EMT strategy types in probes. The rate of CLTs per minute ranged from 0.45 to 1.6.

Child Outcomes

Child total and spontaneous targets. Child total and spontaneous target use across sessions is illustrated in Figure 1. During baseline, total combined communication and motor target use was low for all children. Upon introduction of the intervention, an immediate shift in trend and level, similar to that observed for CLTs, was observed. For Dyads 1 and 3, spontaneous target use began to emerge in the seventh and eighth sessions, respectively. For Dyad 2, there was a slight increase in spontaneous target use during intervention; however, a descending trend was observed toward the end of the intervention. During maintenance, total target use remained at intervention levels in two of two maintenance sessions for Dyad 1, in three of five sessions for Dyad 2, and in one of three sessions for Dyad 3.

Child total and spontaneous communication and motor targets in play and caregiving routines. Data for each target in each routine are displayed in Figure 3. Due to space limitations in the publication, Figure 3 is available online as supplemental material. The data for total communication target use for each child were similar to the patterns of CLTs for their caregiver. An increase was observed in total communication target use in each routine for all participants. Increases in both spontaneous and total communication target use were observed for Dyad 3. During maintenance, for Dyads 1 and 3, the rate of communication target use returned to baseline levels. For Dyad 2, the total target use remained at intervention levels, and some spontaneous use was observed.

Patterns for the motor targets differed from those of the communication targets. While a small but consistent increase was observed in the rate of total target use for Dyad 3 in the play routine, and a slight ascending trend during the caregiving routine in the last four intervention sessions for Dyad 2, the rate of total and spontaneous motor target use remained at or very near baseline levels for all participants during both routines. The rate of total and spontaneous motor target use remained at or near baseline levels during maintenance sessions.

Caregiver Diary Reports

Caregiver 1 completed six weekly diaries. She reported receiving a total of 22 hr of EI services including speech, occupational (self-feeding), and physical therapies during the EPIC intervention. She reported using EMT strategies in meals, play, dressing, hygiene activities, and while sharing books. She reported that she used the strategies in routines and activities that totaled, on average, 7 hr per week (range: 4.83–10.33 hr). She reported using an average of three of the EMT strategy types (range: 2–4); environmental arrangement was the least frequently reported strategy.

Caregiver 2 completed six weekly diaries. She reported receiving a total of 27 hr of EI services including speech, occupational, physical, developmental, and visual therapies during the EPIC intervention. She reported using the EMT strategies in meal, play, dressing, hygiene, and book routines that totaled, on average, 16.73 hr per week (range: 7.0–22.33 hr). For all but one week, she reported using all four of the strategy types. Caregiver 2 gave specific examples of each type of strategy used in routines.

Caregiver 3 completed four of the six weekly diaries. She reported receiving a total of 10.5 hr of EI services including speech, occupational, physical, and art therapies during the EPIC intervention. She reported using the EMT strategies in meal, play, dressing, and hygiene activities that totaled, on average, 10.48 hr per week (range: 9.92–11.25 hr). She reported using all four of the EMT strategy types for all but the first week of intervention.

Social Validity

Each caregiver reported that she found the approach of using the family's everyday routines, activities, and materials for teaching and learning to be *very useful* ($M = 4$). Caregivers also found the coaching framework and the use of the 5Q to guide their intervention planning to be *very useful* ($M = 4$). Caregivers varied in their perspectives about the Visual Model. Two of the three reported the model was

helpful, and one reported the model was *not at all helpful* ($M = 2.3$). All caregivers reported that they continued to use the EMT strategies multiple times each day in the targeted routines and in additional routines in which they had not been coached by the provider. Caregivers reported that they felt more confident in teaching their children new skills after participating in the EPIC intervention.

Discussion

The purpose of this study was to examine the effects of using the FGRBI approach to coaching caregivers to embed both communication and motor learning targets concurrently within daily routines of their infants or toddlers with significant disabilities using EMT strategies. Child outcomes were also examined. Functional relations were demonstrated in the rate of CLTs and use of EMT strategy types across sessions, across routines, and for more than one learning target. While a functional relation was observed for strategy use for both targets, the rate of CLTs and the number of strategy types used for motor targets were lower than those for communication targets. Children demonstrated increased use of their targeted skills when their caregivers began to use the EMT strategies and deliver CLTs. The number of EMT strategy types used and the rate of CLTs remained above baseline level during maintenance sessions. Generalization data were limited, and effects were not observed in generalization probes.

Our results suggest that caregivers can learn to implement EMT strategies to embed instruction for both communication and motor targets concurrently within multiple routines. The use of a single set of strategies for promoting skills across domains potentially reduces the number of different strategies parents need to learn. Second, this study offers preliminary data on the use of EMT strategies to support motor skill development. Given the importance of motor skills to participation in everyday activities and their relations to other domains, and the limited evidence for effective motor interventions (Guralnick, 2017; Horn & Kang, 2012), an intervention that increases opportunities to practice both communication and motor skills in the context of the same routine could enhance child engagement in the routine and provide more frequent learning opportunities, which, in turn, might lead to improved child learning outcomes. Third, the introduction of the EMT strategies resulted in immediate improvement in the accuracy of caregivers' use of embedded instruction as measured by CLTs.

In addition, this study extends the literature on the impacts of a systematic coaching approach, FGRBI, and its coaching process, SOOPR, on parents' use of embedded intervention in everyday routines for their children with significant disabilities. The approach is based upon adult learning theory and family capacity building strategies (Friedman et al., 2012; Woods et al., 2011). It is possible that the use of these strategies and the joint development of the Visual Model for embedding instruction, which engage the caregiver as decision maker to identify their priority outcomes, evaluate their own use of strategies, and place embedded instruction in contexts that are meaningful to parents and children, contributed to caregivers' immediate uptake of EMT strategies.

Although the overall outcomes of the study were positive for the caregivers, there was variability in outcomes across domains and caregiver–child dyads. There were increases in the number of EMT strategy types used to teach both motor and communication targets and the rate of CLTs in both the play and caregiving routines for all three caregivers. The rate of CLTs and the number of EMT strategy types used across routines and targets differed across families. While each caregiver taught both communication and motor targets in both routines, generally there were fewer trials for motor behavior. It is possible that these differences are related to the match between the domain and the number of opportunities for functional practice within routines. For example, while diaper changing provides continuous opportunities for vocalizations and gestures, it may not provide as many natural opportunities for holding objects or for pulling up to stand; the child may transition to the table once, pull up to stand on the table while having pants pulled up, and transition again when leaving the table. To increase opportunities for motor practice, more systematic planning may be needed to increase repetition within routines, or an increased number of routines or opportunities throughout the day may need to be identified (e.g., "Let's talk about all the times each day that Joey needs to move from his crib or the floor to another location and how we can use those as opportunities to pull up").

In addition, a simple count of CLT or EMT strategy types may not be an adequate measure of the quality of embedded instruction by caregivers. For some communication and motor targets (e.g., gestures, use of two hands), all four EMT strategy types could have served as antecedents to elicit the target behaviors. For other targets, only one or two of the strategy types were most appropriate (e.g., modeling would not be appropriate for pull to stand). For the child with visual impairment (Dyad 2), the contingent responding strategy of modeling alone would not be effective for teaching a motor target. These differences may have contributed to the variable outcomes across dyads and activities. However, the data provide promising evidence that caregivers were able to address motor and communication targets in the same context using EMT strategies to implement embedded instruction. Additional factors could be related to the nature of the child's disabilities (e.g., visual impairment), the child's age, and the amount of caregiver support or time needed to embed the targets in the routines.

To enhance internal validity, routines were limited to the two routines identified by the caregiver during assessments, and child targets, while identified by the caregiver, were limited to ones not being taught in other EI interventions

such as by physical or speech therapists. This may have resulted in selection of targets and routines that were not the best contextual match for one another (e.g., opportunities for pull to stand would be limited during feeding; opportunities to use both hands with objects were constrained in snack when foods could not be handheld; parents may have placed higher priority on routines at different points in the intervention) or that provided fewer logical opportunities. While parents reported that in some ways this may have been a limitation, they also felt that the repetition of the routines and systematic approach to targets helped them to cement their learning of strategies.

This study has several strengths. This study meets recommended SCD standards, including the systematic manipulation of the independent variable, measurement of the dependent variables over time, IOA measured on more than 30% of sessions, three demonstration of the effect of the intervention, and more than three data points (a minimum of five) in each phase for each participant (Kratochwill et al., 2013). Other important quality features of the study included fidelity measures of the provider's *implementation* of the coaching procedures for teaching EMT to caregivers, observational measures of the quality and quantity of the caregiver's use of the *intervention strategies*, and observational measures of *child outcomes* associated with the intervention (Dunst & Espe-Sherwindt, 2016). Assessments of generalization and maintenance by caregivers and children are important quality features of the study as well. Finally, the social validity of the intervention for caregivers was measured.

Caregivers expressed approval of the feasibility, usefulness, and effectiveness of the approach. Two of three caregivers reported continued use of the Visual Model; the third caregiver felt that the process of problem solving the 5Q was more helpful than the Visual Model itself. Most importantly, all caregivers reported that they used EMT strategies in between visits and that they continued to use them in everyday activities after visits were completed. This provides evidence that the approach has promise for increasing the confidence and competence of caregivers to embed instruction in everyday routines for their children with significant disabilities in multiple domains as well as the number of practice opportunities children receive.

Limitations

This study has several limitations. First, while functional relations were demonstrated in the intervention context, data assessing generalization of caregiver or child outcomes across routines and targets were limited. An innovative approach to collecting home data (parent collected video) not only reduced the risk of reactivity of video collection by an outside observer but also resulted in a small number of generalization assessments. A second potential limitation is the narrowly defined nature of the learning targets and the fact that intervention was limited to two routines. This could potentially have reduced the functionality of targets and routines. While caregivers reported that the repetition of the two targets and routines helped to cement their learning of strategies, more routines may have provided a greater number of opportunities for practicing skills. Third, the intervention was relatively short in duration and was limited to two routines. While evidence of efficiency is important as discussed above, intervention across additional activities and for more sessions might have resulted in increased use of strategies for motor learning, greater generalization, and stronger maintenance. A longer duration of the intervention would also allow the opportunity for the provider to coach the caregiver in applying EMT strategies and the 5Q to new child targets as initial motor and communication targets are acquired. Fourth, while maintenance data were promising, the maintenance phase was relatively short (up to 5 weeks). A longer maintenance phase would provide stronger evidence.

Implications

This study adds to the body of evidence that caregiver-implemented interventions can be effective with children who have significant disabilities across multiple developmental domains and has several implications for practice and future research related to delivering early intervention services for children with significant disabilities. The differences in preferred routines and targets among the three families highlight the need to identify family priorities for targets and routines and to address the contextual match among child targets, family routines, and teaching strategies (Woods, Kashinath, & Goldstein, 2004). Given the complex needs of families with children with significant disabilities, it is especially important to identify instructional strategies that match these needs and to provide sufficient opportunities for practice. The successful use of the approach to enhance caregivers' capacity to use EMT strategies for both communication and motor targets supports both the viability of a family-guided caregiver coaching approach and the use of one set of naturalistic intervention strategies for embedded teaching of skills across multiple domains. However, as evidenced in this study, more work is needed to provide sufficient opportunities for practice with motor outcomes in everyday routines. Previous research on FGRBI has indicated that practice across at least two routine types is necessary for caregivers to generalize communication intervention strategies across routines (Kashinath et al., 2006); to provide sufficient practice opportunities for both caregiver and child, it may be necessary to engage in systematic planning for motor opportunities across more activities or to create more opportunities within identified activities.

Future research is needed to replicate these results, to refine the coaching approach, and to further adapt EMT for

intervention on multiple goals in different domains. In addition, future studies should include early intervention providers from different disciplines; while the provider in this study did have experience with a primary provider approach, it is not known whether there would be a greater number of trials for motor outcomes if the provider were a physical therapist or a special education teacher rather than a speech language pathologist. Future studies could additionally be designed to assist caregivers in identifying a sufficient number of opportunities for practicing motor skills within naturally occurring routines; systematically program for caregiver and child generalization and maintenance across contexts and skills by teaching across more activities, fading caregiver coaching; and teaching self-monitoring or data collection strategies to track caregiver implementation and child progress. Further research is needed to determine whether the EMT strategies can be used to teach other developmental targets (e.g., social skills, self-care skills) and in additional caregiver-selected activities.

Conclusion

Children with significant disabilities have complex needs that often require intervention in multiple domains and require more repetition to acquire new skills. It is critical that researchers and practitioners continue to develop and evaluate intervention approaches that occur in natural environments, enhance the capacity of caregivers to support their children's development, and can be implemented across multiple domains to address the complex needs of children and families. The functional relationships demonstrated between the intervention approach and caregivers' use of intervention strategies provide support for the use of the approach as a means of teaching interventions which will support caregivers' capacity and confidence in addressing their children's needs across routines and developmental domains.

This study extends previous work on FGRBI by adding a systematic framework that the parent actively participates in developing to guide how they will embed instruction for their child throughout their day. The study also provides initial evidence that the FGRBI approach with EMT intervention strategies can be implemented by caregivers across routines to address specific targets in at least two developmental domains concurrently, increasing efficiency of intervention for both the caregiver and the child. While this study provides promising evidence for the effects of the approach and the use of EMT strategies to address needs in multiple developmental domains, the scope of the study is limited and replications are needed.

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Supplemental Material

Supplemental material for this article is available online.

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