PARENT COACHING IN NATURAL COMMUNICATION OPPORTUNITIES THROUGH BUG-IN-EAR TECHNOLOGY

by

Rachel Hamberger

A Dissertation
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DEDICATION

For all of those who have believed in and supported me along the (very long) road to the completion of this dissertation and especially for those who have shown me the true meaning of the following quote:

"Education is for improving the lives of others and for leaving your community and world better than you found it." --Marian Wright Edelman

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TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF ABBREVIATIONS

Applied Behavior Analysis ..... ABA
Autism Spectrum Disorder ..... ASD
Bug-in-Ear ..... BIE
Developmental Delay ..... DD
Discrete Trial Teaching ..... DTT
Early Intervention ..... EI
Enhanced Milieu Teaching ..... EMT
Naturalistic Instruction ..... NI
Pivotal Response Treatment ..... PRT
Three-Term Contingency ..... TTC

ABSTRACT

PARENT COACHING IN NATURAL COMMUNICATION OPPORTUNITIES THROUGH BUG-IN-EAR TECHNOLOGY

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Language disorders are the most common developmental delay, impacting up to 40% of children under the age of five. Delays in language can lead to academic, social, and behavioral difficulties. Early intervention is essential for building language skills and decreasing potential impacts on other areas of development. Research indicates that the most effective early intervention takes place within the family context in the child's natural environment. Enabling parents to carry out the intervention not only allows for the child to encounter learning opportunities throughout the day but empowers parents to feel effective when playing and interacting with their child. However, parents are not usually taught explicit skills to work with their child with a language disorder. Therefore, the need exists to establish a parent training modality that fits within a family's daily routine, allowing early childhood special educators to coach parents in evidence-based interventions.

Bug-in-ear (BIE) *e*Coaching is an empirically validated intervention for coaching educators of young children, including parents, in-service teachers, and pre-service teachers. The current single case, multiple-baseline study examined whether there was a functional relation between BIE *e*Coaching with parents of young children with language disorders and parent provision of natural communication opportunities and whether parents maintained their provision of natural communication opportunities when the intervention was faded. Data were also collected to assess the social validity of the intervention. The results of the study indicate that BIE *e*Coaching with parents of young children with language disorders was moderately effective in increasing parent provision of natural communication opportunities. Parents were able to maintain their provision of natural language opportunities above baseline levels after intervention was withdrawn. All participants strongly agreed that BIE *e*Coaching was helpful for changing their communication practices with their child and would recommend it to other parents of children with language delays. Practical implications and suggestions for future research were addressed.

CHAPTER ONE

As many as 20% - 40% of young children under five years of age demonstrate a delay in language skills (American Academy of Pediatrics [AAP], 2021; Roberts et al., 2019). While the estimated prevalence varies dependent on age and diagnostics used, data indicate that about two percent of all children have severe language delays (Rosenbaum & Simon, 2016). Language disorders are identified as "difficulties in the acquisition and use of language due to deficits in the comprehension or production of vocabulary, sentence structure, and discourse" (American Psychiatric Association [APA], 2014, Communication Disorders section, para. 2). Language disorder, which is the most common type of developmental delay (DD), is a prominent feature of social (pragmatic) communication disorders (AAP, 2021; APA, 2014). It can impact a child's ability to communicate wants and needs and to form friendships (Rosenbaum & Simon, 2016). A large percentage of children with language disorders also have behavior concerns (Curtis et al., 2019). Language disorders may lead to learning difficulties as the child enters school and may be an early indication of significant disabilities such as autism spectrum disorders (ASD), intellectual disabilities, or hearing loss (Rosenbaum & Simon, 2016).

Statement of the Problem

Early childhood is the time when children are the most susceptible to language development and they frequently acquire language skills through engagement with people

and their environment (Roberts et al., 2019). Children who do not acquire language through natural interactions with caregivers and others in their environment require repeated opportunities and practice to learn and use language (Rosenbaum & Simon, 2016). Depending on the severity of the language delay, children may qualify for evidence-based intervention services (AAP, 2021). Research shows that early intervention customized to address individual deficits is critical for children with language disorders (Rosenbaum & Simon, 2016).

Young children learn language most efficiently through social interactions with parents and/or caregivers and children under five years old typically spend a large portion of their day with their families (Roberts et al., 2019). However, early intervention services are traditionally delivered by a professional to the child and parents are often not taught specific strategies to elicit language from children with language disorders (Branson, 2015; Hill et al., 2017; Roberts et al., 2019). When they are taught strategies, there is often a large learning curve for parents, demonstrating the need for significant practice to master an intervention and be effective in executing it (Koegel, Sze, et al., 2006). In addition to not always being effective, parent training can be expensive and time-consuming for both the parent and the interventionist (Minjarez et al., 2011). Because training must fit into the family routines and is best taught in the natural environment, there is a need for effective and innovative interventions that are cost-effective ways of partnering with parents to deliver their child's interventions in the natural environment (Koegel et al., 2006).

Significance of the Study

Children who develop language in the typical patterns require little or no explicit instruction from their parents, rather they learn social language skills through play and daily interactions (Rosenbaum & Simon, 2016). When children do not develop language in the typical ways, parents are often at a loss of how to teach their children and support language acquisition and use, since children with DD and severe language disorders frequently do not respond to strategies and interventions seen as beneficial for typically developing children (Koegel & Koegel, 2012). This may lead to high parental stress levels which can be socially isolating (Symon et al., 2006). Parental stress and feelings of social isolation can be further exacerbated when children demonstrate maladaptive behaviors, which are more common in children with language disorders (Curtis et al., 2019). Parental stress and isolation can negatively impact the parent-child relationship and inhibit learning of self-regulation skills (Curtis et al., 2019).

Parent training is necessary to ensure comfort in executing interventions and providing learning opportunities for children, as well as ensuring that parents implement interventions with fidelity (Koegel & Koegel, 2012; Meadan et al., 2016). While parent training does not fully dissipate parental stress, it frequently leads to parent empowerment and improvement of self-efficacy, as they learn to use evidence-based interventions with fidelity (Brookman-Frazee, 2004; Meadan et al., 2016). Empowered parents act as collaborators with interventionists, working together to benefit the child.

Language Development

Birth to three years old are the most critical years for language and speech acquisition (National Institute on Deafness and Other Communication Disorders [NIDCD], 2017). Children develop at their own pace, including language and communication skills, however, several organizations have laid out guidelines of expectations as children grow (see Table 1; AAP, 2021). By one and half or two years of age, children typically learn at least one new word a week, follow simple directions, including those requiring them to move around their environment and are initiating joint attention by pointing to items they are interested in to engage their communication partner (AAP, 2021). At two to three years of age, children start to combine two- and three-word sentences and have an expressive vocabulary large enough to label most items and activities in their world (AAP, 2021; NIDCD, 2017). By three to four years of age, children should use four, or more, word sentences, engage in reciprocal conversations by answering simple "Who?" What?" "Where?" and "Why?" questions and recalling activities from their day (NIDCD, 2017). By four to five years of age, children should stay on topic during a conversation, give a variety of details in their sentences, and communicate easily with children and adults (NIDCD, 2017). To meet these milestones, it is best for children to have constant exposure to a variety of stimuli, especially language (NIDCD, 2017).

Table 1

Typical Language Development of Children One-and-a-half to Five Years Old

Age in Years	Typical Milestones
1.5 – 2	• Learn at least one word a week • Follow simple directions • Initiate joint attention
2 – 3	• Combine 2-3 word phrases • Expressive vocabulary large enough to label most items and activities in their world
3 – 4	• Use four (or more) word sentences • Engage in reciprocal conservations • Answer simple “Who?” What?” “Where?” and “Why?” questions • Recall activities from their day
4 - 5	• Stay on topic during a conversation • Give a variety of details in their sentences • Communicate easily with children and adults

When children do not meet language milestones as expected it does not only impact their ability to converse, but it may negatively impact their ability to form

relationships and connect with adults and peers (Rosenbaum & Simon, 2016). Language delays often also lead to challenging behavior, as the child cannot communicate his wants and needs effectively (Curtis et al., 2019). Early intervention is essential for addressing these needs (Heidlage et al., 2020). Depending on individual delays and age, children may qualify for services through early intervention programs or the school division, including speech therapy and/or special education (AAP, 2021). These services can take place in a variety of locations, including the home, a private preschool, a public-school classroom, or a resource room.

If a child qualifies for special services, the type of service(s) and setting are determined by a team of professionals and the child's parents/guardians based on the goals and objectives developed from the child's needs (The IRIS Center, 2019). Parents/guardians are important and equal members of the team that develops the education plan (The IRIS Center, 2019). Often for young children, parent counseling and/or training can be written in as a part of the education plan, because parent involvement in early intervention leads to the most benefit for the child (Brookman-Frazee, 2004; Suppo & Floyd, 2012).

Parent Training

Parents of young children often spend a large portion of their day with their children and therefore have the most opportunities in a day to provide children with experiences and interactions where they can learn, practice, and generalize a variety of skills, including language (Rosenbaum & Simon, 2016; Symon et al., 2006). Thus, it follows, parents should be trained to provide the most beneficial language opportunities

for their children. Researchers agrees that components of successful early intervention include evidence-based, family-centered service delivery in natural environments (Meadan & Daczewitz, 2015).

Studies spanning nearly 50 years indicate that parent involvement in intervention leads to better outcomes for children (e.g., Douglas et al., 2017; Hardan et al., 2015; Koegel & Koegel, 2012; Meadan et al., 2016). Research demonstrates that when explicitly taught, parents acquire the appropriate skills needed to effectively support their children with DD and language disorders (e.g., Duifhuis et al., 2017; Hardan et al., 2015; Matson et al., 2009; Meadan et al., 2016). In fact, some researchers posit that parent training should be the primary type of early intervention to improve language outcomes for children (Roberts et al., 2019).

A recent meta-analysis of 76 studies concluded that parents are capable of learning and executing language support strategies with their young children with language delays, which consequently benefits the children (Roberts et al., 2019). There was a large association between parent training and their use of language strategies and a moderate association between parent training and child outcomes, showing the benefits of working with parents on implementation of language interventions. However, only half of the studies included data on parent outcomes, indicating the need to expand this area of research. More data is needed on parents' acquisition and later execution of language interventions and how to teach these skills most effectively.

Both the Division for Early Childhood ([DEC], 2014) and empirical studies support family-centered and family capacity-building practices, along with family and

professional collaboration in early childhood special education, yet there is no uniform recommendation on how intervention is provided or how parents should be involved (Morin, n.d.). Each state and jurisdiction has its own model and requirements for service delivery. Despite these recommendations, early intervention often remains therapist-child focused (Rush & Shelden, 2011). Parents may attend in office (e.g., speech, occupational therapy) or in home (e.g., applied behavior analysis or early intervention sessions) interventions as an observer or asked to complete follow-up activities such as worksheets or out of context skill practice (Rush & Shelden, 2011). Other times, especially when young children enter early childhood preschool programs, parents rely on written summaries of what has been targeted during a session. A survey of 268 families of children receiving special education services through Part C (early intervention) or Part B (preschool special education) indicated that parents are often not involved in intervention sessions (Bruder & Dunst, 2015). Of parents with children in preschool special education, only 9% shared that they were actively involved in their child's education, while only 50% of the parents of children in early intervention report active involvement.

Coaching in Early Intervention

Coaching is used effectively in parent training to build competence and capacity in caregivers (Able et al., 2017; Ottley et al., 2017). It can be used with families of children with mild disabilities and with families of children who have more significant special needs (Rush & Shelden, 2011). Coaching is a family-centered practice in line with DEC Recommended Practices (2014). Through coaching, mutual goals between the parent and interventionist are identified, the parent participates in practice within daily

routines or familiar contexts, and the interventionist provides evaluative feedback and allows the parent to reflect (Branson, 2015). Coaching allows parents to support their child in daily activities and integrate intervention into their family routines (Rush & Shelden, 2011). This is in contrast to older models of intervention that regard the teacher or therapist as the intervener who engages the child in unrelated drills and passive intervention (Rush & Shelden, 2011). Parent coaching is a process that allows for the development of new skills and self-assessment through an encouraging and supportive relationship (Ottley et al., 2017). Sharing specific examples, explicit instruction, and specific feedback are all key elements of coaching that may occur during a session (Hester et al., 1995).

Feedback. Feedback is defined as information delivered by a person or the environment regarding one's performance (Hattie & Timperley, 2007). Feedback acts as a form of instruction when it occurs after an initial behavior and is delivered to help the learner understand his performance in the context of what is expected (Hattie & Timperley, 2007). Delivering feedback to caregivers of young children builds both competence and confidence in the caregiver (Chung et al., 2020). Feedback is most beneficial for building family capacity when it is "honest, timely, positive, and specific; focused on observed caregiver and/or child behavior; and related to family preferences" (Ottley et al., 2017, p. 15). Feedback can occur in a variety of forms, including oral, written, or video and can be delivered during an interaction, immediately after an interaction, or day(s) later (Ottley et al., 2017). While there is not conclusive research on the optimal rate, frequency, and duration of feedback, immediate feedback has shown to be beneficial (Ottley et al., 2017;

Scheler & Lee, 2002). Although feedback, and more broadly, coaching, are evidence-based approaches used by early intervention practitioners to introduce empirically based interventions to parents, they are not consistently employed by early intervention providers, especially in the traditional face-to-face models (Branson, 2015; Rush & Sheldon, 2011).

Barriers to Early Intervention and Parent Training

Early intervention practitioners encounter barriers as they continue to evolve and improve upon their implementation of the DEC Recommended Practices to be responsive to families' needs and partner with families when developing and providing traditional face-to-face intervention (Keilty & Trivette, 2017). Early intervention can be expensive to implement, and providers may be required to travel many miles to serve geographically distant families (Heitzman-Powell et al., 2014; Lindgreen et al., 2016; Wacker et al., 2013b). Often, parents have trouble scheduling intervention sessions during the day due to their work schedules and the early intervention teams may encounter language or cultural barriers. In some areas, there is more demand for early intervention services than there are practitioners available (Wacker et al., 2013a). And, in the past year and a half, during the COVID-19 pandemic, early intervention practitioners have encountered new challenges due to health and safety concerns. All these challenges taken together indicate that alternatives to the traditional model of face-to-face early intervention may be beneficial in some situations.

Researchers found that technology enhanced parent training can ameliorate some of the above challenges associated with face-to-face parent training, while building parent

capacity (Wacker et al., 2013a). Technology enhanced training may include synchronous, real-time coaching, delivered via chat rooms, instant messaging, Bluetooth, or telephone. It may also include asynchronous activities, such as the use of nonhuman avatars, email, video review, or activity sheets (Anthony et al., 2013; Bullock & Ferrier-Kerr, 2014; Warner, 2012). Synchronous, real-time coaching has a large research base spanning 70 years that supports its use for improving evidence-based intervention implementation and fidelity (Bowles & Nelson, 1976; Coogle et al., 2016; Rock et al., 2009; Scheeler et al., 2009). With the improvement of technology, Bug-in-ear *e*Coaching is an accepted and socially valid method for synchronous real-time coaching (Fettig et al., 2016).

Bug-in-Ear

Bug-in-ear (BIE) *e*Coaching allows for coaching to occur discreetly and in the real-time by connecting the coach and coachee via a headset, allowing for two-way communication (Rock & Holden, 2019). One benefit of the immediate feedback given during BIE *e*Coaching is the ability for the coachee to change her behavior rather than practice errors (Scheeler & Lee, 2002). BIE has the potential to be used with parents to provide a cost-effective intervention where they can receive immediate feedback from interventionists. It has been empirically shown to increase desired teacher behaviors that maintain at high levels a year after *e*Coaching is removed (Rock et al., 2014).

*e*Coaching continues to develop in tandem with technology advancements, as evidenced by the consistent emergence of new studies (Bullock & Ferrier-Kerr, 2014; Geissler et al., 2014). As a socially valid intervention with more flexibility than

traditional coaching, *e*Coaching aims to enhance areas that the coachee or coach has targeted for improvement (Anthony et al., 2013; Fettig et al., 2016; Warner, 2012).

When searching the library databases for general BIE *e*Coaching literature, it appears that a majority of the studies are conducted with pre-service and in-service teachers. It has been introduced to the research literature for parent training, particularly for increasing language and communication (Akemoglu et al., 2020). However, BIE *e*Coaching is typically only used for parent training as a small component of a larger intervention package and dosage or nature of feedback delivery is not detailed in the article narrative (Akemoglu et al., 2020; Vismara et al., 2013). In a 2020 review of telepractice-based parent-implemented language and communication intervention studies for young children with DD, Akemoglu et al. found 12 articles that fit the definition. Of the 12 studies, in eight of them, the researchers used synchronous video and in three the researchers used distance coaching. The review did not clarify the difference between the two intervention platforms, and it was not clarified by referring to the articles included in Akemoglu et al. In five of the 12 telepractice-based studies, parents were given feedback in the moment. However, the articles did not specify the nature or dosage of the feedback, and it was included only as part of a larger coaching package rather than the main intervention (Barahrav & Reiser, 2010; Guðmundstóttir et al., 2017; McDuffie et al., 2013; Vismara et al., 2013; Wainer & Ingersoll, 2015).

Little of the BIE *e*Coaching research centers on proactively increasing communication skills prior to the development of challenging behavior (Akemoglu et al., 2020). Early intervention to increase appropriate communication skills is a way to teach

parents to work with their children and decrease the likelihood of developing challenging behaviors, especially those related to limited communication skills (Koegel & Koegel, 2012). Evidence-based interventions that are embedded into daily routines for young children can increase independent social communication and decrease problem behaviors (Curtis et al., 2019; Hancock et al., 2016).

Naturalistic Instruction

Naturalistic Instruction (NI) is a recommended practice in early intervention that is defined by embedding learning opportunities in daily activities across a child's day (Snyder et al., 2015). It is referred to by a variety of terms, but is distinguished by its four main features: (a) it occurs in the child's natural routines and environment, (b) instruction centers on learning targets that will allow the child to engage more fully in their environment, (c) teaching episodes follow the child's lead or are based on their interests and the child's response is followed by a consequence, (d) intervention is delivered by adults who regularly interact with the child (Snyder et al., 2015). In a review of NI studies, researchers determined that over half (26 out of 42 studies) of the NI studies targeted communication skills (Snyder et al., 2015).

NI strategies that target communication include expanding language and fostering engagement by acknowledging, then expanding a child's attempts at communication (Hancock et al., 2016; Kaiser et al., 2000). Environmental arrangement, prompting and modeling are also employed (Kaiser et al., 2000; Snyder et al., 2015). These strategies are supported by empirical evidence of positive child outcomes for young children with disabilities (Snyder et al., 2015).

Conceptual Framework

This study is grounded in applied behavior analysis (ABA), the science of behavior. The defining characteristics of ABA are that it is: (a) applied, (b) behavioral, (c) analytic, (d) technological, (e) conceptually systematic, (f) effective, and (g) has generality (Baer et al., 1968). Each of these characteristics play a part in the current study.

The study is applied, in that it is socially significant and is designed to enhance the lives of the parents and children participating. The behavior being measured in the study, parent provision of natural communication opportunities, is a specific behavior that needs to be improved and that is measurable, making the study behavioral in nature (Cooper et al., 2007). It is analytic because the study is attempting to demonstrate that there is a functional relation between *e*Coaching through BIE and parent provision of natural communication opportunities. The single subject research procedures are described with replicable accuracy, indicating that the study is technological. It is conceptually systematic because the procedures being used in the study, prompting, positive feedback, and BIE, are named. The study aims to be effective, in that the behavior change will be clinically and socially significant. Finally, the study plans to have generality, so that the skills learned by the parents, and, in turn, their children are generalizable to other situations. The goal of ABA is to systematically apply the principles of behavior to create socially significant changes in behavior, which is the aim of this study (Cooper et al., 2007).

Summary

Early intervention is essential for young children with language delays (Heidlage et al., 2020). Parent involvement in early intervention leads to the best outcomes for children (Brookman-Frazee, 2004; Suppo & Floyd, 2012). Very few studies have been conducted on using BIE to train parents in working with their child. This study aims to address gaps in the literature by employing *e*Coaching through BIE to teach parents to provide natural language opportunities while playing with their child. Natural language opportunities were derived from research on NI. By introducing *e*Coaching through BIE, parents can be trained to implement components of the intervention at a distance.

Research Questions

1. Is there is a functional relation between Bug-in-Ear *e*Coaching with parents of young children with language delays and parent provision of natural communication opportunities?
    a. Do parents maintain the provision of natural communication opportunities when Bug-in-Ear *e*Coaching is faded?
2. Do parents feel that Bug-in-Ear *e*Coaching is a socially valid intervention?

Definition of Terms

Key terms in the study are defined below:

- **Applied Behavior Analysis (ABA).** The science of behavior, focusing on meaningful behavior change for socially significant behaviors (Cooper et al., 2007).

- **Autism Spectrum Disorder (ASD).** A developmental disability marked by significant social, behavioral, and communication challenges.
- **Bug-in-Ear (BIE).** Technology used to provide immediate feedback. In this study, it refers to wearing a wireless earbud to receive real-time feedback through a digital platform.
- **Coaching.** Two or more people (coach and coachee) work collaboratively to establish a goal, the coachee practices skills, and the coach gives feedback on the coachee's performance.
- **Developmental delays (DD).** Impairments in developmental areas, such as language, learning, behavior, or physical development. Impacts about 1 in 6 children.
- ***e*Coaching.** Coaching conducted via BIE to deliver discreet and immediate feedback.
- **Enhanced Milieu Teaching (EMT).** Language intervention blending environmental arrangement, incidental teaching, and communication responses.
- **Feedback.** Information delivered about one's performance by a person or the environment.
- **Language disorder.** The most common DD, characterized by trouble acquiring or using language due to deficits in expressive vocabulary, comprehension, language structure, or discourse.

- **Natural communication opportunities**. Modeled on an evidence-based natural instruction intervention, Enhanced Milieu Teaching. Instruction takes place in the child's natural environment and is embedded into play activities. Composed of the following four areas:
    - **Play and engage.** Uses strategies to build a child's joint attention.
    - **Expanding language**. Builds on the communication that a child initiates by repeating what a child gestures or says and adding one to two vocal words to the communication.
    - **Communication temptations.** Situations set up to promote child communication.
    - **Prompting.** Serves as a signal for the child to say something.
- **Naturalistic Instruction (NI).** Recommended practice in early intervention defined by embedding learning opportunities in daily activities across a child's day**.**

CHAPTER TWO

As many as two percent of all children have severe language delays and up to 20% - 40% of children under five years old demonstrate some level of delay in language (AAP, 2021; Roberts et al., 2019; Rosenbaum & Simon, 2016). When significant, language delays may qualify as language disorders, the most common type of developmental delay (DD; AAP, 2021). Language disorders are defined as "difficulties in the acquisition and use of language due to deficits in the comprehension or production of vocabulary, sentence structure, and discourse" (APA, 2014, Communication Disorders section, para. 2). As a result of their inability to appropriately convey their wants, needs, and thoughts, children with language disorders may display challenging behaviors and difficulties in forming and maintaining family relationships and friendships (Curtis et al., 2019; Rosenbaum & Simon, 2016).

Parent Training

For young children, ages birth to five, with language delays, early intervention is essential for improving their long-term outcomes (Heidlage et al., 2020). Evidence-based, family-centered interventions with service delivery in natural environments, and are all components of successful early intervention, which is essential for children with disabilities (Meadan & Daczewitz, 2015). Parents and family members are typically a child's first teacher and therefore are central to development (Snodgrass et al., 2017). Increasing parent involvement and managing intervention costs through parent training is not a new idea (Matson et al., 2009). Studies demonstrating the importance of parent

training date back to the 1970s and have shown that parent involvement leads to better outcomes for children (Brookman-Frazee, 2004; Suppo & Floyd, 2012).

Parent implemented language interventions should be centered on embedding natural communication opportunities into daily activities and routines (Heidlage et al., 2020). In fact, if an intervention fits into the family context, parents are more likely to use it across settings and throughout the day (Koegel, Openden, et al., 2006). Parents are a critical part of the intervention process; at a minimum, they should be trained when therapy ends, although it is beneficial if parents are trained in tandem with the ongoing intervention (Koegel & Koegel, 2012). Training parents in an intervention when they are not the primary interventionist helps children to maintain gains, or continue to progress, when intervention ends (Lovaas et al., 1973).

Rationale for Parent Training

Research has shown that the communication of children with language disorders benefits from parents learning and implementing language interventions or strategies (Douglas et al., 2017; Heidlage et al., 2020). Potentially, this is because parents are with their children throughout the day and across settings, so if they are trained in an intervention, it is more likely that the skills they teach will be consistently practiced across routines and generalized to new situations (Koegel, Sze, et al., 2006; Symon et al., 2006). Children with language disorders and DD need many opportunities to practice language throughout the day, however, children with DD are given as little as one opportunity an hour when they are in school (Koegel & Koegel, 2012). Therefore, involving parents with the intervention helps to increase these opportunities.

When children are found eligible for special education services, the type of service(s) and setting are determined by a team of professionals and the child's parents/guardians based on the goals and objectives developed from the child's needs (The IRIS Center, 2019). The types of interventions provided are specific to the needs of the child. Parents can learn about interventions in a variety of ways, including: (a) coaching, (b) observing early intervention providers, (c) researching an intervention on the internet, (d) watching videos of an intervention, and (e) reading books. Research on the best way to teach parents an intervention so that it is natural and low-stress continues to evolve (Hardan et al., 2015; Heidlage et al., 2018).

Reducing Parental Stress

Stress levels are often high, and frequently in the clinical range, for parents of children with disabilities (Symon et al., 2006). In addition to stress, parents frequently report feeling social isolation, often citing stereotypic or challenging behaviors, which can be associated with language disorders, as the cause (Curtis et al., 2019; Symon et al., 2006). However, teaching parents to implement a natural language intervention that relies on reciprocity and following their child's lead has been shown to decrease problem behaviors in children with DD as it increases parents' responsiveness to their child's emotional states and increases reinforcement for the use of self-regulation strategies (Curtis et al., 2019). While implementing interventions with children has the potential to add to the above-mentioned stress, embedding language opportunities into daily activities can limit and potentially reduce stress because parents are able to work on important skills with their child within the context of their natural routine and increase their self-

efficacy (Koegel & Koegel, 2012). Self-efficacy and parent empowerment are often goals of parent training, targeted by teaching effective parenting skills, knowledge, and involvement (Brookman-Frazee, 2004). Empowered parents act as collaborators with interventionists, working together to benefit the child. Therefore, it is imperative that training focus on making the intervention work for families and teaching functional skills that lead to maintenance and generalization so that parents feel empowered and successful.

Natural Environment

It is recommended that early intervention be provided in a child's natural environment, and for many young children, that means at home with their parents or a caregiver (DEC, 2014; Koegel, Openden, et al., 2006). Parent training studies conducted in the home have shown effective outcomes (Fettig & Barton, 2013). Parents implemented the intervention and the desired child outcomes increased (Fettig & Barton, 2013).

The argument for natural environments is further strengthened by the data demonstrating that reciprocal interactions between a caregiver or parent and child have a significant impact on child development (Koegel, Openden, et al., 2006). However, children with language disorders often do not naturally engage in these interactions and parents must be taught strategies that will work (Koegel & Koegel, 2012). Reciprocal interaction skills found in NI that are used by professionals to support increased language acquisition include verbal and non-verbal turn taking, responding to children's attempts to gain adult attention, following the child's lead, modeling, and expanding language

(Heidlage et al., 2020). Research has shown that with proper training, parents of children with language disorders or DD are able to learn and employ these strategies, leading to more efficacious interactions with their children (Duifhuis et al., 2017; Hardan et al., 2015; Kaiser et al., 2000; Matson et al., 2009). These strategies are most effective when embedded into play and daily routines, especially for children with more significant delays, according to a meta-analysis of 25 parent training studies (Heidlage et al., 2020). However, many parents find it challenging to embed opportunities onto loosely structured activities such as play and daily routines, further building the case for training and coaching parents in implementing NI (Heidlage et al., 2020; Snodgrass et al., 2017).

Coaching

The research community needs more studies examining the successful components of parent education (Hardan et al., 2015; Heidlage et al., 2018). However, coaching is an empirically validated way for practitioners to introduce evidence-based interventions to parents (Rush & Shelden, 2011). With successful real-time coaching, practitioners can prompt parents to use taught strategies (Ottley, 2016). Coaching allows for the development of new skills and self-assessment through an encouraging and supportive relationship (Rush & Shelden, 2011). Based on the characteristics of coaching in Rush and Shelden's (2011) analysis of 39 research studies, five characteristics of coaching emerged: (a) joint planning, (b) observation, (c) action/practice, (d) reflection, and (e) feedback. Delivering prompts during observation and practice enables parents to receive real time feedback to adjust their interventions as soon as possible. Prompting should be positive, short and specific phrases delivered during pauses in the

communication between parent and child (Ottley, 2016). Parents often need a large amount of practice to master an intervention (Koegel, Sze, et al., 2006). The effectiveness of the prompting should also be revisited every few sessions to determine if something needs to be adjusted (Ottley, 2016). With consistent coaching, parents have become competent enough in interventions that they are able to go back home and train another significant caregiver (Symon, 2005).

Supporting Parent Success

When introducing parents to a new strategy or intervention, presenting information in parent friendly language, rather than professional jargon, makes the intervention more accessible and increases the likelihood that parents will continue to implement it after the initial training (Snodgrass, 2017). Then, as children begin to make progress, it is important to reassure parents that there may be variability from day to day with their child's behavior. To assist with this, and because children with DD and language disorders often need a considerable amount of intervention, it should be fun and meaningful for all involved (Koegel & Koegel, 2012). Making strategies easy to execute and putting them in the context of daily routines makes it more likely that parents will be able to implement the proposed interventions (Harding et al., 2009; Snodgrass, 2017). Celebrating small successes of children with language disorders and of the parent or caregiver can also increase enjoyment of implementing NI (Koegel & Koegel, 2012).

Naturalistic Instruction

Naturalistic Instruction (NI) is an evidence-based approach used in early intervention defined by embedding learning opportunities in a variety of activities and

routines across a child's day (Meadan et al., 2016; Snyder et al., 2015). It allows for repeated practice of communication skills, which promotes acquisition and generalization of new skills (Meadan et al., 2016). NI leads to enhanced skills, including communication, for children with language disorders and DD (Kim & Kang, 2021; Ottley et al., 2017). NI is distinguished by its four main features: (a) it occurs in the child's natural routines and environment, (b) instruction centers on learning targets that will allow the child to engage more fully in their environment, (c) teaching episodes follow the child's lead or are based on their interests and the child's response is followed by a consequence, and (d) intervention is delivered by adults who regularly interact with the child (Snyder et al., 2015). A variety of interventions used in early intervention incorporate these four features, including Pivotal Response Treatment (PRT) and Enhanced Milieu Teaching (Snyder et al., 2015). These interventions have a large body of research supporting parent implementation (Hancock et al., 2016).

Four Main Features

The four main features of NI will be described in the next section. They are: (a) natural environment and routines, (b) meaningful learning targets, (c) following the child's lead, and (d) familiar adults (Snyder et al., 2015).

Natural Environment and Routines

The first main feature of NI is that it occurs in the child's natural routines and environment (Snyder et al., 2015). It is a DEC recommended practice that early intervention be provided in a child's natural environment, and for many young children, that means at home with their parents or a caregiver (DEC, 2014; Koegel, Openden, et

al., 2006). Setting up the environment in a way that fosters child engagement is imperative, including providing toys that motivate the child to engage and connect with their communication partner (Hancock et al., 2016; Kaiser et al., 2000). Teaching skills, especially communication skills, within daily routines is beneficial for young children with language disorders because it creates meaningful, real-life opportunities for them to practice (Heidlage et al., 2020).

Meaningful Learning Targets

The second main feature is instruction that centers on learning targets allowing the child to engage more fully in the environment (Snyder et al., 2015). In a review of NI, a large portion of the 43 studies analyzed targeted communication or preacademic skills (Snyder et al., 2015). Communication is one of the most meaningful targets for young children, giving them a way to get their wants and needs met and to interact with people in their environment. Targeting communication skills can be achieved by setting up meaningful situations for the child to communicate: (a) manipulating situations where the child needs help, (b) placing items in sight but out of reach, (c) only giving a few pieces or items of a desired snack or toy and requiring the child to request the next item, (d) by engaging in partner activities, (e) giving a choice, and (f) pausing in a familiar routine (Hancock et al., 2016; Hatcher & Page, 2020).

Following the Child's Lead

The third element is that teaching episodes follow the child's lead or are based on their interests, and the child's response is followed by a consequence (Snyder et al., 2015). This element encourages the educator to join the child in play by meeting children

where they are and enter their world (Hancock et al., 2016). It requires an adult to observe the child and notice what she is interested in, how she is communicating and what she is communicating (Hancock et al., 2016). If the child is an active communicator during an activity (whether its vocal, sounds, or gestures), it is suggested to make adult interactions and utterances contingent on the child's initiation, thus following the child's lead (Hancock et al., 2016).

Familiar Adults

The final element of NI is that intervention is delivered by adults who regularly interact with the child (Snyder et al., 2015). This stems from the knowledge that language in typically developing children is learned incidentally through interactions with the people who are important in their lives (Hancock et al., 2016).

Parent Implementation

NI can be implemented by teachers, therapists, and parents or caregivers (e.g., Hatcher & Page, 2020; Kim & Kang, 2021; Meadan et al., 2016). Parents have learned to implement NI, such as Enhanced Milieu Teaching (EMT) and Pivotal Response Treatment (PRT), in a clinic setting over 20-26 sessions (Hancock et al., 2016; Kaiser et al., 2000). However, as reflected by the first of the four features of NI, clinic settings are not the natural environment for young children (Snyder et al., 2015). Studies on NI have been conducted in clinic settings and in the home (Hatcher & Page, 2020).

Clinic Based Research

In a study of three parent/child dyads, mothers participated in a 25-hour, weeklong parent education program to learn the components of the NI, Pivotal Response

Treatment (PRT; Symon, 2005). During the training conducted at a university clinic, the parent educator modeled the use of PRT for one to two hours on the first day, and then coached the mother by pointing out opportunities to use it and providing continuous feedback. Over the next four days, the parent educator modeled PRT for about a half an hour each day and then provided feedback for the rest of the session. The parent and parent educator discussed training others for less than an hour during the week. The mothers then went home and trained a significant caregiver in PRT. They did not set aside specific training times, instead training the caregivers as opportunities arose. Data show that not only did the mothers maintain their fidelity of implementation mastery during follow up, the significant caregivers, whom they had trained, also improved in their use of the PRT techniques. Additionally, children increased their appropriate behavior and social communication with both the primary and significant caregivers. This study demonstrates the benefits of parent coaching in evidence-based practices.

A single-subject MBL study was conducted in a university clinic with six parent/child dyads (Kaiser et al., 2000). The dyads were chosen from a larger study and their data were used for this study. Prior to baseline in the multiple baseline study, children were assessed using a variety of standardized language tests that led to the selection of language targets. Following the business-as-usual baseline, during which 10 min of a 15 min play session between the dyads was coded for data, intervention was introduced. During each session, new information was introduced verbally accompanied by handouts/videos. The parents role-played the new skills with the instructor and reviewed video from previous sessions to analyze their use of strategies. This was

followed by a 45-min practice session in which the parent and child played and the parent educator coached parents by providing prompting and positive feedback. After the practice session, parents debriefed with the service provider for 15 minutes to receive feedback and plan for the next session. Three components of Enhanced Milieu Teaching (EMT) were taught in sequence during the study, followed by maintenance, which was measured monthly for six months. There were also 3 sessions after each phase of generalization probes.

Data show that five out of six parents in the study reached criterion for the use of EMT components following 24 clinic training sessions. The sixth dyad did not reach criterion. These gains maintained for at least the six-month period following intervention and five out of six parents were able to generalize what they learned to the home. The results of the study also indicate that child social communication can improve as a result of the parent leading the intervention. While it was not quantitatively measured, all parents were observed to be more responsive and engaged with their child following intervention.

Home Based Research

In a multiple baseline study replicating a parent training strategy that was previously conducted in person, researchers examined whether there was a functional relation between a parent training and coaching program delivered via the internet and parent fidelity of implementation and rate of use of NI strategies (Meadan et al., 2016). All five training components and the coaching intervention took place in the participants' home, via the internet. Training included overview and handouts outlining the strategies,

reviewing videos of other parent/child dyads implementing the strategy, and planning how to integrate into the family's routines. Parent coaching involved the discussion of the targeted strategy and creating a plan, then the coach observed the parent-child interaction for 5-7 min and debriefed following the observation. Coaching sessions took place over three phases twice a week for 30 min for about 3.5 mos. In addition to the coaching discussions, parents received video feedback through edited and annotated video clips of their interactions with their child. Data were recorded on the percentage of high-quality strategy use and the rate per minute of the use of strategies at any quality level.

Results of the study were the same as when the intervention was delivered in person. The average performance score, which was compiled by combining rate and percentage of high-quality strategy use, increased from post-training to coaching for all participants in all phases of the study.

In another single subject study of the benefit of coaching conversations, four parents of children with complex communication needs participated in a six-module online training (75 minutes total) followed by weekly post-training sessions where parents worked with their children and had opportunities following the 15-minute sessions to ask the researcher questions, accompanied by a self-reflection (Douglas et al., 2017). The training proved to increase parent provided support of child communication, and it improved child communication. Larger gains were seen in children with lower baseline communication levels. In a study with a similar intervention structure, gains were also seen in three dyads' parent provision of language opportunities, parent responses to language, and child's use of language (Douglas et al., 2018). However, in

this study, the child with the most limited language at the start did not make as significant gains as his counterparts.

In 2020, a MBL study was conducted across four EMT behaviors and replicated across four parent-child dyads (Hatcher & Page, 2020). The study expanded previous research on EMT by targeting parents from low socioeconomic backgrounds and training them to implement EMT strategies in their home rather than the clinic. Baseline and intervention took place in a room parents identified as the place they were most likely to play naturally with their children. Parents played with their children with parent or child selected toys for 15-16 baseline and intervention sessions during eight or nine 1-hour home visits.

After a business-as-usual baseline, the interventionist sequentially taught parents to employ four EMT strategies (matched turns, expansions, time delays and milieu teaching). A teach-model-coach-review intervention was used to teach each of the four strategies. Teaching sessions consisted of: (a) providing the rationale for the strategy, (b) provide and review a detailed handout of the strategy, (c) give parents examples of the strategy and then role play, and (d) provide instructions about the strategy. Modeling sessions were 10 minutes in length and while modeling, the investigator pointed out pertinent strategies during the session. The following occurred during coaching: the interventionist (a) facilitated set up of the environment in a way that encouraged communication, (b) gave descriptive praise every 2 min. on current or previous strategies, (c) delivered 0-3 reminders were given of the behaviors being taught, and (d) answered 1-3 parent questions during the session. The interventionist did not introduce the next

strategy until parents reached a predetermined criterion. Parents continued using previously learned strategies as they learned a new one. This also allowed for maintenance data to be recorded on the previous strategies while new ones were being taught.

A functional relation was established between intervention and parent use of strategies for all four participants. However, the study met the What Works Clearinghouse standards with reservation. Baseline had three sessions at minimum. Interobserver agreement and fidelity data were only calculated for 20% of the sessions.

Adding to the research on interventions conducted by parents in the home setting, a recent concurrent multiple probe study across play sets was conducted to measure the effect of EMT on Korean American children with Down Syndrome (Kim & Kang, 2021). Data show that following an EMT intervention conducted by an interventionist during 10-min sessions, all four children increased in number and frequency of target words and number and frequency of different words. For each child, the interventionist focused on five target words for three different play themes. The dyad played with the assigned toy and the interventionist used each EMT strategy (model, time-delay, open ended question, choice question, and mand) at least twice per target word. However, one of the key prompt strategies successfully employed in other EMT research, time delay, was not effective. The authors of the study attributed this as a possible result of a cultural barrier, because in the home culture of all four children, the adult initiates conversation, so the participants may not have understood that they could initiate conversation.

Studies conducted on NI in clinic settings versus home settings have similar outcomes; both show improvement in parent and child skills. More research is needed to determine whether there are specific benefits to conducting research with in one setting over the other. However, to fully support children and their families in accordance with the 2014 DEC Recommendations it is beneficial to continue to expand the research in early childhood to find the best ways to facilitate parent implementation of NI in the home environment.

Bug-In-Ear

Bug-in-Ear (BIE) has the potential to aid interventionists in training parents to implement NI in the home environment. It is a nearly 70-year-old technology used to provide feedback in support of skill acquisition (Ottley & Hanline, 2014). The first BIE was known as the "Mechanical Third Ear" and was used to train clinical psychology interns and graduate students to conduct diagnostic testing (Korner & Brown, 1952). It has additionally been used in the medical and dentistry fields (Giebelhaus, 1994).

The mechanical third ear was developed out of supervisor frustration with student therapists performing diagnostic testing and counseling patients (Korner & Brown, 1952). The technology originated as a hearing-aid with an attached wire that could be connected to a wire leading to the observation room, from which supervisors could give feedback. The psychology students who wore the device acted deaf, so as not to let on why they were wearing a hearing-aid.

In a study done in 1976, the researcher transported a soundproof booth from school to school on the top of his car, making the equipment portable, but barely (Bowles &

Nelson). The “bug” was a wired FM radio worn on a belt and the coach was in the same room as the student. In more recent years, BIE technology has rapidly changed. In 2008, Goodman et al. relied on two-way radios with an earbud to communicate with their subjects, but just a year later, in 2009, researchers were using computer conferencing to coach from a distant location with the help of a Bluetooth connection (Rock et al.). Technology continues to evolve, and researchers can now coach from different countries, broadcasting via wi-fi to a small, wireless earpiece.

*e*Coaching

The definition of *e*Coaching varies, but for this study it will refer to virtual coaching conducted via BIE technology to provide discreet, immediate feedback (Geissler et al., 2014; Horn et al., 2021). Coaching is an evidence-based practice of providing feedback to an individual with the goal to enhance an area the coachee or coach has targeted for improvement (Snodgrass et al., 2017; Warner, 2012). *e*Coaching adds the ability for feedback to be delivered immediately and discreetly using technology (Rock & Holden, 2019). It focuses on the immediacy of feedback which is delivered through real-time coaching (Ottley et al., 2017). With advances in technology *e*Coaching, is still developing and research continues to emerge (Akemoglu et al., 2020; Bullock & Ferrier-Kerr, 2014: Geissler et al., 2014). The practice is effective at increasing teachers’ use of evidence-based practices, and allows for greater flexibility (Fettig et al., 2016; Rock et al., 2014; Scheeler et al, 2012). Additionally, it improves outcomes for students (Fettig et al., 2016; Ottley, 2016).

BIE *e*Coaching occurs between two individuals, the coach and coachee, and utilizes three technology components: (a) a device that has a camera, Bluetooth, and can connect to the internet, (b) a Bluetooth headset, and (c) a live streaming program over the internet (e.g., Zoom, Skype; Regan & Weiss, 2020; Rock & Holden, 2019). When BIE *e*Coaching starts, the coachee sets up the device to capture the location where she will be coached (e.g., the classroom), syncs and puts on the Bluetooth headset (Regan & Weiss, 2020). The coachee signs into the streaming program to connect with the coach who is on her device. The coach is able to observe and hear the location used for coaching and can hear the coachee, but those in the coachee's location cannot hear the coach (Regan & Weiss, 2020).

Just as in traditional coaching, in *e*Coaching, the coach and coachee work together to establish a specific goal, which the coach then measures and evaluates (Bullock & Ferrier-Kerr, 2014; Warner, 2012). Having a clear purpose and goal is central to *e*Coaching (Bullock & Ferrier-Kerr, 2014). All parties involved need to know exactly what is being targeted (Ottley, 2016). Additionally, learning goals must be collaboratively established and agreed upon and participants must be willing to be involved (Bullock & Ferrier-Kerr, 2014). Multi-media tools are used to develop the relationship and provide feedback on a short- or long-term basis, driven by the coachee's performance. Feedback on the target skill is delivered immediately during eCoaching and can be classified as diagnostic (Horn et al., 2021; Rock & Holden, 2019). Diagnostic feedback is composed of guidance, cues, corrections, and explanations (Rock & Holden, 2019). Feedback may be delivered via short cues or longer phrases (Rock & Holden,

2019). The format, timing and intensity is based on the needs and responses of the individual receiving feedback (Horn et al., 2021). However, Rock and Holden (2019) caution, coaches should deliver four positive remarks for every one corrective statement. Therefore, while feedback given during *e*Coaching can incorporate corrective statements, coaches should focus on making the feedback positive and specific (Horn et al., 2021). Following coaching sessions, the coachee must take responsibility for reflecting on his or her practice in order to make changes to his or her behavior (Bullock & Ferrier-Kerr, 2014; Ottley, 2016).

There are many benefits of *e*Coaching versus traditional coaching. *e*Coaching is not limited by location, and can be easier to schedule (Anthony et al., 2013; Fettig et al., 2016). Being able to connect coaches and coachees across the country opens many more options for matching personalities and expertise. Being able to connect coaches and coachees allows for the connection of people with similar cultures or backgrounds or who speak the same language (Snodgrass et al., 2017). *e*Coaching can also be less expensive than traditional coaching, in part because more than one person can work with a coach at a time (Anthony et al., 2013). Another benefit to *e*Coaching is that the session can be recorded and revisited later, allowing the coachee to benefit from a session more than once (Anthony et al., 2013).

*e*Coaching allows for real-time feedback to be delivered discreetly to the person for whom it is meant (Horn et al., 2021; Schaefer & Ottley, 2018). The faster receipt of feedback allows coachees to change their practice in the moment and not repeat errors for an entire session, theoretically increasing the speed at which a coachee masters an

intervention (Schaefer & Ottley, 2018). In addition, coachees can practice the corrected skill multiple times within that session (Horn et al., 2021). Concise feedback leads to more gratification with the process, allowing more engagement (Bullock & Ferrier-Kerr, 2014). Additionally, *e*Coaching is a socially valid intervention, with it being rated efficient and very effective by participants (Fettig et al., 2016; Schaefer & Ottley, 2018).

BIE in Education

BIE was introduced into the field of education in 1971 by Herold, Ramirez, & Newkirk, who found supervision of preservice educators was significantly improved with real time feedback (Rock et al., 2009). As real time feedback has been improved and refined, the benefits continue to be seen, because "all types of immediate feedback, including praise, serves as a reminder to teachers to use targeted strategies" (Coogle, Storie, et al., 2019, p. 82). A review of 17 studies employing BIE in education as a means for professional development confirmed that immediate feedback delivered via BIE supports lasting behavior change in pre-service and in-service educators, with 83% of cases reported maintaining the effects of training above baseline after withdrawal of the intervention (Schaefer & Ottley, 2018). Furthermore, the review found that BIE definitively meets the requirements laid out by What Works Clearinghouse to be considered an empirically supported intervention for pre-service and in-service educators and the results of the 63 cases examined showed that immediate feedback was an effective intervention for 89% of the cases (Schaefer & Ottley, 2018).

BIE to Teach the Three-Term Contingency

A variety of target skills have been selected for coaching using BIE in education; one of the most popular targets is the three-term contingency (TTC), focused on the teacher provided antecedent, student behavior and teacher provided consequence of that behavior (Ottley & Hanline, 2014; Schaefer & Ottley, 2018). Both in-service and pre-service teachers have been coached via BIE to effectively implement the three-term contingency (Goodman et al., 2008; Scheeler & Lee, 2002; Scheeler et al., 2012).

BIE using one- to three- word phrases via two-way radios, increased the completion of learn units (the smallest unit in the act of teaching, consisting of a teacher antecedent, student behavior, and teacher response) for three novice teachers (Goodman et al., 2008). This single-subject MBL across teachers, had four stages: (a) prebaseline visits and observer training, (b) baseline, (c) equipment familiarization and intervention activities, and (d) fading and maintenance. Equipment familiarization consisted of a 30-minute training on the equipment and feedback, followed by a probe for knowledge of learn units. The teachers then practiced with the equipment, becoming comfortable after a 30-minute practice session in the classroom. During intervention, feedback from the coach focused on completing learn units. The one- to three-word phrase feedback consisted of questioning, clarifying, correcting, reinforcing, prompting to continue or to slow down or speed up; it was delivered through the radio from the back of the room. However, with so many types of phrases in play, it is difficult to determine which was the successful prompt guiding completion of the learn units. At the end of each lesson, the coach and teacher participated in a five-minute review session. With the coaching, all

three teachers showed an increase in their completion of learn units. For the two who participated in the fading procedure, in which the number of prompts delivered were decreased by half from the intervention phase, teachers maintained similar levels of learn unit completion. While these are promising results, independent versus prompted completion of learn units was not recorded, so it is unclear whether teachers improved their delivery independent of the feedback from researchers.

Similar to Goodman's (2008) use of two-way radios, Scheeler and Lee (2002) used an FM system to provide feedback about completing TTCs to three preservice teachers in a special education practicum at a university. The TTC was defined as the teacher presenting an antecedent, the student response and a teacher delivered consequence. Prior to baseline, the teachers were given a verbal review of the three-term contingency and then it was modeled. During baseline, corrective, delayed, feedback was given 10-15 minutes after the observed instructional session. During the intervention, teachers received feedback about the TTC via an FM system. Immediate feedback was delivered within 1-3 seconds of the observation of an instructional behavior and was either instruction, corrective or reinforcing in nature. The intervention served to increase levels of completed TTC for all three participants, but for two, it demonstrated only a slight increase.

Scheeler was the lead author on two more studies using an FM transmitter to provide feedback to pre-service teachers on TTC trials (Scheeler et al., 2009). The first of two studies reported on in the article was a MBL conducted with three preservice special education teachers who had previously completed an instructional methods course. They

taught in three different settings, a vocational school, elementary special education and a private school for children with moderate to severe disabilities. The dependent variable was percent of completed TTC trials. In baseline, the coaches, two graduate research assistants, delivered delayed feedback to the preservice teachers following each instructional session. Following baseline, the teachers practiced with BIE to get comfortable. In this study, BIE consisted of an FM transmitter with the research assistants sitting in the back of the room. Observations were conducted 1-2 times a week for a 12-week practicum period and lasted 20-30 minutes. Mastery was 90% completion rate over three sessions. BIE was faded out over four steps: (a) feedback was shortened, (b) BIE was turned off but still worn, (c) the technology was removed, but still in view, and (d) it was completely removed. The following fall, maintenance probes were conducted. The study demonstrated a considerable level change for all participants in completed TTC trials. Maintenance data showed that skills were maintained at a level higher than baseline, but not at the same level as intervention.

Experiment two consisted of two undergraduate seniors completing their student teaching. They have previously participated in a practicum on direct instruction (Scheeler et al., 2009). One student taught in a middle school life skills class and the other in a special education 5th grade class. Observations in the MBL study lasted 20 minutes. The same BIE technology was employed, and the study used the same dependent variable as the first. Baseline was identical to experiment 1. When the student teachers experimented with BIE, they practiced training the research assistants rather than students. Observations were conducted once or twice a week for the 14-week field work

assignment. The student teachers programmed for generalization and maintenance, which was conducted four months later when the students entered their own classroom. The authors compared the final five data points in treatment to the maintenance data and found that one student teacher was similar in intervention and maintenance, and one was higher in maintenance than intervention. This indicates that programming for generalization was successful.

Three years later, in 2012, Scheeler et al. published an article on BIE about coaching five preservice teachers on implementing TTC. While the premise was similar to their previous studies, the technology was significantly updated. Instead of an FM transmitter, the authors coached pre-service teachers via Bluetooth headsets and a webcam. During baseline the teachers the researcher gave delayed feedback 5-15 minutes after instruction. Once baseline was stable, teachers were trained on BIE procedures. During intervention, they were given immediate verbal feedback consisting of short phrases that were reminders to praise and praise for completing the three-term contingency. Immediate feedback was delivered within three seconds of the targeted behavior. TTC completion was considered mastered when the teacher completed the trials on 90% of the trials over three sessions. Four of the five teachers reached the criteria in three sessions and the other reached in four. The article did not specify if data were recorded on solely independent trials, or if they were recorded on prompted trials as well. Based on the immediate accomplishment of mastery criteria by all but one teacher, it is possible that data were taken on prompted trials or that the immediate feedback made teachers infinitely more aware of their completion rates.

Another study used BIE to increase the accuracy of undergraduate education majors' discrete trial teaching (DTT; McKinney & Vasquez, 2014). The article did not define correct implementation of DTT, but it typically consists of giving an instruction and then delivering feedback to the student based on their response to the instruction, similar to TTC. This MBL design relied on confederates to play a student with ASD, while the three undergraduates conducted the DTT. During baseline, all participants read a one-page self-instruction manual. Then, during the intervention, the researcher delivered brief encouraging or instructional feedback based on whether the student was correctly implementing DTT or not. A functional relationship between correct delivery of DTT and BIE feedback was suggested.

BIE to Teach Evidence Based Practices

Fifteen teachers enrolled in a graduate program participated in a study in which the first author provided immediate feedback, via BIE, to increase empirically based teaching skills (Rock et al., 2009). The mixed-methods study involved four observations via Skype, three without feedback, to establish a baseline, and one with feedback using a Bluetooth headset. The study had three dependent measures: (a) changes in teaching behavior, (b) changes in classroom climate (including teacher praise and reprimands), and (c) level of disruption and benefit associated with BIE. Student engagement was also measured. The results of the study confirm previous findings that BIE, specifically immediate feedback, has a beneficial effect on teacher behavior. There were statistically significant increases in teacher use of praise and high-access instructional practices (including choral responding and cloze reading) and statistically significant decreases in

low-access instructional practices (including round-robins and teacher read aloud). Student behavior, such as blurt-outs, also showed a statistically significant decrease. This study only contained one feedback session and no maintenance or generalization. It could have shown and more solid effect with at least three feedback sessions and plans for generalization or maintenance.

Rock et al. (2014), conducted a follow up study one and two years later, with 14 of the 15 participants from the 2009 study. The study demonstrated that immediate feedback not only has an immediate effect, but skills are maintained a year late. Teachers taught combinations of K-12 grade in general or special education settings and had an average of 5 years teaching experience. During the first phase of the mixed methods study, the authors provided immediate feedback through *e*Coaching that was either encouraging, correcting, instructing, and/or questioning during 30-minute lessons. This feedback was delivered both while the teacher was talking and while s/he was quiet. Following the 30-minute session, the *e*Coach provided a short summary of strengths and discussed one to three future goals. A year following the feedback sessions, a different study author from the university observed the 30-minute lessons but did not give *in situ* feedback. For data analysis purposes, the 2009 study was considered baseline. The authors then chose 4 videos each from the *e*Coaching and silent observer sessions to further analyze. The three dependent measures were: (a) teaching behavior change (use of low and high access instruction), (b) classroom climate change (including praise), and (c) participants' perceptions surrounding *e*Coaching.

High access instruction, teacher use of praise, and student engagement showed statistically significant increases during the intervention phase and stayed high during the observation sessions a year later. However, praise did drop slightly when the *e*Coaching was withdrawn. Participants' reports of disadvantages with online BIE were focused on difficulties with the equipment. All trainees felt that *e*Coaching was helpful and 12 of the 14 felt online BIE was beneficial for acquiring skills in evidence-based practices. Thirteen of the participants mentioned their appreciation for the positivity of the feedback they received.

Thirteen master's students participated in a replication of the 2009 study (Rock et al., 2012). This study also used the four types of feedback later used in the 2014 study. Following four baseline sessions, the students participated in at least four thirty-minute coaching sessions. As in the original study, the replication found that high access instructional strategies and praise increased to a statistically significant level with immediate feedback. Praise increased from a ratio of 3:1 praise to reprimand/redirection in baseline to 6:1 during coaching. Student engagement and verbal redirections/reprimands did not change significantly. The dependability of the audio and visual capture/recording increased to 100% from 46.55% in the original study, and only 8% of sessions were interrupted by technical difficulties as compared with 22% in the 2009 results.

Combining BIE with Other Interventions

Researchers have begun combining BIE with other interventions to explore ways to enhance and extend the benefits of the evidence-based practice (Coogle, Nagro, et al.,

2019; O'Brien et al., 2021). Two recent studies introduced an intervention package of BIE with a reflection matrix follow-up (Coogle, Nagro, et al., 2019; O'Brien et al., 2021). O'Brien et al. (2021) was a replication of Coogle, Nagro, et al. (2019) with teacher candidates who worked with a different age group. Both studies were multiple probe single case design study across participants and researchers combined *e*Coaching with video-based reflection to examine whether there was a functional relation between the combined intervention and teacher candidates' use of evidence-based. Three teacher candidates participated in each study; in the first study all three were early childhood special educators and in the second study there was one early childhood special educator, one elementary educator and one middle school educator. The 2021 study added a 2 hr orientation for participants to learn about *e*Coaching and video-based reflection, in addition to practicing with the technology.

During baseline, the coach greeted the teacher candidate, then did not interact with her for the rest of the session. In the 2021 study, following the observed session, the coach asked the teacher candidate to write a reflection, but the coach did not share the video from baseline with her. After three to six baseline sessions, the research teams in both studies re-watched the sessions and discussed possible evidence-based practices in which to coach the teacher candidates. Following that, the coach and teacher candidate met for goal setting. This allowed them to collaborate on an evidence-based strategy to target during coaching that would elicit expressive language from a target student. During intervention, the coaches used short affirmative or corrective statements to deliver feedback when the participant exhibited the target strategy. In the 2019 study, corrective

feedback was given based on pre-established quality indicators of how well the teacher candidate used their strategy; the use of corrective feedback was not specified in the 2021 study. In both studies, the coach prompted for use of the strategy when it was not used independently. Following the intervention session, participants were asked to watch the video of their teaching again and to use a matrix to guide reflection on their teaching.

Data were collected in 5s partial intervals, along with the quality of the teacher prompt and whether the student responded to the prompt. Neither article specified what data, if any, were recorded during original baseline sessions. The 2019 article stated that the coaches intended to deliver prompts at least once every minute, but the 2021 article did not specify how often the coaches aimed to deliver prompts during intervention. It also did not specify if the reported data were only unprompted uses of the target strategy or if they also included prompted uses, while the 2019 article measured prompted and unprompted responses, but did not separate them in the graph. Data in the 2019 study demonstrated an increase in level for all three participants' use of strategies and an increase in the quality indicators during intervention. Data in the 2021 study showed that two of three participants demonstrated an increase in frequency and rate of the target strategies during intervention and all participants increased in at least five out of six quality indicators for their prompting; student responses improved as well. BIE plus video-reflection is a promising intervention for increasing teacher use of evidence-based strategies.

Early Childhood and BIE

The research to practice gap can be difficult to overcome, especially in early childhood special education and there has been limited information about the most practical way to do so (Chung et al., 2020). BIE is one suggested way to bridge that gap, but it needs to be executed in authentic settings to confirm that it would be beneficial (Chung et al., 2020; Ottley et al., 2019). In one study, BIE was used to coach teachers through embedded communication strategies (Ottley & Hanline, 2014). They used a multi-phase MBL across four teacher student dyads, teaching three different embedded interventions to teachers across six to nine weeks of 20-minute BIE coaching sessions three to five times a week. Two cell phones and a Bluetooth earpiece comprised the BIE technology. The researcher stood outside of the play area to provide live coaching. A camcorder was used to record all sessions, with an external microphone placed near the dyad and a smart pen was used to record the researcher's feedback. The teachers picked the three communication-based interventions on which they were coached. While the article stated each intervention was coached until a functional relationship was established it did not state what constituted a functional relationship.

The results of the study were consistent with extent literature stating that coaching through BIE is an effective intervention. Two of the four educators learned and increased the frequency of all three strategies, one learned and increased the frequency of two of the three and one learned and increased the frequency of use of one strategy. During maintenance, educators maintained the skills, but at lower frequencies. The authors made the case that better strategies are needed for skill maintenance. This suggestion is further

confirmed in a variety of BIE in education studies (Ottley et al., 2017). The study suggests distance BIE coaching as an area to explore in the future in the area of early childhood education.

In an MBL, multiple-probe design, three pre-service teachers were coached through BIE *e*Coaching in inclusive preschool classrooms during 10-minutes of small group instruction (Coogle et al., 2015). The coaching occurred twice a day for four days. This was one of the few studies which differentiated participant response to prompts versus independent use of the strategies being coached. Coaching focused on four strategies shown to increase communication in young children with ASD: (a) choice making, (b) in sight out of reach, (c) sabotage, and (d) wait time. Following baseline, participants completed a brief training and then took part in feedback sessions. Coaching included prompting every minute for use of a communication strategy (if the participant did not use them spontaneously) and either praise or correction for their use of the strategy. Researchers collected generalization and maintenance data; however, teachers were asked to record themselves, which may have prompted teachers to change behaviors. Two of the three participants demonstrated a moderate to strong effect on the use of communication strategies, and the third showed a strong effect.

Another study that recorded both prompts and independent use of practices was a MBL, multiple probe that took place in inclusive early childhood classroom with 20 students (Coogle et al., 2017). The participant was a 12-year veteran teacher with two master's degrees. She was coached to provide choices and use reinforcement across three students in her class. Data were recorded in 10 second intervals on whether she used one

of the two practices, in addition to the children's responses to the practices and their use of language. BIE was used during small group activities with the goal of intervention taking place during six-minute intervals. Baseline was business as usual, and then the teacher was shown a narrated presentation about antecedents and consequences, including the ones on which she was coached: choice making and reinforcement. During intervention, the first minute was simply to provide positive feedback to the teacher, while the next five minutes were used for coaching, with a prompt delivered every minute that the teacher did not present choices or reinforcement. There were five coaching sessions for each child (which was determined prior to the start of the study) and then an intervention probe every four sessions. The teacher's results were variable, with the results across all three children being higher than baseline. During maintenance, the teacher-maintained use of the strategies at a lower level than during intervention. Additionally, one child increased his use of words while three increased their use of gestures. Overall, *e*Coaching allowed the teacher increased opportunity to work on the children's IEP goals.

A similar multiple-probe study looked at whether there was a functional relationship between *e*Coaching with BIE and teacher use of an antecedent and consequence strategies replicated across three classroom routines (Coogle, Storie, et al., 2019). Also executed with early childhood inclusion teachers, three teachers participated in this study, all of whom had a small number of students with IEPs in their classes. The study measured prompted and spontaneous use of the strategies, in addition to the target child's appropriate (use of functional communication) or inappropriate responses to

teacher strategies. As in the previously summarized study, data were collected in 10s intervals over 6 min. The business-as-usual baseline was coded for teacher use of antecedent and consequence strategies from a list of possible strategies. After five or more baseline sessions, the strategies used infrequently were identified and one antecedent and one consequence strategy were randomly chosen from the selection. The first minute of intervention consisted of just affirmative feedback. During the next five minutes, the coach aimed to deliver a prompt every minute unless the teacher used a communication strategy. If she did, the coach delivered affirmative or corrective feedback. Intervention was carried out over three classroom routines. Maintenance and generalization sessions followed. Two teachers showed three demonstrations of an effect, while one teacher only showed one demonstration of an effect. This was likely because of a carryover effect due to possible generalization of the intervention across routines. Two children showed two demonstrations of an effect and there was no effect for the third child. Generalization of skills was not consistent for any of the participants.

Another study examined results across routines (Coogle et al., 2016). The multiple baseline, multiple-probe design study was conducted with two first year early childhood teachers who were coached on modeling strategies (i.e., self-talk, parallel talk, and expansions) through BIE. One of the teachers taught 6–7-year-olds with ASD, and one taught 4–5-year-olds in an inclusion setting. The intervention took place during teacher-led routines, child-led routines, and mealtime routines. Each routine was assigned a communication strategy, which the teacher was to target. In the business-as-usual baseline, the teacher self-recorded their session and sent it to the coach. During

intervention, coaching took place for six minutes during the routine. The coach used the first minute to acclimate to the situation before beginning the coaching. During the intervention, the goal was that if the teacher did not use the strategy independently, the coach would provide a prompt every minute. Affirmative or corrective feedback was provided to the teacher after a prompted or independent use of the skill. One teacher showed a demonstration of effect for two of the three routines during which she was coached, and her tau-*U* effect size of .64 suggested a moderate effect. The other teacher demonstrated an effect in all three routines and her tau-*U* effect size of .85 suggested a strong effect across routines.

BIE* e*Coaching by Novice Coaches

In a recent study done with 21 early childhood educators, a control group, exposed to didactic training, was compared to an intervention group that had been exposed to didactic training and coaching on their acquisition of communication strategies (Ottley et al., 2019). The coaches were selected from a nonprofit that provided professional development to early childhood educators. They were trained on how to effectively implement BIE and then they coached the intervention group. The educators were coached for six hours over six weeks during either two 30-min sessions or one 1-hr session each week. Sessions started with goal setting and then the coaches sat out of the way in the classroom and prompted the educators through walkie-talkies. At the end of the study, the only significant difference between the intervention and control groups was the use of one of the six strategies that were taught (mand-model). Data also show that this was the most coached of the six strategies, so there is a potential that the coaching

had an impact on the use of specific strategies. This is potentially due to coaches only providing feedback on average every 3.5 minutes. Being coaches from the community rather than the research institution, the coaches felt less comfortable with the BIE model and did not want to be intrusive to the coachees. Future research would benefit from looking at the optimal length of the coaching sessions, as several previous studies focused on shorter coaching time frames. While the educators and coaches both felt the intervention was socially valid, the coaches shared that their real-time coaching focus on communication opportunities was impacted by two factors: (a) the coaches' need to reflect before commenting on the performance of the coachee and (b) poor classroom management was prohibitive of introducing new skills due to the need to focus on behavior. This would also be an area that would need further investigation if this intervention were to be carried out more regularly in the natural environment.

A promising study conducted with four early childhood co-teaching dyads demonstrated that it is possible for non-researchers to carry out the coaching for marked improvement in teacher behavior (Ottley et al., 2017). Four dyads of early childhood teachers participated in a MBL study of 5-7 weeks of BIE coaching with weekly reflection sessions. The dyads were given definitions and examples of the target communication strategies prior to coaching. Each member of the dyad coached the other twice a week for 10-min via headphones connected to walkie talkies or cell phones. They were instructed to provide performance feedback, either praise or a prompt, once per minute during the 10-min session. Following full coaching, the teams participated in an intervention fading phase for three to four weeks and then coaching was withdrawn and

they participated in a maintenance phase. Data were variable for all four dyads but demonstrated an increase of two to five times the baseline data once intervention was introduced. Not all dyads maintained at this level throughout intervention, and one member dropped back to baseline levels, however, this outcome is promising for the future benefits of peer coaching through BIE and supports the hypothesis that those other than extensively trained interventionists can carry out BIE coaching.

Parent Training and BIE

Parent training, while important, it is often not efficient and "there is a growing need for innovative, efficient, cost-effective treatment models that involve families as a mechanism for increasing intensity of intervention" (Minjarez et al., 2011, p. 92). BIE *e*Coaching is an innovative and cost-effective treatment model which allows families to be more involved in their child's intervention. Coaching parents empowers them to better support their children (Snodgrass et al., 2017). Parents can practice skills in real-time and research shows that coachees, including parents, begin to use coached strategies independently (Ottley, 2016). BIE is a unique way to meet the practice recommended by the DEC for working with families of children at risk for or identified as having a developmental delay, that, "Practitioners engage the family in opportunities that support and strengthen parenting knowledge and skills and parenting competence and confidence in ways that are flexible, individualized, and tailored to the family's preferences," (DEC, 2014, p. 10).

Parents have expressed that detailed feedback is valuable and essential in learning to implement interventions (Bryson et al., 2007; Nefdt et al., 2010). Research indicates

that practice with feedback is needed to help parents master an intervention (Koegel & Koegel, 2012). Parent feedback is successful when it contains frequent reinforcement, specific feedback, and rationales for procedure use (Bryson et al., 2007; Ottley, 2016). The use of BIE in parent training bridges the gap between needing qualified professionals to implement interventions and the fact that parents are a child's primary care giver and should be trained in strategies for working with their children (Baharav & Reiser, 2010). An added benefit to training caregivers is that intervention often occurs in the child's natural environment.

In a study comparing two types of parent training, Koegel et al. (1996) found that the more naturalistic intervention led to lower parent stress and higher levels of happiness compared to the more systematic intervention. The results were based on graduate research assistants' ratings on interaction rating scales of a 5-minute video clip of pre-intervention and post-intervention. Results of this study suggest that naturalistic interventions may be beneficial to a family, including the children who make large and significant gains when interventions are conducted in the natural environment (Koegel & Koegel, 2012).

Parent Implemented Functional Analysis and Functional Communication Training

David P. Wacker and colleagues have conducted multiple studies on training parents to conduct functional analyses (FA) of problem behavior via BIE. The results of FA are used to inform interventions to address problem behavior. One of the most common interventions to develop from FA data is functional communication training (FCT; Harding et al., 2009). FCT procedures rely on differential reinforcement for

appropriate communicative responses instead of problem behavior. The communicative responses that are taught are based on the function of the problem behavior determined by the FA.

BIE to train parents to conduct functional analysis (FA) and functional communication training (FCT) is the least expensive way to provide intervention for children with challenging behaviors and developmental disabilities (Lindgreen et al., 2016; Wacker et al., 2013b). In an article comparing three groups of children, Group 1's parents were trained to conduct FA and FCT by in-home behavior consultants between 1996 and 2009, Group 2's parents were trained via telehealth coaching at a regional clinic between 2009-2012, and Group 3's parents were trained at home through telehealth coaching between 2012 and 2014 (Lindgreen et al., 2016). All three treatments were rated highly by parents, but when calculated, the costs associated with Group 3 were the lowest. Wacker et al. (2013b) calculated that the costs associated with telehealth clinic visits were $11,500 to conduct functional analyses and functional communication training, while the same intervention with in-person weekly therapist visits would have been $55,872. The therapists would have had to do 1,100 hours of driving in addition to their time working with families. Another study found that parents saved an average of 2263 miles of driving by participating in telemedicine coaching sessions (Heitzman-Powell et al., 2014).

In a four-phase study, Wacker et al. (2013a) examined whether parents coached by behavior consultants via telehealth in regional clinics would be able to conduct the four FA conditions. Twenty children ages 29-80 months with ASD diagnoses and

problem behavior were selected for the study. The parents participated from one of five regional clinics with support from parent assistants. The first phase of the study was a teleconference training of the parent assistants. The second phase was a 1 hr individual teleconference training of the parent which introduced the procedures. The parent was provided with a 16-page manual that she was encouraged to read. The third phase consisted of parent interview about the child's problem behavior, a daily behavior record for a week, and a preference assessment. These components helped to define the target behavior, develop a preliminary hypothesis about the behavior, and determine preferred and no preferred items for the FA. The fourth phase was a multielement FA conducted by the parent with coaching from the behavior consultant and support from the parent assistant. The FA was performed during 1-hour weekly telehealth visits, with an average of 3.7 5-minute sessions during each visit. The parent was coached before each session about what they were going to do and coached during the sessions.

Results of the study show that parents were able to conduct FA through BIE *e*Coaching. It saved a considerable amount of time, taking about 1.5 hr each week for the parent and parent assistants and 1 hr for the behavior consultant. Whereas, if the behavior consultant had conducted the FA in person, it would have been 8-hours a week for the behavior consultant, including travel time. This indicates that telehealth is a cost-effective alternative to in-home direct service FAs. However, the question remains whether the results of the parent conducted FAs are truly consistent with the function of the problem behavior.

Thirteen children who participated in the above study also participated in a study on functional communication training (Wacker et al., 2013b). Four other children were added to the study, for a total of 17 children with ASD and challenging behavior. All children had completed a FA prior to this study. Sixteen mothers and two fathers acted as the therapists. They had no formal training in behavioral treatment and were coached from a distance by a behavior consultant with on-site parent assistants who had no formal ABA experience. The intervention took place in telehealth centers. The parent assistants and consultant met briefly via telehealth before and after each child's weekly 60 min visit. The study utilized a nonconcurrent multiple baseline design, with baseline consisting of sessions from the FA. Nineteen FCT programs were completed for 17 children and were based on the function of their challenging behavior, either escape, tangible, or attention. In the FCT escape programs, children were taught compliance with a task and then to ask for a break. In the FCT tangible program children practiced appropriate waiting, and then were taught to request a preferred item. In the FCT attention program, children were taught to ask for attention. Parents were asked to practice the skills 10-15 minutes daily. The study did not outline what the parent training component looked like.

The results of the study indicate that parent implemented FCT treatment is comparable to in home treatment by behavior therapists. Problem behavior was reduced by 68.7% for every child, with the majority demonstrating a 90% reduction. Parents indicated that the intervention was highly acceptable, scoring it a 6.47 out of 7 on a Likert scale.

In a two-phase study, Machalicek et al. (2016) investigated the use of BIE in conducting a functional behavior assessment (FBA) and FA and teaching parents intervention strategies based on the FA. The parents of three children with ASD and challenging behaviors participated. They had no experience with FBA/FA but used applied behavior analysis and educational strategies at home. Phase 1 started with a 60 min FBA interview to develop a hypothesis about the challenging behavior and prepare for the FA. The FA was then completed during 60 min weekly *e*Coaching sessions. Each session within the FA lasted 5 minutes, during which parent were provided verbal prompts, error correction, praise for implementing procedures correctly and then descriptive praise and encouragement following a condition. The results of the first phase indicated that *e*Coaching is a successful way to coach parents through FA.

During Phase 2, an intervention based on the results of the FA was developed for each child with an antecedent-based strategy, functional communication training procedures, differential reinforcement of desired behaviors and extinction of challenging behavior. Parents were trained through a review of task analyses, watching the implementation of the strategy through video-modeling, and practice with the child while the researcher provided performance feedback. Mastery of training was considered when parents could independently implement strategies with 80% accuracy over two to three 30-minute sessions. A multi-element design was used to investigate the impact of the intervention strategy on challenging behavior and a clinical (AB) non-experimental design was used to examine the parent education procedure. The social validity of the intervention received moderately positive ratings, possibly because they felt the

equipment was unwieldy. The intervention strategies were associated with a decrease in challenging behavior and each parent continued implementing at least one strategy at the end of the treatment comparison.

Three children, ages 3-4 years old with ASD or Rett Syndrome, were taught to use augmentative communication devices in an adapted multiple probe across contexts study (Simacek et al., 2017). The first context also incorporated an ABAB design. Functional assessment interviews and structured descriptive assessments were conducted with all individuals via telehealth, prior to the study. Additionally, two participants had a FA, carried out by the parents, with coaching and live feedback from the coach. In the A, or baseline phase, the augmentative communication card or device was present, but touching it did not result in reinforcement. During this phase, idiosyncratic behaviors were reinforced. In phase B, or treatment (FCT), the augmentative communication card or device was introduced and resulted in reinforcement, while the child's idiosyncratic behaviors were on extinction. FCT was embedded into three routines for each child. Parents carried out the intervention, with coaching via BIE. Coaching consisted of a most to least prompting procedure and time delay to teach the use of Augmentative and Alternative Communication (AAC). Parents received verbal instructions and feedback and they were connected to the coach via webcam on their personal computer or a borrowed telehealth equipment kit. At any change in procedure, parents received an emailed summary of steps that would be taken in upcoming sessions. Parents rated the intervention as highly acceptable. As AAC was introduced, idiosyncratic behavior

decreased. Overall, the telehealth procedures were successful; parent were able to implement both assessment and intervention.

Parent Implemented Social Language

In a single subject time-series repeated measures design pilot study, 50 minute twice weekly sessions with a speech therapist (period A) were compared with one 50-minute session implemented by a speech therapist and one implemented in the home by a parent (Baharav & Reiser, 2010). Parents were present and encouraged to interact with their child during the speech therapy sessions. The parent session was supervised through BIE by the speech therapist, who provided cues and coaching on a prescribed lesson plan. Both children, who were of preschool age, increased their responses to communicative interactions with home-based sessions. Initiations of communication increased for one participant and maintained at a similar level for the other child. There was a substantial increase in reciprocal social interactions with the implementation of home sessions. Additionally, parents provided more opportunities to elicit social engagement than the clinicians did in two 50-minute sessions. Both parents agreed that *e*Coaching through BIE was valuable and would recommend it to other parents with children with ASD.

In another study by speech language clinicians, eight parents participated in parent education, clinic coaching, and distance coaching sessions (McDuffie et al., 2013). The quasiexperimental design, using a series of A-B replications, scheduled parent education sessions every four weeks. The 90-minute sessions run by a speech language clinician and graduate student in speech language were followed immediately by a face-to-face coaching session. During the coaching session, a graduate student, the coach,

gave parents suggestions of actions to take, praised parent interactions, and modeled what parents could say. These face-to-face sessions were followed by three weeks of distance coaching via a loaned laptop. The coach for the distance sessions provided the same feedback and prompting that was provided in the face-to-face session. Five behaviors were targeted for the parent/child dyads: (a) follow-in commenting (in which the parent commented on what the child was doing or playing with), (b) indirect communication prompts (which includes arrangement of the environment, time delay and choice making opportunities), (c) prompted child communication acts, (d) total child communication acts, and (e) parent verbal response to child communication acts (including interpreting and expanding). Ten-minute baselines were taken during parent/child play samples and there was no coaching or interaction with the parents during this time.

Follow-in commenting increased, with a level change from baseline and then remained stable throughout the intervention. For most dyads, parents' prompts increased over baseline when intervention as introduced, but then decreased slightly during intervention. Parent response to child communication acts and parents contingent verbal responses both increased with the introduction of parent education and coaching. Additionally, there was no difference in the implementations of parent strategies between the face-to-face and video conferencing models.

Another study compared self-directed versus therapist-assisted *e*Coaching interventions (Ingersoll et al., 2016). The pilot randomized control trial study matched 27 children based on their expressive language scores on the Mullen Scales of Early Learning and randomly assigned them to an intervention. The children were between 19-

and 73-months old and fit the criteria for ASD. The parent and child were videotaped in their home for pre-treatment, post-treatment, and a three month follow up. During the video-taped interaction they were asked to play for 10-minutes and then have a snack. The self-directed group accessed the Project ImPACT website that had 12 self-directed lessons, each taking about 75-minutes to complete. The parents had access to the website for six months and were asked to complete one lesson a week and then practice. They received no support or other intervention. The therapist-assisted group also had six-month access to the ImPACT Online website and were asked to complete it at the same rate as the self-directed group. Additionally, the therapist-assisted group had two, 30 min coaching sessions per week (for a total of 24 weeks). During the first session of the week the parent and therapist clarified any questions from the lesson content and how to apply it to the child. During the second session, parents received live feedback on their use of the intervention with their child.

Four of the self-directed parents did not finish the intervention, possibly because they were not as invested in the program as the other parents. In fact, only 69% of the parents in the self-directed group completed the program, compared to 100% of the therapist assisted group. During pre-treatment there was no significant difference between the groups on the variables. Both sets of parents felt more effective and less stressed following intervention. Both groups also increased their positive perception of the children, although the therapist-assisted group had a better view of the child than the self-directed group at post-treatment. Both groups had higher fidelity of implementation post-treatment, but again, the therapist-assisted group was significantly higher than the

self-directed group and the benefits of the program maintained at follow-up. All children displayed significant gains in their language targets, but the therapist-assisted group did marginally better than the self-direct group.

Parent Implemented Research Based Interventions

Four families and seven parents completed the Online and Applied System for Intervention Skills (OASIS) training program containing eight modules with information about ABA (Heitzman-Powell et al., 2014). The modules were interactive tutorials with a 20-item assessment and immediate feedback in the form of written text. Topics included: (a) introduction to ASD and behavioral treatment, (b) defining and observing behavior, (c) principles of behavior, (d) stimulus control, (e) effective teaching strategies, (f) decreasing behavior antecedent control, (g) decreasing behavior consequential control, (h) pulling it all together. Following each module, the parents were coached via BIE from a local telemedicine site and given the materials to be used. During the 90-120 min coaching session, the parents and coach: (a) discussed the module and data collected on problem behavior and incidental teaching during the week (b) assessed parent fidelity on the new skill (if not completed at 81%, the parent was provided feedback and prompts), (c) the parent and child played for five minutes, and finally, (d) there was a question and answer period. The parents completed a pre- and post- measurement by engaging with their child in six activities, which measured a total of 41 skills. They also completed a 48-item multiple choice pre- and post-test.

Overall, the OASIS training was successful. Parents gained 41.23% in their performance of ABA skills and 39.13% in their performance on the multiple-choice test.

Consistent with other BIE research, parent satisfaction with the BIE portion of the intervention was 4.8 out of 5.

As part of a larger study, eight parents were trained in the Early Start Denver Model (ESDM) through a training website and two-way in home video-conferencing (Vismara et al., 2013). In the MBL across parent-child dyads study, the first author and another therapist trained in ESDM conducted 12 weekly 1.5 hr sessions with three 1.5 hr monthly follow-ups. Parents were observed during two 10 min interactions a week to establish baseline. The ESDM was then introduced during weekly sessions. Parents were given the opportunity to learn about a topic through the website before the videoconferencing session or after. The videoconferencing session started with dialogue about what was learned and practiced over the previous week. The parent and child were then observed interacting for 10 min without coaching. Following the observation, a new topic was introduced, and the parent practiced it, while the therapist gave feedback. However, the article did not specify the dosage or type of feedback delivered. Finally, to end the session, the strategy was discussed regarding its use with other caregiver and how to apply it across sessions. Follow up sessions followed a similar pattern, with a 10-minute activity followed by focusing on a topic the parents wanted help with.

The majority of the parents felt the video conferencing was the most important part of the intervention, which helped to increase the children's verbal utterances. The interaction was important to increasing learning outcomes for the parents, consistent with other studies. Parents shared that the intervention gave them a better understanding of how to help their children learn. Typically, it took parents about seven weeks to learn the

program, and six out of eight parents met the fidelity rating criteria for accurate implementation of ESDM.

Preparing for Parent Coaching

Engaging parents through BIE coaching requires careful preparation. Ottley (2016) outlines five steps to plan for BIE coaching with parents:

1. Determine the location for coaching.
2. Decide on which technology will be used for BIE.
3. Confirm the caregiver's comfort with the chosen technology.
4. Determine the strategies to be targeted and the cues which will be used.
5. Evaluate the effectiveness of coaching.

One benefit of BIE *e*Coaching is that it can be conducted anywhere in the child's natural environment and during any routine. This aligns with the first of the DEC Recommended Practices (2014) in creating environments that prompt child development, particularly for children at risk for or who are developmentally delayed. DEC recommends that "practitioners provide services and supports in natural and inclusive environments during daily routines and activities to promote the child's access to and participation in learning experiences," (DEC, 2014, p. 9). When considering the location of BIE, the coach must also take into account whether she will be in the environment with the dyad being coached or will be coaching from a distance via the videoconferencing (Ottley, 2016).

When determining which strategies to target, it is imperative the work within the family's preferences (Ottley, 2016). This too aligns with the DEC Recommended Practice that, "Practitioners and the family work together to create outcomes or goals,

develop individualized plans, and implement practices that address the family's priorities and concerns and the child's strengths and needs," (DEC, 2014, p. 10). Once the target strategies are identified, the coach and coachee should work together to identify what phrases will be used to prompt parents to use the appropriate strategy. The phrases should be concise messages, 2-3 words in length that are specific and positive (Ottley, 2016). Finally, ongoing evaluation of the cues and overall coaching is needed in order to confirm whether BIE is working and feasible (Ottley, 2016).

Social Validity of BIE

Measurement of social validity helps address the gap between research and practice and gives an indication of how likely it is that evidence-based practices will be implemented by natural change agents in the natural environment setting (Chung et al., 2020). Three aspects of social validity are considered: (a) whether is meets the participants' goals, (b) the feasibility of the procedure, and (c) whether the intervention is successful and socially important (Chung et al., 2020). In a study measuring the social validity of BIE, two studies were considered (Ottley et al., 2015). The first, outlined above, involved three early childhood preservice teachers who were coached for four days, twice a day for ten-minute sessions (Coogle et al., 2016). The second was with four in-service early childhood educators who were coached three to five days a week for 15 minutes a day for approximately two months. Observations, interviews, and data analysis were used to assess the social validity of the two studies. Findings showed that BIE coaching increased educator's use of strategies and improved their teaching capabilities. All participants agreed that the coaching did not interfere with their routines or

procedures, and most reported it did not affect the students in the classroom. Additionally, all participants reported that children's communication and engagement improved due to the teachers' coaching. However, not all outcomes were positive. Three of the seven participants did report trouble with the technology, difficulty multitasking, and that the technology distracted the children. This is consistent with other studies where participants have shared that their biggest challenges were the need to multitask during coaching and difficulty with technology (Ottley, 2016).

A recent study was designed to address two research questions, both about the social validity of a telehealth BIE coaching intervention (Chung et al., 2020). In the 8-month study, an early intervention (EI) provider was first trained via modules and coaching on implementation of parent coaching through BIE while the parent was trained via modules on the Internet-based Parent Implemented Communication Strategies (i-PiCS) intervention. Once the researchers felt the EI provider was sufficiently trained, the EI provider began coaching the parent. The dyad focused on environmental arrangement and plus one strategy (modeling, mand-model or time delay) and did not move to the next strategy until the parent reached 80% fidelity over two sessions and reported that she was comfortable with the strategy. Prior to and following the intervention both the EI provider and parent participated in interviews and completed a questionnaire to assess social validity. These data were combined with observational data to answer the research questions. Both the EI provider and parent viewed the intervention as highly useful and felt it supported the child's communication. The parent felt empowered and more confident when working with her son. The multiple sources gave a more robust picture of

the social validity of the intervention and confirmed extant literature that BIE coaching is a socially valid intervention, despite some difficulty with technology and adjusting to input.

Participants report experiencing initial anxiety surrounding the observation and feedback process (Rock et al., 2009). In fact, in one study, 11 of 13 participants admitted this (Rock et al., 2012). Therefore, the authors assert, it is important to establish trust with the BIE participants. Once trust is established, the technology can create a safe and comfortable learning environment for both pre- and in-service teachers (Rock et al., 2014). Rock et al. (2014) found that participants eventually reported that they wanted more feedback via *e*Coaching in the future.

Study participants, typically preservice teachers, have a positive view of BIE and felt it was helpful in shaping their teaching behavior (Ottley & Hanline, 2014; Rock et al., 2009; Rock et al., 2014; Scheeler & Lee, 2002; Scheeler et al., 2006). Seventy-three percent of the 15 in-service K – 12 teacher participants in one study shared that they had positive experiences with their BIE observations, and 80% felt that BIE was a helpful tool (Rock et al., 2009). These numbers increased to 92% and 85% respectively in a replication study conducted with K – 6 in-service teachers (Rock et al., 2012). One participant was quoted as saying, "Wow! The BIE technology is absolutely amazing! Using the technology while I was teaching really helped me learn a few things about myself as a teacher…." (Rock et al., 2009, p. 73). In a later study with 14 out of the 15 participants from the 2009 study, when asked to identify disadvantages of participation in a BIE study, none of the in-service teacher participants identified *e*Coaching as

problematic (Rock et al., 2014). Their complaints had more to do with frustrations with technology glitches, such as slow internet and the Bluetooth falling out of a teacher's ear (Coogle et al., 2017). Despite these issues teachers often stated they wanted to use it in the future to target other behaviors (Goodman et al., 2008; Ottley et al., 2015). Pre-service teachers felt BIE gave them professional insight (Rock et al., 2012), and in-service teachers liked the immediacy and real-time praise (Coogle et al., 2016). One in-service teacher was quoted as saying, "I would definitely encourage it with others. I have seen firsthand how much and how quickly it changed my teaching. We talk about praising our students and giving them immediate feedback. I guess the same is effective for us as teachers" (Scheeler et al., 2010, p. 92). Coaches have also highly rated the effectiveness of BIE (Giebelhaus, 1994). At least one teacher commented that she would recommend the technology to other teachers due to the immediacy of the feedback and the increase in use of strategies (Coogle et al., 2017).

Operant learning principles dictate that immediate, precise and frequent feedback facilitate effective learning (Scheeler et al., 2006). Immediate feedback enables teachers to remedy the situation before the mistake becomes ingrained. In contrast, delayed feedback allows the recipient to practice errors before they are corrected (Scheeler & Lee, 2002). Teachers realized the importance of the immediacy of feedback, and in one study using BIE, eleven of the fourteen teacher participants stated the benefit of immediate feedback to their growth during the study (Rock et al., 2014). In another study, six of seven participants appreciated the immediacy of feedback (Ottley et al., 2015).

Preservice teachers reported that they adjusted to the technology in about 20 minutes, and it became a welcome way to receive feedback (Schaefer & Ottley, 2018; Scheeler et al., 2006). Disruption in teacher behavior was minimal during coaching, despite feedback being delivered while the teacher was speaking (Rock et al., 2009). Nor was the BIE technology reported to be distracting to the teacher or student (Schaefer & Ottley, 2018; Scheeler & Lee, 2002). However, one student teacher reported that she became tired of using BIE as the 14-week experiment went on (Scheeler et al., 2009).

Summary

BIE is an evidenced based intervention that has been used for nearly 70 years in a variety of human services fields. It is empirically validated as an intervention that can change teacher behavior and is socially valid (Schaefer & Ottley, 2018). BIE is becoming a more popular when coaching teachers and parents to support children in the natural environment. In fact, "BIE can be an effective means for providing practitioners and families with real-time coaching within a child's natural environment by enhancing the quality and quantity of instructional strategies that are embedded into routines" (Ottley, 2016, p. 36). No studies were found that had the primary focus of establishing a functional relation between BIE *e*Coaching and increasing parent provision of natural language opportunities in the natural environment (the child's home). In all *e*Coaching parent interventions, BIE was a component of a more extensive intervention to teach a variety of skills.

CHAPTER THREE

The purpose of this study was to answer the following research questions:

1. Is there is a functional relation between Bug-in-Ear *e*Coaching with parents of young children with language delays and parent provision of natural communication opportunities?
    a. Do parents maintain the provision of natural communication opportunities when Bug-in-Ear *e*Coaching is faded?
2. Do parents feel that Bug-in-Ear *e*Coaching is a socially valid intervention?

Chapter Three outlines the methods of the study, including discussion of the participants and setting, along with a description of the needed materials. The independent and dependent variables are operationally defined and accompanied by examples and non-examples of the dependent variable. The research design and data collection procedures are detailed, along with information about interobserver agreement, procedural reliability and social validity. Data analysis is be discussed.

Participants and Settings

Prior to the start of the study, the study was approved by the Institutional Review Board at George Mason University (see Appendix A). Training and coaching sessions took place via BIE technology. The coach and participants connected via the Zoom platform. Participants were on wireless devices in their homes and connected to the sound via a Bluetooth headset. Each dyad's setting within their home was unique to the

family's situation. Descriptions of the individual settings are detailed in the dyad participant information below.

Participant Recruitment

Participants were selected using purposeful criterion-based sampling. Information about the study was shared through a recruitment flyer (see Appendix B) with a public preschool program in the mid-Atlantic United States that serves students with disabilities, via social media, and through two university education departments. Interested parents were included in the study if they: (a) had a child between 24 and 60 months who had a language disorder due to DD or ASD, (b) spoke English as their primary language, (c) had a laptop or tablet that is capable of videoconferencing and could be moved around the house, (d) had high-speed wireless internet in their home, (e) were able to commit to two half-hour session a week of video-conferencing, (f) gave permission to record the sessions, (g) had a primary goal of increasing their child's functional language, and (h) the child was communicating through gestures, single words, or just starting to combine words. Parents were asked to fill out a questionnaire to confirm study criteria (see Appendix C). All participants were awarded a $250 stipend at the end of the study. Five dyads qualified for the study. They lived in three different states, all on the east coast of the United States.

Parent-Child Dyads

This section describes the five dyads, including the mothers' demographic information (see Table 2) taken from the Demographic Questionnaire (see Appendix D)

and the children's educational history and communication levels (see Table 3). Also included in this section is the setting in which the dyad participated in the study.

Dyad One

Dyad one was composed of a mother and son. The son, Laurence, was three years old at the beginning of the study and turned four during the study. He had been in early intervention since he was 18 months old and received a diagnosis of ASD just after he turned two. Laurence had been receiving 40 hours of ABA therapy in home, which started a year before the study began. In the middle of the study, he went back to preschool for a few hours a day. At the start of the study Laurence communicated using single words. He had a vocabulary of about 60 words and was just starting to combine words. Children his age can typically name most things in their environment and carry-on conversations in two- or three-word sentences (Centers for Disease Control and Prevention [CDC], n. d.-a).

He lived at home with his mother, father, and younger sister, who also had language delays. His mother took part in the study and his sister was often present during sessions. Laurence's mother, Mariana, is a 42-year-old Hispanic woman who is bilingual. The family used both English and Spanish at home. Mariana completed some college and is a stay-at-home parent. According to her participation questionnaire, filled out before the study began, Mariana's goal for Laurence was that he "get better with communication skills that he doesn't require so much prompting and he will get better communication with family members and everyone."

Dyad One Setting. Dyad one worked between three areas of their house: (a) the living room, (b) the playroom, and (c) the kitchen table. Most of the sessions took place in the playroom, where Mariana had access to a variety of preferred and engaging toys from which Laurence could choose. She and Laurence typically played on the floor sitting across from each other. The wireless device, a cellphone or laptop, was set up on a shelf where the built-in camera captured the dyad and the toys with which they engaged.

Dyad Two

Dyad two was composed of a mother and son. The son, Barry, was three and a half at the beginning of the study. Barry was in an early childhood special education program with the local school system, in which he participated virtually due to the pandemic. Barry went through medical diagnostics during the study and was given a diagnosis of ASD. At the beginning of the study, Barry's parents reported that he mainly communicated through gestures, but had about 50 single words/word approximations. He did not combine any words. Children his age can typically name most things in their environment and carry-on conversations in two- or three-word sentences (CDC, n. d.-a).

Barry lived at home with his mother, father, and baby sister. Barry's mom, Sara, took part in the coaching for the study, and his sister was sometimes present. Sara is a 34-year-old female of Asian/Pacific Islander descent. She holds a post-graduate degree. Sara works full-time and is in graduate school full-time. Sara's goal for Barry was to improve his functional language skills.

Dyad Two Setting. Dyad two worked across five settings in their home: (a) the back deck, (b) the living room, (d) the front stoop/sidewalk, (d) the kitchen table, and (e)

the basement. The first few sessions took place on the back deck, where Barry and Sara engaged in water play with his water table. They also did a few sessions on the front stoop writing with sidewalk chalk, one in the basement and one at the kitchen table where they painted. Most of the sessions took place in the living room, where Barry had access to a variety of preferred toys. When the dyad worked in the living room, they moved around the space, but Sara typically sat on the floor. The television was often on during sessions, and Barry would occasionally need prompting to refocus.

Dyad Three

Dyad three was composed of a mother and son. The son, Michael, was three-years old at the start of the study. He was at home with his mom during the day and going through the Child Find process with the local school system. Michael had received early intervention speech services since he was 17 months old. He had a diagnosis of verbal and oral Apraxia and is "strong-willed." While Michael's mom estimated he had a vocabulary of 100-200 words, she reported he only consistently asked for two things vocally, "help" and "ice." However, she shared that he communicated well and used a variety of signs. Children his age can typically name most things in their environment and carry-on conversations in two- or three-word sentences (CDC, n. d.-a).

Michael lived at home with his mother, father, and older sister. Michael's mother, Rebecca, is a 41-year-old white female. She was a stay-at-home parent who worked part time. Rebecca had a post-graduate degree. Her main goal for Michael was functional communication with the goal of going to kindergarten.

Dyad Three Setting. Dyad three worked in the living room and kitchen of their home. In the living room, Michael and Rebecca typically played side by side at a coffee table in front of their coach. The wireless device was often propped on the table in front of them and showed their interactions along with the toys with which they engaged. Rebecca always had a few toys available from which Michael could choose, however, he sometimes chose instead to run around the room or go to his toy closet behind the couch and select another toy. In the kitchen, Michael would sit at the table or counter next to Rebecca and engage with an activity.

Dyad Four

Dyad four was composed of a mother and son. The son, Ned, was four and a half years old at the start of the study. He and his twin brother are both diagnosed with ASD, Ned with moderate ASD and his brother with severe ASD. Ned and his brother receive in home ABA therapy during the week and had been in intervention for two years. Ned had about 10 single spoken words and a few signs at the beginning of the study. He threw numerous tantrums a day, which included some self-injurious and aggressive behaviors. Children his age are typically able to retell a familiar story, use rules of grammar correctly, including the use of pronouns, and communicate in multi-word sentences (CDC, n. d. -b)

Ned lived at home with his mother, father, and twin brother. His mother, Adina, participated in the study and his brother was sometimes present during sessions. Adina was a 42-year-old Hispanic female. She had a college degree and was a stay-at-home

parent. Adina is bilingual and speaks both English and Spanish at home. Her goal for Ned was to improve his functional communication.

Dyad Four Setting. Dyad four always worked in Ned's playroom. There were a variety of toys in containers lining the wall, a mattress was on the floor, and the family's two dogs would often wander in and out. On the back of the door that was opposite from the camera of the wireless device, there was a basket out of Ned's reach that frequently had the most highly preferred toys, such as a phone or stickers. Ned and Adina typically sat on the floor facing each other, with a toy in between them.

Dyad Five

Dyad five was composed of a mother and son. The son, Terence, was four and a half years old at the beginning of the study. Terence was enrolled in an early childhood special education program with the local school system and participated virtually due to the pandemic. He had a diagnosis of ASD. Terence's mother reported that he often pulled an adult to the item he wanted. He was just starting to use words and mainly used language for requests. However, he does not express much without being prompted. He was able to repeat multi-word phrases one word at a time if prompted. He could label some familiar items verbally when asked. He was able to read and spell some sight words. Terence's mother, Lori, reported that he also has an augmentative communication device, but he did not typically use it for communication. Children his age are typically able to retell a familiar story, use rules of grammar correctly, including the use of pronouns, and communicate in multi-word sentences (CDC, n. d. -b)

He lived at home with his mother, father and siblings. Lori is a 42-year-old white female. She completed some college and worked part-time. Her main goal in participating in the study was to expand Terence's functional communication. She shared that she was, "concerned [to] not having the direction needed to help him continue using (and expand) his speech over the summer [break]."

Dyad Five Setting. Dyad five began the study by working in their family room. Terence had access to a highly preferred swing and a variety of toys. Over the course of the study, Lori relocated to a kid-sized table in the living room and then a kid-sized table in a kitchen nook where Terence did his virtual schoolwork. One session took place at their vacation home in the living room, but Terence was highly distracted during this session. While working at the kid-sized tables, Lori typically sat behind Terence. The camera was set up in front of the dyad and captured both the work surface and their faces. Terence engaged with highly preferred activities during the sessions, mainly Play-Doh.

Coach

The coach was a PhD candidate and Board Certified Behavior Analyst with a Master's degree in infant and early childhood special education. Prior to the study, she had experience coaching families and school staff in person in creating natural communication opportunities during their day. She connected with families in the study from in her home office on a MacBook Pro laptop and used a Bluetooth earbud to facilitate communication with participants. During one baseline session, the coach connected from a hotel room via her MacBook Pro and earbud.

Table 2

Demographics of Mothers Participating in Study

Demographic	Mariana	Sara	Rebecca	Adina	Lori
Age	42	34	41	42	42
Race	Hispanic	API [a]	White	Hispanic	White
Primary language	Bilingual [b]	English	English	Bilingual [b]	English
Education	Some college	Post-graduate degree	Post-graduate degree	College degree	Some college
Career	Stay at home parent	Works full-time [c]	Works part-time	Stay at home parent	Works part-time
Parent goal for child [d]	Build independence	Functional	Functional	Functional	Functional

[a] API= Asian/Pacific Islander. [b] Bilingual in English & Spanish. [c] Also in school.

[d] Communication focused.

Table 3

Beginning Demographics of Sons Participating in Study

Demographic	Laurence	Barry	Michael	Ned	Terence
Age	3 years	3 years	3 years	4.5 years	4.5 years
Diagnosis	ASD	ASD	Apraxia	ASD	ASD
Early intervention	Since 18 mos	Not reported	Since 17 mos	For 2 years	Not reported
Current intervention	ABA in-home	Virtual ECSE	None	ABA in-home	Virtual ECSE
Primary communication	60 words	Gestures [a]; 50 words	Signs/ gestures [a]; 2 words	10 words; Signs	Pulling [a]; A few words
Lives with	Mom, Dad younger sister	Mom, dad, younger sister	Mom, dad, older sister	Mom, dad, twin brother	Mom, dad, older siblings
Other?				Tantrums, SIB & aggression	Starting to read

Note: ABA = Applied Behavior Analysis; ECSE = Early childhood special education; SIB = Self-injurious behaviors

[a] Primary mode of communication.

Informed Consent

Informed consent was signed by five all parent participants (see Appendix E). The children of the dyad were too young to sign consent and were not the main subjects of the study.

Independent Variable

The independent variable for this study was *e*Coaching through BIE. *e*Coaching was delivered via twice weekly (with a few exceptions due to travel or family commitments) fifteen-to-thirty-minute parent coaching sessions for three months, with the following structure (times listed are approximate, apart from parent practice with coaching):

1. **Check-in & activity selection (5 min):** Parent and primary investigator discussed parent's questions and targeted any issues that had arisen since the previous session. After Check-in, the parents provided their child a choice of activities to engage with that day.
2. **Parent practice with coaching (11 min):** This was the focal point of the twice weekly intervention. Parents practiced providing their children with natural communication opportunities throughout the eleven-minute session. Data and coaching did not occur during the first minute, allowing parents to observe their child and see what they were interested in that day. After the initial minute of each session, data were recorded, and coaching began. The primary investigator coached using prompting and immediate, specific positive or corrective feedback (Rock et al., 2009).
    a. The coach delivered prompts and/or feedback approximately once every minute during the coaching sessions (Coogle et al., 2018).
        i. Prompts were short, specific phrases (Ottley, 2016).

ii. The coach attempted to deliver prompts during a pause in conversation or interactions, when appropriate (Ottley, 2016).

iii. The coach prompted the parent to provide their child with a natural communication opportunity or she gave positive feedback when the parent independently did so. During the study, the coach focused on two aspects of a natural communication opportunity.

    1. *Communication temptations*: situations that the parent set up to promote her child's communication. There were four types of strategies under communication temptations: (a) inadequate portions, (b) assistance, (c) pause in routine, and (d) choice making. These are described in more detail in the dependent variable section.
    2. *Prompting*: provides a signal for a child to say something. There are four strategies included under this heading: (a) time delay, (b) open questions, (c) choice questions, and (d) modeling. These are described in more detail in the dependent variable section.

iv. Each coaching prompt was followed by immediate feedback given within three seconds of the parent's behavior, when appropriate. The feedback specifically labeled the parent's targeted action and included a positive phrase. For example, when the parent provided a model for their child, the coach said, "Nice model."

v. If the parent did not follow the prompt, the coach waited and provided a prompt in the next minute interval.

b. When the parent naturally provided a communication temptation or prompt to their child, the coach provided positive feedback immediately following the behavior and did not provide a prompt in that minute.

3. **Wrap-up (5 min):** The parent and coach discussed and clarified the prompts and feedback delivered during the session and answered additional questions the parent had. The parent and coach analyzed the cues being given by the coach and whether any changes needed to be made. The team discussed implementation during the coming week, mainly, what the parent could target.

Materials

In a short, but successful, study using Bug in Ear in the classroom Rock et al. (2009) set the stage for the technology that was used in the current study. Based on their study, with a few changes to account for technological advancements, the following materials were utilized. The coach used a laptop wireless internet. Mothers used a laptop, tablet, or phone with wireless internet. The wireless devices were connected to the internet and were capable of loading and running the software from Zoom to facilitate the teleconferencing. All participants utilized Zoom software to participate.

A Pro Zoom account was purchased at $14.99 per month. It allowed for unlimited 1:1 video conferencing via a standing meeting link and recording to the 1 GB cloud storage from which videos were then downloaded to an external hard drive. When the coach signed in, all sessions were automatically recorded for data collection, fidelity

of implementation, and interrater reliability purposes. Dependent on their preference, participants used a coach-provided Jabra Talk 25 Bluetooth headset or personal Bluetooth earbuds. Wireless headsets were synced to the wireless device in order to hear the coach's feedback. Once parents signed the informed consent, they were sent a three-page technology information handbook (see Appendix F) that outlined the required technology, how to connect to Zoom, and how to set up the Bluetooth settings (Kurz & Weiss, n.d.). Prior to baseline, the coach and parents signed into Zoom to make sure both parties could connect to the technology, see and hear each other. In addition to the video conferencing materials, a smartphone with the Timer+ application was used by the coach to time the one-minute intervals for the fidelity of implementation checklist and data collection.

Dependent Variable

The dependent variable in this study was increasing parent provided natural communication opportunities. Natural communication opportunities take place in the child's natural environment and are embedded into play activities (Vanderbilt KidTalk, n.d.). Baseline data were collected on four aspects of a natural communication opportunity: (a) play and engage, (b) expanding language, (c) communication temptations, and (d) prompting. During intervention, natural communication opportunities were narrowed down and consisted of parents providing communication temptations and prompting. Parents may engage in one or both components at a time. See below for further explanation of each component.

1. **Communication temptations** are situations set up to promote child communication. All require the communication partner to provide at least three seconds of wait time for the child to communicate before following up.
    a. *Inadequate portions:* The parent provides the child with a small amount of a desired item, requiring her to ask for more of an item.
    b. *Assistance:* The parent sets up a situation where the child needs to ask for help or for someone to move, such as putting a cookie inside a box or asking a parent to move his hand.
    c. *Pause in routine:* The parent pauses in the middle of a familiar routine and waits for the child to fill in the words to the routine (e.g., parent says "Ready, set, _____" and pauses to see if the child says, "Go").
    d. *Choice making:* The parent holds up two items to offer the child a silent choice. The child must communicate to get one of the items.
2. **Prompting** serves as a signal for the child to say something. All four prompting situations used in the study all require the parent to wait at least three seconds for the child to communicate before following up:
    a. *Time delay:* An obvious, but non-verbal cue for a child to communicate. This is often executed by holding up an item and pausing for the child to look and communicate before getting the item.
    b. *Open question:* The parent asks an open-ended question, one that cannot be answered with a yes/no or a choice, and to which there is no single correct answer. This does not include "What is it?" questions.

c. *Choice question:* The parent asks a choice question (e.g., Do you want waffles or eggs for breakfast). This can be supported by visual cues as needed.

d. *Model procedure:* The parent provides a model of exactly what she wants the child to say.

Data Collection Instruments

Initial data were recorded through partial interval recording during 10-minute segments of baseline, intervention, and maintenance. The initial data were taken live during each session by the coach. She then went back and re-watched the video to confirm data were correctly reflected for decisions of when to move to the next phase. The datasheet (see Appendix G) was divided into minute intervals with 13 rows to record the individual steps in the provision of the four components of a natural communication opportunity and an additional three rows to record child communication data. Data were recorded using five notations for each minute long interval. Prompted (P) meant that the parent provided the particular aspect of the natural communication opportunity following a 2-3 word prompt from the coach. An unsuccessful prompt (P̶) was indicated when the coach provided a short prompt, but the parent did not respond or responded incorrectly. Full prompt (FP) was recorded when the parent required a longer explanation of how to prompt than just 2-3 words. An independent response (+) was marked when the parent independently provided an aspect of the natural communication opportunity. When the coach provided positive verbal feedback, the notation (SR) was used. S^R is a notation for reinforcement commonly used in Behavior Analysis (Cooper et al., 2007). The coach also

recorded secondary data to track child communication attempts, including when he initiated communication, responded to a verbal exchange by a parent, and the independence level of the response to the parent and the types of communication (eye contact, gestures, tantrums/crying, vocalizations, words and phrases).

During intervention, parents started to provide more than one natural language opportunity during each minute interval and the data collection tool originally used did not accurately capture all the independent uses of strategies. Therefore, following maintenance, the coach went back through the 115 videos from baseline, intervention and maintenance using a simplified datasheet to capture frequency data on parent provided natural language opportunities, specifically in the areas of communication temptations and prompting (see Appendix H). The datasheet also captured positive feedback from the coach, coach prompting and full prompting. This datasheet was used for interrater reliability.

Research Design

A single-subject, multiple baseline across participants research design was employed to examine whether there is a functional relation between Bug in Ear coaching and increased provision of natural communication opportunities by parents of children with language delays. Based in operant conditioning and applied behavior analysis, single-subject research design (SSRD) is well-suited to address research questions aimed at changing behavior (Gast & Ledford, 2014). SSRD was first described by Sidman in 1960 and has been used in fields such as psychology, special education, communication sciences, and therapeutic recreation (Gast & Ledford, 2014). In SSRD, the participant

serves as his own control, experiencing both the control (non-intervention) and the intervention conditions. SSRD typically involves multiple, systematic measurements of the dependent variable before, during, and after an intervention (Kratochwill et al., 2010). It is used to examine whether the introduction of the independent variable is functionally related to a change in the dependent variable (Horner & Odom, 2014).

SSRD frequently involves more than one participant with four to eight participants being typical (Cooper et al., 2007). The subject may also be a cohesive group of participants, such as a classroom or community (Kratochwill et al., 2010). The data of each subject or group are analyzed individually. This contrasts group comparison designs, where large groups of participants are assigned to different conditions and the data are compiled and compared across conditions. Group research looks at average performance, while SSRD looks for individual performance (Gast & Ledford, 2014).

Multiple Baseline Design

One type of SSRD is the MBL. MBL was introduced in behavioral research in 1968 by Baer et al., as an alternative to the SSRD reversal design, in which the intervention is withdrawn following a change in behavior to demonstrate experimental control. Due to ethical concerns, this is not always possible or advisable, and MBL provides another option (Gast et al., 2014). MBL is also beneficial for use with interventions that teach behaviors that are not reversible, such as tying one's shoes (Baer et al., 1968).

MBL is conducted using three or more participants, stimulus conditions or behaviors, and staggering the introduction of the intervention across them (Cooper et al.,

2007; Gast et al., 2014). The intervention is applied to one participant, stimulus condition, or behavior at a time, and a change in the first dependent variable (DV) is documented (Baer et al., 1968). The intervention is then introduced to the next DV, which should lead to another change, and so forth. A successful MBL design demonstrates a reliable variable because the DV only changes when the intervention is applied directly (Baer et al., 1968).

Baseline data collection for all data sets begins at the same time, and typically continues until the level and trend of the data for all participants, stimulus conditions, or behaviors is stable (Gast et al., 2014). The intervention is introduced in the first tier while the others remain in baseline. Once there is a documented effect (a change in the data pattern), the intervention is introduced in the second tier (Horner & Odom, 2014). This continues until the intervention has been introduced to all participants, stimulus conditions, or behaviors.

Gast et al. (2014) recommended two assumptions be made before the beginning of a study to establish experimental control. The first is that the participants, stimulus conditions or behavior which are being measured should be independent from each other. In other words, if the IV is introduced for one, the others will not change. The second assumption is that the participants, stimulus conditions, or behavior which are being measured are functionally similar, so that when the IV is introduced to one, the effect is likely to be replicated across the others. Being able to replicate the behavior change leads to evidence of a successful intervention (Baer et al., 1968).

Research Procedures

This single subject MBL across participants study evaluated whether there was a functional relation between *e*Coaching via Bug in Ear technology and an increase in parental provision of natural language opportunities. Parents were selected based on the inclusion criteria listed at the beginning of Chapter three and in Appendix A.

Technology Set Up

To participate in the study, parents were required to have wireless technology that was connected to the internet. Two had their own Bluetooth headphones and Bluetooth headsets were sent to the other three participants. All participants had a device with a webcam enabled. Prior to baseline, parents were provided a guide via email for syncing their headset with the computer. The instructions were modeled on a manual written by a research team at George Mason University (Kurz & Weiss, n.d.). Additionally, parents were provided with instructions on how to install and run Zoom. The BIE coach was in touch with parents via email to ensure smooth set up of equipment. Once the equipment was set up, the coach engaged in a 15-min technology-focused practice session to check that both parties could hear each other, and that the coach could see the activity in which parents were engaging. A few adjustments were made to the camera angle.

Baseline

Three to ten days prior to the start of baseline (dependent upon when the family joined the study), parents were sent text training materials via email with information on providing four of the components of a natural communication opportunity (see Appendix I). The materials were based on materials from the Kid Talk Tactics Project, including the

training manual (n. d.) and a presentation given in 2014 (Kaiser & Hampton). Each component is explained in no more than a page, with an example included. Parents were asked to review the training materials prior to the start of baseline sessions.

At the beginning of each baseline session, parents signed into Zoom wearing a Bluetooth® device to connect with the coach. They greeted each other and checked that the sound and video was working. Following these pleasantries, the parent engaged her child in a 1:1 play activity of the child's choosing. After 1 min of engagement, allowing the parent and child to settle into their routine, the primary investigator collected partial interval data in 1 min intervals for a 10 min session. Data were recorded on the four components of a communication opportunity and on child verbal behavior. Ten min is considered long enough to see parent implementation of desired components, but short enough to efficiently score (Minjarez et al., 2011). Following the data recording session, the parent and primary investigator bid each other goodbye and signed off Zoom. Baseline sessions continued for at least five sessions and until the data were stable.

Introduction of the intervention was staggered, as is indicated by the MBL design, so each participant was in the baseline phase for a different amount of time. Intervention was introduced for Mariana after the fifth baseline session, for Sara after the sixth baseline sessions, and for Rebecca after the seventh baseline session. Adina and Lori's baseline data were more variable, Adina's data stabilized after the 10th baseline session and intervention was introduced, while Lori's data stabilized after the 11th baseline session and intervention was introduced.

Bug-in-Ear Intervention

Following baseline, the coach met with each participant to discuss her baseline data and select two goals to focus on during coaching. The coach followed the same script for all participants, during which she shared the percentage of intervals in baseline that each of the four components of a natural communication opportunity were used (see Appendix J). All five participants agreed that the data indicated they work on the areas of setting up communication temptations and prompts while creating natural communication opportunities. Each participant and the coach then decided on a cue word the coach would use to prompt the participant to provide the natural communication opportunity.

During intervention, parents signed into Zoom in the same manner as baseline for each session. Parent coaching sessions were structured in the following way:

1. Check-in & activity selection (5 min)
2. Parent practice with coaching (11 minutes)
3. Wrap-up (5 min)

Check-in allowed parents an opportunity to talk with the coach about questions they had regarding the dependent variables, to clarify questions from the last session, and to discuss any issues with the technology. After check-in, the primary investigator started an 11 min timer on the Timer+ app that was set to beep every minute. The parents then offered their child a choice of activities to work with that day and started to engage in the activity. After the first minute elapsed, parent practice with *e*Coaching started. During *e*Coaching, the coach aimed to provide a prompt or positive feedback at least once every minute. Prompts were delivered by the coach when parents did not provide an aspect of a

natural communication opportunity within the minute. They were single words or short phrases, however, if parents asked questions or did not understand the prompt, the coach provided a longer explanation. Rock et al. (2009) stated, "… consistent delivery of immediate, positive, corrective, and specific feedback can influence both teacher attitudes and teacher behavior" (p. 65). With this in mind, during *e*Coaching the coach used immediate (within three seconds of a parent behavior) and specific (labeling the exact behavior) statements to deliver positive feedback. Following the parent practice with *e*Coaching, the parent and primary investigator participated in a brief wrap-up guided by these five questions:

1. How was the coaching session today?
2. Do you have any questions?
3. You did really well with _____!
4. How did the prompting work for you today? Is there anything I can do differently?
5. What will the goal be moving forward?

The fifth question was asked to ensure that participants were still in agreement with the goals of the intervention and to determine whether they wanted to focus on prompting over communication temptations or vis versa. While answers to these questions were recorded during each session, the information was used solely to shape the following intervention session.

Maintenance

Coaching ended when the parents demonstrated a pattern of success in providing both communication temptations and prompting evidenced by maintaining data points above baseline and showing a steady or improving number of independent provisions of natural communication opportunities. Maintenance started two or three weeks following intervention. The parents signed into Zoom, but the coach did not prompt or give feedback during the following 11-minutes. During wrap up, the parent and coach bid each other goodbye; no questions were answered until after the final maintenance session.

Reliability and Validity

Following the end of the study, reliability and validity data were calculated to ensure that the procedures were consistent and measured the intended behaviors (Gast, 2014). Three types of reliability and validity information were collected: (a) interrater reliability, (b) procedural reliability, and (c) social validity.

Interrater Reliability

Interrater reliability, or interobserver agreement (IOA), is the extent to which two independent observers agree in their measurement of the same event. It is an indicator of measurement quality (Cooper et al., 2007). IOA helps to assess whether the target behavior was well defined, and the measurement system was appropriate. Furthermore, it gives more weight to changes in behavior if both (or more) observers measured the same results. Cooper et al. (2007) outline three requirements for valid IOA measurement. First, observers must use the same system to measure behavior and have the same training on

the use of the system. In this study, the coach trained the second observer in the measurement system prior to observation by scoring videos of *e*Coaching and parents implementing natural communication opportunities and comparing the coding. Second, observers must observe and measure the same event. In this study, this step was facilitated by viewing video recordings of the sessions. Finally, observers must be independent from each other. This was enabled by the video recorded sessions because the observers took data at different times, without talking or interacting with each other. Point-by-point agreement was used to calculate IOA (Ayers & Ledford, 2014). The formula is a count of the number of agreements (occurrences), divided by number of agreements plus the number of disagreements (occurrence marked by one observer and not marked by the other) and the total multiplied by 100. This gave the percentage of agreement between the two observers. It is recommended that IOA be collected for anywhere between 20%-50% of observation sessions, with the typical suggestion being about 33% of sessions (Ayres & Ledford, 2014). For this study, 100% of the sessions were coded by a second person coder. Initial IOA yielded 78% accuracy for participant data across all participants and conditions. The second observer and the author discussed disagreements and came to 100% agreement for all 115 videos.

Procedural Reliability

Procedural reliability indicates whether the independent variable was carried out as intended (Gast, 2014). A different observer watched videos from baseline, intervention, and maintenance to ensure the primary investigator adhered to procedural reliability. Data were collected for 33% of the sessions in baseline, intervention, and

maintenance (Gast, 2014). One datasheet was used for baseline and maintenance (see Appendix K) while a second was used for intervention sessions (see Appendix L). The formula used was the number of observed behaviors divided by the number of planned behaviors multiplied by 100.

Data recorded by the second observer for 33% of the overall sessions (38) showed a 97.56% fidelity of implementation across phases. The intervener maintained a 93.91% fidelity for baseline. This increased to 99% in intervention and 100% in maintenance. During two of the 13 coded baseline sessions, the coach spoke to the parent to ask whether she wanted to continue this intervention due to her child having a difficult time that day. In another baseline session, the coach responded, “Oh good,” when a parent directed a comment to the coach. There were also two baseline sessions when the parent and/or child were not visible for the full session. These instances impacted the baseline fidelity of implementation.

During intervention, there were two of the 20 coded sessions where the coach did not prompt or give feedback during an interval. The coder noted that the coach was watching the interaction between the parent and child and appeared not to want to interrupt the flow of the conversation. In a third intervention session, the coach interacted with the parent during the first minute of the intervention (when she was supposed to remain quiet) to ask for clarification of the child’s behavior, “Is he looking at himself?” These three instances impacted the fidelity of implementation during intervention.

Social Validity

BIE social validity data is mainly subjective (Ottley et al., 2015). Ottley et al., (2015) more closely examined data from two BIE studies, one with in-service and one with pre-service teachers, conducted in the inclusive early childhood classroom setting to gain a deeper understanding of the validity of BIE coaching. The researchers coded transcripts from interviews, observations, and answers to the open-ended questions on social validity questionnaires. Results of the data analysis indicate that BIE coaching is an acceptable intervention, which improves teacher and child outcomes.

To further advance the research on the social validity of BIE coaching use in early childhood, in the current study a questionnaire was distributed via email to parent participants prior to baseline, and following intervention, but before maintenance (see Appendix M). Parents filled out the survey and sent it back via email before starting baseline and before starting maintenance. The pre- and post-questionnaires were ranked on a seven-point Likert scale and asked questions about providing natural language opportunities for children, parent perceptions of the child's communication skills, and about parent comfort with BIE coaching (Coogle et al., 2017; Coogle, Ottley, Rahn, and Storie, 2018; Coogle, Ottley, Storie, et al., 2018). The pre- and post- questionnaires allowed the researcher to compare responses to determine if there had been a change in the parents' levels of comfort with the components of natural language intervention and BIE coaching. The post-survey included four open ended questions about the BIE coaching and immediate feedback that were not asked during the pre-survey.

Data Analysis

Following data collection, data were analyzed to answer the research questions posed at the beginning of the study.

Research Question One Analysis

To answer the question was there a functional relation between *e*Coaching through Bug-in-Ear and parent provision of natural communication opportunities and the sub question of whether parents continued to provide natural communication opportunities when *e*Coaching was removed in maintenance, frequency data were graphed and visually analyzed. Visual analysis has been the primary method of analysis for single subject studies over 50 years (Kratochwill et al., 2014). Data were examined for patterns or changes in level, trend, variability, immediacy of effect, data overlap between phases, and consistency (Kratochwill et al., 2010).

The first three analyses were conducted within each phase (baseline and maintenance). Level refers to the mean data point within a phase. The level was calculated by adding all data in the phase together and dividing the sum by the total number of data points in that phase. Relative level change was also reported to glean more information about the change in level from the beginning of the phase to the end of the phase. Relative level change was calculated by comparing the median values of the first half and the second half of the data series to determine whether there was a therapeutic (increasing) change in level within the phase (Gast & Spriggs, 2014). Trend references the slope of the straight line that best fits the data in a phase. Trend lines were either accelerating (increasing over time) or decelerating (decreasing over time; Gast &

Spriggs, 2014). Variability is the range of data around that best-fit line within a phase. The level of variability was determined by finding the stability envelope, which is 25% of the median of baseline data points and determining how many data points fall within the stability envelope (Gast & Spriggs, 2014). The median was used (rather than the mean) based on Gast and Spriggs (2014), who state that median is less susceptible to being influenced by outlier data. Stable data paths are determined due to 80% of their data points falling within the stability envelope. In this study, any line that had at least 40% of its data fall within the stability envelope was considered to have moderate variability. Anything below that had high variability.

The next three visual analyses are assessed across phases. Immediacy of effect is demonstrated by a difference in level between the final three data points in one phase and the first three data points in the next phase (Kratochwill et al., 2010; Kratochwill et al., 2013). The absolute level change between baseline and treatment was calculated by comparing the change in the first data point in treatment with the last data point in baseline (Gast & Spriggs, 2014). Data overlap between phases is the ratio of data that overlaps between one phase and the next. The smaller the ratio, the stronger the demonstration of an effect. Finally, consistency of data within similar phases refers to how similar data is within like conditions (i.e., comparing multiple treatment phases). To answer the first research question and sub-research question, visual analysis was completed for both the intervention phase and the maintenance phase. In the intervention phase, prompted responses were analyzed separately from independent responses.

In addition to visual analysis, three non-parametric techniques were utilized to measure the effect size of the intervention: Percentage of Non-overlapping Data (PND), Percentage of Data Points Exceeding the Median (PEM) and Tau-U. PND is one of the oldest and most established nonparametric methods used to quantify results of a single-subject study (Parker et al., 2011). To compute PND, a horizontal line was drawn across the graph from the highest data point in baseline. The number of treatment data points that exceeded the point were counted and divided by the total number of treatment data points. To obtain a percentage, this was done for each participant in the study, and the resulting number was multiplied by 100 to obtain the percentage (Scruggs & Mastropieri, 1998; Scruggs et al.,1987). PND can be interpreted using the following guidelines laid out by Scruggs and Masteropieri (1998): scores over 90% are considered very effective, while those that fall in the 70% to 90% range are counted as effective. Scores between 50% and 70% are questionable, and below 50% is an ineffective treatment.

To cross check effectiveness, a second nonparametric measure, PEM, was calculated to show the functional relationship between the independent and dependent variable. PEM was determined by drawing a horizontal line across the graph The line originated at the median data point in baseline when there was an odd number of data points and between the two median data points when there was an even number (Ma, 2006). Because PEM used the median score, it was not skewed by outliers the way that PND can be. The number of treatment data points above the median were then counted and divided by the total number of treatment data points to obtain PEM, which is measured on a scale of 0 to 1. A PEM score of .9-1 denotes a highly effective

intervention, .7-.89 denotes moderate effectiveness, and below .7 is considered not effective (Wendt, 2009).

A third index, Tau-U, was used to analyze nonoverlap between phases combined with within phrase trends. Tau-U is also used to control a positive trend in Phase A. "A complete measure, including both trend and level," Tau-U is a newer single-subject effect size metric that was introduced by Parker et al. in 2011 (p. 297). Tau-U is more discerning as there is not a 100% ceiling and it can more accurately report how large of a separation there is between data sets in two phases. (Parker et al., 2011). Tau-U was calculated using a web-based application (Vannest et al., 2016). A small effect is between 0 and 0.20, a moderate effect is shown between 0.20 and 0.60, a large effect falls between 0.60 and 0.80, and above 0.80 shows a very large effect (Vannest & Ninci, 2015).

Prompting Data

When the coach re-watched the videos for frequency data analysis, she also recorded frequency data for partial prompts and full prompts given by the coach during treatment. She then graphed the data and conducted a visual analysis of the trendline, absolute level change and relative level change to determine whether her prompts increased or decreased during treatment. The coach determined the absolute level change by subtracting the last data point in treatment from the first data point in treatment. The relative level change was assessed by subtracting the level of the second half of data from the level of the first half of data.

Child Data

Supplemental data were collected on two behaviors children displayed during the study, vocal initiation and vocal behavior in response to the child's mother's social communicative behavior. Vocal initiations were defined as any vocalizations, including sound play, words, word approximations, or phrases that were initiated by the child seemingly to engage his parent. Vocal behavior in response to the child's mother was any vocalization (as defined above) that was uttered in the three seconds following a mother's social communicative behavior. Vocalizations in response to the question, "What is it?" were not counted, as the question was not included as a social communicative behavior. These two behaviors were chosen as a way to measure increases in independent child communication (vocal initiation) and social communication (vocal behavior in response).

Child data were tracked using partial interval recording in one-min intervals during the 10-min sessions. Vocal responses by the child were classified as independent, prompted, or in response to a model. The percentage of intervals that independent initiations and responses occurred were then calculated and compared across participants and phases.

Research Question Two Analysis

To answer the second research question, whether parents feel that the Bug-in-Ear coaching is a socially valid intervention, each of the responses from the social validity questionnaire were analyzed. To get an overall mean response per question for the pre- and post-surveys, the parent answers were averaged across participants. This allowed for comparison of parent answers between the pre- and post- survey to determine

whether the mean answer increased for parents after intervention, indicating that parents felt more comfortable with the intervention. Additionally, answers to the pre- and post-survey Likert-scale questions were analyzed per participant to assess whether there was an increase in individual responses following intervention. The four post-intervention survey open-ended questions were coded for common themes (Ottley et al., 2015).

Summary

This single-subject multiple baseline research study investigated whether there was a functional relation between 10-minute sessions of *e*Coaching via Bug-in-Ear and an increase in parents' provision of natural language opportunities. Additionally, the study looked at whether these natural language opportunities were maintained when *e*Coaching via Bug-in-Ear was removed. The study looked specifically at parents' provision of communication temptations and prompts as part of the natural language opportunities. The third question examined the social validity of the intervention.

Data were collected during baseline, intervention and maintenance using partial interval recording during the 10-min sessions. Session videos were later re-watched and frequency data were collected. The frequency data were then graphed, analyzed visually and via three non-parametric measures to answer the first research question and sub-research question. A questionnaire and open-ended questions were used to assess the social validity of the intervention.

Table 4

Summary of Research Questions, Data Collection and Analysis

Research Question	Data Collection	Data Analysis
1. Is there is a functional relation between Bug-in-Ear *e*Coaching with parents of young children with language delays and parent provision of natural communication opportunities? a. Do parents maintain the provision of natural communication opportunities when Bug-in-Ear *e*Coaching is faded?	• Initial data recorded via partial interval recording for each 10-min session in baseline, intervention, and maintenance. • Data reanalyzed for graphing and analysis using frequency count of independent and coach prompted or fully prompted parent provision of the two natural communication opportunities *communication temptations* and *prompting*.	1. Visual Analysis: a. Level b. Trend c. Variability d. Immediacy of effect e. Data overlap between phases f.Consistency 2. Non-parametrics to measure effect size a. Percentage of Non-Overlapping Data (PND) b. Percentage of Data Points Exceeding the Median (PEM) c. Tau-U
2. Do parents feel that Bug-in-Ear *e*Coaching is a socially valid intervention?	Pre- and post- intervention survey	1. Mean responses across participants per question for pre- and post-survey. 2. Difference in pre- and post- intervention. responses per participant 3. Coding for themes for open-ended questions.

CHAPTER FOUR

Chapter four presents the results of the single-subject, multiple-baseline study that sought to answer the following research questions:

1. Is there is a functional relation between Bug-in-Ear *e*Coaching with parents of young children with language delays and parent provision of natural communication opportunities?
    a. Do parents maintain the provision of natural communication opportunities when Bug-in-Ear *e*Coaching is faded?
2. Do parents feel that Bug-in-Ear *e*Coaching is a socially valid intervention?

Data will also be presented on the communication behaviors of young children during the study.

Five mother/son dyads participated in the study. All five children were between 3-years old and 4.5- years old. More information about each dyad is included in Chapter 3. All dyads entered baseline at the same time, and intervention was introduced based on the trend of the data. Following treatment, all participants participated in three maintenance trials, except Mariana, who only participated in two trials due to scheduling issues.

Natural Communication Opportunities

As described in the dependent variable section of Chapter 3, natural communication opportunities consisted of four components: (a) play and engage, (b) expanding language, (c) communication temptations, and (d) prompting. Independent and prompted use of a behavior were recorded for 10 1-min intervals during baseline and

treatment. Based on the data, during baseline, all parents displayed the behaviors composing play and engage opportunities and expanding language opportunities at a higher level than those behaviors associated with communication temptations and prompting. For this reason, the focus of coaching and positive feedback during *e*Coaching was on increasing the parents' provision of communication temptation and prompting opportunities. Therefore, data are reported for independent communication temptations and prompting. Additionally, data are reported on parent use of communication temptations and prompting after being given a prompt by the coach. The two were separated to assess whether parents were able to increase their independent provision with parent coaching.

Communication Temptations and Prompts

As defined in Chapter 3, provision of communication temptations was made up four different behaviors: (a) inadequate portions, (b) assistance, (c) pause in routine, or (d) choice making. Each behavior was described, with an example, in the dependent variable section of Chapter 3. Preliminary data were collected using partial interval recording to track how many one-min intervals parents independently offered a communication temptation opportunity in the 10-min data collection period of each session. These data were used to make determinations on when to move to the next phase in the study. Further analysis was conducted by re-watching the recordings to record trial by trial data of independent use of communication temptations and prompts along with those that were prompted, which was the data used to report results.

Overall outcomes of the study show that all five participants demonstrated an increase in level between baseline and treatment, and maintained levels above baseline during maintenance, two-to-three weeks later (see Figure 1). In baseline, the level of the combined spontaneous provision of communication temptation opportunities and prompts across the five participants was 7.9 per 10-min session (*SD* = 3.8). In treatment the combined level of communication temptation opportunities and prompt provisions was 15.4 (*SD* = 4.19). Four out of the five participants showed an accelerating trend line in treatment. The fifth participant (Lori) demonstrated a decelerating trend with the last four data points improving. Variability in baseline for all participants was moderate to high, with an overall mean of 34% of data points falling within the stability envelope and it stayed moderate to high in treatment with a mean of 31% of the data points falling within the stability envelope. The absolute level change from baseline and treatment across participants, based on the absolute change, was 11 (*SD* = 9.92). The immediacy of effect, based on the level of the last three data points in baseline and the first three data points in treatment, the immediacy of effect was 7.13 (*SD* = 4.63). The overlap between phases was measured using PND, PEM and Tau-U. The mean PND across participants was 47.58% (*SD* = 38.78) with the range across participants of PND from 0% - 87%. Using the average PND score, the results of the study are ineffective. The mean PEM across participants was .83 (*SD* = .15) indicating the intervention was moderately effective. Tau-U = 0.63 (*p* = 0.00), 90% CIs [0.43, 0.82], indicating there was a large effect. All five participants demonstrated an increase in level between baseline and treatment in their

provision of communication temptation opportunities, indicating consistency in the effectiveness of the intervention.

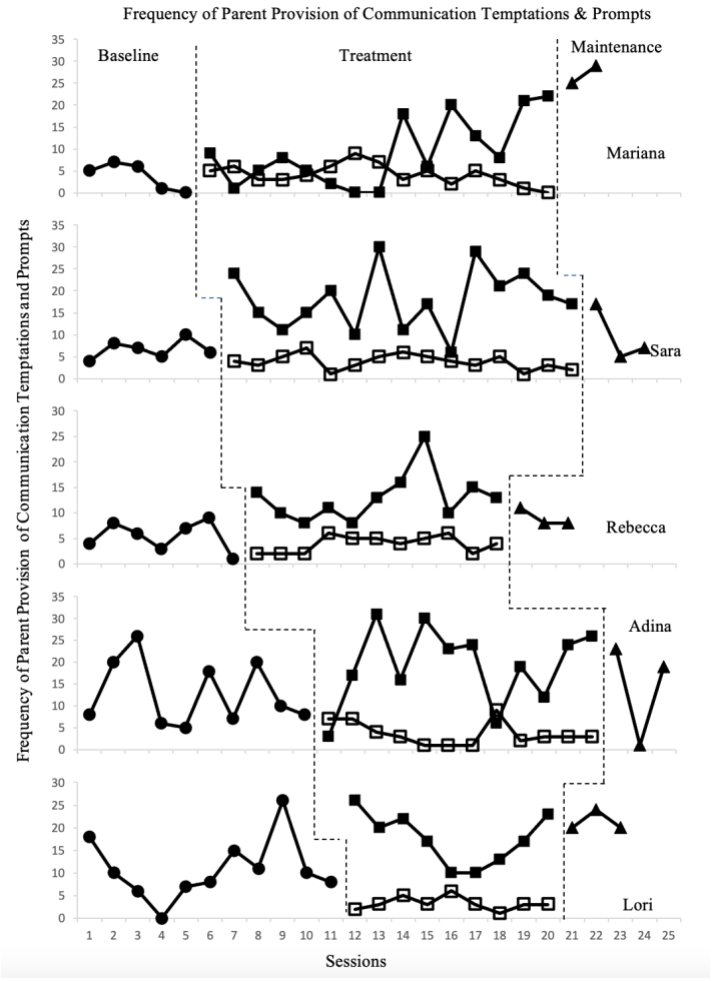

Figure 1. Graph of parent provided communication temptation opportunities and prompts. The frequency of parent provided communication temptation opportunities and prompts within a 10-min data collection session. Frequencies of spontaneous parent provided opportunities are presented over baseline (●), treatment (■) and maintenance (▲), across five mothers engaging in play with their son with a communication delay. Open squares (□) represent prompted parent provisions of communication temptations and prompts during treatment.

Individual results for each participant are described in detail below.

Mariana

The level of Mariana's provision of communication temptation opportunities and prompts was 3.8 during baseline (*SD* = 3.1). The relative level within in baseline decreased from the first half to the second half and baseline had a decelerating trendline. Data in baseline were moderately variable, with 40% falling within the stability envelope. While data in treatment increased in variability, with 20% of data falling within the stability envelope, there was an accelerating trend line. The level in treatment was 9.2 points (*SD* = 7.8). Within the treatment phase, a therapeutic relative level change of 13 was demonstrated with the median value of the first half to the second half of the data changing from 5 spontaneous parent prompts in the 10-min data frame to 18 spontaneous parent prompts in the 10-min frame.

The absolute level change between baseline (0) and treatment (9) was 9 points. The immediacy of effect was 2.67. Seven spontaneous data points overlapped baseline from the fifteen treatment sessions, indicating a questionable treatment (53%) based on PND. PEM was calculated at 0.6, indicating that the intervention was not effective. Tau-U = 0.41 (p = 0.18), 90% CIs [-0.09, 0.92], indicating the intervention had a moderate effect. In the second half of treatment, there was one data point that overlapped with baseline, increasing PND to 85.7% for the second half, and PEM to 1.

Prompted responses showed a decelerating trendline with an absolute level change within the treatment phase of -5, and a relative level change of negative two from the first half of treatment (5) to the second half of treatment (3). Because Mariana

followed all but one prompt given to her, this indicates that the coach delivered fewer prompts at the end of the phase, as Mariana increased her spontaneous responses.

Maintenance. Mariana had two datapoints in maintenance and increased her provision of communication temptation opportunities during that phase, with a 3-point change in absolute level from treatment (22) to maintenance (25), two weeks later. The trend in maintenance was accelerating, with a level of 27 (*SD* = 2.8). No data points overlapped between treatment and maintenance or between baseline and maintenance.

Sara

Sara's level of communication temptation opportunities during baseline was 6.7 (*SD* = 2.2) The baseline trend line was accelerating and variable, with 33% of the data points falling within the stability envelope. There was a relative level deterioration in baseline (-1). During the treatment phase, Sara's level of spontaneous communication temptations and prompts increased to 17.9 (*SD* = 7). Data during treatment were variable, with 13% of spontaneous data falling within the stability envelope and the trend line was accelerating. There was a relative level change during treatment, with the median values of the first half improving by two points in the second half of treatment.

The absolute level change between baseline (6) and treatment (24) was a change of 18 points. The immediacy of effect from the level of the last three baseline data points to the first three data points in intervention was 9.67. Two data points overlapped between baseline and the 15-session treatment, with PND calculated at 87%, indicating treatment was effective. PEM was calculated at .93, which pointed to the treatment being highly effective for Sara to increase her spontaneous provision of communication

temptation opportunities and prompts. Tau-U = 0.91 (p= 0.001), 90% CIs [0.44, 1] which indicates a very large effect.

Prompted responses showed a decelerating trendline with an absolute level change during treatment of negative two and a relative level change of negative one from the first half of treatment (4) to the second half of treatment (3). Because Sara followed all prompts given to her, this indicates that the coach delivered fewer prompts at the end of the phase.

Maintenance. Sara's trend line in maintenance was decelerating. The level of maintenance was 9.7 (*SD* = 6.4), which was a decrease of 8.3 from the level of treatment, but which remained above the level of baseline (6.7). All data points in maintenance overlapped treatment, and two of the three maintenance data points overlapped baseline. Two of the three maintenance data points were above both the level and median of baseline, while none were above the level of treatment, but one was equal to the median of treatment.

Rebecca

Rebecca's baseline level of provision of communication temptation opportunities and prompts was 5.4 (*SD* = 2.9). Overall, the baseline trend line was decelerating. There was a relative level change of 1, with the first half median at six and the second half median at seven. Baseline data showed variability, with 20% of data points falling within the stability envelope. The level improved to 13 in treatment (*SD* = 4.8). Variability continued in treatment and 27% of the data points fell within the stability envelope. The

data trend within treatment was accelerating. There was a relative level change increase of five during treatment, from 10 to 15.

The absolute level change from baseline (1) to treatment (14) was immediate, with an improving change of 13. The immediacy of effect from the level of the last three points in baseline to the first three points of intervention was 5. Two of the eleven treatment data points overlapped when calculating Rebecca's spontaneous use of communication temptations and prompts between baseline and treatment. PND was 81.8%, interpreted as effective. PEM was calculated at 1, suggesting that the intervention was highly effective. Tau-U = 0.92 (p= 0.001), 90% CIs [0.45, 1] indicating a very large effect.

Prompted responses showed an accelerating trendline with an absolute level change within the treatment phase of two, and a relative level change increase of two from the median of the first half of treatment (2) to the median of the second half of treatment (4). Rebecca followed all prompts given to her, so this indicates that the coach delivered more prompts at the end of treatment, despite Rebecca increasing the median number of strategies used during treatment.

Maintenance. Rebecca's data demonstrated a decelerating trendline in maintenance. Maintenance had a level of nine (SD = 1.7) which was a decrease of four from the level of treatment, but which remained above the level of baseline (5.4). Rebecca participated in three maintenance sessions. All data points in maintenance overlapped treatment, and two of the three maintenance data points overlapped baseline.

All three maintenance data points were above both the level and median of baseline, but below the level and median of treatment.

Adina

Adina's level of provision of communication temptations and prompts during baseline was 12.8 (*SD* = 7.5). The baseline trend was decelerating. The relative level change in baseline was improving, with a change of two points from the median of the first half (8) to the median of the second half (10). Data were moderately variable in baseline, with 40% of data falling within the stability envelope. Adina's level of spontaneous communication temptations and prompts increased to 19.25 (*SD* = 8.9) in treatment. Treatment demonstrated an accelerating data trend. The treatment data were variable, with 25% of the data points falling within the stability envelope. The relative level change from the first half of treatment (20) to the second half (21.5) improved by one and a half.

There was no absolute level change from baseline (8) to treatment (3) in the data for Adina's spontaneous use of strategies and prompts. The immediacy of effect from the last three data points in baseline to the first three in treatment was 4.33. Ten of the twelve treatment data points overlapped with baseline, leading to a PND of 16%, indicating an ineffective treatment. PEM was calculated at .83, with ten of twelve treatment data points falling above the median of baseline, nine. This PEM calculation indicates that the intervention was moderately effective. Tau-U = 0.38 (p= 0.13), 90% CIs [-0.032, 0.8], indicating a moderate effect.

Adina's prompted use of strategies showed a decelerating trendline. There was an absolute level change of negative four during treatment and relative level change of negative one half from the median of the first half of treatment (3.5) to the median of the second half of treatment (3). Adina followed the prompts given by the coach; this indicates that the coach decreased the number of prompts given by the end of intervention.

Maintenance. Adina's data demonstrated a decelerating trendline in maintenance. Maintenance had a level of 14.3 (*SD* = 11.7) which was a decrease of 4.95 from the level of treatment, but which remained above the level of baseline (12.8). Adina participated in three maintenance sessions. All data points in maintenance overlapped treatment and baseline. Two maintenance data points were above the level and median of baseline, while one was above the level and median of treatment.

Lori

Lori's level of provision of communication temptation opportunities and prompts during baseline was 10.8 (*SD* = 6.9). The baseline data trendline was accelerating, however, the final three data points demonstrated a downward trend. There was an improving relative level change from the median of the first half of baseline (7) to the median of the second half (11) of four. Data in baseline were variable, with 36% falling within the stability envelope. The level of treatment data increased to 17.6 (*SD* = 5.7) and demonstrated a deteriorating decelerating trend. The second half of the nine-session treatment showed an increasing trend in spontaneous provision of prompts and communication temptations. Variability was high in treatment, with 22% of data falling

within the stability envelope. There was a deteriorating relative level change of negative six from the median of the first half (21) to the median of the second half (15) of treatment.

The absolute level change between baseline (8) and treatment (26) was 18 points. The immediacy of effect from the last three data points in baseline to the first three data points in treatment was 8. All nine data points in treatment overlapped with the baseline data, due to an outlier in baseline. This led to a PND of 0% indicating an ineffective treatment. PEM was calculated at .78, which indicates moderate effectiveness of the intervention. Tau-U = 0.59 (p= 0.03), 90% CIs [0.15, 1], demonstrating a moderate effect.

Lori's prompted use of strategies showed a minimally decelerating trendline with an absolute level change of one. The relative level of prompted use of strategies did not change from the first half of treatment (3) to the second half (3). Because Lori followed all of the prompts given, this indicates that the coach delivered a consistent number of prompts across treatment.

Maintenance. Lori's data demonstrated a minimally ascending trendline in maintenance. Her absolute level decreased by three from treatment (23) to maintenance (20), two weeks later. Maintenance had a level of 21.3 (SD = 2.3) which was an increase of 3.7 from treatment and remained above the level of baseline (10.8). Lori participated in three maintenance sessions. All data points in maintenance overlapped treatment and baseline. All maintenance data points were above the level and median of baseline and treatment.

Social Validity

Between baseline and treatment, and again after treatment, participants filled out an 11-question social validity questionnaire. The questions were the same on both questionnaires, and participants indicated their agreement with each statement on a seven-point Likert scale (1=strongly disagree to 7= strongly agree). The post questionnaire included an additional four items, all in short-answer form. All five participants responded to all questions in both the pre- and post- questionnaires. Participant scores showed a mean increase on all 11 items between pre- and post-intervention (see Table 5).

Likert-scale social validity questions fell into three areas: (a) feelings towards bug-in-ear technology to receive immediate feedback, (b) parent confidence, and (c) child communication. The area that showed the largest gain in ratings across all questions in the category was child communication (M = 2.13, SD = 0.99). All five participants indicated an increase of at least one point in two of the three areas composing child communication (regular communication with words or word approximations and effective communication with words or word approximations). For the nine other questions, at least one participant had a rating that did not change between pre- and post-survey.

Feelings Toward Bug-in-Ear Technology

All participants strongly agreed that receiving immediate feedback via bug-in-ear was helpful in changing their communication practices with their child (M = 7, SD = 0). This response was an average increase of 2 points from the original responses, however,

one participant moved from strongly disagree to strongly agree over the course of treatment. All five participants also strongly agreed that they would recommend immediate feedback via bug-in-ear to other parents of children with delays in communication (M = 7, SD = 0). This was an average increase of 1.6 points for each participant from the original survey response. All participants agreed or strongly agreed that bug-in-ear technology to receive feedback was manageable (M = 6.6, SD = 0.55).

Parent Confidence

The mean score on the post-questionnaire for each of the five questions composing the parent confidence category fell in the agree range (all question means were between 6 - 6.4). Of these questions, the one that showed the biggest gain was *I currently do well at expanding my child's language* (M = 2.2, SD = 2.17). *I currently do well at playing and engaging my child* showed a mean increase of 1.6 (SD = 1.82), as did *I currently use communication temptation strategies to encourage my child to communicate* (SD = 2.30). The item *I currently use prompting strategies to encourage my child to communicate* showed a mean increase of 0.6 (SD = 1.52). Scores on the question *I am confident in working and playing with my child* ranged from 5-7 on the post-survey. This was a mean increase of 1.2 points (SD = 2.77) from the pre-survey range of 1-7.

Child Communication

As mentioned above, this was the area that saw the largest change between pre- and post-intervention. On the post intervention survey, parents all slightly agreed, agreed or strongly agreed that their child communicated regularly with words or word approximations (M = 5.8, SD = 0.84). This was a mean increase of 2.6 (SD = 1.82) from

the pre-intervention mean of 3.2 (*SD* = 1.79). The statement *my child communicates effectively using words or word approximations* had an increase of 2.8 (*SD* = 1.64), from a range of 1-5 to a range of 5-7. The statement *my child does not get frustrated with communication* rose a mean of 1 (*SD*= 1.00) from a pre-survey range of 1-3 (*M* = 2, *SD* = 1) to a post-survey score of 3 across all participants.

Table 5

Mean Increase from Pre- to Post- Intervention Social Validity Questionnaire

Survey Item	*M*	*SD*	Range
Feelings Towards Bug-in-Ear Technology			
1. Receiving immediate feedback via bug-in-ear will be helpful in changing my communication practices with my child.	2	2.55	0-6
2. Receiving immediate feedback via bug-in-ear is something that I will recommend to other parents of children with delays in communication.	1.6	1.34	0-3
2. Using the bug-in-ear technology to receive feedback will be manageable.	0.4	0.55	0-1
Parent Confidence			
3. I currently do well at *playing and engaging* with my child.	1.6	1.82	0-4
4. I currently do well at *expanding* my child's language.	2.2	2.17	0-5
6. I currently use *communication temptation strategies* to encourage my child to communicate.	1.6	2.30	-1-5
7. I currently use *prompting strategies* to encourage my child to communicate.	0.6	1.52	-1-5
10. I am confident in working and playing with my child.	1.2	2.77	-2-5
Child Behavior			
8. My child communicates regularly using words or word approximations.	2.6	1.82	1-5
9. My child communicates effectively using words or word approximations.	2.8	1.64	1-5
11. My child does not get frustrated with communication.	1	1	0-2

Note. N = 5. Responses given on a seven-point Likert-scale with 1 representing strongly disagree and 7 representing strongly agree. Change in scores were obtained by subtracting participant responses on the pre-intervention questionnaire from their responses on the post-intervention questionnaire. Survey statements were based on Coogle, et al., 2017; Coogle, Ottley, Rahn, et al., 2018; Coogle, Ottley, Storie, et al., 2018. Numbering next to statement denotes order that questions appeared to participants.

Child Behavior

Data were collected on two child behaviors during the study, vocal initiations, and vocal behavior in response to the child's mother. Vocal initiations were defined as any vocalizations, including sound play, words, word approximations or phrases that were initiated by the child. Vocal behavior in response to the child's mother is any vocalization (as defined above) that was uttered in the three seconds following a mother's communicative behavior. The vocal response by the child could be independent, prompted, or in response to a model.

Vocal Initiations

Mean vocal initiations across children did not show a significant change between baseline (M = 47%, SD = 0.19), treatment (M = 50%, SD = 0.24) and maintenance (M = 51%, SD = 0.19). However, there was a slight (3 percentage point) increase between baseline and treatment and a slight increase again (1 percentage point) between treatment and maintenance. As shown in Figure 2, three of the five children demonstrated an increase in mean vocal initiations from baseline to treatment. Laurence showed an increase of 13 percentage points. Barry showed an increase of 12 percentage points and

Terence showed an increase of 15 percentage points. All three children maintained vocal initiation levels above baseline in maintenance, with Barry showing another increase (nine percentage points) in maintenance. Michael (10 percentage points) and Ned (17 percentage points) both displayed a decrease in vocal initiation between baseline and intervention. Maintenance showed an increase of vocal initiations for both of them, but not to baseline levels. Their data paths in treatment both displayed a downward trend. Laurence had a slight upward trend and Barry and Terrence both had flat trend lines.

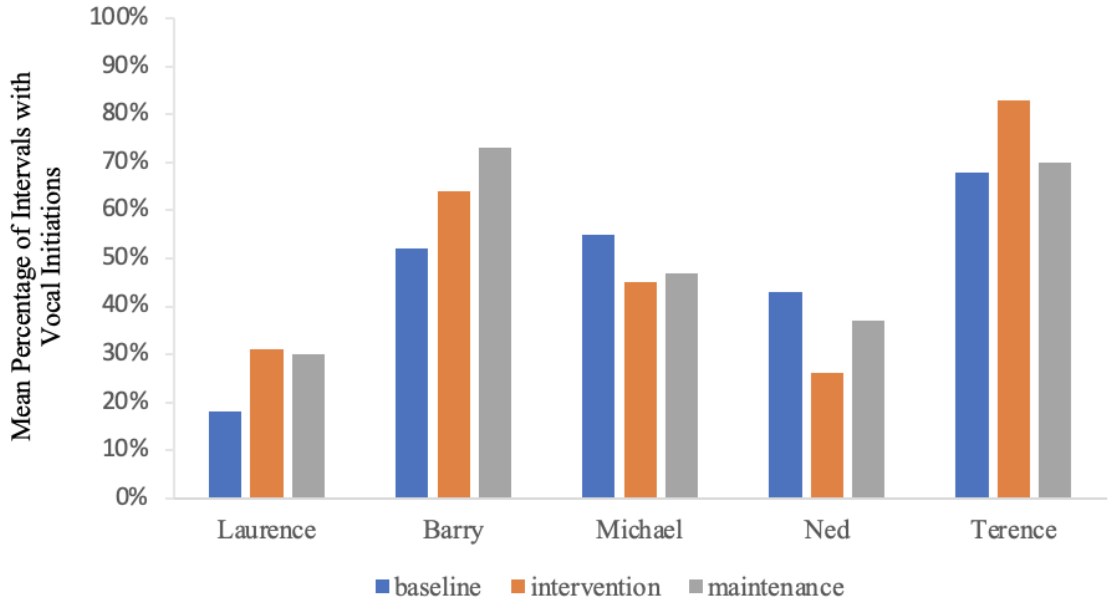

Figure 2. Graph by child of percentage of intervals with vocal initiations. The percentage of one-min intervals where children initiated vocal behavior while engaged in play with their mother in a 10-min data collection period. Mean data for baseline, intervention and maintenance are represented.

Vocal Response

Vocal response behavior across children showed a moderate level increase of 29 percentage points from baseline (*M* =36%, *SD* = 0.17) to treatment (*M* = 65%, *SD* = 0.18). Another increase was demonstrated between treatment and maintenance (*M* = 86%, *SD* = 0.09). As shown in Figure 3, all children demonstrated an increase from baseline to treatment and then again from treatment to maintenance. Barry showed the

largest increase, 43 percentage points, from baseline (30%) to treatment (73%). He also responded to his mother in 100% of maintenance intervals in all three sessions. Terence showed an increase of 32 percentage points from baseline to intervention, and Laurence and Michael both showed a 27-percentage point increase. Laurence then showed a 40-percentage point increase from treatment to maintenance. The trendlines for all five children were positive during treatment.

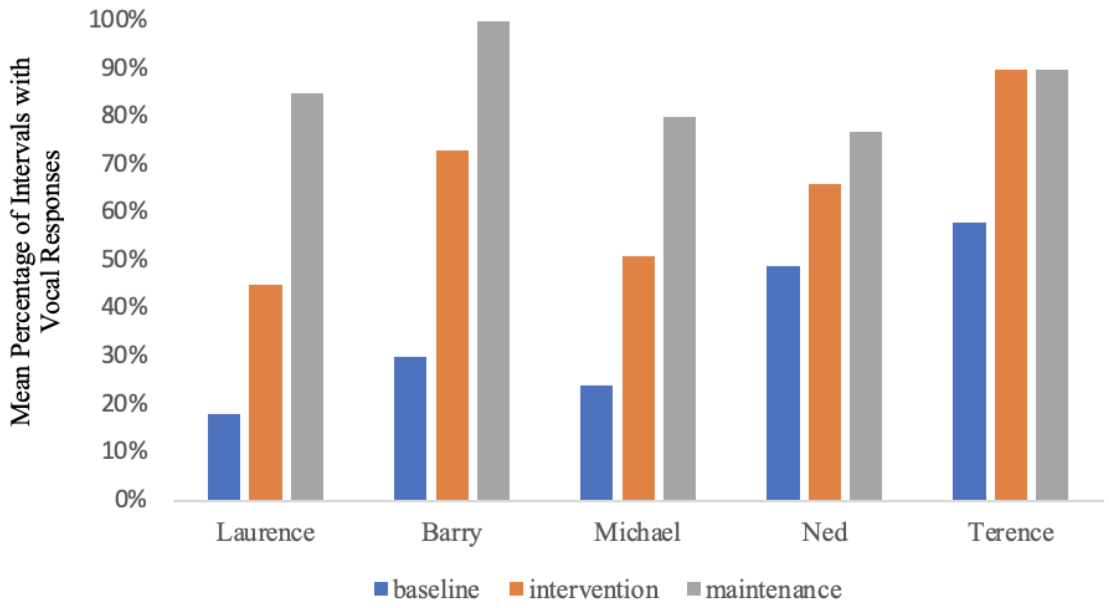

Figure 3. Graph by child of percentage of intervals with vocal responses. The percentage of one-min intervals where children vocally responded to communication from their mothers while engaged in play for a 10-min data collection period. Mean data for baseline, intervention and maintenance are represented.

Summary

The results of the single-subject, multiple-baseline study demonstrated that Bug-in-Ear *e*Coaching with parents of young children with language delays was moderately effective in increasing parent provision of natural communication opportunities. Parents were able to maintain their provision of natural language opportunities above baseline levels after intervention was withdrawn. All participants strongly agreed that BIE

feedback was helpful in changing their communication practices with their child and would recommend it to other parents of children with language delays. Parent confidence levels also rose from baseline to treatment. These results indicate that BIE coaching is a socially valid intervention for increasing parent provision of natural communication opportunities.

CHAPTER FIVE

The primary purpose of this study was to examine the effectiveness of the use of BIE *e*Coaching to teach parents of young children with language disorders to provide natural communication opportunities and whether parents maintained their use of the strategies after coaching was faded. Additionally, data were collected to determine parents' feelings towards Bug-in-Ear use for intervention. Child communication data were collected as additional information. The study was conducted via Bug-in-Ear coaching while the parent/child dyad was in their home and the coach was in her home. The mother and coach connected through Zoom on their computer or tablet/phone using Bluetooth headsets and coaching took place in the family's natural environment while the dyad engaged in play activities.

The four criteria of single-case intervention research design standards (Kratochwill et al., 2013) guided the development of the study: (a) systematic manipulation of the independent variable, to minimize threats to internal validity; (b) documentation of interobserver agreement in each condition; (c) three or more attempts to demonstrate an effect of the intervention at three points in time to show a functional relation; and (d) a minimum of three data points per phase, with a preference for five. A multiple baseline study inherently staggers the introduction of the independent variable. In this five-tier multiple-baseline study, Bug-in-Ear coaching was systematically introduced across all five participants once each participant's baseline data stabilized; therefore, it meets the criteria set out by Kratochwill et al. (2013). Interobserver

agreement data was recorded for 100% of the sessions in the current study. The coach and the independent assessor compared data after each session. Initial data were 78% in agreement on average. Following discussions about each session, the independent assessor and the coach came to 100% agreement for each for the 115 sessions in the study. Design standards require that at least 20% of sessions in each condition have 80% or higher agreement. This study met the second standard. The third standard, that there are at least three attempts to demonstrate an effect was also met, because there were five baseline and five intervention phases, which provided five opportunities to demonstrate an effect. The fourth standard is that each condition has at least three data points to qualify as a demonstration of an effect, with a preference for five data points per phase. In the current study, baseline and intervention, which is the main demonstration of an effect, all had at least five data points, and met the standard. Four of the five participants had three data points in maintenance, and one only had two data points.

The single-case research design standards were updated in the time between the study being designed and final data analysis (What Works Clearinghouse, 2020). Despite the update, this study continued to meet the Single Case Design Standards Without Reservation. The study meets the standards in all five areas: (a) Data is available for the study in graphical form, (b) the independent variable was systematically manipulated, (c) inter-assessor agreement was conducted on all sessions in the study (which is more than the 20% required), (d) the study is unlikely to have residual treatment effects because intervention was introduced in a staggered fashion, and (d) there were six phases with five data points where there was an attempt to demonstrate an effect.

Summary of Findings

The first research question asked whether there was a functional relation between BIE *e*Coaching with parents of young children with language disorders and parent provision of natural communication opportunities. Visual analysis is used to identify a functional relation:

> The presence of a functional relation can be confirmed when (a) there is a successful attempt to replicate effects of a condition and (b) similar conditions generate similar levels and trends within (intra-participant replication) and across (interparticipant replication) participants in a study. Establishing a clear pattern of responding during similar conditions and showing consistent patterns of behavior change when conditions change increases confidence that the independent variable had an effect on the dependent variable(s). (Barton et al., 2018, p. 194).

These are determined by examining the consistency of level, trend and variability within phases, and immediacy of effect, proportion of data overlap and consistency of data between phases (Gast & Spriggs, 2014; Kratochwill et al., 2013). The visual analysis of the data shows moderate evidence of a functional relation between BIE *e*Coaching and parent provision of natural communication opportunities and that all parents showed an increase from baseline to treatment.

The sub question to the first research question asked whether parents would maintain the provision of natural communication opportunities when BIE *e*Coaching was faded. All five participants maintained their provision of natural communication

opportunities above baseline levels once BIE *e*Coaching was faded, with two participants maintaining above baseline and treatment levels.

The second research question was whether parents felt BIE *e*Coaching is a socially valid intervention. All participants strongly agreed that BIE *e*Coaching was helpful in changing their communication practices with their child and all five strongly agreed that they would recommend it to other parents of children with language delays. Parent confidence levels also rose from baseline to treatment. These results indicate that BIE *e*Coaching is a socially valid intervention for increasing parent provision of natural communication opportunities.

Supplemental Data on Coach Prompts

Four out of five participants demonstrated a decelerating trendline in the number of prompted responses they delivered, which indicated that the coach delivered fewer prompts to those participants over the course of treatment. Additionally, three out of five participants had a negative relative level change, and a fourth participant showed no relative level change. This gives further evidence to the assertion that as treatment progressed, the coach decreased the number of prompts she delivered, leading to the conclusion that parents increased their independent use of the strategies.

Supplemental Child Data

While the data collected for the research questions focused on parent behavior, supplemental data was used to track child behavior. Both the percentage of intervals where children initiated vocal communication and the percentage of intervals where they vocally responded to their mother's communication was recorded. The total data level

only increased three percentage points from baseline to treatment with another increase of one percentage point from treatment to maintenance for independent initiation of vocal communication. Three of the five children demonstrated independent increases in their level of vocal initiation.

The level of child vocal responses to parent social interaction nearly doubled from baseline (36%, *SD* = 0.17) to treatment (65%, *SD* = 0.18) and increased another 20 percentage points (86%, SD = 0.09) during maintenance. The increase was seen across all children from baseline to treatment and for four of the five children from treatment to maintenance. The fifth child maintained his high level of vocalizations from treatment (90%) to maintenance (90%).

Discussion

This study was designed with two main dependent variables: (a) parent provision of natural communication opportunities, (b) social validity of BIE *e*Coaching per participant report. This section will be dedicated to an analysis of the findings based on the dependent variables.

Parent Provision of Natural Communication Opportunities

There was moderate evidence of a functional relation between BIE *e*Coaching and parent use of strategies. This finding is significant, especially given that the coach sent parents written information via email prior to baseline about providing natural communication opportunities. All of the parents also had experience with early intervention services and some regularly observed their child's therapy session. The demonstration of an effect when intervention was introduced strengthens the results of

the study given parents' previous exposure to providing parents with natural communication opportunities, showing that parents benefit from the opportunity to practice strategies in vivo with feedback.

Level and Trend

All five mothers demonstrated an increase in the provision of natural communication opportunities with BIE *e*Coaching. As seen with Coogle et al. (2017) when BIE *e*Coaching was introduced, all participants demonstrated an increase in level for the target behavior, but the data demonstrated some variability. Additionally, three out of the five mothers reversed their trend lines from decelerating to accelerating, and another maintained an accelerating trend line. The fifth participant, Lori, went from an accelerating to a decelerating trend line. Lori's highest data point in treatment was in the first session and her independent use of strategies declined over the next four sessions. During the final four sessions of treatment, Lori's spontaneous use of natural communication opportunities reliably increased each session but did not reach the level of the first session of treatment, thus impacting the overall trendline.

Variability

Ottley et al. (2017) saw considerable variability in peer coaching through BIE, which impacted the strength of the functional relation. Similarly, the data in the current study were variable in both baseline and treatment, which impacted the strength of the functional relation between BIE coaching and parent provision of natural communication opportunities. It is not unusual for data involving human subjects to be variable and

because this study was conducted in the natural environment rather than a clinical setting, variability is not highly surprising (Parker et al., 2011).

Variability in this study was impacted by a variety of factors, aside from the setting, some of which were also mentioned by Ottley et al. (2017), including the types of activities the dyad chose and child's changing interests, parent engagement, sibling presence, and the child communication level at the start of the study.

Activity Type. Activities such as reading or letter play and coloring often led parents to prompt labeling of items (not considered natural language opportunities in this study), while activities such as manipulatives and physical play often led parents to prompt more requests and comments. However, even Mary, Adina, and Lori, who engaged in the same or similar activities during every session of intervention still exhibited a large amount of variability in the number of prompts and communication temptations they independently provided each session. In fact, Rebecca, who engaged in a variety of play types with her son, had the least amount of variability, although still very high, during treatment (27% in the stability envelope).

Parent Engagement. Parent engagement was impacted by several factors, including the presence of siblings during sessions, technology problems (mainly poor wireless connections), parent questions and frustrations both related to the study and not, toileting breaks and changes in environment. These factors represent the human nature of this study. For instance, Adina demonstrated a low score for independent provision of opportunities during treatment session 8 and an increased need for prompts. This was due to Ned's twin being present during the session and tantrumming the entire 10-min.

Additionally, Ned had chosen a new activity that required the coach to support Adina in providing and adapting the prompts for him. The overall outcomes demonstrate that despite the variability of the data, this intervention can be moderately effective and integrated into the natural environment, which is where families require the most support and generalization of language skills (Snodgrass et al., 2017). The ability for this intervention to be performed in authentic settings moves the BIE research closer to the needed step of bridging the research to practice gap (Ottley et al., 2019).

Sibling presence. Three participants had siblings engaged in a few or all the sessions. Mariana's younger daughter attended nearly all the sessions. Sara's younger daughter, who was about a year old, participated in about a half to three quarters of the sessions. Adina's son (Ned's twin) was present for a few sessions. Initially, the concern was that siblings would create an added distraction and make it more difficult for the parent to fully participate. For Mariana, whose daughter with language delays was present for all sessions along with her son with ASD, this appeared to be the case at the start of treatment. She had a PND of 28.57% for the first half of treatment sessions, with five out of seven data points overlapping. However, for the second half of treatment, only one out of seven data points overlapped with baseline, meaning 85.71% of the data was non-overlapping. For the first half of intervention, she required an average of 5.14 prompts, but this dropped to an average of 2.71 prompts in the second half of intervention. These changes in the data indicate that while it took a little longer, Mariana was able to internalize the prompts from the coach and excel at providing Laurence with natural language opportunities while her daughter was playing in the same space. In fact,

in the last session of treatment she required no prompts and provided Laurence with 22 natural language opportunities. This is an increase of more than 18 opportunities over her baseline level (3.8).

Both Sara and Adina's other children joined sessions, but not as consistently as Mariana's child. During baseline and intervention Sara and Adina had to contend with tantrums from their children not involved in the study. However, Sara still maintained the highest PND of the five participants, 87%, indicating that the intervention was effective for her. Her PEM was even higher and indicated a highly successful intervention, demonstrating that she was able to continue the intervention despite distractions from her daughter. Although Adina had a PND indicating no effect, her PEM indicated that the intervention was moderately effective. Lori, who did not have a second child present during the study, had a similar PND, which indicated no effect and a PEM indicating moderate effectiveness. These similar results lead to the conclusion that Adina's data patterns were not necessarily due to the presence of her other son. But it should be taken into account that in the session when Ned's twin tantrummed for most of the 10 minutes, Adina provided only six independent prompts, even though her level during intervention was 19.25. This data indicates that his tantrums did potentially impact Adina's ability to focus on providing Ned as many natural communication opportunities as possible.

Child's Communication Level. Michael, Ned, and Terence had vocabularies of 10 or fewer spoken words at the start of the study, while Laurence and Barry had 50 or more. This did not appear to impact the effectiveness of the intervention, but Adina (12.8) and Lori (10.82) did provide a higher level of natural language opportunities to

Ned and Terence, respectively, during baseline than Mariana (3.8) and Sara (6.67) provided to Laurence and Barry during baseline. This is potentially because Laurence and Barry had more vocal communication at the outset, and Mariana and Sara did not need to work as much to elicit their communication. Rebecca provided a low level of prompts to Barry in baseline (5.43) even though he did not have many vocal words. However, she asked him a high level of labeling questions to engage him. Since labels did not count as a natural communication opportunity, her prompting level stayed low in baseline.

Immediacy of Effect

As seen in Coogle, Ottley, Rahn, and Storie (2018), all participants demonstrated immediacy of effect in the increase from baseline to intervention. The immediacy of effect in Coogle, Ottley, Rahn, and Storie (2018), was demonstrated with teachers participating in BIE *e*Coaching to increase naturalistic communication strategies, while the current study extends the extent literature by showing the immediacy of effect of BIE *e*Coaching to increase naturalistic communication strategies with parents. The immediacy of effect demonstrated that there was a functional relation between BIE *e*Coaching and parent provision of natural communication opportunities. The mean change from the last three data points of in baseline to the first three data points in intervention, or the immediacy of effect was 5.93 (*SD*= 2.84). This is only independent parent responses and does not consider those responses that were prompted by the coach. Because prompting was the main component of the intervention, it is not surprising that independent parent use of strategies did not show a larger immediacy of effect. Although Mariana's absolute level change was nine, the immediacy of effect was the lowest for her, at 2.67. This was

likely a result of her initial confusion of what she needed to do. During intervention session two, Mariana expressed her frustration and said, “I just don’t know what to do.” As a result, the coach gave more explanations during the first several sessions. As intervention continued and Mariana felt more comfortable, the coach was able decrease the lengthy explanations during intervention and move those conversations to the debrief.

Effect Size Measures

Due to data variability, the effect size measures examining overlap were skewed. This was especially apparent for Lori and Adina. Both had PNDs indicating no effect, while their PEM scores indicated that there was a moderate effect. Adina had an outlier in baseline, that if not considered, moved her PND score from 16% to 50%. While this remains not effective, it is moving closer to being effective, and includes four more data points than PND with the outlier. Had Lori not had an outlier in baseline, her PND score would have moved from 0% to 44%, which includes four more data points than when the outlier is considered.

Four out of five participants showed a decelerating level of prompting required by the coach. While Rebecca’s level of prompting was accelerating throughout treatment, the slope of the line for independent responses was steeper than the slope of the line for prompted responses, indicating that Rebecca was increasing her use of independent responses during intervention at a faster rate than she required prompting.

Maintenance of Natural Communication Opportunities

When Bug-in-Ear prompting was faded, all parents-maintained levels of provision of natural communication opportunities above that of baseline. Two of the five parents

(Mariana and Lori) also maintained their levels above treatment levels. Maintenance of strategies above baseline levels has been seen in other studies of BIE eCoaching, however they were conducted with early childhood teachers (e.g., Coogle, Ottley, Rahn & Storie, 2018). This study adds to the literature by expanding the findings to coaching of parents using BIE eCoaching.

Mariana had two data points in maintenance due to scheduling conflicts. The other four mothers had three data points in the maintenance phase, meeting the What Works Clearinghouse standards with reservation (Kratochwill et al., 2013). The data points in maintenance for all participants except Mariana overlapped all treatment data. Two participants had no overlap in maintenance with datapoints above the median score in treatment. One had 2 overlapping data points and two had three overlapping data points. While parents did not maintain their same level of provision of natural communication opportunities in maintenance as in treatment, the fact that they all maintained above baseline levels indicates that they continued to use the strategies even when the coach's prompts were faded out.

Social Validity of Bug in Ear

Similar to research conducted with early childhood educators, participant responses to the 11-question social validity questionnaire indicated that BIE *e*Coaching was a socially valid intervention (Ottley et al., 2015). Following intervention, all participants said they strongly agreed, the highest possible score, with the statement that *immediate feedback via BIE will be helpful in changing my communication practices with my child* and the statement that *immediate feedback via BIE is something that I will*

recommend to other parents of children with delays in communication. Three participants indicated that they strongly agreed that using BIE to receive feedback was manageable and two indicated that they moderately agreed with that statement. In the short answer responses, four of the five parents shared that feedback through BIE helpful for them to learn new strategies for working with their child. One said, it was "a really meaningful approach – it supported the needs of my child by supporting me as his primary caregiver." Another shared that the BIE *e*Coaching approach helped her son focus on her, instead of him hearing the feedback from the coach and in turn she was able to communicate better with her child. One parent simply stated, "the bug-in-ear is wonderful." She also shared that it was great "to have someone to remind me what to do in the right moment." Another parent wrote the experience "helped me learn how I can provide my son with more opportunities to engage and use words to communicate" and that BIE "was a big help in teaching me new strategies to allow him to feel more independent with his communication."

In response to the statement, *I am confident in working and playing with my child,* one parent responded strongly agree, three parents moderately agreed, and one parent slightly agreed. Adina's scores increased from strongly disagree (1) to moderately agree (6) and she wrote that she "loved the whole experience, gave me more confidence." Rebecca increased from slightly disagree (3) to moderately agree (6) and shared, "this experience has taught me to allow my Apraxic child more time to attempt to use words" while sharing that many prompts were "suggestions to alter the play in ways that encouraged more communication from my child." Lori maintained her confidence at the

baseline level of strongly agree but shared that the experience with BIE "was a big help in teaching me new strategies to allow [my son] to feel more independent with his communication." Mariana maintained her confidence at her baseline level of moderately agree and shared that the "experience was awesome. I have seen how the ABA therapist of my son works, but [being] able to practice like this has been so amazing for me. I feel a lot more confident now." Sara's scores decreased from baseline to post-intervention, moving from strongly agree (7) to slightly agree (5). This potentially could be because Sara became more reflective throughout the process and rated herself harder during the second time through the questionnaire. Her ratings did not completely line up with her narrative response to the open-ended question, in which she shared:

> This experience has made a significant difference in my confidence while also providing me tangible skills. Prior to this experience, I was worried about how to expand my child's play and how to provide him with more opportunities for speech. This experience has given me an opportunity to learn how to do exactly that and given me the confidence to know that I'm on the right track. While working with [the coach], I have seen such a significant improvement in my child's communication and engagement in play.

Two of the parents shared that they did not experience any challenges with the BIE *e*Coaching to receive immediate feedback. The other three parents shared challenges about the nature of immediate feedback rather than difficulty with the technology. One parent wrote that "it took a few sessions to get used to the immediate feedback, especially around giving myself permission to respond to the feedback in the moment." Mariana

wrote that she experienced the challenge of integrating what she was learning and the need to think fast while working with her son. Rebecca mentioned the challenge of working with a child with apraxia, and that he would get frustrated or lose interest in the task when he "was unable to verbalize his communication in the moment." Despite these challenges mentioned, all five of the parents strongly agreed that they would recommend BIE *e*Coaching to other parents of children with communication delays and would that the coaching via BIE *e*Coaching was helpful in changing communication practices with their children.

Unanticipated Findings

There were several unanticipated findings in the study, including reduced tantrums for Ned, the emergence of new words, increased word usage and word combinations for all child participants, and a change in the quality of parent/child interactions.

Tantrum Reduction

The least anticipated finding was the decrease in tantrums for Ned. During baseline, Ned's tantrums included crying and aggression. Aggression consisted of the self-injurious behaviors (SIB) of head banging and hitting himself, and aggression towards his mom in the form of kicking, headbutting and hitting. During the ten 10-min baseline sessions, tantrum behaviors occurred in 70% of the sessions, with an average of 3.3 (range 0-9) per session. The average aggression per session was 2.2 instances (range 0-6) and the average crying per session was 1.1 instances (range 0-6). During the 12 intervention sessions, tantrum behaviors decreased, only occurring in 25% of the

sessions, with an average of 0.83 per session (range 0-6). Tantrum behaviors decreased to an average of 0.42 instances of aggression (range 0-3) per session and 0.42 instances of crying (range 0-6), with aggression only occurring in two sessions and crying only occurring in three sessions. Adina was also noted to redirect Ned from crying within one second of his starting to cry during intervention session 7. This was a significantly faster redirection than during baseline when he would cry for several minutes at a time. During the three 10-min sessions of maintenance, no tantrum behaviors were observed.

The decrease in tantrum behaviors is inversely related to an increase in Ned's vocal responses to his mother. From baseline to treatment, Ned increased the level of his vocal responses from 49% of intervals to 66% of intervals and from intervention to maintenance, he increased the level of his vocal responses to 77% of intervals. During baseline, Adina asked Ned a lot of questions that required him to label toys or point to certain pictures. Hypothetically, Ned saw this as a task, and used the tantrum behaviors to avoid the task. As Adina joined Ned more in preferred play activities and shifted the interactions to be more child directed (i.e., allowing him to request preferred items and increasing the opportunity to request by withholding parts of the activity) he became more likely to engage with her and reciprocate her interactions. This finding is promising and is similar to the finding noted in Curtis et al. (2019) that when parents target reciprocity and following their child's lead, they are more likely to respond to their child's emotional state and reinforce self-regulation skills, which reduces challenging behavior.

Quality of Parent Child Interaction

Anecdotally, the quality of interactions between Sara and Barry, Adina and Ned, and Terence and Lori changed in the duration of the study. This extends the social validity responses from parents found in Meadan et al. (2016) stating that they felt they interacted in a new way with their child after intervention. In that study, parents shared that they felt the use of natural strategies in daily routines influenced both the child's involvement in family activities and their communication.

In the current study, starting during Sara's 6th intervention session, the primary interventionist noted in anecdotal notes that Barry was starting to engage Sara during play, it was no longer just Sara trying to engage Barry. As such, Sara had the opportunity to expand on Barry's language and did not need to provide as many opportunities for natural language through prompting or communication temptations. While this may have skewed Sara's data for the study, it was a positive outcome for her relationship with Barry. Additionally, Sara commented during two or three sessions that Barry was using new words for the first time. In the last two sessions of intervention Barry was noted to combine several sets of two words spontaneously. By maintenance sessions 2 and 3 Barry was highly engaged with Sara and did not require prompting to language. He was observed to initiate 2–3-word phrases and imitate Sara's models and expansions in play. This is a significant increase over baseline, where Barry was not observed to use phrases to initiate or respond in communication.

Ned's interactions with Adina changed as well. By intervention 9, he was engaging in more reciprocal play. He was observed to initiate silly games and eye

contact. He was also engaging in joint attention with Adina. While Terence's engagement with Lori was not noted to change as noticeably as Ned or Barry, he was observed to engage longer with items (Playdoh) in play during the sessions. Because the study was set up to increase requests and similarly meaningful language, Lori was not presented with as many opportunities to prompt Terence in later sessions. However, it was noted that his language was more genuine and meaningful when he did engage, and his sentences were longer.

Limitations

As with all research studies, this study had limitations. Therefore, although the results of the study are promising, the limitations of the study must be kept in mind while interpreting the results. Three of the major limitations are researcher as intervener, duration of study, and participant limitations.

Researcher as Intervener

The researcher was the one to conduct sessions across baseline, intervention, and maintenance. The researcher has 18 years of experience working in educational settings with young children with disabilities. Parent training has increasingly become a part of the researcher's work with children, and there is the potential that she could rely on past experience when coaching parents. Additionally, parents were aware of the researcher's experience as an early childhood educator and Board Certified Behavior Analyst and sometimes asked questions outside the scope of the research study intervention.

While the intervention was structured so that feedback was to be delivered every minute, the researcher used that goal as a guideline rather than an imperative. If a child

was engaged appropriately in an activity, she did not feel a need to require that the mother provide a prompt. While this may have compromised the integrity of the intervention's structure and skewed data (as referenced above in the section on the quality of parent child interaction), it lends itself to bridging the gap between research and practice, making BIE interventions more applicable to the situations early intervention providers encounter.

Duration of Study

Intervention sessions were conducted for between one to two months (9-15 sessions), depending on the dyad and when they entered intervention. While in person parent coaching often lasts at least two months, previous research on BIE with educators, 76% of the studies had 10 or fewer sessions of intervention (Hancock et al., 2016; Schaefer & Ottley, 2018). Because this was the first known time BIE had been used to coach parents in providing natural communication opportunities, acquisition rate was unclear, and therefore, mastery criteria for the study were not clear cut. Parents were not ready to end the study and wanted additional support with their children. Two behaviors were targeted within the dependent variable so in some cases, the intervener continued with BIE coaching by switching the focus from one behavior to the other. This should be adjusted should the study be done again. The criteria laid out in Chung et al. (2020) would serve as guidance for creating a better structure. In their study, the EI provider only focused on one strategy at a time and did not introduce the next strategy until the coachee was performing the strategy with 80% fidelity over two sessions and reported that she was comfortable with the intervention.

Participant Limitations

Due to parents' various levels of knowledge and learned behaviors in interacting with their children, some parents had to be taught priming behaviors, such as pausing after asking a question before they could properly execute prompts and communication temptations. Meadan et al. (2016) noted that coaching allows parents to break down familiar interventions and routines for communication exchanges and learn new strategies that may be more beneficial for children. Because the current study was conducted in-vivo, the breakdown and buildup of new strategies could occur at a faster pace. However, this changed the focus of coaching for some sessions, especially early in intervention.

Additionally, as children matured and their language and play improved, the children required less prompting from their parent to interact with the environment. The children started to interact more spontaneously and engage in activities for longer periods of time, which meant they did not need to ask for items, and instead engaged their parents in other ways that were not captured under the researcher's definition of natural communication opportunity. This likely impacted data, especially at the end of the study.

Practical Implications

Early intervention is imperative for children with language delays and other developmental disabilities, allowing them to learn ways to communicate and engage with their environment. Early intervention is most effective when it is evidence based, delivered in a natural environment setting, and family centered (Meadan & Daczewitz, 2015; Meadan et al., 2016).

Parents as Educators

Parents are a critical component for child progress, and studies dating back to 1970 have demonstrated that their involvement leads to better outcomes for children (Brookman-Frazee, 2004; Koegel & Koegel, 2012; Suppo & Floyd, 2012). Because children with delays often do not respond to typical interventions and strategies that parents might employ, parents benefit from being taught new strategies that would be more effective (Koegel & Koegel, 2012). Many previous studies, both single subject and RCT, did not take sufficient data on parent training procedures to determine what aspects are most beneficial to parents (Heidlage et al., 2020). The current study aimed to address the research gap on BIE *e*Coaching with parents, extending the research that practice with feedback is beneficial when helping parents master an intervention (Koegel & Koegel, 2012). By using BIE to teach parents to implement NI strategies, ideas for future research from a previous study was explored (Hancock et al., 2016). The outcomes of the current study show a moderate functional relation with using BIE *e*Coaching to prompt and coach parents in real time and allow them practice with feedback. This is promising for both current practice and for future research.

Setting

The current study was conducted in the families' natural environment. By using BIE *e*Coaching, parents are empowered to be the primary interventionists, which has been shown to lead to better child outcomes (Brookman-Frazee, 2004; Chung et al., 2020; Suppo & Floyd, 2012). The child's preferences were used to elicit communication and siblings were part of some interventions. The moderate functional relation to

increased parent behavior seen in the natural environment intervention has promising implications because research states that children make significant progress when interventions are conducted in the natural environment (Koegel & Koegel, 2012). NI research makes several suggestions about environmental arrangement of the space to facilitate parent-child interactions, including to limit distractions and set up areas that provide definite boundaries for children (Hancock et al., 2016). Because this was not defined as part of the independent or dependent variable, after initial suggestions for environmental arrangements were made, it was not something that was discussed at length. While Barry had more distractions in his environment during sessions (such as the TV on in the background and a variety of toy options) and Michael may have benefitted from an area that decreased his temptations to run around and leave the play area, both of their mothers' outcomes were in the effective to very effective range. This suggests that while environmental arrangement is ideal, other aspects of creating connections with children (following a child's lead and matched turns) may be more important.

Benefits Over Traditional Interventions

The current study confirms the extent literature that BIE is a successful way to coach families that is less expensive than traditional interventions (Wacker et al., 2013b). If the families have internet and a video enabled device, they can participate in the intervention. BIE technology also opens the possibility that families can pair with different people and personalities, or those people who might live across the country but have appealing training or a necessary specialty to address the child's needs (Anthony et al., 2013). This is particularly true for those families who may have medically fragile

children and have more difficulty leaving the house for traditional therapies or school. Or for families in rural areas of the country that are harder to reach or significantly increase travel time for service providers (Heitzman-Powell et al., 2014).

An added benefit and practical outcome of this study was that it took place during a global pandemic. Most children were unable to attend in person school and therefore lost out of some traditional therapies. By using parent coaching through BIE, interventionists would have been able to reach families whose children might not have sat willingly for virtual classes.

Time Commitment

The BIE *e*Coaching that was used in this study also required families to dedicate significantly fewer hours to 'therapy.' Most studies published about parent implementation of NI outline the intense twice weekly training required for two to four months to learn to implement NI strategies (Hancock et al., 2016). However, not all parents have the time to devote to such intense time requirements. This study demonstrated that parents can learn NI strategies in less time through BIE *e*Coaching. Furthermore, BIE makes learning such interventions more accessible for families and allows them to fit learning a new skill to support their child into the context of family life. In line with previous studies conducted on *e*Coaching, with teacher participants (Coogle et al., 2015; Ottley et al., 2017), parent coaching only occurred in 10-minute sessions, with an added minute for dyads to settle in. Then, as parents learned and became comfortable with the strategies, they could integrate them into the child's day or routine. The outcomes of the study demonstrate that parents do not need lengthy training in the

theory of an intervention and how to execute it. Instead, parents benefitted from frequent prompting and feedback to shape their behaviors. This is in line with previous research stating that feedback is essential for parents to learn to implement an intervention (Bryson et al., 2007; Koegel & Koegel, 2012).

Aspects of Coaching

In previous studies and recommendations for BIE coaching, it was suggested that pre-prescribed 2-3 word phrases be employed to prompt parents (Ottley, 2016). Other research indicates that this may need to be adjusted based on individual needs of the coachees (Rock & Holden, 2019). During the current study, the pre-prescribed phrases were not always effective, and the coach frequently had to expand the length of the direction given or give more background around a prompt. The coach attempted to fade these longer phrases out as soon as possible to maintain fidelity.

The current study focused on individual parent training. In a meta-analysis of 25 RCT parent training studies, it was shown that only 56%, or 14 studies, provided individualized training to parents (Heidlage et al., 2020). The meta-analysis also revealed that session lengths for parent training ranged from 20 min to 180min (M = 91.2 min.) for an average of 15.3 sessions (range 1-55 sessions). The current study demonstrates that parents can acquire skills for providing language opportunities for their children by engaging in much shorter, 11-min sessions. Two previous studies trained parents in the EMT intervention in 20-26 sessions (Hancock et al., 2016; Kaiser et al., 2000). The current study trained parents to implement EMT-based strategies in 9-15

sessions. While their implementation was not at fidelity for EMT, they were able to learn and implement strategies that benefitted their children in a shorter number of sessions.

Naturalistic Instruction

Previous research on using BIE with parents was focused on teaching them to assess maladaptive child behavior and implement specific interventions to address that. BIE has also been used with parents as part of a package intervention that requires significant parental time or it has been used in an intervention that took place in a clinical setting rather than the families natural environment. This is the known first study to use BIE in short periods of time to coach parents in the family's natural environment to implement an intervention to increase functional communication that was designed to measure the benefits of the intervention. Chung et al. (2020) also targeted BIE coaching during short intervention sessions, but the focus of the study was on social validity and the data was not taken specifically to measure parent acquisition of skills.

Conducting intervention in the child's natural environment allowed parents to have a few minutes before and after the intervention to debrief with the coach. Children could play in their environment while the parent talked to the coach. The coach did not require the debriefs and always asked the parent whether they had time. Parents made time to debrief, even if the discussion was short. They appeared to value the opportunity to process progress they were making and ask any questions they had. The debrief also assisted in building trust between the participants and the which in turn created a safe and comfortable learning environment for the parents, which is imperative to the outcome of the BIE intervention (Rock et al., 2014).

Future Research

Multiple studies point to the need for more generalization research in the BIE literature (Coogle et al., 2015; Coogle et al., 2016; Ottley et al., 2015; Schaefer & Ottley, 2018). Future studies could examine ways to program for generalization within BIE coaching, particularly with parents. Because the current study aimed to be practical for the parents and engaging for the children, generalization was unintentionally programmed for already, which could potentially strengthen the parents' use of the strategies in the long run. However, it might be interesting to see whether the rate of parent skill acquisition changes more quickly based on the type of activity the dyad is engaged in. Research could also be conducted to examine rate of skill acquisition (providing natural language opportunities) and whether short sessions or long sessions were more beneficial and whether these variables impact the maintenance and generalization data. Sessions in previous research have varied from 6-30 min. depending on the study (Schaefer & Ottley, 2018). Another area for future research would be to examine the feasibility of coaching multiple family members at once, if the child were playing with more than one caregiver (Ottley, 2016).

It is established that in coaching professional development, positive feedback and corrective feedback are two of the most important aspects of performance feedback (Schaefer & Ottley, 2018). Further research should breakdown feedback given to parents during BIE to see what aspects are more important. Additionally, feedback should be systematically delivered to test the benefits of giving key words or short phrases versus

narrative feedback. Schaefer and Ottley (2018) found that the majority (53%) of studies used key words or short phrases during coaching.

Future research should also be conducted to include the impact on children when parents are coached to provide more language opportunities for them through BIE. As of a 2018 review of literature, only four studies systematically recorded changes in student behavior (Schaefer & Ottley). This will better speak to the impact on children when parents are taught to carry out interventions. One way to do this would be to record the Mean Length of Utterance (MLU) for children prior to intervention, following intervention and during the maintenance period. Another possibility to would be look at the topography of results, such as whether the child vocalized, verbalized, gestured or signed (Meadan et al., 2016). For instance, Barry spontaneously requested from his mom, "mama train, make it," during session 15 of intervention. At the start of the intervention, parents reported that Barry had about 50 words and only used them as single words. The four-word request that was observed during session 15 was a promising development in Barry's language. There were three or four intervention sessions when Sara shared that Barry used a new word, they had never heard him use before.

Conclusion

BIE *e*Coaching is an empirically validated intervention frequently used to coach pre-service and in-service teachers. There is a growing body of research for using BIE to coach early childhood educators (e.g., Coogle et al., 2017; Coogle et al., 2015; Coogle et al., 2016; Coogle, Storie, et al., 2019; Ottley et al., 2017; Ottley & Hanline, 2014). However, there is a gap in the research for the use of BIE *e*Coaching with parents to

increase their use of NI to target communication skills. The current single case, multiple-baseline study examined whether there was a functional relation between BIE *e*Coaching with parents of young children with language disorders and parent provision of natural communication opportunities and whether parents maintained their provision of natural communication opportunities when the intervention was faded. Social validity of the intervention was also assessed. The results of the study indicate that BIE *e*Coaching was moderately effective in increasing parent provision of natural communication opportunities. Parents were able to maintain their provision of natural language opportunities above baseline levels after intervention was withdrawn. Participant responses indicated that BIE *e*Coaching was a socially valid intervention for changing their communication practices with their child. They agreed that they would recommend it to other parents of children with language disorders.

Appendix A

IRB Approval

Office of Research Integrity and Assurance

Research Hall, 4400 University Drive, MS 6D5, Fairfax, Virginia 22030
Phone: 703-993-5445; Fax: 703-993-9590

DATE:	May 20, 2020
TO:	Anna Evmenova, PhD
FROM:	George Mason University IRB
Project Title:	[1486900-3] Parent Coaching in Natural Communication Opportunities Through Bug-in-Ear Technology
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	May 20, 2020
REVIEW TYPE:	Expedited Review
REVIEW TYPE:	Expedited review category #7

Thank you for your submission of Amendment/Modification materials for this project. The George Mason University IRB has APPROVED your submission. This submission has received Expedited Review based on applicable federal regulations.

Please remember that all research must be conducted as described in the submitted materials.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form unless the IRB has waived the requirement for a signature on the consent form or has waived the requirement for a consent process. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by the IRB prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to the IRB office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed (if applicable).

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the IRB.

This study does not have an expiration date but you will receive an annual reminder regarding future requirements.

Please note that all research records must be retained for a minimum of five years, or as described in your submission, after the completion of the project.

Please note that department or other approvals may be required to conduct your research in addition to IRB approval.

If you have any questions, please contact Kim Paul at (703) 993-4208 or kpaul4@gmu.edu. Please include your project title and reference number in all correspondence with this committee.

GMU IRB Standard Operating Procedures can be found here: https://rdia.gmu.edu/topics-of-interest/human-or-animal-subjects/human-subjects/human-subjects-sops/

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within George Mason University IRB's records.

Appendix B

Participation Flyer

Doctoral Dissertation Participants Sought

Seeking parent participants for a doctoral dissertation study
(George Mason University, IRBNet number: 1486900).

Learn to **embed more language opportunities** for your child into daily play activities to increase his/her communication attempts throughout the day. Participate from the **comfort of your own home** with live bi-weekly coaching sessions through bug-in-ear technology while you play with your child.

Time commitment: an hour a week for about 3 months

Interested parents will be **included in the study** if they:

(a) have a child between 24 and 60 months who has an educational label of developmental delay or autism,
(b) speak English as their primary language,
(c) have a laptop or tablet that is capable of videoconferencing and can be moved around the house,
(d) have high-speed wireless internet in their home,
(e) are able to commit to one half-hour session twice week of video-conferencing,
(f) give permission to record the sessions,
(g) have a primary goal of increasing their child's functional language,
(h) the child is communicating through gestures, single words, or just starting to combine words

If you are interested, please contact Rachel Hamberger rhamber1@gmu.edu.

Study overseen by Dr. Anya Evmenova (aevmenov@gmu.edu).

** Participants who complete the study will receive a $250 stipend **

Appendix C

Participation Questionnaire

1. What is your child's date of birth?
2. What is the primary language spoken in your home?
3. Do you have a laptop or tablet that can easily be moved around your house?
4. Do you have wireless, highspeed internet?
5. Are you available for two 30-minute coaching sessions a week with time spent practicing in between?
6. Are you willing to allow the coaching sessions to be recorded?
7. How does your child communicate primarily?
    a. Gestures
    b. Signs
    c. Word approximations (how many does your child have? _____)
    d. Single words (how many does your child have? _____)
    e. Combining two words (how many phrases does your child have? _____)
8. What is your primary goal for your child if you were to participate in this training? (please circle one)
    a. Improvement of self-help skills
    b. Improvement of pre-academic skills
    c. Improvement of functional language skills
    d. Improvement of motor skills

Appendix D

Demographic Questionnaire

1. Parent age:

2. Parent gender: Male Female Other

3. Child gender: Male Female Other

4. Parent ethnicity:
    - White, non-Hispanic
    - Black, non-Hispanic
    - Hispanic or Latino
    - Asian or Pacific Islander
    - Native American
    - Other

5. Child ethnicity:
    - White, non-Hispanic
    - Black, non-Hispanic
    - Hispanic or Latino
    - Asian or Pacific Islander
    - Native American
    - Other

6. Highest level of parent education:
    - Some high school
    - High school diploma
    - Some college
    - College degree
    - Post-graduate degree

7. Parent employment status (please check all that apply):
    - Stay at home parent
    - Part-time student
    - Full-time student
    - Part-time job
    - Full-time job

Appendix E

Informed Consent

George Mason University
Helen Kellar Institute for Human disAbilities
(703) 993-3670; FAX: (703) 993-3681
Email: rhamber1@gmu.edu; aevmenov@gmu.edu

Informed Consent

Dissertation Title: Parent Coaching in Natural Communication Opportunities Through Bug-in-Ear Technology

Purpose: The purpose of this study is to investigate whether there is a relationship between Bug-in-Ear coaching with parents of young children with disabilities and parent provision of natural communication opportunities. Additionally, the study will track the purposeful vocal communication attempts made by children.

Participation Requirements: If you agree to participate, you are also agreeing to the participation of your child. Prior to the start of the study, you will be asked to review a short training manual about establishing natural communication opportunities for your child. You will also be given a manual to assist in connecting to the technology. During baseline and intervention, you will connect virtually with the researcher, via Zoom, on your computer or Tablet for each 30-minute session (two times a week). For the baseline sessions, you will play with your child and the coach will collect data on the communication strategies that will be coached later. Following baseline, you and the coach will set a goal. Each intervention session will start with a quick planning discussion, then the coach will communicate with you via a Bluetooth headset by providing prompts and reinforcement to elicit communication from your child while you play with him/her for 11 minutes. This will be followed by a quick debrief.

All sessions will be recorded for data analysis and reliability purposes. These files will be kept confidential and will not be used for anything outside of the dissertation research. It is projected that the study will take place over about a three month time frame, with coaching sessions occurring twice a week for about thirty minutes each.

If you agree to participate in this study, we will collect demographic information about you and your child. Any information collected will be kept confidential, and only be viewed by project staff. The data and recordings will be destroyed five years after the study.

Inclusion Criteria:

Interested parents will be **included in the study** if they:
(a) have a child between 24 and 60 months who has an educational label of developmental delay or autism,
(b) speak English as their primary language,
(c) have a laptop or tablet that is capable of videoconferencing and can be moved around the house,
(d) have high-speed wireless internet in their home,
(e) are able to commit to one half-hour session twice week of video-conferencing,
(f) give permission to record the sessions,
(g) have a primary goal of increasing their child's functional language,
(h) the child is communicating through gestures, single words, or just starting to combine words
Foreseeable Risks: There are no foreseeable risks or discomforts.

Voluntary: Your participation is voluntary, and you may withdraw from the study at any time, even after signing the consent, for any reason.

Benefits: The personal benefits for participation may include improved language skills for your child, and improved comfort for you in working with your child. If you complete the study, you will be compensated with a $250 stipend.

Costs: There are no costs to you or your child.

Confidentiality: All data collected in this study will be confidential; all person-identifiable data will be coded so that no one, including individual students or parents can be identified. The de-identified data could be used for future research without additional consent from participants. All data relating to this dissertation will be kept and maintained in the student researcher's locked filing cabinet. All relevant data will be stored in a locked filing cabinet for 5 years after the completion of the dissertation. Videotapes will be stored on Google Drive or Dropbox during the course of data collection. Following the study, the videos will be downloaded on to a flash drive which will be stored in a locked filing cabinet in the primary investigator's office on the GMU campus. Coaching will take place in a private room in the coach's house to protect participant privacy.

While it is understood that no computer transmission can be perfectly secure, reasonable efforts will be made to protect the confidentiality of your transmission. Participants may review Zoom's website for information about their privacy statement. https://zoom.us/privacy

Researchers: This study is being conducted by Rachel Hamberger, PhD candidate, with the supervision of **Dr. Anna Evmenova** from the College of Education and Human

Development at George Mason University (GMU). You can reach them at telephone number: 703-993-3670 for questions or concerns. You may also contact the GMU Institutional Review Board (IRB) Office at 703-993-4121 if you have questions or comments regarding your child's rights as a participant in this research. This project has been reviewed according to George Mason University procedures governing your child's participation in this research.

_____ _____

Name (print) Signature

_____

Date of Signature

Appendix F

Technology Information Handbook

Technology Needed

1. **Laptop or Tablet**
    - Either a MAC or PC laptop or tablet with a 1 GHz Intel processor and access to a high-speed broadband connection is required.
2. **Bluetooth Headset**
    - The parent will wear the headset to receive feedback from the coach. This can be one owned by the parent, or provided by the coach.
    - If the parent's computer is not Bluetooth enabled, a Bluetooth adapter will also be required.
3. **Web Cam**
    - The web cam built into the parent's computer may be used in order for the coach to view the parent and the play area.
    - If the parent does not have a webcam built into his/her computer or if the view of the parent or play area is inadequate, a separate wide-angle web cam can be installed in the play area.
4. **Zoom**

- Zoom is a free Internet download.

- The parent will need to download Zoom prior to the *e*Coaching sessions. The parent does not need to create an account. The coach will send a link to the meeting room prior to each session.

Set-Up Procedures for the Parent (MAC Version)

There are four major components to the BIE system: (1) laptop or tablet that is either Bluetooth enabled or has a Bluetooth adapter, (2) a Bluetooth headset, (3) a web camera (probably built in to your computer), and (4) the videoconferencing software, Zoom.

Step 1: Set up your laptop to interact with the Bluetooth headset.

1. If using a Mac, your computer is most likely Bluetooth enabled and will not require a Bluetooth adapter.
2. Make sure the headset is fully charged. See headset manual for directions.
3. On the Bluetooth Headset, turn the button to the ON position. Keep the headset within close range of the computer.
4. On the laptop, go to SYSTEM PREFERENCES.
5. Click on BLUETOOTH.
6. You should see the name or brand of the headset appear in the box as the laptop searches for devices.
7. When you see the device and a button next to it that says PAIR, click the PAIR button.
8. Once the headset is paired with the device, you will see the headset name in the Bluetooth panel. You can close the panel.

Step 2: Set up Zoom.

1. Download Zoom to your laptop. You can download it by clicking on "Zoom Desktop Client" from the Zoom Help Center.
2. Clink on the link in the email sent by your coach.
3. Click "Open Zoom.us" when the pop up appears.
4. Select "Join with Video" when prompted.
5. Select "Join with Computer Audio" when prompted.
6. You should be able to see the coach on the screen.

Step 3: Change Zoom Settings for Bluetooth Headset

1. Once in a Zoom meeting, locate the microphone on the lower left corner labeled "mute." To the right is small carrot/arrow, click on this to bring up the sound input menu.

2. For the "Microphone" option choose: "Built-In (Internal) Microphone" in the drop down menu. This allows the coach to hear you and your child.

5. For the "Speakers" option choose the name of your Bluetooth headset in the drop down menu.

6. You are ready to begin your coaching session.

***Note**: When coaching session is complete, disconnect from Zoom and turn off the Bluetooth headset. Place Bluetooth headset in charger to recharge for the next session.*

Adapted from: Kurz, L. & Weiss, M. (n. d.) *Bug-in-Ear (BIE) coaching manual for special education internships.*

Appendix G

Datasheet

Trial by Trial Data	Min 1	Min 2	Min 3	Min 4	Min 5	Min 6	Min 7	Min 8	Min 9	Min 10	% occur
Play and Engage											
1. On child's level											
2. Imitates/expands child's play											
3. Child initiates communication											
Child Communication											
1. Initiates communication through: Eye contact, cries/tantrums, gestures, vocalizations, words, phrases											
2. Responds to social exchange by parent (not just labeling): eye contact, gesture, vocalization, word, phrase											
3. Was response to parent independent, partially prompted or modeled?											
Expanding Language											
1. Imitates child's communication											

2. Expands by 1-2 words											
Communication Temptation Strategies											
1. Inadequate portions: wait 3 seconds											
2. Assistance: wait 3 seconds											
3. Pause in Routine: wait 3 seconds for child to communicate											
4. Choice making: *silently hold up two choices – wait 3 seconds*											
Prompting											
1. Time Delay											
2. Open question (not what is it)											
3. Choice question											
4. Model procedure											

(prompted= P; unsuccessful prompt = ~~P~~; independent = +; incorrect response = -; coach provided reinforcement = SR)

Appendix H

Frequency Data

Parent Name:	Activities:
Session:	** track behaviors starting 1 minute after coach starts timer **

	Parent Provided Natural Language Opportunities	**Totals**
Communication Temptations • Inadequate portions • Assistance • Pause in routine • Silent choice making Prompting • Time delay • Open question • Choice question • Model procedure		
	Intervention Only – Coach Provided Prompts and Reinforcement	
Coach positive feedback		
Coach prompt (for communication temptation or prompting)		
Coach full prompt (for communication temptation or prompting)		

Appendix I

Training Manual

Thank you for agreeing to participate in my dissertation research! I will be coaching you to *increase natural communication opportunities* for your child. Prior to the start of coaching I would like to share essential materials with you on four of the components that can be used to increase natural communication. Together, we will choose two to work on during our twice weekly sessions.

The components of the natural communication opportunities have roots in evidence-based practices for children with developmental delays. A key component is that the intervention occurs in the child's natural environment and is embedded into play activities. The following pages have more details about the individual components:

1. Play and Engage
2. Expanding Language
3. Communication Temptations
4. Prompting

We will start with the assumptions that: (a) your child is communicating, it just may not be through an appropriate or desired behavior, and (b) the social interaction between a child and adult is the basis for communication. We are going to work to strengthen functional communication skills and social engagement during our time together. Before we get started, observe your child, and notice how s/he is communicating, and what is most motivating for her/him to request. This will help to shape our work.

** One thought to keep in mind – limit the directions you give, instead use your language to narrate what your child is doing.

Play and Engage

Joint attention is key in developing communication and play is a good way in which to engage a child to establish joint attention.

The Steps:

1. Play alongside your child, get down on their level
2. Follow your child's lead:
    a. Imitate their actions (unless they are inappropriate/destructive). It is ok if they do not use a toy as intended, the key is to engage *with* your child.
    b. Expand play actions
    c. Let your child initiate the communication
        i. Communication can take many forms, including:
            1. Vocalizations
            2. Pointing
            3. Showing
            4. Giving
            5. Nodding or shaking head
            6. Pushing items away
            7. Looking
            8. Smiling
3. Try to avoid giving directions and questions – allow your child to lead the play

Expanding Language

The Steps:

1. When the child initiates communication, imitate his/her communication and expand upon what they say by one or two words
    - Example:
        - Child: [gives block]
        - Adult: [gives block] block!
        - Child: blocks
        - Adult: build blocks!

Child Communication	Language to Model
Current: Vocalizations, no gestures Target: single words	Expand vocalizations, model gestures, pair gestures with single words, one –two word utterances
Current: Vocalizations & gestures Target: single words	Expand vocalizations & gestures with words; one-two word utterances
Current: Gestures, vocalizations, some single words Target: single words	one and two word utterances; expand single word utterances; model verbs
Current: 50+ words (including a variety of verbs) Target: two words	Two word utterances; expansions that combine words the child is already using; early two word utterances
Current: Two word utterances with different types Target: 3 words	3-5 words.

(Kaiser & Hampton, April 2014, p. 43)

Communication Temptation Strategies

These are situations you can set up to promote your child's communication.

You will most likely only set one of these up at a time

1. **Inadequate portions**: Give your child a small amount of a desired item, requiring them to ask for more of the item.
    a. Example:
        i. Only give your child small part of a cookie
        ii. Wait for 3 seconds
            1. If your child communicates via a gesture, vocalization or word, provide them with cookie, while saying, "Cookie"
            2. If your child does not communicate, model the word and give the cookie (the goal is to keep engagement going)
2. **Assistance:** Present items in a manner that requires children to ask for help.
    a. Examples:
        i. Give a child his snack in a sealed container so that he has to ask you to open it.
        ii. Wait for 3 seconds
            1. If your child communicates via a gesture, vocalization or word, provide them with cookie, while saying, "Open"
            2. If your child does not communicate, model the word and open the container (the goal is to keep engagement going)

3. **Pause in Routine:** Wait in the middle of a familiar routine before doing an expected action, in order to see if the child will ask for the action to resume.
    a. Example:
        i. Say, “Ready, set,” and pause before saying “go” or pushing cars down a ramp. See if your child will fill in “go.”
        ii. Wait for 3 seconds
            1. If your child communicates via a gesture, vocalization or word, say, “Go!” and push the car down the ramp.
            2. If your child does not communicate, model the word and push the car down the ramp (the goal is to keep engagement going)
4. **Choice Making:** Silently hold up two items and wait to see if the child communicates for one of the items.
        i. Wait for 3 seconds
            1. If your child communicates via a gesture, vocalization or word, provide them with the item they indicated and say the word.
            2. If your child does not communicate, say, “Do you want, _____ or _____,” and hold each item out to them. See if your child reaches for an item this time. If they do, label it.

Prompting

There are four types of language prompts, or signals for a child to say something.

Types:

1. **Time Delay:** An obvious, but non-verbal cue for a child to communicate
    a. Example:
        i. The adult holds up an item and gives an expectant look and pauses for the child to communicate before completing an expected action
        ii. As above, wait for 3 seconds to see if they child communicates.
            1. If your child communicates via a gesture, vocalization or word, provide them with the item and say the name of the item.
            2. If your child does not communicate, model the word and give the item (the goal is to keep engagement going)
2. **Open Question:** The adult asks a question that cannot be answered with a yes/no or a choice, and to which there is no single correct answer.
    a. Example:
        i. What comes next?
        ii. What should the bears eat on their picnic?
3. **Choice Question:** The adult offers two options for the child in their question. This is easily supported by visual cues.
    a. Example:
        i. Do you want waffles or eggs for breakfast?

ii. Wait for 3 seconds

1. If your child communicates via a gesture, vocalization or word, provide them with the item while saying, “You want _____”
2. If your child does not communicate, model the word and give the item (the goal is to keep engagement going)

iii. What should we play today? Tag or duck, duck, goose?

4. **Model Procedure:** Say exactly what you want the child to say.
   - **a.** “Want cookie”
   - **b.** “Open box”

<u>The Steps:</u>

1. Start with the least intrusive prompt appropriate for your child (time delay is the least intrusive, while modeling is the most intrusive).
   a. If needed, follow the least intrusive prompt with a more intrusive one.
2. Always end a prompting session with the child receiving the item s/he requested. If necessary, increase your prompt level to ensure success.

Appendix J

Pre-Intervention Discussion and Training Session – Script

1. Of the four components of a natural communication opportunity (outlined in the training manual), which do you think you did the best with? Which did you find challenging?
    a. *Play and Engage:* playing at your child's level, following his lead, letting child initiate communication
    b. *Expanding Language:* Imitating and expanding on your child's communication
    c. *Communication Temptations:* Setting up situations to promote communication
    d. *Prompting:* Supporting or signaling to communicate

2. Based on the data, you did
    a. Play and engage, by getting on your child's level, imitating/expanding your child's play or having your child initiate communication average of ___ % of the time in the 10-minute baseline sessions.
    b. Expanded your child's language by imitating his communication or expanding his language by 1-2 words an average of ___% of the time in the 10-minute baseline sessions.
    c. Used communication temptation strategies by providing inadequate portions, the need for assistance, pausing in a familiar routine, or offering

a silent choice an average of ___% of the time in the 10-minute baseline sessions

d. Used the prompting strategies of time delay, open questions, choice questions or model procedure an average of ___% of the time in the 10-minute baseline sessions.

3. Based on this data, I am thinking that we can target increasing your use of communication temptation strategies (setting up opportunities to promote communication) and prompting (supporting or signaling to your child to communicate). Each strategy has four aspects, let's talk through them and decide which two you want to focus on primarily.

    a. **Communication Temptation Strategies:**

        i. **Inadequate portions**: Give your child a small amount of a desired item, requiring them to ask for more of the item.

        ii. **Assistance:** Present items in a manner that requires children to ask for help.

        iii. **Pause in Routine:** Wait in the middle of a familiar routine before doing an expected action, in order to see if the child will ask for the action to resume.

        iv. **Choice Making:** Silently hold up two items and wait to see if the child communicates for one of the items.

** All of these require you to pause and wait three seconds before prompting your child **

b. **Prompting Strategies**

i. **Time Delay:** An obvious, but non-verbal cue for a child to communicate

ii. **Open Question:** The adult asks a question that cannot be answered with a yes/no or a choice, and to which there is no single correct answer (not labeling)

iii. **Choice Question:** The adult offers two options for the child in their question. This is easily supported by visual cues.

iv. Model Procedure: Say exactly what you want the child to say to communicate something meaningful to him.

** All of these require you to pause and wait three seconds before prompting your child or repeating the prompt **

4. Thank you for picking two components! Now let's choose a cue so that I can prompt you to try them during our session.
5. If that cue is not enough of a prompt for you (e.g., does not change your behavior), I will give you the exact words to say or action to do, such as:
    a. Inadequate portions: "Just give him two goldfish"
    b. Time delay: "Hold up the item and pause"
    c. For all of the aspects, I may prompt you to "wait" and count to three before prompting again.
6. I will also provide verbal reinforcement for you when you are on the right track.
7. What questions can I answer for you?

Appendix K

Fidelity of Implementation Checklist: Baseline & Maintenance

Parent: _____

Baseline/Maintenance session number: _____

	Yes	No	Comments?
Parent signed on to Zoom		☐	
Parent and child are visible, if not, primary investigator asked parent to reposition		☐	
Conversation prior to data collection limited to pleasantries, technology checks and question answers unrelated to providing natural communication opportunities		☐	
Primary investigator announces start of 11-minute timer		☐	
No verbal exchanges between parent and primary investigator during 11-minute data collection period		☐	
Following data collection, the only discussion is limited to pleasantries, technology checks and question answers addressing next steps.		☐	**If it is the last session of maintenance, discussion can talk about progress and how the intervention went overall.**

Appendix L

Fidelity of Implementation Checklist: Treatment

Parent: _____

Treatment session number: _____

	Yes	No	Comments?
Parent signed on to Zoom	☐	☐	
Parent and child are visible, if not, primary investigator asked parent to reposition	☐	☐	
Primary investigator follows up on previous session and/or asks if there are any questions.	☐	☐	
Primary investigator announces start of 11-minute timer	☐	☐	
No verbal exchanges between parent and primary investigator during 1st minute of data collection	☐	☐	
The primary investigator provided one prompt or positive statement per minute for the next ten minutes:			**Note if child & parent were off screen for any interval**
Minute 2	☐	☐	
Minute 3	☐	☐	
Minute 4	☐	☐	
Minute 5	☐	☐	
Minute 6	☐	☐	
Minute 7	☐	☐	
Minute 8	☐	☐	
Minute 9	☐	☐	
Minute 10	☐	☐	
Minute 11	☐	☐	
Following data collection, the primary investigator asks these five questions:			**Exact wording is not necessary**
1. How was the coaching session today?	☐	☐	
2. Do you have any questions?	☐	☐	
3. You did really well with ____.	☐	☐	
4. How did the prompting work? Is there anything I can do differently?	☐	☐	
5. What will the goal be moving forward? What do you want to work on next time?			

Appendix M

Pre-Intervention/Post-Intervention Survey

Name:

How old is your child?

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
Receiving immediate feedback via bug-in-ear was helpful in changing my communication practices with my child.	1	2	3	4	5	6	7
Receiving immediate feedback via bug-in-ear is something that I will recommend to other parents of children with delays in communication.	1	2	3	4	5	6	7
Using the bug-in-ear technology to receive feedback was manageable.	1	2	3	4	5	6	7
I currently do well at *playing and engaging* with my child.	1	2	3	4	5	6	7
I currently do well at *expanding my child's language.*	1	2	3	4	5	6	7
I currently use *communication temptation strategies* to encourage my child to communicate.	1	2	3	4	5	6	7
I currently use *prompting strategies* to encourage my child to communicate.	1	2	3	4	5	6	7

My child communicates regularly using words or word approximations.	1	2	3	4	5	6	7
My child communicates effectively using words or word approximations.	1	2	3	4	5	6	7
I am confident in working and playing with my child.	1	2	3	4	5	6	7
My child does not get frustrated with communication.	1	2	3	4	5	6	7

How long has your child been receiving special education and/or therapy services?

Please answer the following questions as you feel is most appropriate.

1. How has this experience impacted you as a parent of a child with a communication delay/disability?

2. What aspects of immediate feedback were beneficial to you?

3. What challenges did you experience with receiving immediate feedback?

4. To what extent did the bug-in-ear feedback support the communication needs of your child?

Based on: Coogle et al., 2017; Coogle, Ottley, Rahn, et al., 2018; Coogle, Ottley, Storie, et al., 2018

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BIOGRAPHY

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