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Abstract : *Paraeducators often support students with the most intensive academic, life, and behavioral needs, which includes students with intellectual and other developmental disabilities (IDD; e.g., autism spectrum disorder; ASD), yet they typically enter the classroom with inadequate preparation to perform their roles effectively. Using a multiple-baseline research design replicated across participants, we evaluated the effects of job-embedded bug-in-ear (BIE) coaching delivered by the teacher on paraeducators' use of behavior specific praise (BSP) while teaching transition-age students with ASD. Findings confirmed each of the three paraeducators immediately increased the percentage of occurrence and rate per minute in which they offered BSP. They sustained these high levels during fading. Further, the special education teacher, who served as the eCoach, and the paraeducators reported BIE was an effective form of paraeducator professional development. Finally, changes in expressive social and communicative behaviors were observed in student participants as a result of the intervention. These results extend literature on BSP and also help establish BIE coaching as an evidence-based practice for paraeducators.*

Paraeducators play a critical role in supporting and providing individualized services to students with intellectual and other developmental disabilities (IDD; e.g., autism spectrum disorder; ASD; Rosenberg et al., 2020). According to the U.S. Department of Education (2019), approximately 435,817 paraeducators are employed nationwide to provide support to school-aged students who receive special education services. Despite the growing presence of paraeducators in schools, providing adequate professional development (PD), including coaching, to these valuable staff members remains a challenge (Brock & Carter, 2013). That is, many paraeducators are hired to support students with intensive learning, life, and behavioral needs, yet they lack adequate knowledge and support to do so effectively (Brock & Carter, 2013; Rosenberg et al., 2020). The absence of formal preservice paraeducator training intensifies the need to offer quality in-service learning and development opportunities (Horn, 2021).

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Effective Professional Learning and Development for Paraeducators

Based on results from a foundational, systematic review of the literature on paraeducator-delivered teaching practices, Brock and Carter (2013) found paraeducators' implementation of evidence-based practices (EBP) feasible with effective PD. Correspondingly, recommendations for preparing paraeducators include providing clear and focused directions on a specific EBP and offering follow-up support to promote the transfer of skills to the classroom (Brock & Carter, 2013). Unfortunately, paraeducator-focused PD

does not typically follow these principles. Instead, training often consists of one-day workshops, which have been shown to be ineffective for increasing classroom-based application (Brock & Anderson, 2021; Joyce & Showers, 2002). While researchers have explored what paraeducators' professional learning and development should entail, less is known about *how* to effectively put ideologies to practice when working with students with IDD (Brock & Anderson, 2021). Consequently, special education teachers are often expected to assume the responsibility of training and supporting paraeducators in the classroom (Brock & Anderson, 2021).

The Promise of Bug-In-Ear Coaching with Paraeducators

Performance feedback delivered through coaching has been shown to be a promising approach to paraeducator-based PD, including those who support students with IDD (Brock & Anderson, 2021). *e*Coaching is an empirically validated method for providing pre- and in-service special education teachers with immediate feedback delivered via bug-in-ear (BIE) technology (Coogle et al., 2015; Ploessl & Rock, 2014; Scheeler et al., 2012), and there is a growing body of *e*Coaching literature specific to teaching students with IDD (Horn et al., 2020; Horn, 2021; Rosenberg, 2020). Initially, the individual receiving coaching (e.g., teacher, paraeducator; herein and after referred to as coachee) participates in a brief training specific to the target teaching behavior (e.g., Horn et al., 2020; Scheeler et al., 2018). Next, the coachee, wears a Bluetooth earpiece facilitating two-way communication with the *e*Coach (e.g., trained teacher or specialist) while they are actively teaching (Rock et al., 2009). Feedback delivery occurs in real-time, and is positive, instructive, and corrective; thus, enabling the coachee not only to change their practice immediately but also to continue making improvements through ongoing implementation opportunities (Scheeler et al., 2004). Positive outcomes have been documented as a result of BIE interventions wherein special education pre- and in-service teachers are the coachees (e.g., Horn et al., 2020; Ploessl & Rock, 2014; Rock et al., 2009, 2012, 2014). Less is known, however, about the efficacy of BIE on paraeducator behavior when working with students with IDD, yet, preliminary findings suggest BIE is a viable method for improving paraeducator-delivered instruction (Rosenberg et al., 2020; Scheeler et al., 2018).

To date, only two paraeducator-focused BIE investigations (i.e., paraeducator coachees), have been published (Rosenberg et al., 2020; Scheeler et al., 2018), both of which used an experimental, single-case methodology to measure the effects of BIE coaching when teaching students with IDD. Scheeler et al. (2018) measured the effects of BIE on increasing contingent specific praise, also referred to as behavior specific praise (BSP), given by paraeducators to secondary students with ASD. Findings revealed a functional relationship between BIE coaching and paraeducator-delivered specific praise statements. Rosenberg et al. (2020) measured the effects of a BIE coaching package on paraeducators' use of incidental teaching to increase self-advocacy statements for students with IDD. Paraeducator coachees successfully implemented the EBP as a result of the intervention, and student achievement data revealed positive learning outcomes resulted from paraeducator-delivered instruction (Rosenberg et al., 2020). Both paraeducator-focused investigations not only extended BIE research, but also the two different researcher teams (i.e., Rosenberg et al., 2020; Scheeler et al., 2018) contributed significantly to the paucity of literature on effective training methods for paraeducators who support students with IDD. Further, their findings supported the notion that paraeducators are capable of implementing EBPs with fidelity when provided with job-embedded guidance and support (Brock & Carter, 2013; Rosenberg et al., 2020; Scheeler et al., 2018).

Despite similarities in the Scheeler et al. (2018) and Rosenberg et al. (2020) studies, there are important differences that warrant attention. As noted above, Rosenberg et al. (2020) provided BIE coaching to increase paraeducators' use of incidental teaching strategies, whereas Scheeler et al., (2018) sought to improve paraeducators' use of BSP. Although both are important, the latter is recognized as a potential evidence-based practice that can be used quickly, easily, and often to increase students' engagement, decrease challenging behaviors, and improve attendance (Royer et al., 2019; Zoder-Martell et al., 2019). BSP requires teachers and/or paraeducators to communicate

verbally or in writing "explicitly what malleable factor within the student's locus of control is being praised" (e.g., "Good job studying for this science test, your effort paid off"), rather than uncontrollable factors such as intelligence (e.g., "You're so smart") or ability (e.g., "You're a natural-born leader"; Royer et al., 2019, p. 113). Moreover, Markelz et al. (2021) cautioned when students repeatedly receive general praise (e.g., good job), they are likely to become immune to it thereby diminishing the impact markedly. Yet, in most classrooms, BSP does not meet recommended standards (Markelz et al., 2021) –18–30 BSP per hour (Floress et al., 2020; Floress & Jenkins, 2015). As a result, a need exists not only to increase practical application of BSP but also to conduct studies investigating the effects of BSP when teaching students with IDD and include students measures (Royer et al., 2019; Zoder-Martell et al., 2019).

Another notable methodological difference between the two investigations centered on who provided the BIE coaching (i.e., performance-based feedback). In Rosenberg et al. (2020), a university-based *e*Coach provided on-the-spot feedback to paraeducators. In contrast, Scheeler et al. (2018) measured the effects of a teacher-delivered BIE intervention whereby two special education teachers were trained to *e*Coach four paraeducator participants. Though positive effects were observed in each study, the latter was unique in that a teacher, who is natural to the environment, was the *e*Coach (i.e., interventionist), rather than an outside researcher.

Investigating the effects of teacher-delivered, job-embedded, coaching interventions is critical, as paraeducator training in schools tends to be the responsibility of special education teachers (Brock & Anderson, 2021; Horn, 2021). Additionally, Scheeler and her colleagues (2018) found BIE to be an advantageous paraeducator coaching method precisely because it was job-embedded (i.e., carried out during regularly scheduled instructional time without requiring the follow-up meetings that accompany delayed feedback). The teacher-delivered BIE intervention was not only effective but results from the social validity survey highlighted the efficiency and feasibility in terms of time commitment and classroom applicability (Scheeler et al., 2018). Further, both teachers reported they would recommend using the BIE device to others. Perhaps the most important finding in both investigations was that BIE was shown to facilitate meaningful change in paraeducators' classroom teaching practices in an unobtrusive manner while supporting students with IDD (Rosenberg et al., 2020; Scheeler et al., 2018). Finding valid and easy-to-implement PD approaches for paraeducators is vital, as doing so strengthens the quality of paraeducator-delivered instruction and consequently optimizes student outcomes (Kretlow & Bartholomew, 2010). BIE has been shown to meet this need, yet more research is needed to 1) consider BIE as an EBP PD approach for paraeducators who support students with IDD, 2) validate the sustainability of BIE on paraeducator-led instruction once BIE is removed, 3) evaluate paraeducator perceptions of receiving BIE coaching, and 4) determine the effects of paraeducator instruction when receiving BIE feedback by including student measures. We conducted this study in response to the aforementioned needs. The purpose of our study was to extend the extant BIE literature by evaluating the effects of a BIE intervention wherein paraeducators receive immediate feedback from the special education teacher while instructing transition-age students with ASD. Also, we investigated fading effects. Finally, we measured students' expressive social and communicative responses to receiving praise from a paraeducator to assess the direct effects of the intervention on students. Our investigation addressed four research questions:

Research Question 1: How does immediate feedback delivered via BIE technology by a special education teacher impact paraeducators' use of behavior specific praise?

Research Question 2: How does the systematic fading of BIE coaching affect paraeducators' sustained use of behavior specific praise?

Research Question 3: What social and communicative responses (e.g., eye contact, facial expression, vocalizations or verbalizations) are observed in transition-age students with ASD in response to receiving praise from a paraeducator who is simultaneously receiving in ear feedback on their use of behavior specific praise?

Research Question 4: How do the paraeducators and special education teachers view the social validity of BIE coaching for job-embedded professional learning and development?

Method

Participants

Study participants included one special education transition teacher (hereinafter referred to as "teacher"), three paraeducators, and three students with ASD, all of whom accessed an adapted curriculum. Prior to the study, the teacher and special education administrator expressed to the researchers their need to provide high quality, job-embedded PD to paraeducators. Although paraeducators attended several in-service trainings throughout the school year, transferring newly learned knowledge and skills to the classroom was not occurring. This lack of transfer learning is well established in the professional literature (Joyce & Showers, 2002; Scheeler et al., 2018) and was verified, in this study, through stable baseline data.

After obtaining approval to conduct the study from the Institutional Review Board (IRB), we invited Elaine, the teacher, to participate in the study. After we obtained her consent, we asked her three paraeducator colleagues to also participate in the study. Faye, Danny, and Will, signed consent and agreed to participate, as did three students, Damani, Jason, and Shamar, all of whom were at least 18 years of age and able to provide consent themselves. Paraeducator-student dyads remained constant throughout all phases of the study and were determined by regular instructional/paraeducator assignment. All BIE sessions were recorded, which enabled us to evaluate paraeducator performance as well as student response measures. We, as research team members, had limited access to student files, including IEP goals. We assigned pseudonyms to maintain the anonymity of student and staff participants.

Teacher Interventionist. Elaine, a White female, was a special education teacher; she acted as the *e*Coach during this study. Elaine held a bachelor of arts in special and elementary education and a master of science in special education. She was also a Board Certified Behavior Analyst® (BCBA®) with 12 years of experience as a special education teacher, including her current assignment as the campus-based transition teacher. Previous positions included teaching in a high school autism support program and middle school emotional/behavioral support classroom. At the time of the study, Elaine had been a mentor teacher for three years and attended PD regularly, which consisted of special education mentor trainings, cognitive coaching, and supervision courses. Elaine reported she read an article on *e*Coaching but did not have first-hand experience using BIE to provide immediate feedback.

Dyad 1: Faye and Damani. Faye, a Black female, was a paraeducator with eight years' experience in special education, five of which were in the campus-based transition program supporting students with ASD. Her highest level of education was a high school diploma with some college courses; Faye attended some PD offered through the school district. Prior to participating in the study, Faye had no previous experience with *e*Coaching and BIE technology. Throughout the study, Faye provided individualized instruction to Damani, who was a 21-year-old Black male student with a diagnosis of ASD and intellectual disability (ID). At the time of the study, Damani was in his third and final year as a student in the campus-based transition program where he received 1:1 and small-group instruction. Damani transitioned through the building with minimal support from staff. He communicated verbally, with a typical sentence length between four and five words. Sessions for this dyad took place during Damani's daily 1:1 instructional time, while he worked on individualized transition IEP goals.

Dyad 2: Danny and Jason. Danny, a Black male, was a paraeducator with 18 years' experience in the field of special education, two of which were in the campus-based program supporting students with ASD. Danny's highest level of education was a bachelor's degree; he attended routine PD offered through the school district. Danny had no experience with *e*Coaching and BIE technology prior to participating in this study. During the study, Danny provided individualized instructional support to Jason. Jason was a 19-year-old Black male student with a diagnosis of ASD. He commonly repeated phrases verbalized by others and when prompted, Jason communicated using single-word responses (e.g., "yes"). Sessions for this dyad took place

during Jason's daily 1:1 instructional time while he worked on individualized transition IEP goals.

Dyad 3: Will and Shamar. Will, a White male, was in his second year of employment as a paraeducator in the campus-based transition classroom and had a total of five years' experience supporting students with ASD. Will's highest level of education was a bachelor's degree; he attended PD offered by the school district throughout the year. Will had no previous experience with *e*Coaching and BIE technology. During the study, Will provided individualized instruction to Shamar, a 21-year-old Black male student who had a diagnosis of ASD and communicated verbally using four- and five-word sentences. Sessions for this dyad took place during Shamar's daily 1:1 instructional time while he worked on individualized transition IEP goals.

Setting

Study participants worked at or attended an urban school district in the southeastern U.S. with a student enrollment of 30,776 students. The minority enrollment was 78% of the student body (majority Black); approximately 21% of students were White. Just under 76% were identified as receiving free and reduced lunch. All research sessions occurred during regularly scheduled instructional times over the span of three months in the special education classroom located on site at the main campus location of a local public research university with approximately 24,000 college students. The study participants were all faculty, staff, or students of the campus-based transition program partnering with the university. The program enrolled students between the ages of 18 and 22 with ASD who followed an adapted curriculum.

Materials

Internet access was required for all data collection and coding. The paraeducators, teacher, first author, and independent observers had access to a private and secure cloud-based account where they were able to securely and privately login and record and/or view sessions. The teacher and each paraeducator logged in simultaneously. As the *e*Coach, the teacher assumed responsibility for recording.

Paraeducator Materials. All paraeducators used an iPad Mini® 128GB 4th Generation device (hereinafter referred to as "iPad") to stream sessions. The device measured 5.31 x 0.24 x 8 inches and weighed 10.4 ounces. The iPad was encased in an Otterbox® Defender Series Case with a clear plastic screen protector. The paraeducators used a LINKCOOL® 360 Degree Rotation Flexible Octopus Travel Tripod to hold the iPad in an upright position during all recorded sessions. Each paraeducator wore a Voyager Legend™ UC Plantronics® B235 Bluetooth earpiece during intervention sessions as they received immediate, job embedded feedback from the teacher.

eCoach (Teacher) Materials. The teacher viewed sessions in real-time through a private cloud-based meeting streamed on an HP ProDesk 600G1 Desktop Computer. To hear sessions and provide immediate, job embedded feedback to paraeducators, the teacher wore a Koss™ SB40 Computer Headset. Two-way communication was transmitted through the teacher's headset and paraeducator's BIE device, as the teacher was in a separate campus-based office during sessions.

Experimental Design

We used a multiple-baseline research design (Ledford & Gast, 2018) replicated across three participants to evaluate the effects of the intervention (i.e., teacher's use of BIE technology to provide performance-based feedback in real-time to paraeducators' to increase the use of BSP during 1:1 instruction). The conditions of the design included baseline, intervention, fading, and maintenance. Due to the individualized nature of 1:1 instruction, there was variability in the frequency of opportunities for paraeducators to offer praise statements across sessions. We followed the calculation used by Scheeler et al. (2018) to account for variability and compare paraeducator's use of BSP to non-BSP. The percentage of BSP was determined by dividing the total number of BSP

statements delivered to a student by the total number of [all] praise statements delivered, multiplied by 100 (Sheeler et al., 2018). The length of each session was determined by the duration of the lesson (range = 9–16 minutes). To account for variability in lesson duration, we also calculated the rate of BSP given per minute. That is, the total number of BSP statements delivered in each session was divided by the session length (Markelz et al., 2021).

Paraeducators remained in baseline for at least five sessions. After the first paraeducator's baseline data revealed stability and data did not present an accelerating trend in the direction predicted by the intervention (Horner et al., 2005), that paraeducator entered the intervention condition while the other paraeducators remained in baseline. The second paraeducator began intervention after the first paraeducator completed three intervention sessions while presenting an accelerating trend direction, while their own data illustrated stability in baseline. This staggered process continued for all paraeducators. After paraeducators reached a criterion of 90% BSP statements for three consecutive sessions during intervention, they moved into the fading condition for three sessions. Following that condition, all paraeducators participated in one maintenance session.

Throughout the study, we visually analyzed the data across all conditions. Specifically, we evaluated the level, trend, the immediacy of the effect between baseline and intervention conditions, and the effect size of the intervention (Ledford & Gast, 2018). To determine the immediacy of the effect, we compared changes in level between the last three data points in the baseline condition to the first three data points in the intervention condition (Kratochwill et al., 2010). We calculated Tau-U to measure effect size, reporting and interpreting the intervention effects as small effect (<.20), moderate (.20–.60), large (.60–.80), or very large (>.80; Vannest & Ninci, 2015). Tau-U estimates intervention effects by considering the nonoverlapping data points and trends between baseline and intervention (Vannest & Ninci, 2015). To analyze findings from the social validity measures, we analyzed responses numerically and by identifying themes associated with the goals, procedures, and outcomes of the study from the teacher and paraeducators.

Independent and Dependent Variables

As each paraeducator began intervention, they received immediate, job embedded feedback delivered by the *e*Coach (i.e., teacher) via BIE technology. As paraeducators worked 1:1 with students, BIE enabled them to receive discreet performance feedback in real-time on a specific practice (i.e., BSP) as they were actively engaged in teaching (Horn et al., 2020; Rock et al., 2009). Similar to the investigation by Scheeler et al. (2018), immediate feedback given to paraeducators by the teacher occurred within three seconds of the target behavior.

We included three dependent variables and measures in this investigation. First, we evaluated the use of BSP offered by the paraeducator to the student, as measured by the percentage of total BSP statements and rate of BSP statements given per minute in response to a targeted student behavior (e.g., verbal and/or gestural identification of an emergency vs. non-emergency). All phase change decisions were based on the first dependent variable. Second, we analyzed how students responded when they received praise from the paraeducator. That is, we observed verbal and nonverbal behaviors that immediately followed (i.e., within 3 seconds) student-directed praise: 1) making eye contact with the paraeducator, 2) changes in facial expression, and 3) verbalizations (e.g., "thank you") or vocalizations (e.g., giggle). Because higher social skills are associated with greater job-related success, yet many secondary students with IDD demonstrate needs in these areas (Carter et al., 2021), we were also interested in learning how students responded to praise and if there were observable changes in student responses between baseline and intervention conditions. For that reason, we observed student responses to all praise (i.e., specific and non-specific). Third, social validity questionnaires assessed the ease and effectiveness of receiving feedback (paraeducator) and the teacher's ability to provide feedback using BIE technology.

Both the teacher and administrator identified BSP as a behavior they sought to increase in paraeducators. Our definition of BSP in this study is consistent with that of Scheeler et al. (2018), linking a positive verbal statement to the behavior being reinforced. For example,

"Good job quickly identifying an emergency situation," or "Great work accurately sorting medical supplies." Also consistent with Scheeler et al. (2018), if the paraeducator repeated the student's response or thanked the student for demonstrating the transition-specific, target behavior, data were not considered nor coded as BSP.

Social Validity

To assess the social validity of the third dependent measure, we asked the teacher and paraeducators to complete a questionnaire at the conclusion of the study. We adapted both questionnaires (teacher and paraeducator) from Sheeler et al. (2018) to measure the ease and effectiveness of delivering (teacher) or receiving (paraeducator) immediate feedback delivered via BIE during instruction. The teacher questionnaire consisted of the following questions: (a) Did you like providing feedback to teacher assistants using Bug-in-Ear (BIE) technology? (b) Do you have any suggestions for the researchers on ways to improve or change the way we use BIE for teacher assistants? (c) Would you recommend using the BIE device/earpiece to others? If no, please give a brief explanation for your answer. (d) What impact, if any, did using BIE have on your students (e.g., changes in student behavior, student outcomes, etc.)? (e) What impact, if any, did using BIE have on teacher assistants (e.g., changes in teaching behavior, etc.)? (f) Do you feel using BIE technology in the classroom is an effective form of PD? If not, please give a brief explanation for your answer. (g) Is there anything else you feel is important to tell us about the study you were involved in?

The paraeducators' social validity questionnaire consisted of the following questions: (a) Did you like receiving feedback from the teacher using Bug-in-Ear (BIE) technology? (b) How do you feel about wearing the earpiece while teaching? Were you distracted by the feedback? (c) Do you have any suggestions for the researchers on ways to improve or change the way we use BIE for teacher assistants? (d) Would you recommend using the BIE device/earpiece to others? If no, please give a brief explanation for your answer. (e) What impact, if any, did using BIE have on your students (e.g., changes in student behavior, student outcomes, etc.)? (f) What impact, if any, did receiving feedback from the teacher via BIE have on your teaching? (g) Do you feel using BIE technology in the classroom is an effective form of PD? If not, please give a brief explanation for your answer. (h) Do you have other questions or comments related to your experience using BIE technology in the classroom?

Procedure

As described earlier in this section, all sessions were recorded, enabling researchers to see and hear each instructional session while also listening to feedback offered by the teacher via BIE technology during intervention conditions. Paraeducators provided 1:1 instructional support that followed each student's individualized transition program and addressed employment, self-help, and safety skills. We, as research team members, did not have access to students' IEPs nor to their transition-related goals. Following typical instructional protocol, paraeducators sat across the table from students during each session, and the other paraeducators were not located in the classroom so observer or carryover effects were minimized. All sessions revolved around students' daily schedules and took place when 1:1 instruction typically occurred. Depending on individualized schedules, some students were out in the community or working in the classroom adjacent from where recorded sessions were taking place. Data collection occurred daily, up to five days a week, as determined by student/staff absences, school cancellations, schedule changes, or other unanticipated disruptions.

Baseline. During baseline, we asked the teacher and paraeducators to teach as they typically would, providing 1:1 instructional support as described previously. The paraeducator wore the BIE earpiece, but it was turned to the "off" position throughout the baseline condition. The sessions were recorded for coding purposes only and paraeducators wore the BIE device simply to become familiar with wearing the earpiece while teaching. The teacher also logged into the meeting and kept her microphone muted; thus, in-ear feedback was not given during baseline sessions.

Following baseline data collection, each paraeducator attended a brief 1:1 training session with the first author lasting approximately 20 minutes. The training took place in a meeting room located in the same university building as the campus-based transition classroom. Training consisted of a detailed description of BSP followed by several modeled demonstrations of correct BSP implementation. Successful completion of training was achieved as each paraeducator distinguished between general praise and BSP statements and independently modeled examples of BSP. The intervention condition followed as each paraeducator completed training successfully.

Intervention. Introduction of the independent variable (i.e., immediate feedback delivered via BIE) was staggered across participants (Horner et al., 2005). In-ear feedback delivered by the teacher to paraeducators was concise, specific, corrective, and positive in nature (Scheeler et al., 2004). Further, feedback delivery occurred within three seconds of the behavior being reinforced (Sheeler et al., 2018). Prior to each intervention session, the teacher and paraeducator logged into the private cloud-based meeting. The teacher logged in from her office using a laptop computer and headphones with a built-in microphone. The paraeducator performed a brief technology setup prior to the lesson. First, the paraeducator used the secure, cloud-based app on the iPad to login and join the meeting. This included connecting to video and positioning the tripod so that the lesson could be electronically observed. Second, the paraeducator turned the BIE device to the "on" position, and after it automatically connected to the iPad, they did a brief audio check to ensure two-way communication with the teacher was working. The first author provided a step-by-step "technology setup" handout that was kept on the shelf next to the iPad in the classroom. The technology setup typically took less than one minute.

During each intervention session, the teacher provided individualized performance feedback in real-time to the paraeducator as they were actively teaching. Following a similar protocol to Scheeler et al. (2018), the teacher reinforced paraeducators' use of BSP by saying "Good specific praise" within one to three seconds following the observed behavior. In contrast, when the paraeducator provided non-specific praise, the teacher immediately gave corrective feedback (e.g., "Be specific" or "Say, 'Good job identifying an emergency'"). Treatment integrity data revealed the teacher reliably provided corrective performance feedback and BSP to paraeducators throughout the intervention. Immediate verbal feedback delivered via BIE was the only performance feedback received by paraeducators throughout the study. The intervention phase continued for each paraeducator until they reached a criterion of 90% BSP for three consecutive data collection sessions. Next, the intervention was immediately faded.

Fading. The intervention was faded over three consecutive sessions. During the first session, the paraeducator wore the BIE device yet did not receive in-ear feedback. During the second session, the paraeducator placed the BIE on the table in plain sight though it was not worn. During the third session, the paraeducator left the BIE in the storage case on a visible shelf on the opposite side of the classroom from where the session was taking place.

Maintenance. We collected follow-up data measuring each participant's ability to deliver BSP to students without receiving real-time feedback via BIE. Maintenance data evaluated the percentage of BSP given during the instructional session as well as the rate per minute BSP was given independently by the paraeducator. Unforeseen, mandatory U.S. school closures resulting from the global COVID-19 pandemic limited maintenance data collection to one session for each participant.

Interobserver Agreement

We calculated interobserver agreement (IOA) to ensure reliability across participants and conditions (Horner et al., 2005). Two independent observers coded all data by viewing the recorded sessions. The first author trained a graduate research assistant to be the primary

observer across all participants and conditions. At the time of the study, she held a bachelor's degree in speech-language pathology with a minor in special education and was pursuing a graduate degree in speech-language pathology with plans to work with children and young adults with ASD when she completed her program. A second trained graduate research assistant collected reliability data across a minimum of 33% of all conditions (range = 33% – 100%). The secondary observer was finishing her master's degree in special education while working as a special education teacher in an autism-support classroom. She planned to pursue her doctoral degree in special education and had research interests aligned with this study.

The first author calculated IOA by dividing the total number of agreements by agreements plus disagreements, multiplied by 100 (Ledford & Gast, 2018). IOA on the first dependent variable (i.e., BSP given by paraeducators) was calculated across 67% of all baseline sessions, 64% of all intervention sessions, and 33% of all fading sessions. IOA was calculated across 100% of maintenance sessions, as there was only one maintenance probe per paraeducator. Mean agreement during baseline was 93% (range = 85%–100%); mean agreement during intervention was 94% (range = 86%–100%); mean agreement during fading was 97% (range = 90%–100%); and mean agreement during maintenance was 95% (range = 93%–96%).

To assess treatment integrity (TI), a graduate research assistant used a checklist developed by Sheeler et al. (2018) to collect TI data across 23% of intervention sessions. We assessed TI of the following teacher behaviors: (a) Teacher and paraeducator login to private cloud-based meeting with video on, (b) Teacher connects to audio with headset; Paraeducator wears BIE in "on" position, enabling two-way communication, (c) Teacher provides performance-based feedback to paraeducator (corrective feedback or verbal praise) within 3 seconds of target behavior, (d) all feedback delivered by teacher on the dependent variable is verbal and given in real-time (not written or delayed). TI was 100% across all coded sessions, and through informal observation, researchers noted the positive nature in which all feedback was given, even when correction was needed.

Results

In this investigation, we addressed four research questions. First, we measured the effects of immediate feedback delivered via BIE by a special education teacher on paraeducators' use of BSP while providing 1:1 transition-related instruction to students with IDD/ASD. Our visual analysis of the data on the percentage and rate per minute of BSP statements given by the paraeducator in each session revealed a functional relation. Second, we measured paraeducators' continued use of BSP as BIE coaching was systematically faded over three consecutive sessions. Data showed all three paraeducators continued to offer BSP to students at high rates during fading. Third, we evaluated students' observable social responses to praise, as measured by eye contact, facial expression, and vocalizations or verbalizations. All students increased social responding in at least one form after the introduction of BSP delivered by their paraeducator. Finally, social validity questionnaires evaluating the ease of use and effectiveness of BIE technology revealed participants found this to be a feasible, beneficial form of job-embedded PD.

Paraeducators' Use of Behavior Specific Praise

Figure 1 depicts the percentage of BSP given by paraeducators each session, across baseline, intervention, fading, and maintenance conditions. Figure 1 also shows the rate per minute BSP was offered across phases. During baseline, the percentage of BSP ranged from 0 to 10 across participants and the rate of occurrences per minute ranged from 0 to .3. When the independent variable was introduced (i.e., immediate feedback delivered via BIE) during the intervention condition, we observed positive changes in the percentage and rate in which BSP was given by paraeducators. High rates of BSP continued as the intervention was faded and removed from the environment all together.

As shown in the first tier in Figure 1, an immediate effect was observed in Faye's data between baseline (2%) and intervention (63%) conditions, indicating an initial increase of 61% after introduction of the intervention. Faye's mean performance level across intervention sessions was 76% (range = 58%–98%), compared to 3% (range = 0%–5%) during baseline. Thus,

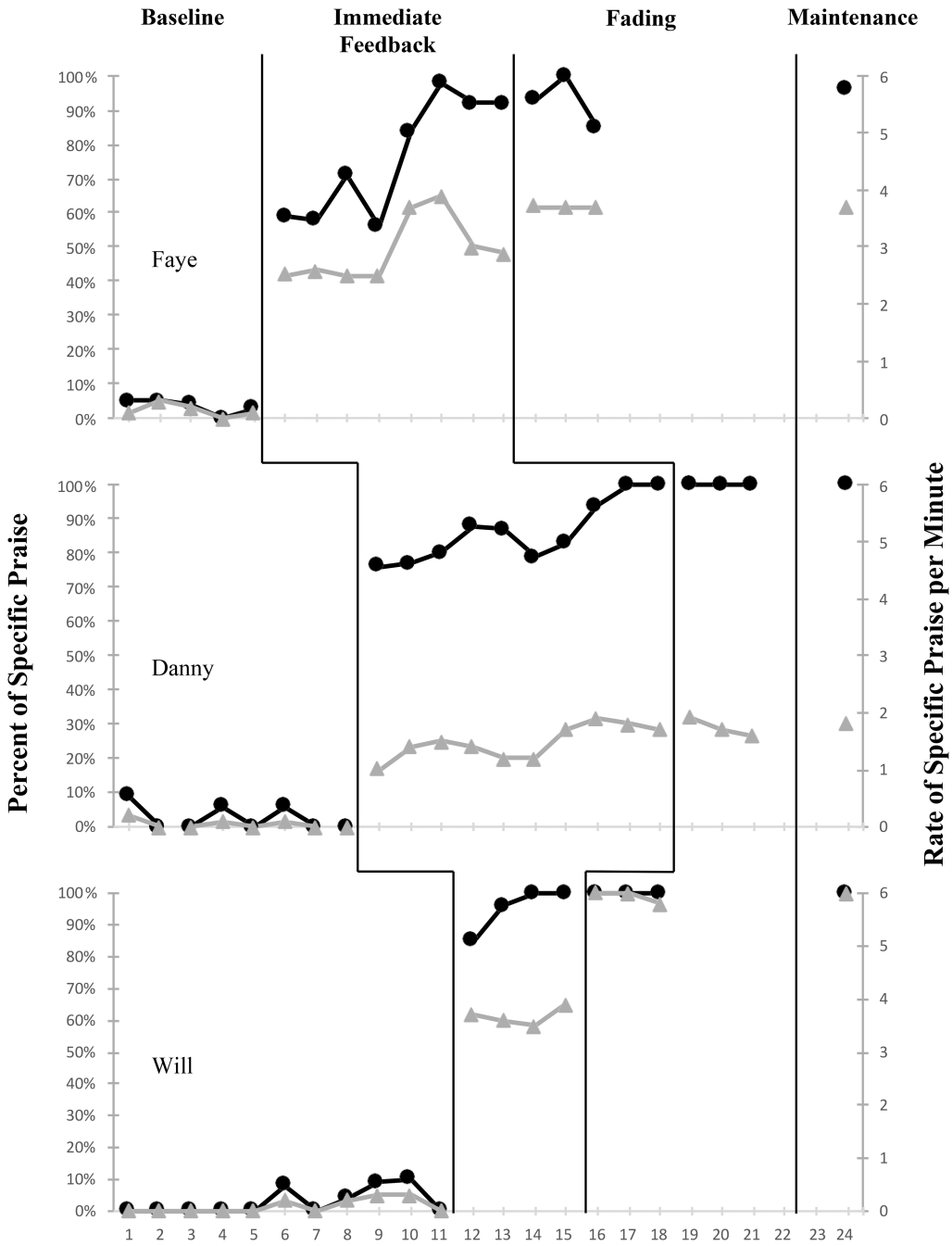

Figure 1. Specific Praise Statements Given by Paraeducators. *Note.* Closed circles represent percentage of specific praise statements and closed triangles represent rate per minute of specific praise statements given by paraeducators.

there were no overlapping data points across baseline and intervention phases, demonstrating a very large effect with a Tau-U effect size of 1.00 $CI_{90\%}$ [.44, 1.00] (p = .003). Faye's performance continued at high levels (M = 93%, range = 85%–100%) as the intervention was

faded and her use of BSP was maintained over time. The rate per minute Faye used BSP during baseline was low (M = .1, range = 0–.3) and increased during intervention (M = 3, range = 2.5–3.9). The rate per minute Faye offered BSP increased as the intervention was faded, and high rates were sustained during the maintenance condition as well (M = 3.7).

The second tier of the graph in Figure 1 depicts performance data for Danny. An immediate effect between baseline (2%) and intervention (78%) conditions was observed for Danny, indicating an initial increase of 76% upon introduction of the independent variable. There were no overlapping data points between baseline and intervention phases, and Danny's Tau-U was 1.00 $CI_{90\%}$ [.54, 1.00] (p = .000) also showing a very large effect. The mean performance level during baseline was 3% (range = 0%–9%) and increased to 86% (range = 76%–100%) during intervention. Danny's use of BSP was 100% across all three fading sessions as well as the follow-up session. The rate per minute Danny gave BSP during baseline was low (M = >.1, range = 0–.2), yet increased immediately with the introduction of the independent variable (M = 1.4, range = 1–1.9). Danny continued using high rates of BSP during fading (M = 1.7, range = 1.6–1.9) and maintenance phases (M = 1.8).

As depicted in the third tier of Figure 1, an immediate effect was observed in Will's data between baseline (6%) and intervention (94%) conditions, indicating an initial increase of 88% after introduction of the intervention. There were no overlapping data points between baseline and intervention phases, demonstrating a very large effect with a Tau-U of 1.00 $CI_{90\%}$ [.43, 1.00] (p = .004). Will did not give a high percentage of BSP during baseline, as evidenced by his mean performance level (M = 3%, range = 0%–10%). Upon introduction of the independent variable, Will's mean performance level increased to 95% (range = 85%–100%). Will's performance remained stable at 100% as the intervention was faded and this continued through the maintenance phase (M = 100%). The rate per minute Will used BSP during baseline was similar to the other participants (M = .1, range = 0–.3). However, an increase was observed after the introduction of the independent variable (M = 3.7, range = 3.5–3.9). Will's rate per minute of giving BSP continued to increase during fading (M = 5.9, range = 5.8–6) and high rates were sustained over time (M = 6).

Immediate feedback delivered by a special education teacher to paraeducators via BIE resulted in substantial increases in the mean percentage of occurrences of BSP by all participants (Faye = 73%; Danny = 83%; Will = 92%). The mean rate per minute BSP was given during instruction increased for all participants as well (Faye = 2.9; Danny = 1.4; Will = 5.8).

Students' Responses to Praise

To answer our second research question, we evaluated how student participants with ASD responded socially to praise. Specifically, we observed eye contact, facial expressions, and vocalizations or verbalizations, all of which immediately followed praise given by paraeducators. Table 1 shows the mean rate of student responses to praise per session across baseline and intervention phases.

Damani worked 1:1 with Faye, and the rate per session he made eye contact in response to receiving praise nearly doubled between baseline and intervention conditions (Baseline M = 5.8, range = 3–8; Intervention M = 11, range = 3–22). Damani was also observed smiling more frequently when Faye gave BSP (Baseline M = 1.6, range = 0–4; Intervention M = 4.4, range = 1–7). During baseline, Damani used few vocalizations or verbalizations in response to praise given by Faye (M = 2.6, range = 0–5) and noteworthy increases were observed during the intervention phase (M = 12, range = 8–16).

Jason worked 1:1 with Danny for the duration of this study. The rate per session Jason made eye contact with Danny in response to receiving praise during baseline was low (M = 4.4, range = 2–9); however, his rate of eye contact increased during the intervention phase (M = 12, range = 5–13). The rate in which Jason smiled in response to receiving praise increased from baseline to intervention as well (Baseline M = 3.1, range = 1–5; Intervention M = 5.3, range = 2–9). Jason's rate of using verbalizations or vocalizations did not change much between baseline and intervention phases

TABLE 1

Mean Rate of Student's Responses to Praise

Student Response	*Damani*			*Jason*			*Shamar*		
	Baseline	*Intervention*	*Difference*	*Baseline*	*Intervention*	*Difference*	*Baseline*	*Intervention*	*Difference*
Eye Contact	5.8	11	+5.2	4.4	12	+7.6	5.8	11.8	+6
Facial Expression	1.6	4.4	+2.8	3.1	5.3	+2.2	3.2	17.8	+14.6
Vocalizations/Verbalizations	2.6	12	+9.4	0	.4	+.4	2.7	2	−.7

Note. Student response data included responses to all praise given by paraeducator (e.g., specific and non-specific praise).

(Baseline M = 0; Intervention M = .4, range = 0–.4).

Shamar worked 1:1 with Will throughout the study. The rate per session he made eye contact in response to receiving praise more than doubled between baseline and intervention conditions (Baseline M = 5.8, range = 0–10; Intervention M = 11.8, range = 5–19). During baseline, Shamar was not observed smiling frequently (M = 3.2, range = 1–5). However, during the intervention phase, Shamar's rate per session of smiling increased (M = 17.8, range = 13–23), while there was a slight decrease in Shamar's rate of verbalizations and vocalizations (Baseline M = 2.7, range = 0–6; Intervention M = 2, range = 0–4).

In sum, when paraeducators used BSP while teaching transition-age students with ASD, changes in expressive social behaviors were observed in all three student participants (see Table 1). Observed behavior changes were unique to each individual, and students engaged in at least one social behavior at a notably higher rate in the intervention condition. For instance, the rate of Damani's vocalizations and verbalizations increased by 9.4 per session, Jason's rate of eye contact increased by 7.6 per session, and the rate per session in which Shamar smiled increased by 14.6 per session.

Social Validity

To answer the third research question, the special education teacher and three paraeducators completed questionnaires after data collection was complete. Both open- and close-ended questions were included; the teacher questionnaire consisted of seven questions, whereas the paraeducator questionnaire contained eight questions. Responses are summarized and include some direct quotes.

The teacher stated BIE was "… much less intrusive way to offer feedback." She also indicated it took between 4-5 sessions to become comfortable and "find a pause and flow in the process." In response to the question asking if BIE would be recommended to others, the teacher explained "… In most of the professional development I've gone to, there is rarely any follow-up on skills learned and I think this [BIE] would help bridge that gap." Further, the teacher observed increases in

paraeducators' use of BSP when working with students throughout the day.

All paraeducators indicated they "liked" receiving immediate feedback from the teacher using BIE, and one elaborated, "It was helpful feedback to let me know what to say during the right times." Two paraeducators did not find BIE to be distracting, but one did get distracted sometimes, stating "[I] had to pause and make sure I was listening to the teacher." Two paraeducators would recommend using BIE to others, and one of them stressed the importance of having a teacher who is a good fit. In contrast, one paraeducator would not recommend BIE to all, as some may "get distracted by it." One paraeducator indicated as a result of immediate feedback delivered via BIE, they "praised the kids more" while another paraeducator stated they became "more aware of when to praise." All three paraeducators agreed BIE was an effective form of PD, and one stated it would be "especially [effective] for new teacher assistants."

Discussion

The purpose of this study was to extend the existing BIE literature by examining the effects of teacher-delivered BIE coaching on increasing paraeducators' use of BSP when working with transition-age students with ASD. We also investigated the effects as the intervention was faded and measured observable social responses in students with IDD/ASD in response to receiving praise. Results suggest BIE coaching is an effective method for providing job-embedded PD to paraeducators. Our findings are consistent with Rosenburg et al. (2020) and Scheeler et al. (2018) in that a functional relation was observed between variables when paraeducators received immediate feedback via BIE. Further, this study extends the literature in two noteworthy ways. First, this experimental investigation contributed to the emerging body of literature to help establish BSP as an EBP (Royer et al., 2019; Zoder-Martell et al., 2019). Second, and similar to both Rosenburg et al. (2020) and Scheeler et al. (2018), our findings suggest *e*Coaching to be a viable method for providing ongoing training and support to paraeducators who support students with IDD.

Paraeducators' Instructional Practice

Paraeducators increased the proportion in which they delivered BSP statements and used BSP at considerably higher rates while working 1:1 with students with IDD/ASD. Our results confirmed the rate in which paraeducators delivered BSP to students while being *e*Coached far exceeded the recommended rate (Markeiz et al., 2021)-18 -30 BSP statements delivered per hour (Flores et al., 2020; Flores & Jenkins, 2015), which equates to .3-.5 per minute. The mean rate per minute paraeducators were observed delivering BSP in our study was 5.92 (range = 5.76-6.0). All three paraeducators reached criterion and sustained the acquired teaching behavior as BIE coaching was systematically faded. There were, however, observable differences in the rate per minute paraeducators gave BSP. For example, Danny used BSP with 100% accuracy during the last two intervention sessions and he sustained this level across fading and maintenance conditions while the rate per minute he used BSP was notably lower than that of Faye and Will. However, anecdotal notes revealed Danny used greater variety in BSP statements compared to Faye and Will. That is, although his rate per minute was lower, the quality of BSP given by Danny reflected careful thought and consideration to the behavior being reinforced (e.g., "Yes, Jason! You correctly [behavior being reinforced]!"). In contrast, the rate per minute Will gave BSP during fading and maintenance conditions was nearly three times that of Danny's, yet there was less variation in the phrases used, albeit specific (e.g., "Good job [behavior being reinforced]"). Despite individual instructional differences observed across paraeducators, our investigation showed job-embedded BIE coaching contributed to high levels of BSP given by paraeducators while supporting students with ASD. Further, fading and follow-up data revealed all paraeducators continued giving BSP at high rates following the intervention. Finally, social validity surveys indicated paraeducators "liked" receiving performance feedback via BIE and also felt this intervention was an effective form of job-embedded PD.

Students' Social Responses

Student measures evaluated observable social responses to receiving praise from the paraeducator

across baseline and intervention conditions. Changes in expressive social and communicative behaviors were observed across all students with ASD when paraeducators used BSP. Damani increased his rate of vocalizations and verbalizations by 9.4 per session and was observed saying "thank you," which often accompanied eye contact and/or a smile immediately following the paraeducator giving BSP. When the paraeducator used BSP, Jason increased eye contact at a rate of 7.6 per session. Shamar was observed smiling in response to receiving BSP at an increased rate of 14.6 per session between baseline and intervention conditions. Overall, these findings are promising, as they help validate the social validity of the intervention when working with students who have ASD. As noted by Carter et al. (2012), higher displays of social skills in students with IDD/ASD is a known predictor of post-secondary employment (Carter et al., 2012).

Implications for Practice

One implication for practice from this study involves the ease and effectiveness of a job-embedded training method for paraeducators. Without a doubt, paraeducators who support students with IDD/ASD need and deserve effective job-embedded PD to optimize student learning (Brock & Anderson, 2021). Our results help validate teacher-delivered BIE coaching as a feasible method for improving and sustaining paraeducator-led instruction. Consistent with findings from Scheeler et al. (2018), immediate feedback delivered via BIE resulted in paraeducators using high rates of BSP when working 1:1 with transition-age students with ASD. Notably, these behavior changes (i.e., use of BSP) were observed across other settings throughout the day and maintained when BIE was faded and eventually removed.

Another important implication for practice relates to the use of BSP when working with students with IDD/ASD. In addition to evaluating the effects of the independent variable (i.e., immediate feedback delivered via BIE), we investigated how student participants responded to changes in paraeducator behavior. Changes in social skills were unique to each student. Still, each of the three students were observed engaging in increased rates of at least one of the measured social behaviors (i.e., eye contact, facial expression, vocalizations/verbalizations) when paraeducators gave increased rates of BSP. For example, Damani was observed saying "thank you," which was often coupled with eye contact and/or a smile in response to Faye's BSP. Student measures contribute to the social validity of this intervention and are encouraging, as they highlight the direct impact paraeducator-delivered high leverage practices have on students with ASD. Also, as noted previously and although by no means conclusive, because higher social skills predict postsecondary employment outcomes for students with severe disabilities, such as IDD (Carter et al, 2012), the students who participated in this study may be poised for greater success in school, work, and life.

Limitations and Future Directions

While interpreting the results of this study, there are some limitations to take into consideration. First, due to unforeseen school closures in response to the COVID-19 pandemic, we were unable to collect generalization data and we were only able to obtain one follow-up data point for each paraeducator. Future researchers should consider collecting these data to assess if acquired teaching behaviors are maintained over time and generalized to novel settings. Second, two of the three paraeducators, Danny and Will, earned bachelor's degrees and Faye had taken some college courses. Although their educational backgrounds were not specific to the field of special education, their levels of education may not be representative of all paraeducators and could have influenced their response to the intervention. Thus, we recommend researchers consider paraeducators' level of education and training in future investigations. Third, we did not use a tool to measure the effectiveness of paraeducator-delivered BSP. Though anecdotal notes described some variability in the specificity of praise delivery, utilizing the Behavior-Specific Praise-Observational Tool (BSP-OT) would have enabled us to further analyze the characteristics of the praise given by paraeducators beyond classifying it as "specific" (Marketz et al., 2021, 2020). Future researchers should consider using BSP-OT.

Fifth, we replicated the fading procedure used in Scheeler et al.'s (2018) BIE study with paraeducators. Future *e*Coaching researchers should investigate structured approaches to fading that include but are not limited to gradually decreasing the amount of immediate, in ear feedback provided, especially when coaching on more complex teaching skills. Despite the limitations, our research extends paraeducator-focused BIE literature and validates the direct effects BSP has on students with IDD/ASD.

Conclusion

Paraeducators play a critical role in the education of students with disabilities, including those with intensive academic, life, and behavioral needs; however, research specific to effective, job-embedded paraeducator-focused PD is limited (Brock & Anderson, 2021). Scheeler et al. (2018) and Rosenberg et al. (2020) found BIE to be a viable method for providing performance feedback to paraeducators in real-time while they are actively instructing students with ASD. Our study further validates their findings. We extended previous work by investigating fading effects as well as observable changes in expressive social behaviors in students with ASD when they receive praise. Results from our study showed paraeducators continued to give BSP at high rates after the intervention was faded. These findings also add the literature on an emerging EBP (i.e., BSP; Royer et al., 2019; Zoder-Martell et al., 2019), as this teacher-delivered BIE intervention led to paraeducators giving BSP at optimal levels that far exceed recommended rates (Floress et al., 2020; Floress & Jenkins, 2015). Further, expressive social and communicative changes were observed in each of the students in response to receiving BSP. Finally, and perhaps the most noteworthy, as the third experimental investigation by an independent group of researchers at a different geographic location, this study has merit to help establish BIE coaching as an EBP for paraeducators who support students with IDD/ASD.

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