Effects of Providing Individualized Clinical Coaching with Bug-in-Ear Technology to Novice Educators of Students with Emotional and Behavioral Disorders in Inclusive Secondary Science Classrooms

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Students with emotional and behavioral disorders (EBD) have been reported to benefit greatly from participating in general education science classrooms. However, behaviors that this group of students present are frequently cited as reasons for excluding them in such settings. In this study, three novice middle school science teachers received individualized clinical coaching (ICC) with bug-in-ear (BIE) technology to increase their use of three-term contingency (TTC) trials among students who had EBD in inclusive science classrooms. Researchers used a multiple probe across participants single case design (Gast, 2010) to examine the percentage of the teachers' completed TTC trials for managing student behaviors, the rate of correct student responses among students with EBD, and maintenance of implementing TTC trials after prompt fading. Visual data analysis was conducted, and Tau-U analysis of non-overlap and trend data confirmed that ICC with BIE was effective in increasing teachers' use of TTC trials when working with middle school students with EBD in inclusive science classroom.

Introduction

Students with Emotional and Behavioral Disorders and Science Content

Students identified with an emotional or behavioral disorder (EBD) have history of experiencing high rates of academic and behavioral failure (Bullock & Gable, 2006; Mitchell, Kern, & Conroy, 2019; Wagner, Cameto, & the National Center on Secondary Education and Transition, 2004). Consequently, the culminating educational event for a large percentage of students with EBD has resulted with them dropping out of school (Mitchell et al., 2019). Furthermore, upon leaving the educational system, outcomes for students with EBD include limited employability and high rates of involvement in correctional systems and mental health services (Carter, Trainor, Sun, & Owens, 2009; Lane & Carter, 2006). Despite these facts, researchers have demonstrated that when students with EBD are included in general science

classrooms, they engage with their peers successfully during inquiry-based group instruction and experience improved academic success (Gillies, 2008; Scruggs & Mastropieri, 2007).

Students with EBD may benefit from inquiry approaches when teachers provide ample opportunities to ensure student engagement (Therrien, Taylor, Watt, & Kaldenberg, 2014). However, a persistent characteristic among the majority of teachers to improve the educational or postsecondary outcomes for their students with EBD is the lack of sufficient preparation to appropriately engage them (Brownell, Ross, Colon, & McCallum, 2005; Garland, Vince Garland, & Vasquez, 2013; Leko, Brownell, Sindelar, & Kiely, 2015). Accordingly, a hallmark of high-quality teacher preparation programs is providing opportunities for nascent teachers to learn and practice the effective integration of evidence-based classroom management strategies into content pedagogy (Billingsley, Griffin, Smith, Kamman, & Israel, 2009; Leko et al., 2015; McLeskey et al., 2017).

Evidence-Based Practices for Managing Behaviors

In order to address teachers' concerns related to behavior management (Garland et al., 2013), researchers support the integration of proactive, evidence-based classroom management strategies into teaching routines to increase engagement and behavioral outcomes (Conroy, Sutherland, Snyder, Al-Hendawi, & Vo, 2009; Simonsen, Fairbanks, Briesch, & Sugai, 2008). Simonsen and her colleagues (2008) explored the use of procedures that incorporate multiple features of effective classroom management to better meet the needs of students who are EBD in the general education setting. The researchers concluded that providing: (a) active engagement of students, (b) effective responses to their appropriate behaviors; and (c) effective responses to inappropriate behaviors provided evidence-based approaches teachers could integrate into their routines to increase academic and behavioral outcomes for their students with EBD (Simonsen et al., 2008).

One evidenced classroom management strategy that incorporates three of the strategies curated by Simonsen et al. (2008) is known as a three-term contingency (TTC) trial. The components comprising TTC trials include: (1) the presentation of an antecedent to the student (i.e., opportunity to respond), (2) student response, and (3) teacher response to the student with either praise or error correction (Scheeler, McKinnon, & Stout, 2012). Three-term contingency trials "are basic units of instruction in which students learn new behaviors by getting chances to

respond and receive feedback on the appropriateness of their responses" (Scheeler & Lee, 2002, p. 233). Three-term contingency trial completion is a high leverage teaching skill found to be a consistently strong predictor of effective instruction in terms of academic and behavioral success across disability categories over time (Albers & Greer, 1991; McLeskey et al., 2017).

Individualized Clinical Coaching

When implementing an evidence-based practice (EBP) like TTC trials, teachers benefit from expert and individualized coaching support to effectively assimilate components of the procedure with fidelity (Scheeler, Ruhl, & McAfee, 2004; Scheeler et al., 2012). Scheeler (2008) identified three key components in helping novice teachers sustain teaching skills learned in the university classrooms during their initial years of teaching: (1) using immediate feedback to promote acquisition of skills, (2) training and support to promote maintenance of behaviors, and (3) increasing opportunities for interactions with mentors and feedback in the classroom setting. Individualized clinical coaching (ICC) with immediate feedback alerts the instructor to modify specific teaching techniques and perform them correctly the next time an opportunity arises during instruction (Duchaine, Jolivette, & Fredrick, 2011; Vince Garland, Vasquez, & Pearl, 2012; Vince Garland, Holden, & Garland 2016). Individualized clinical coaching from a supervisor or expert can aid novice teachers in reinforcing effective teaching skills rather than allowing an incorrect or ineffective technique to become habitually implemented (Scheeler et al., 2012; Vince Garland et al., 2012; Vince Garland et al., 2016).

Bug-in-Ear Technology

One discreet method of providing novice teachers with ICC on their use of evidence-based practices is through audio and video technologies, collectively referred to as Bug-in-Ear (BIE) (Ottley, Grygas Coogle, Rahn, & Spear, 2017; Coogle, Rahn, Ottley, & Storie, 2016; Rock, Gregg, Gable, & Zigmond, 2009; Rock, Schumacker, Gregg, Howard, Gable, & Zigmond, 2014). The major components that comprise BIE include the Internet, a web camera, and a wireless earpiece as means of receiving and sending audio communication. Web conferencing platforms used in conjunction with BIE technology facilitate discreet observations and feedback to novice teachers during coaching sessions.

In their metanalysis of the use of ICC via BIE among preservice and in-service practitioners, Schaefer and Ottley (2018) determined that ICC with BIE has a strong evidence base for increasing frequency and accuracy of teaching behaviors of practitioners in a variety of classroom settings. Using BIE, mentors and supervising teachers can unobtrusively observe and coach teachers as they provide instruction (Coulter & Grossen, 1997; Giebelhaus, 1994; Rock, Gregg, Thead, Acker, Gable, & Zigmond, 2009). Individualized clinical coaching delivered with BIE serves as a dynamic learning model for novice teachers because the supervisor can adapt the feedback to the contextual demands of the classroom environment experienced by the teacher (Rock, Zigmond, Gregg, & Gable, 2011; Scheeler, 2008).

Novice science teachers in particular stand to benefit from coaching with BIE due to the high-stakes nature of meeting college and career readiness standards (CCRS) to a wide variety of student populations (President's Council of Advisors on Science and Technology, 2012). The discreet support of a virtual coach optimizes the likelihood of increasing academic and behavioral performance among teachers' most challenging students, those labeled EBD (Scheeler, McAfee, Ruhl, & Lee, 2006). This study is distinguished from others because of its exclusive focus on the use of BIE in secondary science classrooms where novice general educators taught adolescents with EBD.

Method

The investigators of this study queried the following research questions: (1) Will the intervention of providing ICC to novice secondary science teachers with BIE affect the percentage of completed TTC trials; and (2) Will the intervention of providing ICC to novice secondary science teachers with BIE affect the rate of correct answers among students; and (3) Will the teachers maintain their newly learned behaviors when the intervention is removed? A multiple probe across participants' single case design (Gast, 2010) was utilized to examine the effects of providing ICC with BIE to novice secondary science teachers on their use of TTC trials while they taught students labeled EBD in their classrooms. A multiple probe design is a variation of a multiple baseline design in that data are collected recurrently to evaluate trends and patterns in data within and between tiers (Horricks & Morgan, 2011).

Multiple baseline procedures are ideal for evaluating change over time, and therefore, are particularly useful in teacher preparation research (Scheeler, et al., 2012). A single subject

research design was chosen because it allows for the participants to serve as their own comparison (Tankersley, Harusaola-Webb, & Landrum, 2008) and has been found to be particularly useful in defining educational practices at the individual level (Gast, 2010; Horner, Carr, Halle, McGee, Odom, & Wolery, 2005). Furthermore, single subject designs have been considered to be philosophically parallel to special education's core principles of individualized instructional decision-making and frequent monitoring of student progress (Tankersley et al., 2008).

Participants underwent concurrent baseline sessions. After three baseline sessions, a visual analysis was conducted and the first participant began the intervention phase. When the dependent variable showed a clear and marked acceleration of trend, the second participant began intervention. This process was repeated for each participant. Once a participant met the mastery criteria of 80% for fidelity of TTC trials for three consecutive sessions, maintenance data were collected for the remainder of the study.

Participants and Settings

A convenience sample of three novice general education secondary science teachers from a large suburban public-school district agreed to participate in this study (see Table 1). Criteria for participation in the study included: (a) participants must be novice science teachers (in their first three years of teaching), and (b) participants must have at least one student identified as receiving services under IDEA (1997) for EBD. The participants in the study were Eliza, Katherine, and Tom (pseudonyms). None of the participants had received any formal preparation or coursework in behavior management prior to the study. The participants all stated that they had difficulty managing classroom behaviors, especially among particular students during specific classroom periods.

Table 1

Descriptions of Teachers

Name	Grade level	Years teaching	Previous career	Age	Ethnicity	Gender	No. of students in class
Eliza	7	2.5	Early childhood teacher	29	Caucasian	Female	23
Katherine	9	.5	Athletic trainer	24	Caucasian	Female	24
Tom	6	.5	Biologist	24	African American	Male	23

Prior to data collection, the primary researcher met with the teachers individually. During the meetings, the primary researcher reviewed examples and non-examples of TTC trials within middle school science curriculum with each teacher. The teachers were then shown video recordings that depicted the same examples and non-examples. The teachers were also taught how to setup and use the respective BIE equipment that would be used during the study. The primary researcher met with the teachers twice to practice the use of BIE technologies, during which the teachers prepared their equipment and connected with the researcher online. From an adjacent room of each teacher's science building, the researcher asked the teacher to speak as he or she moved to each of the four corners of the classroom. Once reliable audio and video reception was established, remote observations were scheduled and conducted.

Throughout the study, sixty-seven 15-minute online observations were conducted across participants using the Adobe® Connect™ web conferencing platform and Bluetooth earpieces. During the sessions, the teachers were providing instruction in their secondary science classrooms in which students with EBD were present in their classes. The observations were analyzed and coded over a six-week time period. Because a multiple-baseline design was used, the teachers' numbers of overall sessions varied according to how much time they spent in the baseline condition (see Figure 1).

Data Analysis (Dependent Measure)

Data were collected and visually analyzed to address the three research questions. Tau-U analysis of non-overlap and trend of data was used to demonstrate effects of the treatment on the dependent variables. Tau- U was derived from individual phase contrasts for the three participants and aggregated into single omnibus effect sizes. (Parker, Vannest, Davis, & Sauber, 2011).

Fidelity of Implementation and Inter-Observer Agreement

To provide evidence of Inter-observer agreement (IOA) and fidelity of implementation a second observer was independently trained and observed 30% of all sessions. For IOA, point-by-point analysis was calculated and scores ranged from 90-100% across all observations and participants. Procedural fidelity of the investigator's provision of virtual coaching was assessed and found to be 100% across all participants during baseline and treatment conditions.

Results

Research Questions One and Three

The first question asked if the percentage of completed TTC trials would be affected by the intervention of providing ICC with BIE. The opportunity to complete a TTC trial was counted if the teacher presented the student with an opportunity to respond (antecedent). A completed TTC trial was counted only if all three of the components occurred in the following succession: (1) opportunity to respond (antecedent), (2) student response (behavior), and (3) praise or error correction (consequence). Then, the percentage of completed TTC trials was calculated by dividing the total number of completed trials by the total number of opportunities to complete trials and results were calculated from the data. A graph of the teachers' completion of TTC trials over the course of the investigation is presented in Figure 1.

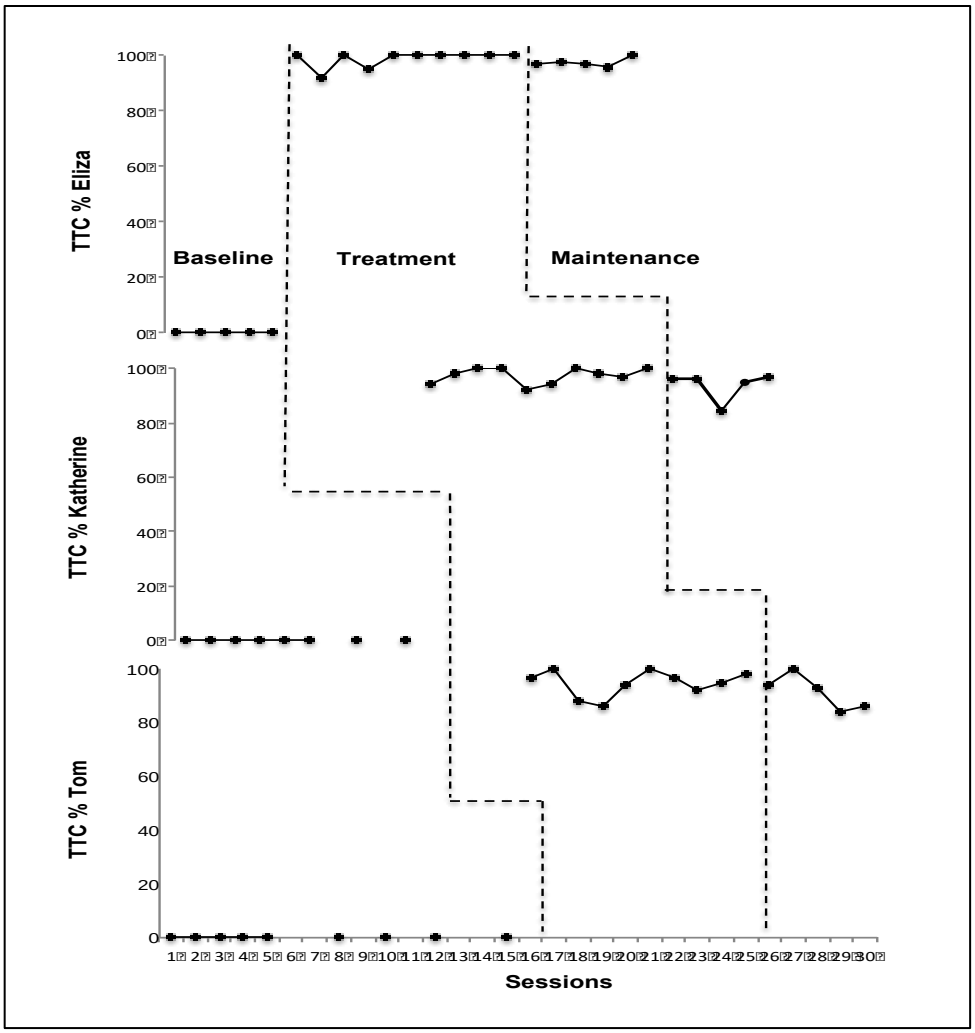

Figure 1. Percentage of Completed TTC Trials Across Conditions. Tau-U = 1, $p = 0$ for RQ1 and RQ3.

During the baseline condition, a non-accelerating trend was consistent among all of the teacher participants. Therefore, the investigator randomly drew names to determine which teachers would enter into the treatment condition. The only variable that changed between baseline and treatment conditions was the provision of ICC with BIE. Short prompts such as "remember to praise," "correct the error," and "be specific" were used to minimize participant distraction. A positive change in trend direction was noted for each of the three teachers when moving from baseline to treatment conditions, and change was observed to be directly relative to the coaching intervention.

An analysis of change across similar conditions indicated that across participants, baseline levels were maintained until ICC with BIE was introduced, causing accelerated levels in each of the participants' data. Participants' percentage of completed TTC trials improved during the first session the coaching intervention was introduced. Across participants, the overall mean gain from baseline phase (0%) to intervention phase (97.1%) was 66%. All participants successfully met criteria for termination of intervention (i.e., 90% mastery for three data points in a row) and maintained the teaching behavior after the intervention was removed on an average of 94.2% proficiency, thereby affirming our third research question.

Research Question Two

The objective for analyzing the data of the second research question was to determine the effect that providing ICC with BIE had on the rate of correct answers among students with EBD. The only variable that changed between baseline and treatment conditions was the provision of ICC with BIE to the teachers. The ICC provided by the primary researcher took the form of brief reinforcing statements after complete TTC trial completion, such as "excellent", as well as their prompts that were targeted to their students such as "repeat the question", "reinforce correct response" and "correct the error". Correct student responses were both verbal and nonverbal. Opportunities for students to respond varied across sessions and study conditions, depending on the activities taking place in their classrooms.

Eliza: During the first baseline session, Eliza's students correctly responded to antecedents at a rate of 0.27 per minute, averaging a rate of 1.00 per minute throughout the baseline condition. Eliza subsequently participated in a total of ten treatment sessions. During the treatment condition, the mean rate of correct student responses to Eliza's antecedents increased

to 2.01 per minute. When the treatment was removed, Eliza's students correctly responded to her prompts at a mean rate of 1.93 per minute.

Katherine: During the first baseline session, Katherine's students correctly responded to antecedents at a rate of 0.60 per minute, averaging a rate of 1.37 per minute throughout the baseline condition. Katherine subsequently participated in a total of ten treatment sessions. During the treatment condition, the mean rate of correct student responses to Katherine's antecedents increased to 2.02 per minute. When the treatment was removed, Katherine's students correctly responded to her prompts at a mean rate of 1.89 per minute.

Tom: During the first baseline session, Tom's students correctly responded to antecedents at a rate of 0.60 per minute, averaging a rate of 1.01 per minute throughout the baseline condition. Tom subsequently participated in a total of ten treatment sessions. During the treatment condition, the mean rate of correct student responses to Tom's antecedents increased to 1.74 per minute. When the treatment was removed, Tom's students correctly responded to his prompts at a mean rate of 1.88 per minute. Table 2 displays the mean rate per minute of correct student responses to teacher prompts across teachers and conditions.

Table 2

Mean Rate Per Minute of Correct Student Responses Across Teachers and Conditions.

Teacher	Baseline	Intervention	Maintenance
Eliza	1 (0.27-1.53) 5 Sessions	2.01 (1.40-2.46) 10 Sessions	1.93 (1.20-2.40) 5 Sessions
Katherine	1.37 (0.60-2.00) 8 Sessions	2.02 (1.07-2.67) 10 Sessions	1.89 (1.07-2.40) 5 Sessions
Tom	1.01 (0.60- 1.53) 9 Sessions	1.74 (1.07- 2.73) 10 Sessions	1.88 (1.33- 2.60) 5 Sessions
Average across participants	1.23 (0.27—2.00) 22 Total Sessions	1.92 (1.07-2.73) 30 Total Sessions	1.90 (1.07- 2.60) 15 Total Sessions

The level of correct student responses increased in each of the teachers' classrooms when the teachers received ICC with BIE. However, the rate of correct student responses fluctuated in Katherine's classroom, as the rate of correct student responses increased initially, then decreased. During the final six treatment sessions, her number of correct student responses accelerated. Figure two displays the frequency of correct student responses per minute across all conditions of the study.

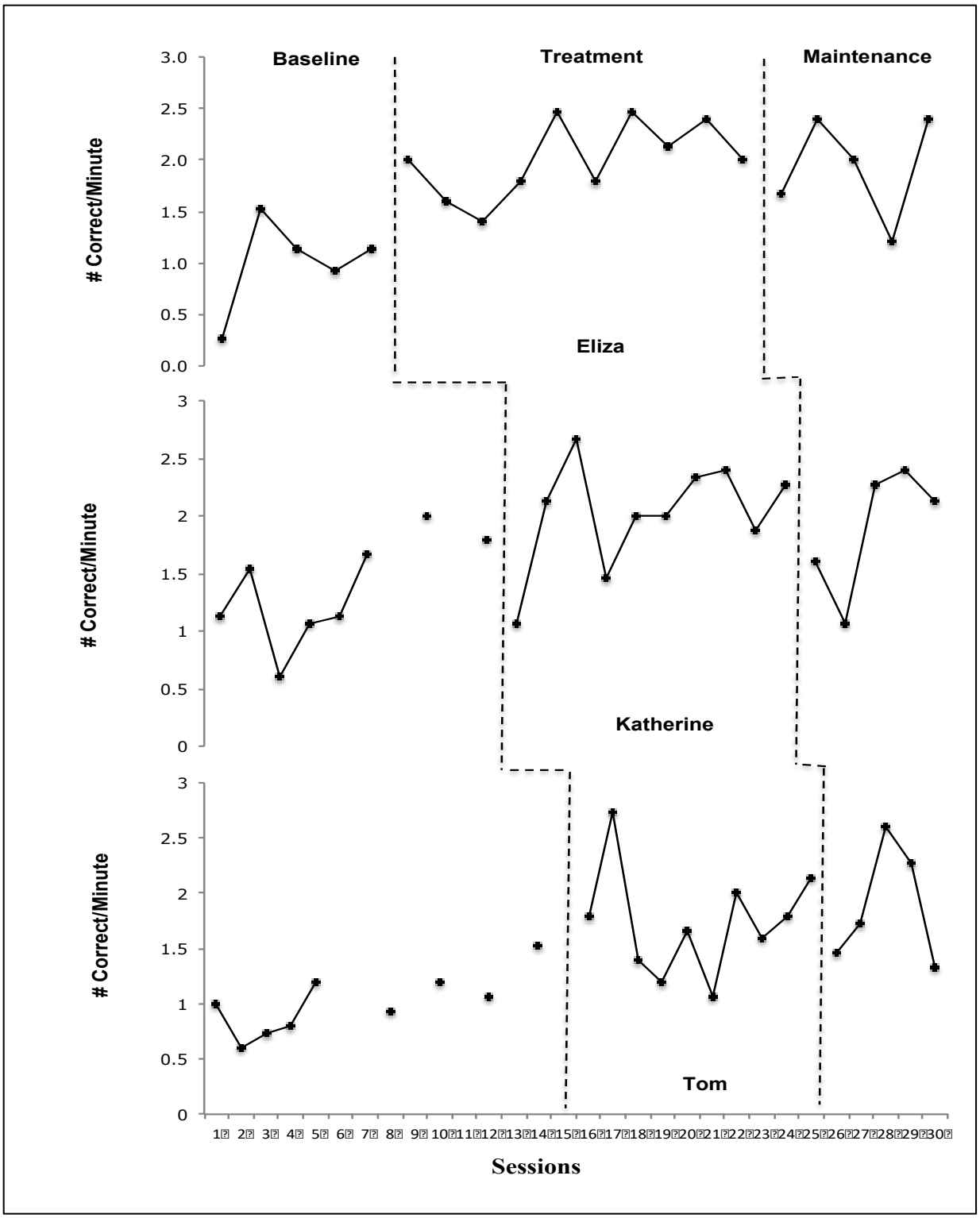

Figure 2. Frequency of Correct Student Responses Per Minute Across Conditions. Tau- U = 0.83, $p = 0$.

Tau-U analysis of combinations of non-overlap and trend data were calculated using Tau-U analysis of effect size using the Tau-U Calculator (Vannest, Parker, & Gonen, 2011). Scaling of effect size for Tau-U follows the same conventions as Cohen's d for regression and correlation analyses (Vannest et al., 2011). Treatment condition results reflect a Tau value of 1 indicating that the intervention had a large effect.

The school-wide positive behavioral interventions and supports (SWPBIS) paradigm for proactive behavioral management used in most schools today recommends the use of praise as an intervention (Myers, Simonsen, & Sugai, 2011). A post hoc analysis of the data revealed that each teacher's mean ratio of praise to error correction increased from the baseline to the treatment condition, and aligned with the recommended ratios during treatment and maintenance conditions. Acceptable ratios range from three to four for every corrective statement to six per 15-minute observation session (Alberto & Troutman, 2012; Myers et al., 2011; Sutherland, Wehby, & Copeland, 2000). Table three displays the ratios of each teacher's use of praise to error correction across each condition of the study.

Table 3

Ratios of Teachers' Mean Ratio of Praise to Error Correction Across Conditions.

Teacher	Phase	Ratio
Eliza	BL	0.2:1
	IV	4.1:1
	M	5.7:1
Katherine	BL	0.2:1
	IV	7.5:1
	M	9.9:1
Tom	BL	0.1:1
	IV	4.5:1
	M	7.4:1

Social Validity

In this study, the investigator attempted to evaluate Wolf's (1978) third dimension of social validity (i.e., the social importance of the effects of behavioral treatment). Social validity survey results from this study reflect the participating teachers valued they were able to receive expert feedback while they taught without the distraction of having another person in their classroom (Wolf, 1978). Katherine was uncertain about receiving feedback initially, but said

once she got used to wearing the earpiece, it became part of the routine. "When the study was over, I actually missed having the feedback that I came to rely on," she stated. On the note of quality of feedback, Tom stated, "It was very relevant and helpful during times that could have gotten out of hand if I didn't follow through with my students". Eliza stated she valued the discreet manner in which supervision and feedback were given. "My class was not disrupted from someone coming in or leaving… It was less threatening than administrative observations. I could be myself".

When asked about whether the teachers noticed any impact on their students from their receiving immediate feedback via BIE, all of the teachers responded they did notice positive changes in their student's behavior. "I have seen a HUGE improvement in behavior from my students. Students that wouldn't do any work have started producing (some) work, particularly in the case of (Steven). I've learned a lot from this experience and would definitely do it again!", wrote Eliza. Katherine stated, "My students responded better when I was given cues. I was amazed at some of the results. It just goes to show how far praise and follow through can go." Tom also mentioned the result of increasing the rate of praise with his students. "I did find that they (the students) responded better when they got praised for following directions and when I was more positive with them. I will definitely continue to use this strategy in the future."

Limitations

Although the results of this study provide evidence that the intervention increased teachers' correct use of TTC trials and increased correct student responses, the results of this study are not without limitation. Procedural and participant factors inherently affected the generalizability of the results of the study. Because of the small sample size and purposive sampling used in this study, generalizability of results of single subject studies is limited to the participating novice science teachers in inclusive classrooms only (Cooper, Heron, & Heward, 2007; Gast, 2010; Horner et al., 2005; Kazdin, 2011). A probability also exists that those who participated in the study may be different from the actual population, introducing a potential of source bias (Heinman, 2000). Another limitation is the mere virtual presence of the investigator (i.e., the teachers and students knew they were being observed) may have influenced the behavior of anyone who knew of the observations, thereby limiting the results.

Considerations for Researchers and Practitioners

While students with EBD can have success with science content, ongoing preparation among novice teachers should occur to ensure that the needs of this population of students' unique behavioral characteristics are met in inclusive settings (Mastropieri et al., 2006). If novice science educators are sufficiently prepared to manage classroom behaviors when students with EBD are present, they can then focus their skills on delivering rich engaging curriculum to all of their students (e.g., hands on activities, labs). Individualized clinical coaching from an expert can assist novice general educators in providing immediate positive or corrective feedback to their classes when students with disabilities are included - even those students who teachers are most reluctant to include. The ICC in this study positively affected the teachers' ability to use TTC trials within such contexts.

Novice teachers in challenging environments could benefit from the guidance and feedback from an expert using virtual coaching without the addition of the distraction of having another person in the classroom (Scheeler et al., 2012). Future studies could consider preparing mentor teachers to use BIE to provide feedback and professional development to their colleagues from a classroom in the same school. By doing so, practitioners in their nascence could be supported more consistently throughout the school year by their colleagues and increase the diversity of the students they serve.

Although this study focused on preparing novice secondary science teachers to manage classroom behaviors of students labeled EBD in inclusive settings, the intervention used is neither exclusive to novice secondary science teachers nor students labeled EBD. Rather, completing TTC trials is a strategy appropriate for use by teachers of all students. As research has shown, novice teachers of all students have historically expressed a lack of readiness to manage classroom behaviors (Fuller & Brown, 1975; Garland et al., 2013). The teachers in this study were coached to use the strategy with fidelity while including students with the most challenging behaviors in their classrooms. If the novice teachers in this study could be prepared to use an evidence-based strategy for managing classroom behaviors with fidelity while including students labeled EBD in their classrooms, this technique provides a strong rationale for all novice teachers to receive similar preparation during their clinical experiences (Scheeler, Bruno, Grubb, & Seavey, 2009).

When teachers are able to manage behaviors confidently and consistently, their time can be devoted to the task of teaching content and increasing student learning (Garland et al., 2013). Implications of this study include that the secondary teachers who had students with EBD in their inclusive science classroom had opportunities to change their behavior, which could have potentially changed the course of the postsecondary outcomes for their students with EBD. By giving novice general educators ICC in using EBPs for managing difficult classroom behaviors in a discreet manner with BIE, researchers and teacher educators could provide students with EBD a greater likelihood of truly receiving their educational services in the least restrictive environment (LRE). Further research is needed to support novice teachers in this EBP across the content areas. Additional studies that utilize ICC with BIE and TTC trials the ultimate goal of teacher preparation of ensuring student engagement and increased learning outcomes for students with EBD occurs in an environment with the teacher with the strong content knowledge and positive peer models for behavioral change.

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